Abstract number	First Name	Last Name	Affiliation	Session	S=oral, P=Poster, session #	Modality	Author(s)	Title	Abstract Body
100	Sjoerd	Barten	Wageningen University	01: MOSAiC Observations in the Context of Historical Data	P1 (23)	in-person	Johannes G.M. Barten, Laurens N. Ganzeveld, Gert-Jan Steeneveld, Maarten C. Krol	Near-surface atmospheric composition during MOSAiC: A comparison with 18 years of CAMS reanalysis data	Reanalysis data are commonly used to study trends in air pollutants and greenhouse gases. Furthermore, they often serve as boundary conditions for regional scale or local-scale atmospheric chemistry and transport models. Therefore, it is important that these reanalysis products accurately reflect independent observations. MOSAiC has brought for the first time year-round observations of many atmospheric trace gases over the Arctic sea ice previously confined to specific land-surface stations. Here, we will compare the observations of MOSAiC trace gases with the Copernicus Atmospheric Monitoring Service (CAMS) reanalysis data which is part of the ECMWF. We show the representativeness of the MOSAiC observations with respect to 18 years of reanalysis data of greenhouse gases and air pollutants. Furthermore, we will address the seasonal variability in trace gases observations during MOSAiC and compare this with the multi-year seasonal cycle in CAMS.
160	Jennifer	Comstock	Pacific Northwest National Laboratory	01: MOSAiC Observations in the Context of Historical Data	S01-1	in-person	Jennifer Comstock and Chitra Sivaraman	ARM Observations and Advanced Data Products during MOSAiC	The Department of Energy's Atmospheric Radiation Measurement (ARM) User Facility deployed an extensive suite of instruments to measure aerosols, clouds, precipitation, and radiation during the MOSAiC expedition. These detailed high-resolution measurements coupled with model simulations enable new process understanding to help identify model deficiencies and inform improvements. ARM has developed resources for modelers such as model forcing datasets, diagnostic packages, simulators, and best estimate products to facilitate model studies. This presentation will provide an overview of available datasets and future plans regarding ARM's Value Added Products (VAPs) and diagnostics and metrics tools for model evaluation. We seek input from the MOSAiC community regarding future datasets and diagnostics that will enhance process studies and model evaluation efforts. We will also show comparisons of a subset of measurements at ARM's long-term North Slope of Alaska (NSA) observatory in Utqia¡vik to provide context during the MOSAiC expedition and across the 25-year dataset at NSA to demonstrate the potential application of ARM datasets.
148	Don	Perovich	Thayer School of Engineering, Dartmouth College	01: MOSAiC Observations in the Context of Historical Data	S01-3	in-person	Don Perovich, Bonnie Light, Madison Smith, Melinda Webster, Polona Itkin, Ian Raphael, David Clemens-Sewall, Chris Polashenski, Jennifer Hutchings	A different time. A different place. A different ice? Snow and sea ice at MOSAiC and SHEBA.	We explore similarities and differences in snow and sea ice properties between MOSAiC and SHEBA. The MOSAiC field experiment was conducted on first and second year sea ice and drifted along the Transpolar Drift from October 2019 to October 2022. In contrast, the SHEBA field experiment was primarily on multiyear ice drifting in the Beaufort Gyre from October 1997 to October 1998. We compare aspects of snow and sea ice properties between MOSAiC and SHEBA, including snow depth, ice thickness, ice growth, surface melt, bottom melt, albedo evolution, solar partitioning, ice motion, and melt pond depth and extent. There were similarities between the two experiments, such as the seasonal evolution of albedo. However, there also were differences with thinner ice and less snow at MOSAiC compared to SHEBA. For additional context, the Mosaic results are compared to data from autonomous ice mass balance buoys deployed at the North Pole Environmental Observatory from 2000 to 2013.
75	Andreas	Preußer	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research	01: MOSAiC Observations in the Context of Historical Data	S01-5	in-person	Andreas Preußer, Thomas Krumpen, Mario Hoppmann, Marcel Nicolaus	Sea ice mass balance buoys during MOSAiC in the context of long-term buoy data in the Transpolar Drift system	The physical properties of sea ice play a critical role in modulating interactions between the underlying ocean and the lower atmospheric boundary layer in terms of energy-, momentum- and moisture-transfer. Of particular importance is the temporally evolving thickness of the ice and snow layers, both of which result from seasonally and spatially variable growth and decay processes. Initially very thin ice in the Siberian Arctic in autumn 2019 and high drift speeds in the subsequent spring and summer months sets the MOSAiC period apart from what was previously regarded as "typical conditions" in the Arctic. To find out whether this evolution is imprinted on datasets from autonomous drift platforms, we present a comparison between sea-ice properties derived from sea ice mass balance buoys (IMBs) during MOSAiC and from similar buoys deployed in the Transpolar drift system between 2012 and 2022, together with a first look at external influencing factors. To achieve this, a uniform processing scheme is developed and applied to all buoy datasets to minimize methodological ambiguities in the derivation of snow, ice, and ocean interfaces. Thereby, we evaluate whether the observed mass balance variations in 2019/2020 were significantly different
101	Benjamin	Rabe	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany	01: MOSAiC Observations in the Context of Historical Data	S01-6	in-person	Benjamin Rabe, Myriel Vredenborg, Sandra Tippenhauer, Céline Heuzé, Team MOSAiC OCEAN and the MOSAiC CTD/rosette team	Upper Arctic Ocean hydrography during MOSAiC: CTD/rosette data and the context from historical observations	During MOSAiC thousands of hydrographic profiles have been measured with the shipÂ´s CTD, the on-ice Ocean City CTD, the Microstructure profiler and autonomous ice-tethered profilers. Combining these temperature-salinity measurements provides us exceptional resolution along the MOSAiC track. We use temperature and salinity to analyse the water masses of the upper Arctic Ocean observed during MOSAiC. Moreover, we compare these observations with a comprehensive dataset of historical hydrographic data from the region to put our findings into a long-term context. We will put particular emphasis on introducing the CTD/rosette dataset, obtained next to the ship and in Ocean City. Along the MOSAiC track we find signatures of halocline waters formed north of Fram Strait (convective lower halocline) as well as halocline waters formed in the Barents Sea (advective-convective lower halocline). We see pronounced changes in the salinity and temperature of the lower halocline in comparison to the historical data, in particular, at the beginning of the drift. We put the warm Atlantic Water temperature in the context of historical observations and investigate whether Pacific Water was present along the MOSAiC track. Furthermore, we relate conditions in the polar mixed-layer and the upper halocline to seasonal forcing and local surface conditions.
212	Amy	Solomon	CIRES/NOAA	01: MOSAiC Observations in the Context of Historical Data	S01-2	in-person	Amy Solomon, Matthew Shupe, Ola Persson	A comparison of SHEBA and MOSAiC wintertime atmospheric boundary layer statistics	It is challenging to evaluate and improve the simulation of Arctic boundary layer processes, especially in the central Arctic in winter due, in part, to limited observations. Two notable exceptions are the MOSAiC and SHEBA campaigns, year-long drift experiments that took place in different regions of the Arctic and separated by 22 years. Both campaigns took intensive measurements of all components of the surface energy budget, as well as, atmospheric boundary layer, cloud, snow, sea ice, and ocean properties at a number of different sites. In this presentation we use these observations to evaluate to what extent wintertime boundary layer statistics and process relationships differ between the MOSAiC and SHEBA campaigns.

193	Daniel	Watkins	Brown University	01: MOSAiC Observations in the Context of Historical Data	S01-4	in-person	Daniel M. Watkins, Monica M. Wilhelmus, Angela C. Bliss, Jennifer K. Hutchings	Summer ice dynamics observed by MOSAiC: drift characterization and comparison to climatology	During spring and summer 2020, the MOSAiC observatory drifted across through the Fram Strait and into the East Greenland Current, where the observatory broke apart and the ice floes surrounding the observatory dispersed. The Fram Strait and Greenland Sea are historically poorly observed by drifting buoy data, because high ice velocity results in brief residence times compared to the central Arctic. As a result, the MOSAiC drift tracks represent a considerable fraction of the total observational records for the region.To what extent does the MOSAiC drift represent typical drift? We examine the historical context through two primary tools: buoy trajectories from previous expeditions and from the International Arctic Buoy Program, and through remote sensing observations of drift velocity. We use a new algorithm, Ice Floe Tracker, to identify sea ice floes in moderate resolution satellite imagery spanning 2003-2020. Although drift velocities during MOSAiC were anomalously high, we find consistent trajectory statistics in both MOSAiC and in the remote sensed data indicating the presence of an anomalous dispersion regime.
144	Jan	Chylik	University of Cologne	02: Process Modeling at Multiple Scales	P1 (43)	in-person	Jan Chylik, Benjamin Kirbus, André Ehrlich, Niklas Schnierstein, Manfred Wendisch, and Roel Neggers	Multilayer Mixed-phase Cloud Interactions during MOSAiC and MOSAiC-ACA Simulated on a Closed Trajectory	Mixed-phase clouds transformations are argued to play an important role in the ongoing Arctic Amplification. The MOSAiC and MOSAiC-ACA field campaigns provided unprecedented observations of such cloud systems, in that they sampled the same air mass at two end of a well-defined, closed trajectory. However, the broad range of scales involved and the lack of in-situ observations between the sites complicate the interpretation of the collected data on mixed phase clouds. Therefore, we employed a virtual laboratory to study the transformation processes and identify their relevance. High-resolution Lagrangian large-eddy simulations follow a boundary-layer air parcel, with the initial conditions and large-scale forcing derived from ERA5 reanalysis, and are constrained by in-situ observations of aerosol concentrations, the vertical thermodynamic structure, and surface boundary condition. The simulations are validated against independent cloud measurements. While the importance of both the radiative interactions and the seeder-feeder mechanism is identified. The sensitivity of these processes to the experimental setup is investigated, focusing on impacts of the composition of the mid-level cloud decks on the lower-level clouds. The implications for the Arctic Amplification will be discussed, as well as future studies.
184	Frank	Kauker	Alfred Wegener Institute	02: Process Modeling at Multiple Scales	S02-6	in-person	Florent Birrien, Frank Kauker, Luisa von Albedyll, Valentin Ludwig, Kirstin Schulz, Helge Goessling, Michael Karcher	On Modeling seasonal evolution of the ice thickness distribution along the MOSAiC drift	The single-column sea ice model ICEPACK (cf. CICE consortium) has been adapted to simulate ice thickness distribution (ITD) evolution along the MOSAiC drift. This Lagrangian approach allows to fully exploit the ice and snow observations collected during MOSAiC. The model is initialized with observed ITDs (from airborne electromagnetic surveys) which provide an accurate and representative initial state of sea ice. The model is forced by atmospheric (re)analyses (NCEP/CFSv2 or ERA5) and prescribed snow depth (from SIMBA buoys), observed ocean conditions, and deformation fields derived from the distributed buoy network in order to study thermodynamic (growth/melt) and dynamic (ridging) response of the sea ice. Here we will present the Lagrangian framework and a comparison between simulated and observed ITDs and evaluate model performance to describe the evolution of sea ice in the MOSAiC winter period. Special attention will be given to the ocean forcing which turned out to be conceptually difficult to implement. Vertical heat fluxes at the mixed layer interface as well as mixed later temperature and salinity calculated or gathered during MOSAiC are used for the determination of the bottom boundary layer of ICEPACK. Several different implementations are describes and their impact on the sea ice evolution is discussed.
2	Anisbel	Leon	Leibniz Institute for Tropospheric Research	02: Process Modeling at Multiple Scales	S02-1	in-person (virtual?)	Anisbel León Marcos, Bernd Heinold, Manuela Van Pinxteren	Modeling marine primary organic aerosols and their impact on clouds	Marine organic aerosol is a major contributor to cloud condensation nuclei and ice nucleating particles over pristine open-ocean and coastal regions and thus has an important impact on radiation, precipitation, and atmospheric dynamics. In the Arctic, the summer-time sea ice loss and the rapid ice retreat are critical factors for potentially increased marine aerosol emissions. In our planned studies with the aerosol-climate model ICON-HAM, we want to investigate the influence of primary marine organic aerosol on the Arctic climate and its rapid warming. The implementation of a detailed, species-resolved ocean emission and the interactions with mixed-phase clouds in ICON-HAM allows for studying the efficiency of marine organic species as potential ice nucleating particles (INP). Here, we present sensitivity model simulations and the first results of the comparison with satellite retrievals, in-situ aerosol, and INP measurements. We aim to evaluate the ice nucleation potential of marine organic aerosols over dust particles transported from mid-latitudes to determine the dominance of aerosols from local marine sources in clouds.
106	Vasco	Mueller	Alfred-Wegener-Institute	02: Process Modeling at Multiple Scales	P1 (44)	virtually	Vasco Müller, Nikolay Koldunov, Qiang Wang, Sergey Danilov, Thomas Jung	EDDY KINETIC ENERGY VARIABILITY IN THE ARCTIC OCEAN FROM A 1-KM MODEL SIMULATION	Mesoscale eddies might play a substantial role for the dynamics of the Arctic Ocean, making them crucial for understanding future Arctic changes and the ongoing "atlantification" of the Arctic Ocean. However, simulating high latitude mesoscale eddies in ocean circulation models presents a great challenge due to their small size and adequately resolving mesoscale processes in the Arctic requires very high resolution, making simulations computationally expensive. Here, we use a seven-year simulation from the unstructured-mesh Finite volumE Sea ice-Ocean Model (FESOM2) with 1-km horizontal resolution in the Arctic Ocean. This very high-resolution model setup can be considered eddy resolving and has previously been used to investigate the distribution of eddy kinetic energy (EKE) in the Arctic. Now, with a simulation spanning several years, we evaluate the changes of EKE in the Eurasian Basin and the connection to other properties like sea-ice cover, baroclinic conversion rate and stratification. EKE seasonality is influenced predominantly by sea-ice changes, while monthly anomalies have different drivers for different depths levels. The mixed layer is strongly linked to the surface and thus to sea-ice variability. Deeper levels on the other hand are shielded from the surface by stratification and influenced more strongly by baroclinic conversion.

50	Roel	Neggers	University of Cologne, Germany	02: Process Modeling at Multiple Scales	S02-4	in-person	Roel Neggers, Jan Chylik, Niklas Schnierstein	The entrainment efficiency of persistent Arctic mixed-phase clouds inferred from daily large-eddy simulations covering the full MOSAiC drift	Low-level mixed-phase clouds occur persistently in the high Arctic, and play a key role in climate feedback mechanisms, air mass transformations, and sea ice melt. Top entrainment driven by radiative cooling modulates these clouds by affecting the boundary-layer heat budget. However, reliable measurements of this small-scale process are scarce. We present new insights on Arctic entrainment based on daily Large-Eddy Simulations covering the full MOSAiC drift. The high-resolution Eulerian experiments are centered around the Polarstern, and resolve Arctic turbulence and clouds. Time-composite ERA5 forcing is used, while the initialization and lower boundary conditions are based on observations. We find that about 1 out of 3 simulated days contain liquid-phase clouds, a result roughly consistent with previous studies. Drift-average heat budget studies are conducted, showing that the full column is roughly in Radiative-Advective Equilibrium (RAE). In contrast, the conditionally sampled heat budget of the cloudy boundary layer is dominated by cloud top cooling. Warming by top-entrainment counters this effect, but not fully, representing an entrainment efficiency of about 30-40 %. Entrainment thus keeps liquid cloud-baring air masses warmer for longer, prolonging their life cycle. Inversion strength plays a key role in this effect, by boosting the warming efficiency of entrainment.
70	Niklas	Schnierstein	University of Cologne, Germany	02: Process Modeling at Multiple Scales	S02-3	in-person	Niklas Schnierstein, Jan Chylik, Roel Neggers	A year in LES: Standardized daily high-resolution Large Eddy Simulations of the Arctic boundary layer during the MOSAiC drift	The MOSAiC project collected and evaluated an unprecedented amount of atmospheric data making it invaluable for modern Arctic research. Apart from providing direct new insights into the Arctic climate system, such observational data sets can also serve as a basis for dedicated high-resolution modeling to augment the measurements and fill critical data gaps. This presentation describes ongoing work to generate and analyze a library of over 300 daily LES covering the complete MOSAiC drift. The simulations center around the Polarstern Research Vessel in an Eulerian frame of reference with periodic boundary conditions. The non-homogeneous vertical grid focuses on optimally resolving turbulence and clouds in the lowest part of the atmosphere while maintaining sufficient resolution for higher altitudes. The experiments are initialized by radiosonde profiles and aerosol measurements in addition to sea-ice data measured locally and by satellite imagery. The large-scale forcing is a time-composite derived from the ERA5 reanalysis data set. We will present a preliminary analysis of the library of simulations, including the first evaluation against available MOSAiC data sets, and discuss the impacts of the experimental configuration. Finally, we explore the scientific potential of this virtual, high-resolution data set for gaining insight into Arctic Amplification.
163	Gunilla	Svensson	Stockholm University	02: Process Modeling at Multiple Scales	S02-5	in-person	Gunilla Svensson, Michail Karalis, Matthew D. Shupe	Investigating the effects of warm air intrusions on the Arctic boundary layer using the AOSCM.	In 2020 two successive warm air intrusions (WAIs) made their way into the Arctic, crossing over the MOSAiC site during the targeted observing period (TOP) of 12-22 April. The direct impact of each of these intruding warm air masses can be traced in the observed strong effect on the surface energy budget terms and near melting surface temperatures. The resulting surface warming appears to have, in turn, perturbed the boundary layer from its initial stably stratified state, with the observations showing an interesting alternation of turbulent regimes over the duration of the TOP. In this study, simulations of these WAI episodes are performed using the coupled Atmosphere Ocean Single Column Model (AOSCM). While being relatively successful in representing the changes in near-surface quantities, our experiments highlight the model's inability to represent the observed changes in the surface turbulent fluxes and boundary layer structure, especially during the cooling periods in-between and after the warm advection events. Sensitivity analysis is performed to further address the deficiencies in the model's boundary layer physics and
211	Tian	Tian	Danish Meteorological Intitute	02: Process Modeling at Multiple Scales	P1 (45)	virtually	Tian Tian, Richard Davy, Shuting Yang, Leandro Ponsoni, Steffen M. Olsen	Better representation of Arctic sea ice leads in the EC-Earth3 for reducing model biases in the Arctic	A cold bias in surface temperature is found in the Arctic in winter in CMIP6 historical simulations. This cold bias is often associated with overestimated sea ice thickness, hence introducing substantial uncertainty in the projected Arctic climate change in the future. We hypothesize that the bias is partly due to the lack of representation of heat fluxes through sea ice leads in the GCMs. In order to test the hypothesis we introduce a new parameterization to better simulate the turbulent heat fluxes through leads and an ensemble with the EC-Earth3 AOGCM is performed. By assessing the mean states and climate trends in the Arctic for the period 1980-2014, we find that the new parameterized heat fluxes effectively alleviate the known cold bias in winter. The new parameterization is particularly beneficial to the region with excessive sea ice cover in the North Atlantic-Arctic sector. We attempt to use the advanced fine-resolution satellite product ! as well as the release of the MOSAiC in-situ measurements to develop new model evaluation methods for assessing the role of key processes in determining the surface energy budget in the Arctic as well as detecting the missing processes attributable to regional bias in sea ice simulations.
48	Gabriella	Wallentin	Karlsruhe Institute of Technology, KIT	02: Process Modeling at Multiple Scales	S02-2	virtually	Gabriella Wallentin, C.Hoose, P.Achtert, M.Tesche	Arctic Mixed-Phase Multilayer Cloud Sensitivities with the ICON model: MOSAiC Cases	Multilayer clouds had a 52% frequency of occurrence during the MOSAiC campaign [P. Achtert et al. in prep.]. Here we present a detailed high-resolution analysis on the interaction between individual cloud systems for a case study in early September 2020. Focus is on the microphysical interaction between ice and mixed-phase cloud layers. We run the ICON model in a cloud resolving limited area mode with refined nests to reach large eddy simulation mode. The domains are centred around the Polarstern with horizontal grid spacing down to 75m. Initial and boundary conditions are supplied from either ICON or IFS analysis. We additionally employ the aerosol extension (ART) which is tuned for warm cloud-aerosol interactions with interactive sea salt and sulfate. The various simulations include (i) sensitivities to microphysical parameters, such as CCN and INP concentration, as well as (ii) sensitivities to initial and boundary data and horizontal and vertical grid spacing. Preliminary results on the modelled multilayer cloud system highlight a high dependency on the initial and boundary data quality as well as domain resolution, while the microphysics have a seemingly smaller impact on the formation and detailed structure of the multilayer cloud system.

171	Nils	Hutter	Cooperative Institute for Climate, Ocean, & Ecosystem Studies, University of Washington, Seattle, WA, USA	03: Numerical Model Improvements in the Next Decade	S03-6	in-person	Nils Hutter, Cecilia M. Bitz, Luisa von Albedyll	Linking the evolution of floe-scale ice characteristics to its deformation history using satellite observations	Arctic sea ice is a mosaic of ice floes whose distribution and thicknesses greatly impact the interaction of sea ice with the atmosphere and the ocean. However, we are still lacking knowledge of the physics to describe the complex interplay of ice floes that are a key characteristic of sea ice. In our contribution, we outline a framework to characterize sea-ice deformation at the floe-scale from observational data by studying the mechanical interaction of multiple identifiable floes. We use Sentinel SAR imagery and ICESat-2 data acquired during the MOSAiC expedition to map ice floes and their thickness in the larger area around Polarstern. This combination of data products allows us to describe the floe-size distribution of floe diameters from hundreds of kilometers down to tens of meters. With the repeated coverage of SAR imagery, ice motion is tracked and deformation estimates are derived. By combining both floe-size estimates and deformation rates we provide insights into how the floe composition changes in regions that were exposed to deformation. Finally, we present a parameterization of this relationship between floe sizes and mechanical redistribution for large-scale continuum sea-ice models.
47	Ralf	Jaiser	Alfred-Wegener-Institut	03: Numerical Model Improvements in the Next Decade	S03-4	in-person	Ralf Jaiser, Cheng You, Jonas Hügle, Dörthe Handorf, Annette Rinke, Falco Monsees, Mark Weber, Alexey Rozanov, Zoi Paschalidi, Alexander Cress	Weather forecast reliability in context of synoptic events and ozone concentration anomalies	High quality weather forecasts have been one of the backbones of the successful MOSAiC expedition. But, how good have they been? In the project SynopSys, we tackle this question by assessing data of the ICON-NWP model that has been used operationally by German Weather Service during the expedition. The project focusses on two major subjects: Synoptic events and the interaction between troposphere and stratosphere. During the MOSAiC expedition in spring 2020, one of the strongest ozone depletion events in the high latitudes of the northern hemisphere has been observed. In the operationally used ICON-NWP data we observe a warm bias of the forecast during the time and in the region of ozone depletion in the stratosphere. In our research, we discuss the origin of this anomaly and evaluate potential impacts on the tropospheric forecast. An improvement of the forecast in this context is expected to not only benefit stratospheric forecasts for the Arctic region, but potentially leads to improvements for lower latitudes as well through large-scale
162	Jørn	Kristiansen	Met Norway	03: Numerical Model Improvements in the Next Decade	S03-1	in-person	Jørn Kristiansen	Developing re-analysis and short-range numerical weather prediction for the European Arctic	Numerical weather prediction (NWP) combines physical models and observations to monitor and predict the evolution of Earth system components. In the Arctic, there are specific challenges related to process understanding, modeling and observations. Met Norway has developed and implemented a short-term, high-resolution weather prediction system - AROME-Arctic - for the delivery of reliable and accurate weather forecasts and warnings. Based on AROME-Arctic, the Copernicus Arctic Regional Reanalysis (CARRA) combines past observations with NWP, to provide a comprehensive description and consistent time series of the observed climate as it has evolved during recent decades. The Polar Prediction Project and its Year of Polar Prediction helped advance predictive capabilities and our understanding and model representation of key processes. Future improvements in analysis and prediction capacities will benefit from the unique MOSAiC observation datasets. There is a tremendous opportunity and role for physical modeling and data assimilation (including reanalysis) in making observations into usable products. However, at present, satellite observations are not used optimally for weather prediction and climate monitoring in the Arctic, particularly in seasons and areas with snow and sea ice. Investments in observing systems must be accompanied by a continued investment in NWP and high performance computing.
96	Malte	Müller	Norwegian Meteorological Institute	03: Numerical Model Improvements in the Next Decade	S03-3	in-person (virtual)	Malte Müller, Yurii Batrak, Erin E. Thomas, Frode Dinesen, Keguang Wang, Timothy Williams	Towards an Arctic coupled kilometer-scale atmosphere, snow/sea-ice, ocean, and wave forecasting system.	The development of coupled Earth modeling systems on a kilometer-scale resolution is a new frontier for operational forecasting. However, accurately representing interactions between atmosphere, snow/sea-ice, ocean, and waves are challenging due to the complexity of interactive mechanisms, the limited accuracy of the model components, and the availability of observations to resolve and assess relevant coupled processes. We have been developing coupling approaches between a convective-scale weather forecasting system for the European Arctic and sea-ice, wave, and ocean models of varying complexity. In order to assess the model's realism and uncertainties we are utilizing a multitude of observations, including field-campaign data, as well as satellite retrievals and standard in situ observations. We found significant sensitivities and improvements as a result of coupling the weather prediction system to these models. We will report on uncertainties introduced by the use of different sea ice products and models, as well as on the role of a multi-layer snow model in correcting a warm bias of the sea-ice surface temperature. Furthermore, we will discuss coupled km-scale atmosphere-wave-ice and atmosphere-ocean simulations with a focus on short time scales (hours-to-days) and give a perspective for parameterizing sub-components within the coupled system by means of machine learning.
28	Zoi	Paschalidi	German Meteorological Service (DWD)	03: Numerical Model Improvements in the Next Decade	S03-2	virtually	Zoi Paschalidi, Alexander Cress	Evaluation and Improvement of Arctic Forecast: Data Assimilation of MOSAiC Expedition Data for SynopSys Project	Numerical weather models aim to forecast accurately and precisely weather situations on all spatial and temporal scales, which is though challenged by the insufficient worldwide observation coverage. The high resolved MOSAiC data shed a light on the conditions in the Arctic, an essential area for the global weather. The project SynopSys, a collaboration of the German Meteorological Service with the Alfred-Wegener Institute and the University of Bremen, combines the state-of-the-art MOSAiC weather data together with remote sensing products and the ICON-NWP model, to evaluate and improve ICON weather forecasting capabilities in the Arctic. The operational ICON is employed to assimilate all measurements, from synoptic station data to ascending and descending radiosondes. Sensitivity studies have taken place for the different observation systems to identify the ones with the highest influence on the arctic model forecast. The improvement of the weather forecast itself and the analysis is further studied, as well as their impact on the forecast of the mid-latitudes. High meteorological interest has the studied period of April 2020, due to the observed day-to-day variability - a cold period at the beginning of the month was followed by strong warm air intrusion, challenging the model forecast and analysis performance.

156	Thomas	Rackow	ECMWF	03: Numerical Model Improvements in the Next Decade	P1 (24)	in-person	Thomas Rackow, Xavier Pedruzo Bagazgoitia, Irina Sandu, Steffen Tietsche, Nikolay Koldunov, Lorenzo Zampieri	Sea ice imprints on atmospheric winds, temperature, and cloud cover	Storm- and eddy-resolving climate model simulations at the kilometre-scale have recently become possible in projects such as the EU's nextGEMS. The direct simulation of storms in the atmosphere and mesoscale eddies in the ocean is opening a new route to better climate models or digital twins that are less prone to errors and historical assumptions in physical parameterizations. Here we highlight an emerging new field, namely the direct global numerical simulation of cracks in the sea ice cover and their interaction with the overlying atmosphere in climate model simulations. It is via this cryospheric pathway of opening leads that the ocean and atmosphere can exchange huge amounts of heat and moisture in both the model and reality, which impacts winds and temperatures. The far-reaching imprint of sea ice cracks in our global simulations even on the overlying simulated cloud cover hints at an untapped potential for a more realistic simulation of clouds, which were shown to be a major source of uncertainty in projections of future climate.
80	Damien	Ringeisen	McGill University	03: Numerical Model Improvements in the Next Decade	P1 (25)	virtually	Nils Hutter, Luisa von Albedyll	The LKFs' intersection angles distribution and the mechanical properties of Arctic sea ice.	Sea ice rheological models struggle to reproduce the intersection angles between linear kinematic features (LKFs) in arctic sea ice. The intersection angles are linked to sea ice mechanical properties and can be used to infer new sea ice rheological models. We use the sea ice vorticity to discriminate between acute and obtuse LKFs intersection angles within two sea ice deformation datasets: the RGPS and a new dataset from the MOSAiC drift experiment. Acute angles dominate the intersection angles distribution (IAD), with unique peaks at 49º±1º and 42º±4º. The IAD agrees well between both datasets, despite the difference in scale, periods, and geographical location. The divergence and shear within the LKFs also have the same distribution; however, the dilatancy angle (ratio of shear and divergence) is weakly correlated with the intersection angle. Using the IAD, we infer that the shape of the yield curve or plastic potential for sea ice resembles the shape of a teardrop or a Mohr-Coulomb shape. These new insights into the mechanical properties of sea ice will help design new high-resolution sea ice models.
23	Amy	Solomon	CIRES/University of Colorado and PSL/NOAA	03: Numerical Model Improvements in the Next Decade	S03-5	in-person	Amy Solomon, Matthew Shupe, UFS Microphysics Development Team	Advancing the ability to simulate Arctic mixed-phase clouds observed during MOSAiC with single column model experiments	NOAA is developing a Unified Forecast System (UFS) that will be used as the next US operational weather forecast system. To advance the ability to make meaningful forecasts of the Arctic system, a single column model forced by observations taking during MOSAiC has been designed. This model is being used to test and improve microphysics and boundary layer processes needed to simulate the phase partitioning of cloud liquid and ice in Arctic mixed-phase clouds. Evaluation of these model studies with observations taken during MOSAiC will be presented.
138	Deborah (Jacqueline)	Bozzato (Stefels)	Groningen Institute for Evolutionary Life Sciences, University of Groningen, Groningen, The Netherlands	04: Bridging Temporal and Spatial Scales in Observations and Models	S04-5	virtually	Bozzato D., van Leeuwe M. A., Peeken I., Webb A. L., Stefels J. and the MOSAiC ECO Team	Sulfur cycle and MOSAiC. A yearlong dataset in the Arctic.	During the MOSAiC expedition, we collected a yearlong dataset focused on the organic sulfur cycling, with emphasis on DMSP (i.e., dimethylsulfoniopropionate), an organic osmolyte, cryoprotectant and anti-oxidant (Stefels et al. 2000), produced globally by many groups of marine phytoplankton and particular groups of bacteria (e.g., Zheng et al. 2020). Moreover, DMSP can be converted to the semi volatile gas dimethylsulfide (DMS), which can be released into the atmosphere and contribute to the formation of cloud condensation nuclei. For this project, we collected a record of DMS(P) concentrations and distribution within the water column at several depths, ranging from 2 to 100 meters, with a particular emphasis on the spatial and temporal variability of these important compounds. By coupling measurements of concentrations of DMSP, DMS and dimethyl sulfoxide (DMSO) using Proton Transfer Reaction Mass Spectrometry (PTRMS), with identification of the microorganisms driving these processes using high-performance-liquid-chromatography (HPLC, ECO Team effort), we aim to not only quantify the molecules part of the sulfur cycle, but also to unravel the role of phytoplankton biomass and distribution on DMSP production in the Arctic.
208	Laurens	Ganzeveld	Wageningen University	04: Bridging Temporal and Spatial Scales in Observations and Models	S04-4	in-person	Laurens Ganzeveld, Johannes G.M. Barten, Laurie Novak, Hans-Werner Jacobi,Detlev Helmig, Dean Howard, Hélène Angot, Jacques Hueber, Steve Archer, Ludovic Bariteau, Kevin Posman, and Byron Blomquist	What explains MOSAiC's springtime ozone depletion? Inversion layer versus large-scale sources and sinks	Spring 2020, the MOSAiC observations on trace gases showed clearly anticipated ozone depletion with ozone mixing ratios reaching near zero for prolonged periods (multiple days). Interestingly, the depletion of ozone was not only observed in the very stable inversion layer but also occurred during periods of quite intense exchange between the boundary layer and lower free troposphere. Evaluation of the mechanisms explaining these observed depletions, including the role of advection and entrainment of airmasses reflecting different footprints, requires application of models also given the limited selection of observations of halogen species. The latter are deemed to be mainly responsible for the effective destruction of ozone. But application of these models to support analysis of the MOSAiC observations then requires a realistic representation of the snow and sea-ice halogen and ozone sources and sinks, gas-phase and heterogeneous chemistry and bou! ndary layer dynamics. Rather than applying 3-D modelling experiments, we perform 1-D modelling experiments being constrained with re-analysis data to consider the large-scale contribution to observed local-scale meteorology and ozone dynamics. We will present results of 1-D modelling experiments especially aiming at identifying the contribution of entrainment of lower free tropospheric air masses to the observed ozone depletion in the inversion layer.
22	Jennifer	Hutchings	Oregon State University	04: Bridging Temporal and Spatial Scales in Observations and Models	P2 (17)	in-person	Jennifer Hutchings, Angela Bliss, Daniel Watkins, The Distributed Network Team	Tracking the spatial and temporal variability of sea ice motion and deformation	The statistical and spectral properties of sea ice drift and deformation change as the physical forcing and friction related to ridging and ice floe interactions evolve in time. The MOSAiC Distributed Network (DN) shows increasing episodic deformation and deformation rates during the transition from winter to melt in the Greenland Sea. We describe the changing shape of the probability density function and changing spectra of divergence and shear rates. There is emergent coherence of the deformation as length and time scales increase. Hence it is important to pay attention to scales integrating over when using DN deformation data to interpret or upscale measurements taken at nodes in the DN. Sea ice deformation during the MOSAiC drift has different temporal and spatial scaling properties to previous campaigns. Placing this behavior in the context of open water fraction and ridging rates, the time and spatial evolution of deformation can be related to ice-ocean-atmosphere interactions and the sea icescape changes affecting the ecosystem. Discussion would be welcome to define sea ice kinematics data products that would best support interdisciplinary studies using MOSAiC data.

26	Jennifer	Kay	University of Colorado	04: Bridging Temporal and Spatial Scales in Observations and Models	S04-3	in-person	Kay, J.E., DeRepentigny, P., Holland, M. M., Bailey, D. A., DuVivier, A. K., Blanchard-Wrigglesworth, E., Deser, C., Jahn, A., Singh, H., Smith, M. M., Webster, M. A., Edwards, J., Lee, S.-S., Rodgers, K. B. and N Rosenbloom	Changing surface sea ice melt within observational constraints can improve Arctic sea ice simulation with minimal non-polar climate impacts	We isolate the influence of sea ice mean state on pre-industrial climate and 1850-2100 climate change within a fully coupled global model. The sea ice model physics are modified within in-situ observational constraints to increase surface albedo, reduce surface sea ice melt, and increase Arctic sea ice thickness and late summer cover. Importantly, increased Arctic sea ice in the modified model reduces a present-day late-summer ice cover bias. Of interest to coupled model development, this bias reduction is realized without degrading global top-of-atmosphere energy imbalance, surface temperature, surface precipitation, and major modes of climate variability. The influence of these sea ice physics changes on transient 1850-2100 climate change is compared within a large initial condition ensemble framework. Despite similar global warming, the modified model with thicker Arctic sea ice than the original model has a delayed and more realistic transition to a seasonally ice free Arctic Ocean. Yet, differences in transient climate change between the modified and original model are challenging to detect due to large internally generated climate variability. More broadly, our work shows the importance of sea ice surface melt processes and the value of large initial condition ensembles for credible model-to-model and observation-model comparisons.
30	Felix	Linhardt	Kiel University, Department of Geography	04: Bridging Temporal and Spatial Scales in Observations and Models	P2 (18)	in-person	Felix Linhardt, Victor Lion, Gerit Birnbaum, Natascha Oppelt	The "Böötle" remote controlled water colour spectro-radiometry platform	Multi- and hyperspectral remote sensing of water bodies relies heavily on the availability of in-situ data for model building as well as calibration and validation. Shallow waters are especially challenging for data collection, as the draft of a vessel or sensor can be a limiting factor, and manual measurements 'on foot' may disturb the environment. The newly developed "Böötle" remote controlled water colour spectro-radiometry platform allows for the simultaneous collection of hyperspectral, bathymetric and temperature data in waters as shallow as 15cm. It is equipped with three OceanOptics STS-VIS spectro-radiometers, a Tritech PA500 point sonar, and a DS18B20 temperature probe. Propulsion is achieved by two air screws, thereby limiting the impact on the water column and the bottom substrate. The platform is remotely controlled with a maximum range of 100m. A web interface is provided via wireless network, which allows for configuration and control of the sensor array. During the development special emphasis was given to the localization of the acquired data points. With a GPS receiver and two camera based systems, three independent positioning systems are available. As an example, two melt pond datasets are presented based on the Böötle deployments during MOSAiC and the Polarstern cruise ATWAICE 2022.
95	Hannah	Niehaus	University of Bremen	04: Bridging Temporal and Spatial Scales in Observations and Models	S04-2	in-person	Hannah Niehaus, Larysa Istomina, Tim Sperzel, Evelyn Jäkel, Gerit Birnbaum, Niklas Neckel, Niels Fuchs, Melinda Webster, Nicholas Wright, Felix Linhardt, Ran Tao, Marcel Nicolaus, Gunnar Spreen	Melt Pond Fraction derived from Sentinel-2 Data: Bridging from MOSAiC to Arctic-wide estimates	Melt ponds on Arctic sea ice significantly reduce the surface albedo and impact the surface energy budget. However, climate models struggle to realistically represent melt ponds because of their complexity and variability and the mismatch with observational scales. To overcome this mismatch, bridging between high resolution in-situ measurements and regional but medium resolution satellite observations is necessary. We derive melt pond fractions from high resolution (10 m) Sentinel-2 satellite imagery along the MOSAiC drift in June and July 2020. This product is evaluated using higher resolution (0.5 m) helicopter-borne and satellite products. A spatial analysis of melt pond evolution on the MOSAiC Central Observatory shows contrasts between a level ice and a highly deformed ice part, the latter of which exhibits exceptional early melt pond formation compared to the vicinity. Before drainage, pond fractions on the Central Observatory were on average 6 % higher than in the vicinity. The now validated Sentinel-2 melt pond fraction product may be used to upscale the ground truth to medium resolution (1 km) daily, pan-Arctic satellite observations. We present first results of comparing Sentinel-2 and Sentinel-3 derived pond fractions paving the way for improving Arctic-wide datasets and assessing melt pond coverage in climate models.
57	Benjamin	Rabe	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany	04: Bridging Temporal and Spatial Scales in Observations and Models	S04-1	in-person	Benjamin Rabe, (alphabetical) Alejandra Quintanilla Zurita, Angela Bliss, Anneke Sperling, Annette Rinke, Daniel Watkins, Don Perovich, Gunnar Spreen, Helge Goessling, Ivan Kuznetsov, Jennifer Hutchings, Julia Regnery, Marcel Nicolaus, Mario Hoppmann, Matthew Shupe, Ola Persson, Ruibo Lei, Tao Li, Thomas Krumpen, Tim Stanton, Wieslaw Maslowski, Ying-Chih Fang, and the MOSAiC Distributed Network Task team	Using distributed observations of the coupled Arctic system to capture spatial and temporal variability	The MOSAiC Distributed Network (DN) of autonomous ice-tethered systems ("buoys") aimed to resolve the variability across the MOSAiC observatory at a range of spatial and temporal scales. The system of different sites or nodes, set up radially around the central observatory, consisted of buoys of varying complexity, ranging from position-only drifters to systems aimed at fluxes of different variables through the ocean, the sea ice and snow, and the atmosphere just above the ice. The full set of buoys aimed to cover both feedbacks in the coupled system around the ocean-ice-atmosphere interface as well as three-dimensional processes, motivated by the limited horizontal resolution of state-of-the-art coupled climate models. This presentation will briefly describe the setup and performance, then highlight the ability to observe different processes using example measurements from two selected time periods: one 30-day part spanning December and January, another and the early summer absence of Polarstern, during which no manual observations were carried out at the central observatory. Both purely physical as well as biologically- and chemically-relevant observations will be presented. The results will be presented in the context of other observations and numerical modelling.

65	Iris	Thurnherr	Geophysical Institute, University of Bergen, Bergen, Norway and Bjerknes Centre for Climate Research, Bergen, Norway	04: Bridging Temporal and Spatial Scales in Observations and Models	S04-6	virtually	Iris Thurnherr, Andrew Seidl, Camilla F. Brunello, Aina Johannessen, Alena Dekhtyareva, Harald Sodemann	Identifying Lagrangian matches of air masses during MOSAiC and ISLAS2020 using stable water isotope measurements	Limited knowledge on how moist processes affect moisture cycling is an important contribution to model uncertainties. A useful natural tracer for moist processes in the water cycle and to identify Lagrangian connections are stable water isotopes. Isotopic measurements contain Lagrangian information as they record the effect of phase changes and mixing during moisture transport. Here we use stable water isotopes and Lagrangian models to assess the consistency of the atmospheric water cycle in numerical weather prediction models. During late winter 2020 simultaneous measurements of stable water isotopes in water vapour were conducted in the central Arctic on Polarstern during MOSAiC and at the sea ice edge in Ny Alesund during the ISLAS2020 field campaign. These observations allow to identify changes in the isotopic composition of water vapour during transport and due to the onset of ocean evaporation close to the sea ice edge. By combining Lagrangian measurements and modelling using LAGRANTO air parcel trajectories and the particle dispersion model FLEXPART, we identify air mass matches, and assess the effect of moist processes occurring during moisture transport from the Central Arctic to the sea ice edge.
174	David	Clemens-Sewall	National Center for Atmospheric Research	05: Aggregated Datasets and Methods for Model Evaluation	S05-4	in-person	David Clemens-Sewall, Marika Holland, Angela Bliss, Chris Cox, Michael Gallagher, Jennifer Hutchings, Bonnie Light, Don Perovich, Chris Polashenski, Kirstin Schulz, Maddie Smith, Melinda Webster	Progress Towards an Icepack model Case Study for the MOSAiC Expedition	To improve the representation of sea ice thermodynamics in Earth System Models (ESMs), we seek to compare model simulations with observations. However, direct comparison of models and in-situ observations is challenging because the sea ice components of ESMs typically simulate vastly larger spatial scales (e.g., 100x100 km) than the footprint of in-situ observations (e.g., 1x1 km). Additionally, standalone sea ice simulations are typically forced with reanalysis data, which have considerable biases and uncertainties. To address these challenges, we are developing a MOSAiC-based forcing package to conduct a case study of the Icepack model. We simulate the evolution of snow and sea ice on a Lagrangian, drifting parcel following the Central Observatory from October to July. The model is initialized from ice conditions observed in Autumn and forced with observed fluxes from the atmosphere and ocean. We present progress towards this case study, including the compilation of the initial conditions and forcing, and preliminary comparisons of the simulated snow and ice thicknesses and albedo evolution with observations. We discuss the challenges introduced by ice dynamics, lateral boundary conditions, and measurement gaps. Anticipated applications of this case study include improved parameterizations of melt ponds, snow, and albedo processes.
206	Michael	Gallagher	CIRES/NOAA	05: Aggregated Datasets and Methods for Model Evaluation	P2 (79)	in-person	Michael R. Gallagher, Chris Cox, Matthew Shupe, Taneil Uttal, Leslie Hartten, Sara Morris,	Encapsulating knowledge in datasets for a brighter future, perspectives on a MOSAiC merged product	The YOPP siteMIP project has produced a wealth of expertise, resources, and utility by producing consensus merged data files for research with observations at Arctic supersites. As MOSAiC scientists work to finalize their detailed individual datasets, the time is ripe to encapsulate the requisite expertise in a digestible format for future researchers. Here we present a first cut at a merged product following the groundwork laid by YOPP and outline the utility of such efforts.
124	Polona	Itkin	UiT The Arctic University of Norway	05: Aggregated Datasets and Methods for Model Evaluation	P2 (82)	in-person	Polona Itkin, Glen Liston	Tracking winter floe evolution and sea ice damage from SAR-derived deformation	Here we present a novel sea ice deformation products that can be used for the assessment of model rheology performance for the MOSAiC drift. Sea ice floe edges become indistinguishable inside the winter pack ice of the central Arctic. They freeze together into clusters of floes - deformation elements (DE), that move relative to each along linear kinematic features (LKFs) activated by weather events. Consequently, the geometric characteristics of these DE evolve at a synoptic scale. In this work we use displacements between space satellite Synthetic Aperture radar (SAR) image pairs to detect deformation rates. By thresholding these rates for a sequences of deformation fields we 1) track sea ice cover than underwent sea ice deformation (damaged ice), and 2) derive LKF area, intersection angle, and DE area and shape. The method is applied to the winter collection of Sentinel-1 SAR imagery available over the MOSAiC campaign. Our results show continuously active winter sea ice cover and its fracturization at strongest weather events. We also observe regularly distributed LKFs (damaged sea ice) that is seemingly independent of sea ice thickness and age. Some damaged areas are reactivated in temporally distant deformation events.
205	Rajka	Juhrbandt	Alfred Wegener Institute Bremerhaven	05: Aggregated Datasets and Methods for Model Evaluation	S05-6	virtually	Rajka Juhrbandt, Suvarchal K. Cheedela, Nikolay Koldunov, Thomas Jung	A Virtual Field Campaign along the MOSAiC expedition track	One of MOSAiCs central goals was the collection of observational data for improving the representation of the Arctic system in climate models. In this contribution, we present a method for direct comparison of observational with model data, namely the principle of Virtual Field Campaigns (VFCs). VFCs select data from a climate model according to a chosen expedition path. In this use case, the VFC method is tested by applying it along the MOSAiC expedition path using data from the AWI climate model. The data collected from the VFC is then evaluated with respect to the influence of Arctic Atlantification, more specifically of the Arctic Atlantic water layer depth, its temperature and the stratification in the Arctic halocline layer. We use data from preindustrial, present day and future time ranges to assess the development over time. Further plans include especially the adaptation of the selection process from the currently used nearest neighbour method to, e.g., an interpolation method.

110	Valentin	Ludwig	Alfred Wegener Institute (AWI)	05: Aggregated Datasets and Methods for Model Evaluation	S05-5	in-person	Valentin Ludwig and the SIDFEx Team: Helge F. Goessling, Axel Schweiger, Valentin Ludwig, Laurent Bertino, Ed Blockley, Frédéric Dupont, Wendy Ermold, Rüdiger Gerdes, Robert Grumbine, Yukie Hata, Jennifer Hutchings, Frank Kauker, Thomas Krumpen, Jean-François Lemieux, François Massonnet, Bill Merryfield, E. Joseph Metzger, Malte Müller, Marcel Nicolaus, Cyril Palerme, Michael W. Phelps, Thomas Rackow, Till A. S. Rasmussen, Simon F. Reifenberg, Ignatius Rigor, Suman Singha, Amy Solomon, Nick Szapiro, Steffen Tietsche, Jinlun	Deformation forecasts for the MOSAiC Distributed Network from the Sea Ice Drift Forecast Experiment (SIDFEx)	The deformation of sea ice drives the opening and closing of leads within the ice pack, which can impact the ice mass balance through freezing and melting processes. In our contribution, we assess the capability of a variety of sea-ice forecasting systems to represent and predict the deformation mainly of the MOSAiC Distributed Network (DN), but also of buoy arrays at larger spatial scales. We know from previous studies that the systems have skill at predicting the motion of individual buoys, but expanding this analysis to an array of buoys to study deformation is something novel, the current state of which we will be presenting here. So far, our findings show insignificant correlation for the smallest DN configuration, but significant correlation around 0.7 for a larger DN configuration and an Arctic-wide array. The forecasts stem from the Sea Ice Drift Experiment (SIDFEx). In the framework of SIDFEx, we have been collecting more than 200,000 forecasts for trajectories of single sea-ice buoys in the Arctic and Antarctic since 2017. Forecasts are provided by various forecast centres and collected and archived by the Alfred Wegener Institute (AWI). Their lead times range from daily to seasonal scales.
129	Maximilian	Maahn	Leipzig University	05: Aggregated Datasets and Methods for Model Evaluation	S05-2	virtually	Maximilian Maahn, Nina Maherndl, and Isabelle Steinke	Measuring snowfall properties with the Video In Situ Snowfall Sensor	We do not know the exact pathways through which ice, liquid, cloud dynamics, and aerosols are interacting in clouds while forming snowfall but the involved processes can be identified by their fingerprints on snow particles. The general shape of individual crystals (dendritic, columns, plates) depends on the temperature and moisture conditions during growth from water vapor deposition. Aggregation can be identified when multiple individual particles are combined into a snowflake. Riming describes the freezing of cloud droplets onto the snow particle and can eventually form graupel. In order to exploit these unique fingerprints of cloud microphysical processes, optical in situ observations are required. The Video In Situ Snowfall Sensor (VISSS) was specifically developed for MOSAiC to determine particle shape and particle size distributions. Different to other sensors, the VISSS minimizes uncertainties by using two-dimensional high-resolution images, a large measurement volume, and a design limiting the impact of wind. Tracking of particles over multiple frames allows determining fall speed and particle tumbling. Here, we present how particles are detected and tracked and show first results from the MOSAiC campaign that allow to evaluate snowfall formation parameterizations in atmospheric models.
5	Sergey	Matrosov	CIRES, University of Colorado and NOAA PSL	05: Aggregated Datasets and Methods for Model Evaluation	P2 (80)	in-person	Sergey Matrosov, Matthew Shupe, Taneil Uttal	Evaluating moisture conversion processes based on MOSAiC snowfall, cloud and water vapor retrievals	This presentation will introduce a high temporal resolution snowfall rate/flux product based on the radar-based retrievals for the snow accumulation period (mid October 2019 - mid May 2010). These retrievals will be then compared with other available snowfall measurements during the MOSAiC campaign and the advantages, limitations and also uncertainties of different MOSAiC snowfall sensors will be discussed. Quantitative analyses of MOSAiC snowfall accumulations and intensities will be presented and frequencies of occurrence of different snowfall rates will be shown. The role of different snowfall microphysical processes (e.g., snowflake riming, aggregation) will also be discussed. The MOSAiC snowfall rate retrievals will be then analyzed in conjunction with concurrent estimates of cloud liquid and ice water paths from a ground-based microwave radiometer and cloud radar measurements, respectively, and also near-surface relative humidity and temperature. Based on these analyses, the observationally-based statistical relations among these moisture-related geophysical parameters will be developed. These relations can provide information on efficiency of the moisture conversion in the Arctic atmosphere. They can be used for evaluating different precipitation parameterization processes in models such as snowflake growth by water vapor deposition and a conversion of supercooled cloud liquid to precipitable solid hydrometeors.
10	Felix	Pithan	Alfred Wegener Institute, Helmholtz centre for polar and marine science	05: Aggregated Datasets and Methods for Model Evaluation	S05-1	virtually	Felix Pithan, Marylou Athanase, Sandro Dahlke, Antonio Sánchez-Bení-tez, Matthew D. Shupe, Anne Sledd, Jan Streffing, Gunilla Svensson, and Thomas Jung	Nudging allows direct evaluation of coupled climate models with in-situ observations: A case study from the MOSAiC expedition	While numerical weather prediction models are routinely assessed against a large array of observations, comparing climate models and observations usually requires long time series to build robust statistics. Here, we show that by nudging the large-scale atmospheric circulation, climate model output can be compared to local observations for individual days. Radiosondes, cloud remote sensing and surface flux observations serve as reference observations for a MOSAiC case study in April 2020. The climate models AWI-CM1/ECHAM and AWI-CM3/IFS miss the diurnal cycle of surface temperature, likely because both models assume the snow pack to have a uniform temperature. CAM6 uses three layers to represent snow temperature and represents the diurnal cycle more realistically. During a cold and dry period with pervasive thin mixed-phase clouds, AWI-CM1/ECHAM only produces partial cloud cover and overestimates downwelling shortwave radiation at the surface. AWI-CM3/IFS produces a closed cloud cover but misses cloud liquid water. Our results show that nudging the large-scale circulation to the observed state allows a meaningful comparison of climate model output even to short-term observational campaigns. We suggest that nudging can simplify and accelerate the pathway from observations to climate model improvements and substantially extends the range of observations

81	Tim	Sperzel	Leipzig Institute for Meteorology, Leipzig University, Germany	05: Aggregated Datasets and Methods for Model Evaluation	P2 (81)	in-person	Evelyn Jäkel, Tim R. Sperzel, Manfred Wendisch, Hannah Niehaus, Gunnar Spreen, Astrid Lampert, Falk Pätzold, Marcel Nicolaus, Ran Tao, Wolfgang Dorn, Lara Foth, Annette Rinke	Observations and modeling of areal surface albedo of Arctic sea ice based on (AC)3 and MOSAiC data	The spread of climate model results quantifying the snow-ice surface albedo feedback is partly caused by the significant sensitivity of the simulated sea ice surface albedo with respect to surface warming. Therefore, the accurate representation of the Arctic sea ice and its evolution throughout the year, particularly in the melting period, is crucial to obtain reliable climate model projections. Here we evaluate the results of the surface albedo scheme of the coupled regional climate model HIRHAM-NAOSIM against airborne and ground-based measurements. The corresponding observations were conducted during the MOSAiC expedition and during five aircraft campaigns within the framework of the (AC)3 project. We found a seasonal-dependent degree of agreement between measured and modeled surface albedo for cloud-free and cloudy situations. The current albedo scheme has projected an earlier onset of melting and a more realistic width of surface albedo frequency distributions in summer than the former albedo scheme. In spring, however, the cloud effect on surface albedo was overestimated by the model, while the albedo scheme for cloudless cases showed a smaller bias than the former scheme without cloud-depending parameters.
135	Shreya	Trivedi	University of California, Los Angeles	05: Aggregated Datasets and Methods for Model Evaluation	S05-3	virtually	Imke Seivers, Shreya Trivedi, Tido Semmler, Marylou Athanase	Comparing Arctic Sea-ice and Snow Thickness in MOSAiC data with CMIP6 simulations	Arctic sea-ice cover has rapidly declined in the recent past. Snow on sea-ice was shown to be instrumental in driving the variability in sea-ice thickness(SIT). Therefore, an improved assessment of sea-ice/snow thickness and their variations will help in understanding absolute changes in sea-ice distributions. Hence, the ability of climate models to realistically simulate the observed changes in Arctic sea-ice has become a central measure of model performance in Arctic-focused climate-model intercomparisons. Here, we examine the simulated Arctic sea-ice and snow thickness in CMIP6. Models have proven to simulate a different annual cycle compared to observed Arctic-wide satellite observations. However, satellite snow/sea-ice thickness measurements still come with quite large uncertainties. The MOSAiC dataset provides a unique opportunity to compare in-situ observations with the currently existing climate models. To perform meaningful comparisons with CMIP6 simulations, we define "proxy years" with similar maxima/minima Arctic sea-ice extent as in the MOSAiC year. Our preliminary results found that the selected models seem to align well with the MOSAiC derived snow thickness. In contrast, the SIT does not agree well with the observed annual cycles showing relatively high inter-model spread during the winter season. This proposed proxy approach paves the way for further meaningful model evaluation.
112	Carola	Barrientos-Velasco	Leibniz Institute for Tropospheric Research	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06B-6	in-person	Carola Barrientos-Velasco, Hartwig Deneke , Hannes J. Griesche, Anja Hünerbein, Andreas Macke, Patric Seifert, and Matthew D. Shupe	Investigation of the cloud radiative effect during MOSAiC based on CERES and Polarstern observations	Several poorly understood feedback mechanisms related to clouds contribute to Arctic amplification and introduce significant uncertainty in climate models. Our goal is to present preliminary results contrasting the satellite-based estimates of the cloud radiative effect (CRE) from the Clouds and the Earth's Radiant Energy System (CERES) over the central Arctic with the unique in-situ and remote sensing observations collected during the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition. The remote sensing observations aboard Polarstern are used to characterise the macro- and microphysical properties of clouds employing the synergistic Cloudnet algorithms as inputs for 1D radiative transfer simulations. The consistency of our simulations, CERES products, and upwelling and downwelling shortwave and longwave radiative fluxes collected on the ship and at four stations on the ice are evaluated for different situations, including clear-sky periods. We found that clouds enhance the net radiative fluxes at the surface by about 41.0 Wm^-2 and 15.0 Wm^-2 during polar night and polar day, respectively. The uncertainty of the CRE inferred from CERES and radiative transfer simulations are compared. The influence of spatiotemporal variability of clouds and atmospheric conditions on the comparison of the point-like measurements with the satellite footprints is discussed.
143	Jason	Dodson	Science Systems and Applications, Inc.	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06A-6	in-person	J. Brant Dodson, Patrick C. Taylor	Towards a more realistic representation of NASA CERES-derived surface radiative fluxes during polar night: a comparison with the MOSAiC field campaign	The Arctic remains one of the more difficult regions observe, and so satellite observations are a critical tool for observing the region, such as those from Clouds and the Earth's Radiant Energy System (CERES). But validating the satellite surface radiative flux estimates is difficult because of the lack of in situ measurements. The extensive high-quality surface radiative flux and meteorological measurements collected from MOSAiC provide a useful check on flux retrievals from CERES instruments. We compare MOSAiC and CERES surface radiative fluxes during October through March of 2019-2020 using the large set of meteorological measurements also collected by MOSAiC, specifically cloud properties. Previous work identified a significant source of error in the CERES estimate of surface downwelling longwave flux as the estimate of low level cloud amount when compared with MOSAiC W-band radar measurements. Continuing this work, we examine the effects of errors in cloud water path on surface radiative fluxes. When using all cloud conditions, errors in cloud water are also significantly correlated with surface radiative flux errors, though the size off the effect is only about half that of cloud amount. But when considering low cloud conditions only, the effects of cloud water and cloud amount are comparable.
9	Carolina	Gabarró	Institute of Marine Science (ICM-CSIC) & BEC	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06A-2	virtually	C. Gabarró, F. Hernandez-Macia, M. Huntemann, G. Spreen, R. Dadic, L. Thielke	Using measurements and models to understand sea ice L-band emission using the ARIEL radiometer on MOSAIC	The ARIEL L-band (1.4GHz) radiometer was deployed during the MOSAiC expedition to measure the emissivity of sea ice and snow. Data was acquired during the summer period along transects which enabled us to measure the microwave emission of different ice types and snow conditions (Gabarró et al. 2022). Additionally, ARIEL also acquired data in stationary mode, in close vicinity to other radiometers (ELBARA and HUTRAD), all observing the same area of snow and ice. Simultaneously, in situ measurements were acquired to characterize ice and snow, e.g. ice thickness from GEM surveys, snow depth and snow characteristics from Magnaprobe and snow pits, and snow surface temperature, ice cores, and more. We will show the comparison between the ARIEL and the ELBARA brightness temperature measurements and also with several existing microwave emission models including: Burke (Gabarró et al. 2022), MEMLS and SMRT models. Before running the emission models, a thermodynamic model is used to compute the evolution of the ice structure during each leg and thus obtain the input for MEMLS and SMRT. The final objective of this analysis is to improve the quality of the thin sea ice thickness estimates acquired by the SMOS satellite mission, which carries an L-band radiometer.

27	wenkai	guo	UiT the Arctic University of Tromso	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06B-2	in-person	Wenkai Guo, Polona Itkin, Suman Singha, Anthony Paul Doulgeris, Malin Johansson, Gunnar Spreen	Winter to summer sea ice classification of TerraSAR-X ScanSAR images for MOSAiC incorporating per-class incidence angle dependency of image textures	We provide sea ice classification maps of a time series of TerraSAR-X ScanSAR (TSX SC, HH) images from Oct. 2019 to June 2020 for MOSAiC (average 3 scenes per week). This dataset provides constant coverage over R/V Polarstern, with a wide spatial coverage (approx. 100x150km) and relatively high spatial resolution (pixel spacing 8.25m). Sea ice is classified into leads, young ice, and level and deformed first-year or multi-year ice. We establish per-class incidence angle (IA) dependencies of TSX SC intensities and Gray-Level Co-occurrence Matrix textures from freezing to melting. We use a classifier that corrects for these dependencies, using HH intensities and textures as input. Kalman filtering removes image artifacts including scalloping and inter-scan banding (prominent in TSX SC textures). Classification results are produced from class probabilities adjusted by Markov Random Field contextual smoothing, and evaluated by classification accuracy (83.7% average) and comparison to ice surface roughness estimates (approx. 80% correct correspondence). Prominent peaks in lead and young ice fractions are found in late Nov. 2019 and March 2020. Time series of class fractions are further compared to indicators of ice openings from other MOSAiC studies.
173	Nils	Hutter	Cooperative Institute of Climate, Ocean and Ecosystem Studies, University of Washington, Seattle, USA	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (63)	in-person	Nils Hutter, Lorenzo Zampieri	Machine learning based estimates of ice and snow thicknesses derived from airborne surface topography and temperature measurements	Reliable sea ice and snow thickness observations are crucial for documenting the rapid changes in the Polar environments and understanding climate-relevant processes. Still, thickness remains one of the variables with the highest uncertainty. Altimeter-based estimates of sea ice thickness convert point measurements of freeboard to ice thickness with the hydrostatic balance and rely on snow thicknesses and density assumptions that lead to high uncertainties. Surface topography holds valuable information on snow and ice features and could inform better retrieval methods for snow and ice thicknesses. Here, we present a machine learning retrieval technique designed to distinguish previously unregarded surface features and predict ice and snow thickness. We use colocated winter MOSAiC airborne laser scanner observations and thermal infrared imagery for predicting the snow and ice thickness. We implement different architectures with varying predictors (freeboard, elevation, reflectance, and surface temperature), input sizes (16m to 64m), and complexity (1-d or 2-d topography). We use the transect ice and snow thickness measurements to train and validate the models. Furthermore, we discuss the performance of different ML models in connection to their potential application to ICESat-2 data, and present the first ice and snow thickness estimates for the entire MOSAiC central
92	Arttu	Jutila	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06B-1	in-person	Arttu Jutila, Nils Hutter, Stefan Hendricks, Robert Ricker, Luisa von Albedyll, Gerit Birnbaum, Christian Haas	MOSAiC airborne laser scanning of the sea-ice surface: data product overview and insights to seasonal roughness evolution	Between September 2019 and September 2020, we conducted a total of 35 floe grid and 29 transect flights over the MOSAiC Central Observatories and surrounding sea ice with the airborne laser scanner to map changes of the sea-ice surface during the full annual cycle at high spatial resolution and coverage. In this presentation, we give an overview of the first version of the released data with illustrative examples. The data products include point cloud segments, gridded segments, and gridded merged maps. In addition, we emphasize important aspects of the data products that potential users should consider for their applications. In the latter part of this presentation, we take a look at the first results on the temporal evolution of sea-ice surface roughness in the Central Observatory and the Distributed Network during the first part of MOSAiC from October 2019 to July 2020. Here, we calculate roughness from the point cloud data as the standard deviation of across-swath surface elevation on a per scan-line basis.
13	Hyun-Cheol	Kim	Korea Polar Research Institute (KOPRI)	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (64)	in-person	Jeong-Won Park, Hyun-Cheol Kim	Performance evaluation of tracking MOSAiC ice floe using spaceborne X-band SAR	In the context of rapid environmental changes, the polar ocean's sea ice condition has been transitioning in terms of thermodynamics and kinematics. Estimating the sea ice drift field is important for studying kinematic change and its impact on the thermodynamic processes and supporting maritime safety. Ice motion is being tracked at a large scale daily; however, a higher resolution product is desirable for more reliable monitoring of rapid changes in sea ice. The use of wide-swath SAR has been extensively studied; yet, recent high-resolution X-band SAR sensors have not been tested enough. We examine the feasibility of KOMPSAT-5 and COSMO-SkyMed for retrieving sea ice motion using the MOSAiC expedition dataset. The ice drift match-ups extracted from consecutive SAR image pairs and buoys in the central Arctic were used for performance evaluation and validation. In addition to individual tests for each sensor, a cross-sensor combination was tested to overcome the drawback, the long revisit time of high-resolution SAR. The experimental results show that higher accuracies are achievable from both single- and cross-sensor configurations of X-band SARs compared to wide-swath C-band SARs, and that sub-daily monitoring is feasible from the cross-sensor
118	Karl	Kortum	German Aerospace Center	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06B-3	in-person	Karl Kortum, Suman Singha, Gunnar Spreen, Arttu Jutila, Nils Hutter, Gerit Birnbaum, Robert Ricker, Luisa von Albedyll	Extrapolating Airborne Laser Scanner Derived Sea Ice Classes to Synthetic Aperture Radar Measurements	Retrieval of sea ice types using Synthetic Aperture Radar (SAR) has the potential for near real-time and high resolution monitoring of the polar regions throughout the year. The core challenge of the idea has, since its inception, been the unavailability of in-situ measurements of the ice. Not only does this impede the rate at which progress can be made, progress itself becomes hard to recognise as we do not have extensive in-situ data to validate the results. Using helicopter-borne Airborne Laser Scanner (ALS) data and near coincident SAR acquisitions from the MOSAiC mission we can alleviate this problem with twenty matched product pairs. We compare five different deep learning classifiers and can establish their performances for ice types directly derived from the ALS measurement. We find a clear discrepancy between methods which are able to learn from the class distributions (segmentation) and those that cannot (classification). These findings infer a limit of the validity of classifiers trained from e.g. ice-charts, where the spatial class distributions are not covered well by the data. For the first time we can compute accuracies of modern classifiers for SAR-based retrieval, which are truly representative of their real-world performance.
140	Jean	Lac	Sorbonne Université - CNRS	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (65)	in-person	Jean Lac, Hélène Chepfer, Assia Arouf, Michael Gallagher	Low opaque clouds formed over Fall Arctic open water enhance Greenland's west coast surface cloud warming	Greenland ice-sheet plays a major role in the global sea level rise. Its surface melting is directly linked to the energy received at the surface. Clouds radiatively impact the surface energy balance. The net cloud radiative effect at Greenland's surface is driven by the longwave cloud warming, as the high albedo of Greenland's surface decreases shortwave cloud cooling. However, the role of clouds on the Greenland ice-sheet's melt is still under discussion. CALIPSO lidar high-quality cloud observations open new opportunities for understanding cloud processes above the Greenland ice-sheet and their radiative impact. In this study we show that more clouds over newly open water in response to Arctic sea-ice retreat during Fall has an impact on Greenland's surface energy budget. In fact, low stratocumulus clouds formed over open water in the Baffin Sea are advected toward Greenland's west coast during September, causing an increase of the cloud longwave surface warming of 40W/m2 at a daily scale. Moving forward, this study highlights the importance of considering local processes in future studies about the role of clouds on the Greenland Ice-sheet in present and future climate.

55	Xiaomei	Lu	NASA	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (66)	in-person	Xiaomei Lu; Yongxiang Hu	Evaluation of ICESat-2 snow depth in Arctic using the MOSAiC data	Snow cover on sea ice has many significant effects on the ice mass balance and general heat exchange processes between the ocean and the atmosphere. Moreover, accurate characterization of snow depth on sea ice is important for improving the accuracy of satellite altimeter estimates of sea ice thickness. The Advanced Topographic Laser Altimeter System (ATLAS) instrument, onboard the Ice, Cloud, and land Elevation Satellite-2 (ICESat-2) launched on 15 September 2018, is designed to measure ice-sheet topography and sea ice freeboard as well as atmospheric properties and global vegetation. Fortunately, the ICESat-2 ATL03 global geolocated photon data set provides the very high vertical resolution of surface-returned photons including the subsurface photons that penetrate into the snowpack and undergo multiple scattering, which offers a unique and exciting opportunity to study snow depth using ICESat-2 lidar multiple scattering measurements from snow. A novel snow depth method is proposed and applied to ICESat-2 photon data. In this presentation, we will talk about the new snow depth method and its application to Arctic snow depth retrieval over sea ice. Finally, we evaluate the ICESat-2 snow depth results using the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) in-situ snow depth results.
8	Emily	Monroe	SSAI/NASA LaRC	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (67)	in-person	Emily Monroe, David Rutan, Seung-hee Sam, Seiji Kato, Fred Rose, and Patrick Taylor	Illuminating albedo: using MOSAiC data to assess the CERES Cloud Radiative Swath (CRS) albedo quantification process	Increasing surface and lower tropospheric air temperatures as a result of rising greenhouse gases are expected to be most pronounced over the Arctic. Such rapid changes alter the surface climate of the region, and impacts can be observed atmospherically, oceanographically, and biogeophysically. Accurately quantifying the impact of decreasing surface albedo on the surface energy budget with satellite observations alone is complicated by a lack of shortwave radiation during winter and seasonal/spatial heterogeneity of surface type and associated spectral albedo. NASA's Clouds and the Earth's Radiant Energy System (CERES) project features the Cloud Radiative Swath (CRS) product, which builds upon the Single Scanner Footprint (SSF) product by using the NASA Langley Fu-Liou radiative transfer model to calculate a robust and high-quality array of surface and atmospheric radiative fluxes on an instantaneous, footprint-level scale. This study aims to use MOSAiC and CRS data to illuminate potential uncertainties in the CERES albedo production process, with goals of determining 1) spectral albedo under clear sky conditions when stratified by ice concentration, 2) the uncertainty associated with CERES surface albedo 'history maps' when compared against observations captured during MOSAiC, and 3) the magnitude of variation between meteorological inputs compared to those from
16	Vishnu	Nandan	University of Manitoba, Canada	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06A-3	in-person	Vishnu Nandan, Julienne Stroeve, Rosemary Willatt, Robbie Mallett, Rasmus Tonboe, Marcus Huntemann, Team ICE and ATMOS Members, James Mead, John Yackel, Claude Duguay and Randall Scharien	Year-long measurements of snow-covered sea ice using KuKa radar	The fully-polarimetric, surface-based Ka- and Ku-band KuKa radar successfully collected year-long measurements of snow-covered sea ice and melt pond signatures from the MOSAiC floe. Radar measurements (both in the altimetry and scatterometry modes) were collected coincident with in situ snow/sea ice geophysical property and meteorological measurements These novel measurements has significantly improved our understanding of how snow pack and its geophysical properties critically affect Ka- and Ku-band radar signals, impacting snow depth and sea ice thickness retrieval accuracy from satellite radar altimeters This talk will discuss ground-breaking published research findings from the KuKa radar deployment during MOSAiC. We show how the fully-polarimetric capability of KuKa radar can be used to derive snow depth on sea ice. The MOSAiC floe underwent significant winter warm wind events and a spring rain-on-snow event. These events caused significant changes in snow and sea ice geophysical properties and KuKa radar detected these changes and its associated effect on dominant radar scattering surfaces, affecting the accuracy of snow depth estimates. In a warming Arctic, our findings from MOSAiC will improve satellite algorithms to derive accurate snow depth and sea ice thickness estimates from presently operational and forthcoming CryoSat-2, AltiKa, Sentinel-3 and CRISTAL satellite radar altimeter missions.
32	Natascha	Oppelt	Kiel University (Germany)	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (68)	virtually	Natascha Oppelt, Max Jakob Martius, Melinda Webster	Large-scale melt pond evolution observed by Sentinel-2	Melt ponds play a significant role in the energy balance of the Arctic and enhance ice melting during Arctic summer. Therefore, they form an important parameter for climate modelling. Remote sensing represents an efficient method for assessing the large-scale distribution and evolution of melt ponds with a high spatial and temporal resolution. In this approach, we use mosaicked Sentinel-2 data from different dates during the Arctic summer of 2020 to model melt pond fraction at larger scales. SkySat-derived classifications of melt pond coverage of the corresponding time periods with a spatial resolution of ~ 0.5 m serve as reference for the Sentinel-2 derived melt pond fractions. Considering the spectral variability of different types of melt ponds, we compare different approaches (random forest, extreme gradient boosting and neural network) to determine the most suitable machine learning algorithm for monitoring melt pond distribution and evolution.
53	Robert (Arttu)	Ricker (Jutila)	NORCE Norwegian Research Centre	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (69)	in-person	Robert Ricker, Steven Fons, Arttu Jutila, Nils Hutter, Kyle Duncan, Sinead L. Farrell, Nathan T. Kurtz, and Renée Mie Fredensborg Hansen	Linking scales of sea ice surface topography: evaluation of ICESat-2 measurements with coincident helicopter laser scanning during MOSAiC	Information about the sea ice surface topography is crucial. NASA's Ice, Cloud, and land Elevation Satellite-2 (ICESat-2 senses the sea ice surface topography with six laser beams. To assess the capabilities and uncertainties of ICESat-2 products, coincident high-resolution measurements of the sea ice surface topography are required. During the year-long Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) Expedition in the Arctic Ocean, we successfully carried out a coincident underflight of ICESat-2 with a helicopter-based airborne laser scanner (ALS) achieving an overlap of more than 100 km. Our goal is to investigate how the sea ice surface roughness and topography is represented in ICESat-2 products, and how sensitive ICESat-2 products are to leads and small cracks in the ice cover. We compare the ALS measurements with the ICESat-2's primary sea ice height product, ATL07, and the high-fidelity surface elevation product developed by the University of Maryland (UMD). By applying a ridge-detection algorithm, we find that 16 % (4 %) of the number of obstacles in the ALS data set are found using the strong (weak) center beam in ATL07. Significantly higher detection rates of 42 % (30 %) are achieved when using the UMD product.

98	Philip	Rostosky	University of Bremen	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06B-4	in-person	P. Rostosky, J. E. Rückert, M. Huntemann, D. Clemens-Sewall, K. Ebell, L. Kaleschke, J. Lemmetyinen, A. R. Macfarlane, R. Naderpour, J. Stroeve, A. Walbröl, G. Spreen	Influence of warm air intrusions on satellite sea ice concentration algorithms	In April 2020, the MOSAiC floe was hit by two consecutive warm air intrusions, raising the air temperature from -30°C to almost 0°C. A strong false drop in derived sea ice concentration by most satellite algorithms was observed during and after the second warming event. Depending on the algorithm, the retrieved ice concentration was 5% to 30% too low, not limited to the MOSAiC area but on a large fraction of the Arctic. An analysis of ground-based radiometer, terrestrial laser scan observations and snow property measurements collected during MOSAiC revealed that the formation of a large-scale glazed ice layer at the top of the snow likely caused this underestimation of satellite derived sea ice concentration. Analyzing 40 years of winter sea ice climate record and ERA5 reanalysis data, we show that large-scale warming waves have become more frequent in the last 20 years. In particular the warming waves reaching above -2°C we have found to have a strong impact on most sea ice concentration retrievals leading to a significant underestimation of sea ice area estimates. In the last 10 years, these warming events occurred frequently in April and are an important source of uncertainty in satellite derived sea ice data.
185	Randy	Scharien	University of Victoria	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06A-4	virtually	Randall Scharien, Aikaterini Tavri, Vishnu Nandan, Adria Blanco-Cabanillas, Mallik S. Mahmud, Gunnar Spreen, John Yackel	L-band frequency radar backscatter during sea ice growth and decay phases at the MOSAiC expedition	During MOSAiC, a sled-mounted L-band frequency (1.3 GHz) radar scatterometer system was successfully deployed on sea ice for several weeks during freeze-up, winter and melt periods. Time-series polarimetric backscatter was measured coincident to comprehensive snow and sea ice geophysical micro-meteorological variable measurements. The system collected data across a wide range of incidence angles that correspond to satellite configurations, e.g. 20° to 50°, and from a small field of view (metre-scale), enabling detailed investigation into signature controlling properties. Here, the L-band backscatter of sea ice are examined in the context of varying in situ snow and sea ice parameters during ice growth and decay phases, in combination with model simulations from the Snow Microwave Radiative Transfer model (SMRT). Since the system operated at the lowest frequency of the active microwave instrumentation at MOSAiC, it provides deeper relative penetration into the snow-ice volume and novel insights into the seasonally evolving and event-driven internal ice physical and thermodynamic properties. We show that L-band backscatter is explained by radar interaction at the ice-ocean interface during the growth phase, recognizable at smaller incidence angles, and provide insights into the potential utility of L-band synthetic aperture radar from upcoming missions ROSE-L and NISAR.
161	Maximilian (Gunnar)	Semmling (Spreen)	German Aerospace Center DLR-SO, Neustrelitz, Germany	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (70)	in-person	M. Semmling, J. Wickert, M. Hoque, D. Divine, S. Gerland, G. Spreen	Modelling and Estimation of Sea-Ice Reflectivity: MOSAiC Results on GNSS Reflectometry	The L-band signals transmitted by Global Navigation Satellite Systems (GNSS) are a promising source for sea-ice remote sensing as they partly penetrate into ice upon reflection. Reflecting interfaces of sea-ice layer and snow cover contribute to the reflected signal. We present calculations of sea-ice reflectivity for GNSS signals based on a multilayer reflection model. Therefore, we assume coherent reflection conditions, satellite elevation angles of 3° to 30° and layers of the different media (with their relative permittivity): dry snow cover (~1), low/high-salinity ice layer (~3/~5) and underlying sea water (~70). Furthermore, we analyze reflectivity profiles estimated from GNSS reflectometry data of the first MOSAiC drift period (10/2019 to 06/2020) in the central Arctic. The comparison of model and estimation results shows that oscillation patterns occur when low permittivity coincides with low conductivity (low-salinity ice or dry snow). The patterns are particularly strong in late April 2020 after three days of warm air intrusion at the ice floe. We conclude that structural changes of the sea-ice/snow layers upon temperature change can be detected by reflectometry measurements. Upcoming satellites (e.g. ESA's nano-satellite PRETTY) will provide further opportunities to study
18	Victor	Smirnov	Arctic and Antarctic Research Institute	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P2 (74)	virtually	Victor Smirnov, Maxim Znamensky, Nikolai Kolabutin, Jari Haapala	Deformation and destruction of sea ice - a source of wave processes of different spatial and temporal scales	Analysis of dynamic processes makes it possible to identify a wide range of waves occurred on the ocean's surface. There are shown processes of different time and space scales when ice is affected by wind and oceanic swell waves. In the spectra of storm swell waves, the effect of increase in the oscillations frequency with time is noted. An explanation is proposed for this phenomenon as due to the movement of cyclones towards the drifting station. Field data on the mechanics of ice breaks indicate intense movements and bends of ice fields (loss of stability - buckling). The contribution of wave processes to the mechanics of large-scale ice breaks and the nature of the appearance of the ocean ice cover ordered structure is estimated. Particular attention is paid to the large-scale mechanics of the phenomena of ice compression and ridging, self-oscillatory processes and tidal ridging. Data on low-frequency horizontally polarized oscillations with possible ice movements along breaks in a close-packed ice cover were obtained. The scientific results presented during the Mosaic expedition can be used both to improve weather and climate forecast models and to predict the sea ice state in real time when solving engineering problems of the Arctic.

166	Gunnar	Spreen	University of Bremen	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06A-1	in-person	Gunnar Spreen, Estell Cardellach, Tánia Casal, Oguz Demir, Claude R. Duguay, Carolina Gabarró, Stefan Hendricks, Marcus Huntemann, Joel T. Johnson, Lars Kaleschke, Steen Savstrup Kristensen, Juha Lemmetyinen, Mallik S. Mahmud, Reza Naderpour, Vishnu Nandan, Robert Ricker, Philip Rostosky, Janna Rückert, Randy Scharien, Mike Schwank, Maximilian Semmling, Julienne Stroeve, Aikaterini Tavri, Linda Thielke, Rasmus T. Tonboe, Luisa von Albedyll, John Yackel	Remote Sensing of Sea Ice on the MOSAiC Ice Floe â€" What have we learned?	DDuring MOSAiC several remote sensing instruments designed for observing the sea ice and its snow cover were installed on the ice floe next to Polarstern and on the vessel itself. In particular the following measurements were performed during MOSAiC: (i) 0.5-89 GHz microwave radiometers, (ii) L- to Ka-band microwave radar scatterometers, (iii) reflected GNSS measurements, and (iv) infrared, visual, and hyperspectral cameras. The remote sensing measurements were accompanied by extensive measurements of snow and ice properties. By having these coincident multi-frequency remote sensing and in-situ observations, factors influencing the emission, reflection, and scattering of microwaves in sea ice and snow can be better understood. New remote sensing methods can be developed and contribute to new and upcoming satellite missions like CIMR, CRISTAL, ROSE-L and AMSR3. Here we will summarize what we have learned so far. Different studies have looked, e.g., into radar backscatter for impact of rain and snow redistribution, into ice thickness retrieval from GNSS-R and radiometers, on the impact of warm air intrusions on sea ice concentration from microwave radiometers, and more. The results provide new estimates for uncertainties of satellite retrievals of, e.g., sea ice thickness, concentration, and snow depth, and how to potentially improve them.
188	Aikaterini	Tavri	University of Victoria	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06B-5	in-person	Aikaterini Tavri, Randall Scharien, Malin Johansson, Melinda Webster, Hannah Niehaus and Polona Itkin	C- and L-band SAR scattering mechanism retrievals for the MOSAiC floe in the melt season	Synthetic Aperture Radar (SAR) is an effective tool for sea ice mapping. However, in the melt season, the SAR backscatter is highly variable due to surface heterogeneity, and ice types are not easily identifiable. SAR polarimetric parameters and scattering mechanism decompositions offer additional information about the sea ice properties, improving our monitoring capacity. Polarimetric parameters were retrieved from first-year and second-year ice samples of the MOSAiC floe using both ALOS-2 (L-band) and Radarsat-2 (C-band) imagery acquired during the melt season. These parameters were combined with in-situ datasets from repeat surveys, IMB buoys, and melt pond measurements from air- and space- borne sensors. Surface scattering mechanisms are shown to dominate, but relative scattering mechanisms shift according to melt stage and radar parameter, such as frequency and incidence angle. By mapping these changes, and specific events such as melt onset, pond formation, and drainage, we determine the contribution of melt ponds as the driver of backscatter variability. Our work presented at the first MOSAiC conference showed that entropy depicted pond drainage events. In addition, melt pond fraction products are used for linking processes between local and regional scales. Understanding these relationships will improve sea ice mapping and classification in the melt season.
88	Linda	Thielke	University of Bremen	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (71)	in-person	Linda Thielke, Marcus Huntemann, Dmitrii Murashkin, Gunnar Spreen	Investigating the relevance of small-scale leads for satellite surface temperatures	In winter, small cracks and leads act as windows for increased heat exchange from the warmer ocean to the colder atmosphere. These features are becoming increasingly present in a warming Arctic when the sea ice is thinning, moves faster, and breaks up easier. We characterize the spatio-temporal variability of small-scale leads based on high-resolution (1 m) observed surface temperatures collected via helicopter during the MOSAIC 2019/2020 expedition. To investigate leads from surface temperatures, we developed a temperature threshold-based lead classification for 35 flights from October 2019 to May 2020. Our results show that the lead width distribution follows a power law in agreement with previous studies while we now extend it to a much finer scale; i.e., there are many narrow leads and a decreasing number of wider leads. Motivated by the high number of small-scale leads, we investigate their relevance for the sub-footprint scale variability of thermal infrared satellite data, e.g., MODIS surface temperatures. We perform a one-to-one comparison of helicopter-borne temperature maps (1 m resolution) with MODIS scenes (1 km resolution) to investigate how much the satellite surface temperature is influenced by the small leads.
11	Luisa	von Albedyll	Alfred Wegener Institute	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	S06A-5	in-person	Luisa von Albedyll, Dmitrii Murashkin, Sascha Willmes, Nils Hutter, Linda Thielke, Stefan Hendricks, Lars Kaleschke, Gunnar Spreen, Christian Haas	Lead fractions from SAR-derived sea ice divergence during MOSAiC	In the polar winter, leads play a crucial role in altering atmospheric, ecological, and oceanic processes. We analyze the potential of SAR-derived divergence to estimate lead fractions. We derive two lead-fraction products from divergence calculated from SAR scenes along the drift track of MOSAiC. The divergence-derived lead fractions consider all divergence grid cells. The linear kinematic features (LKF)-derived lead fractions consider only those divergence cells identified as part of an LKF beforehand. We compare the novel lead-fraction products to six lead-fraction products derived from classified SAR, satellite-borne thermal infrared, passive microwaves, an altimeter (Kuband), and helicopter-borne thermal infrared data. Our results show that divergence-derived and LKF-derived lead fractions identify leads with high reliability, high spatial resolution and coverage, and moderate temporal coverage. We note that the mean lead fractions of all analyzed lead-fraction products vary by 1-2 magnitudes. We attribute the differences to the different detected physical lead properties and methodological reasons like the spatial resolution. We conclude that it is crucial to choose the lead-fraction product in accordance with the application. Last, we estimate the instantaneous new ice production in the leads and compare the results to airborne ice thickness observations.

68	Andreas	Walbröl	Institute for Geophysics and Meteorology, University of Cologne, Cologne, Germany	06: From the Ice Floe to Space - Remote Sensing and MOSAiC	P1 (72)	in-person	Andreas Walbröl, Susanne Crewell, Ronny Engelmann, Mario Mech, Daria Paul, Kerstin Ebell	Benefit of combining low and high frequency microwave radiometer measurements for Arctic water vapour	In our research project on Arctic Amplification $(AC)^3$, we focus on the influence of water vapour on Arctic Amplification. During the MOSAiC expedition, the low-frequency Humidity and Temperature Profiler (HATPRO) and the high-frequency Microwave Radiometer for Arctic Clouds (MiRAC-P) were deployed to derive time series of integrated water vapour (IWV) and liquid water path (LWP), but also coarse temperature and humidity profiles with high temporal resolutions. The single-instrument retrievals of IWV revealed a potential for a synergy of HATPRO and MiRAC-P. Compared to radiosondes, HATPRO performs better than MiRAC-P during moist conditions (IWV > 10 kgm-2), while this behaviour is inverted for dry conditions (IWV < 5 kgm-2). The comparison of IWV from satellites with our products will be presented during the conference. We also aim to improve the vertical resolution of the humidity profiles by combining both radiometers. In this study, we present the concept and first results of a new neural network retrieval trained with ERA5 data, which has been forward simulated with the Passive and Active Microwave Radiative Transfer Tool (PAMTRA) to obtain the corresponding brightness temperatures. We analyze the information benefit of the synergetic over the singleâ€"instrument retrieval based on optimal estimation ideas.
134	Philipp	Anhaus	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	P1 (48)	in-person	Philipp Anhaus, Christian Katlein, Ilkka Matero, Marcel Nicolaus, Stefanie Arndt, Daniela Krampe, Benjamin A. Lange, Julia Regnery, Jan Rohde, Martin Schiller, Ran Tao	Under-ice environment surveys using a remotely operated vehicle during the MOSAiC expedition 2019/20	Improving our understanding of the climate and ecosystem of the sea-ice covered Arctic Ocean was a key objective during MOSAiC. We aimed for a better understanding of the linkages of physical and biological processes at the interface between sea ice and ocean. To enhance the quantification of these linkages, year-round observations of physical, biological, and chemical parameters are needed. We operated a remotely operated vehicle (ROV) equipped with an interdisciplinary sensor platform to simultaneously measure these parameters underneath the drifting sea ice. These observations were made synchronous in time and place enabling a description of their spatial and temporal variability. Overall, we completed more than 80 surveys covering all seasons and various sea ice and surface conditions. We focused on optical parameters, sea-ice bottom topography, and upper ocean physical and biological oceanography. In addition, visual documentation of the under-ice environment was performed, nets for zooplankton were towed, and the ROV was used for instrument deployment and maintenance. Here, we present all ROV sensor data, allowing for a comprehensive picture of the under-ice environment. We are inviting discussions on further collaboration in data analyses and usage, in particular co-location and merging with other datasets from MOSAiC and other (also future) projects.
186	Stephen	Archer	Bigelow Laboratory for Ocean Sciences	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	P1 (49)	in-person	Archer, Stephen; Blomquist, Byron; Angot, Hélène; Bariteau, Ludovic; Barten, Sjoerd; Bozzato, Deborah; Gallagher, Michael; Ganzeveld, Laurens; Helmig, Detlev; Howard, Dean; Hueber, Jacques; Jacobi, Hans-Werner; Posman, Kevin; Jacqueline Stefels; Alison Webb	Characterizing the sources of local DMS emissions to the Central Arctic atmosphere during the summer.	Dimethylsulfide (DMS) emissions from sea-ice, meltponds or seawater sources, are oxidized in the atmosphere to form a range of products including methanesulfonic acid (MSA) and sulfuric acid (SA). These oxidation products may lead to new particle formation and growth, affecting cloud properties; and may influence atmospheric chemistry, including halogen chemistry. During Leg 4 and Leg 5 of MOSAiC, near-continuous measurements of DMS flux were obtained by eddy correlation (EC) from the ship bow tower at 20 m height. We endeavor to explain the magnitude and variability in the EC-derived DMS fluxes through a combination of i) small footprint, short timescale, measurements of DMS fluxes made using a dynamic chamber (DC) to quantify emission from specific surface types; ii) model prediction of the footprint of the EC measurement and characterization of the surface composition; iii) estimation of the biogenic source strength of the fluxes through analysis of sea-ice and water concentrations of DMS and its precursor dimethylsulfoniopropionate (DMSP). The analysis covers the Arctic summer period, and illustrates the impact of the extensive meltwater layers that formed during this period, on the exchange of trace gases between ocean and atmosphere.
155	Byron	Blomquist	Bigelow Laboratory for Ocean Sciences	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07B-4	in-person	Blomquist, Byron; Archer, Stephen; Angot, Hélène; Bariteau, Ludovic; Barten, Sjoerd; Cox, Christopher; Gallagher, Michael; Ganzeveld, Laurens; Helmig, Detlev; Howard, Dean; Hueber, Jacques; Jacobi, Hans-Werner; Persson, Ola; Posman, Kevin; Shupe, Matthew	Surface Fluxes of Carbon Dioxide and Methane from Dynamic Chambers and by Direct Eddy Correlation during the MOSAiC Drift Campaign	Turbulent fluxes of CO_2 and CH_4 were measured by eddy correlation (EC) from the ship bow tower at 20m height and from the MetCity ice camp tower at 10m. Weekly dynamic chamber (DC) flux measurements were performed over a variety of ice and snow surface types in the Central Observatory within 1-2 km of the ship. EC and DC results show broad agreement in the magnitude and variance of GHG fluxes. Mean fluxes over weekly timescales show an emission of these gases in the winter of <1 mmol/m2/d for CO_2 and <5 µmol/m2/d for CH_4 and a transition to deposition fluxes of approximately the same magnitude in melt season. But on shorter timescales and over varying surface morphologies there is considerable variance. We will present an analysis of observed fluxes with respect to surface characteristics and EC flux footprint to highlight processes driving the observed variability. MOSAiC observations represent an extensive intercomparison between the closed-path, dry air EC method and the open-path EC method for CO_2 flux. We will show results highlighting the most significant challenges and errors inherent to the open path method for carbon flux measurements in the cryosphere.
169	Jessie	Creamean	Colorado State University	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07B-1	in-person	Jessie M Creamean, Kevin R Barry, Camille Mavis, Thomas C J Hill, Carson Hume, Paul J DeMott, Jessica Mirrielees, Kerri Pratt, Ivo F Beck, Nora Bergner, Benjamin Heutte, Julia Schmale, Clara J M Hoppe, Allison A Fong, Emelia Chamberlain, Jeff Bowman, Matthew D Shupe, Sandro Dahlke, Melinda Webster	Snowcaps, lids, and lenses: The hurdles Arctic INPs must overcome to become airborne	Aerosols and clouds play a critical role in regulating radiation reaching the Arctic, which is warming faster than anywhere else globally. However, the magnitude of their effects is not adequately quantified, especially in the central Arctic directly over the sea ice. Specifically, aerosols called ice nucleating particles (INPs) are important for cloud lifetime, radiative effects, and precipitation. While marine biological processes have been demonstrated to be potentially key sources of INPs in the Arctic summer, exact sources and emission processes of these particles remain highly uncertain. Here, we report a preliminary investigation on the evolution of the central Arctic aerosol INP population over the course of the summer in the context of open water sources on the sea ice surface. The highest concentrations of INPs were observed during the summer melt, likely from marine biological production in local open waters such as melt ponds and leads. However, the maximum INP concentration period only lasted for a couple weeks mid-summer. We dive into possible explanations for the unexpectedly low INP concentration outside of this period, including features like snow-capped melt ponds, freshwater melt layers, and ice-lid-covered melt ponds and leads that likely reduced emission of microbial materials from water.

46	Sandro	Dahlke	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Potsdam, Germany	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07A-2	in-person	Sandro Dahlke, Amélie Solbès, Matthew D. Shupe, Christopher J. Cox, Marion Maturilli, Annette Rinke, Wolfgang Dorn, Markus D. Rex	Transforming cloudy air masses and surface impacts: a case study confronting observations, reanalyses and coupled model simulations	Variability in the components of the Arctic surface energy budget and the atmospheric boundary layer (ABL) structure are to a large extent controlled by synoptic-scale changes and associated air mass properties. The transition of air masses between the radiatively clear and cloudy states, along with their characteristic surface impacts in radiation and BL structure, can occur in either direction and on short time scales. In both states as well as during the transition, insufficient model representation of radiative processes and cloud microphysical properties cause biases in numerical weather prediction- and climate models. We employ observations from radiosondes, MET tower, and the ShupeTurner cloud microphysics product, which itself synthesizes a wealth of instruments, for the classification of an event of transition between low-level mixed phase cloud and clear conditions. The observed air mass properties and transition process are compared to ERA5 reanalysis data and output from a simulation of the coupled regional climate model HIRHAM-NAOSIM which applied non-spectral nudging to ERA5 in order to reproduce the observed synoptic-scale changes. The approach highlights the potential of event-based analysis of transformations of cloudy Arctic air masses by confronting models with observations.
167	Paul	DeMott	Colorado State University	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07B-3	in-person	Paul J. DeMott, Benjamin E. Swanson, Jessie M. Creamean, Yutaka Tobo, Thomas C. J. Hill, Kevin R. Barry, Sonia M. Kreidenweis, Ivo F. Beck, Gabriel Freitas, Dominic Heslin-Rees, Julia Schmale, Bart Geerts, Christian Lackner and Paul Zieger	Using MOSAiC and other site data to understand ice nucleating particle sources and impact in Arctic cold air outbreaks	Cold air outbreak (CAO) cloud systems ensue due to large latent and sensible oceanic surface fluxes when Arctic air exits southward over North Atlantic ice-free ocean. Ice nucleating particles (INPs) initiate primary ice formation, impacting cloud microphysics, structure and precipitation in CAOs. We compare immersion freezing INP concentrations in suspensions from filters collected over the ice (MOSAiC) with those measured following transport across a Svalbard (Ny-Ãlesund) site to the Cold Air Outbreaks in Marine Boundary Layer Experiment in Norway (Andenes) for trajectory-linked CAOs. At most times, INP concentrations were lower over the ice than after transit over open ocean in winter, though less distinct during spring. Freezing following thermal treatment and peroxide digestions of particle suspensions indicate a dominance of organic INPs, as expected for marine emissions. However, normalizations by total aerosol surface area or volume give INP active site densities exceeding those predicted by existing parameterizations of sea spray INPs. Sources may be from biogenically-enhanced emissions from turbid seas or transfer into the boundary layer of organic free tropospheric INPs (e.g., arable soil, biomass burning particles) during strong CAO convective mixing. Sources and impacts will be further explored through numerical modeling exercises and a future aircraft campaign.
7	Guenther	Heinemann	University of Trier	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07B-5	in-person	Guenther Heinemann	Evaluation of CCLM simulations of vertical profiles and ABL structure during MOSAiC	The regional climate model CCLM was used for simulations for the MOSAiC period with horizontal resolutions of 15km (whole Arctic) and 5km (area of the drift). CCLM is used in a forecast mode (nested in ERA5), and uses a thermodynamic sea ice model. Sea ice concentration is taken from AMSR2 data and from a high-resolution data set (1km) derived from MODIS data. The model was evaluated using radiosonde data and data of different profiling systems for the winter period (Nov.-April). The comparison with radiosonde data shows very good agreement for temperature, humidity and wind. In agreement with a previous study for near-surface quantities, a slight cold bias is present in the ABL for Nov. and Dec., while there is a slight warm bias in March and April. High-resolution lidar and radar wind profiles as well as temperature profiles from a microwave profiler are used for the comparison with CCLM for case studies, which include low-level jets.
86	Zoe	Koenig	NPI/UiB/UiT	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	P1 (50)	in-person	Zoé Koenig, Michael Gallagher, Céline Heuzé and Janin Schaffer	Dynamics of the North Greenland polynya in summer 2020.	In August 2020, the polynya North of Greenland opened. This area of open water up to 88 N was used to relocate Polarstern northward at the beginning of leg 5, but also provided a unique opportunity to study this extremely undersampled region. Combining observations from the ship, in particular expendable hydrographic profiling probes (XCTDs), and atmospheric reanalysis, we investigate the dynamics of the opening of the polynya and its influence on the water column. The opening of the polynya is most likely caused by southerly winds lasting for nearly 10 days, from July 26 to August 4. In the polynya, surface waters are warmer than the freezing point, and the mixed layer is about 40 m deep. Hydrographic characteristics below the mixed layer (and above 200 m) indicate contributions from waters of Atlantic origin and glacial meltwater. Currently, we are investigating the impact of the polynya on the different such as heat fluxesfluxes between the atmosphere and the ocean.
179	Brice	Loose	University of Rhode Island	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07A-5	in-person	Brice Loose, Xiaomei Lu, Yongqiang Hu, Mollie Passacantando	The surface ocean capillary-gravity wave spectrum as observed by ICESat-2 ATLAS: Application to air-sea transfer during the MOSAiC drift.	ATLAS, the LIDAR instrument on ICESat-2 can resolve single photon returns, which are emitted at a rate of 10 kHz, providing the potential for exceptionally high sampling resolution of a stationary ocean surface wave field. These measurements have already demonstrated the potential to reveal sea surface elevation over a range of scales from the entire geoid, down to the level of gravity waves with wavelengths less than 3 km. Here, we explore the feasibility of retrieving the ocean surface wavefield in the capillary-gravity spectrum of wavenumbers 40-200 rad m-1, which in turn reveals ocean surface processes that correlate with air-sea exchange. We seek to develop a measure of the wave height variance, compared with measurement uncertainties within this wavenumber spectrum. At these smallest of ocean surface wave scales, the limitations in photon travel times must be considered, including clock error aboard the ATLAS instrument. The potential for ocean surface turbulence measurements using ICESat-2 is an exciting area of application. We explore the potential to develop these estimates and apply them to air-sea gas exchange during the MOSAiC drift.
198	Wieslaw	Maslowski	Naval Postgraduate School	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07B-6	virtually	Younjoo Lee, Jaclyn Clement Kinney, Robert Osinski, Mark Seefedlt, Milena Veneziani, Hailong Wang	Ice-Ocean Dynamical Coupling Feedback on Arctic Amplification	Thinning and shrinking of the Arctic sea ice cover can promote a positive ice-ocean feedback (IOF) loop, on top of the snow/ice/surface-albedo and water vapor-surface temperature feedback. In addition to changes in ice kinematics, a thinner/reduced ice cover promotes a positive feedback in the upper ocean, where excess heat has accumulated and the changing ice regime through ice-ocean coupling can make this heat available to further reduce ice growth in winter and increase ice melt in summer. The proposed IOF extends the ice-albedo feedback loop to account for details of ice-ocean dynamics especially in the presence of warm (i.e., above freezing temperature) water below. We argue that this feedback can operate both in summer and winter and its role in Arctic Amplification is expected to increase with climate warming due to decreasing sea ice cover and increasing upper Arctic Ocean heat storage. Selected examples of such ice-ocean coupling will be discussed based on results from

151	Jessica	Mirrielees	University of Michigan	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07B-2	in-person	Jessica A. Mirrielees, Jessie Creamean, Emily J. Costa, Nora Bergner, Julia Schmale, Markus Frey, Rachel M. Kirpes, Swarup China, Andrew P. Ault, Kerri A. Pratt	Identification and Chemical Composition of Sea Spray Aerosol Particles during MOSAiC	Sea spray aerosol (SSA) particles are produced from bubble-bursting and wave-breaking processes at the ocean-atmosphere interface. Within the Arctic pack ice, SSA are produced from open leads, as well as transported from the marginal ice zone and ice-free ocean. SSA contribute to both direct and indirect radiative forcing and participate in heterogeneous reactions with trace gases, releasing halogens and forming nitrate and sulfate. SSA composition can also be influenced algae and bacteria that produce exopolymeric substances. This enriches SSA during the bubble bursting process, resulting in organic-coated sea salt particles. Previous studies of SSA in the fall, winter, and spring have been limited to the coastal Arctic, and very few of SSA measurements are resolved to the scale of individual particles to identify the influence of marine-derived organics. To investigate this knowledge gap, atmospheric particles were sampled daily during the MOSAiC expedition from September 2019 to October 2020. Individual particles were later analysed using scanning electron microscopy with energy-dispersive x-ray spectroscopy (SEM-EDX) to determine their elemental composition. Raman microspectroscopy was also carried out on individual particles to identify and characterize marine organics coating SSA. This presentation will focus on SSA identified from fall-spring during MOSAiC.
102	Malte	Müller	Norwegian Meteorological Institute	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	P1 (51)	in-person (virtual)	Malte Müller, Y. Batrak, L. Hermannsdörfer, Matthew D. Shupe, Philip Rostosky	Analysis of the representation of sea ice surface temperature and radiative states in atmospheric reanalyses	Atmospheric reanalyses have significant systematic errors in their representation of the Arctic surface energy budget. In the present study, we evaluate contemporary atmospheric reanalysis over sea-ice covered areas and during polar night. For the evaluation we use surface observations from the N-ICE 2015 and MOSAiC drift campaigns, as well as satellite-based sea-ice surface temperature, sea-ice thickness, and snow depth observations. We find that during clear-sky conditions, when observed temperatures are often below -30 C, the reanalyses have a warm bias of 5 to 10 C. Analysis of the surface energy budget indicates that to a large extent, this warm bias can be attributed to the missing representation of a snow layer on top of sea-ice and to errors in the sea-ice thickness. In addition, the reanalyses do not separate the two Arctic winter states, i.e. radiatively clear and opaquely cloud, and show a cold bias during observed cloudy states. The high frequency and spatial inhomogeneity of observations taken from the distributed network of observing sites during MOSAiC allow us to analyze the spatio-temporal representativeness errors of the models, which reflects on the issue of comparing relatively coarse resolution reanalysis products against point observations and satellite retrievals.
158	Chris	Polashenski	Dartmouth College/ USACE CRREL	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	P1 (52)	in-person	Luisa von Albedyll, David Clemens-Sewall, Jari Haapala, Jenny Hutchings, Polona Itkin, Ian Raphael	In-ice stress observations at the MOSAiC central observatory in context of large scale dynamics	Observations of the time-varying stress in the sea ice surrounding the MOSAiC floe were collected at ~15 locations across the floe using vibrating wire stress gages. Observations were collected up to once per minute and processed to show magnitude and orientation of primary and secondary principal stresses. Stress conditions were highly active. The only significant period of limited activity was in late February and early March. We process and present the stress data in a variety of manners to show periods of activity, coherence of forces observed across the floe, stress states at the time of known fracture/ridging events, and differences in forces measured across ice types. The data helps clarify the magnitude and direction of the forces experienced by the Central Observatory and highlights the heterogeneity of stress propagation through the mosaic of ice floes. Further comparisons show the degree to which local observations of stress align with large scale convergence and divergence. Events at the local scale are found to sometimes, but not always, align with events seen in larger scale observations.
192	Evgenii	Salganik	Norwegian University of Science and Technology	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07A-3	in-person	Evgenii Salganik, Benjamin A. Lange, Philipp Anhaus, Christian Katlein, Ilkka Matero, Julia Regnery, Knut V. Høyland, Mats A. Granskog	Differential summer melt rates of Arctic sea ice ridges, level first- and level second-year ice	During the melt season, sea ice melts from the surface and bottom. The melt rates substantially differ for sea ice ridges and undeformed first- and second-year ice. Ridges generally melt faster than undeformed ice, while the melt of ridge keels is often accompanied by further summer growth of their consolidated layer, which increases their survivability. We examine the spatial variability of ice melt for different types of ice from in situ drilling, coring, and multibeam sonar surveys from a remotely operated vehicle. Seven sonar surveys performed from June 24 to July 28 were analyzed and validated using seven ice drilling transects. The area investigated by the sonar (0.4 km by 0.2 km) consisted of several ice ridges, surrounded by first- and second-year ice. We show a substantial difference in melt rates for sea ice with different drafts. We also show how ridge keels decay depending on keel width, steepness, and orientation relative to the ice drift direction. These results are important for quantifying ocean heat fluxes for different types of ice during the advanced melt, and for estimation of the ridge contribution to the total ice mass and summer meltwater balances of the Arctic Ocean.
109	Martin	Schneebeli	WSL Institute for Snow and Avalanche Research	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07A-4	in-person	M. Schneebeli, A. R. Macfarlane, D. N. Wagner, S. Hämmerle	Microtomographic imaging of X-ray absorptive inclusions in fresh sea ice and snow	During the MOSAiC-expedition, the sea ice - snow interface was sampled with a special corer such that the original microstructure was not disturbed. These samples with 66 - 86 mm diameter were immediately scanned at -12°C using desktop micro computer tomography (µCT 90). The X-ray contrast between sea water (approximately 32 PSU) is too low to have sufficient contrast compared to sea ice. However, small inclusions in the strongly metamorphosed winter snow and brine channels showed high X-ray absorption (corresponding to eight times the concentration of seawater). These were found up to a height of about 2 cm above the sea-ice snow interface. The inclusions are between 0.1-1 mm large, and are discontinuous. The large pores in the snow make the transport of brine into the snow unlikely from capillary effect. A possible explanation for the existence of these inclusions could be the constant sublimation and deposition of the sea ice surface under the large temperature gradient (around 100 K m-1) between November - April. The inclusions are likely ikaite ($CaCO_3 \cdot 6H_2O$). Our observation shows that minerals formed in sea ice can be found in the overlying snow, and have the possibility of being redistributed by wind.

209	Matthew	Shupe	University of Colorado / NOAA	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07A-1	in-person	Matthew Shupe, Ola Persson, Christopher Cox, Michael Gallagher, Amy Solomon, Taneil Uttal, Anne Sledd, Donald Perovich	Partitioning cloud impacts on the central Arctic surface energy budget	The Arctic surface energy budget is strongly controlled by the presence or absence of optically thick clouds, leading to two distinct states of the longwave radiative budget. With the introduction of sun in summer, the radiative states become more complicated, but clouds still play a major role. Generally, the cloud-controlled surface radiative budget drives variability in the overall surface energy budget, while other terms such as turbulent and conductive heat fluxes respond to the cloud radiation. Observations from the MOSAiC expedition are used to examine this complex cloud-surface system over an annual cycle. The specific focus is on how clouds partition the surface energy budget year round, and the cumulative effects of clouds versus clear sky on accumulated energy at the sea ice surface. Using process relationships among different parameters, the effects of clouds on each energetic component are examined as a function of cloud presence, cloud phase, and condensed cloud liquid and ice. These results, when combined with other Arctic observations, are contributing to the development of a conceptual model for the cloud-surface coupled energetic processes that impact the surface energy budget and surface skin temperature.
189	Tim	Stanton	Naval Postgraduate School and Moss Landing Marine Laboratories	07: Arctic Atmosphere-Sea Ice-Ocean Coupling and Feedbacks, including Biophysical	S07A-6	in-person	Timothy Stanton, William Shaw, Matthew Shupe, Ola Persson, Chrisopher Cox, Michael Gallagher, John Toole	Arctic Ocean Surface Boundary Layer Momentum Balances from the MOSAiC Distributed Network	Measurements of turbulent shear stress a few meters above and below the sea ice and also profiles of ocean velocity, temperature, and salinity, obtained from an array of ice-based observatories in the central Arctic Ocean during the MOSAiC program, are used to investigate the momentum balance of the under-ice ocean boundary layer. We find that the mixed layer is populated with energetic inertial and mesoscale currents. The measurements have adequate temporal resolution for the inertial balance to hold. Effects of ocean eddies are minimized by limiting the integration depth to an estimate of the actively turbulent layer. The wind stress is well correlated with the integrated boundary layer acceleration (r = 0.86) but is smaller by about a factor of about 0.75. We attribute the residual to barotropic pressure gradients and internal ice stress gradients. The ocean stress measurements are used to investigate further form drag and gradients of the internal ice stress. There are periods when the observed ocean stress disagrees with the stress at that depth predicted from the wind stress, ocean acceleration, and pressure gradient. This indicates that form-drag and ice stress can be important terms in the momentum budget.
132	Philipp	Anhaus	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09B-1	in-person	Philipp Anhaus, Christian Katlein, Marcel Nicolaus, Arttu Jutila, Nils Hutter, Christian Haas	Relation between sea-ice draft and freeboard and its seasonal evolution in the Central Arctic	Relating the sea-ice surface to the under-ice topography is a timely scientific effort. This relation is crucial for estimating the ice thickness distribution for largeâ€scale modelling, for assessing the mechanical force that ships need to overcome, for risk evaluation of offshore structures, for determining roughness to derive wind and water drag coefficients, for sound scattering, and for the confinement of oil spills. Existing relations are based on numerical modelling assuming estimates of snow depth, and snow and ice densities or are based on field observations confined to specific areas and short time periods. MOSAiC provided the first year-long, high-resolution dataset of sea-ice draft derived from a multibeam echosounder. In combination with freeboard estimates from airborne mapping of the surface, we construct the 3D sea-ice topography to study the evolution of sea-ice geometry. We can obtain direct relations between draft and freeboard on a bi-weekly basis for an ice floe drifting from the North Pole to Fram Strait during winter, spring, and summer. A precise evaluation of total ice thickness, ice density, freeboard, draft and their respective relations on small scales is crucial information to satellite remote sensing ice thickness retrievals, a key asset of climate monitoring in the Arctic.
63	Angela	Bliss	NASA Goddard Space Flight Center	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09A-1	virtually	Angela C. Bliss, Jennifer K. Hutchings, Daniel M. Watkins, and the MOSAiC Distributed Network Team	Sea ice deformation regimes from GPS buoys in MOSAiC DN1 and DN2	Sea ice drift and deformation rates evolve over the sea ice seasonal cycle as the ice transitions through the autumn growth, winter consolidation, and spring and summer break-up phases and are impacted by episodic forcing from wind, currents, tidal oscillations and by ice interaction with coastlines. The MOSAiC Distributed Network provides a unique opportunity to develop time series of deformation rates from arrays of GPS buoys in two consecutive years. The primary Distributed Network (DN1) was deployed and maintained throughout the MOSAiC drift campaign, reaching the ice edge in Fram Strait in late July 2020. A second, smaller Distributed Network (DN2) was deployed near the north pole in August 2020 with autonomous GPS measurements continuing into May 2021. The drift trajectory of DN2 tracked further west along the northeastern coast of Greenland than that of DN1, thus, the resulting time series of sea ice divergence and shear rates reveal the pack is in different dynamic regimes under differing force balance. In this work, we present time series of deformation around DN1 and DN2 and examine the impacts of the differing drift trajectories on the apparent deformation regimes.
150	Robyn	Boeke	SSAI/NASA	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	P2 (42)	in-person	Robyn Boeke, Patrick Taylor, Linette Boisvert	Factors affecting Arctic Sea Ice Survivability as observed from MOSAIC and from Space	A warming Arctic is accompanied by rapid sea ice melt, thinning sea ice, and increases in heat/moisture exchange at the surface. Increased newly-exposed open water and thinner sea ice- which is more sensitive to atmospheric forcings- heavily impact local surface radiation balance and survivability of sea ice. Despite their importance to Arctic climate, interactions between energy fluxes and sea ice are poorly represented in GCMs. Since local Arctic changes have Arctic-wide impacts, understanding the factors influencing sea ice survivability at the process level is crucial. This study couples MOSAiC observations with a new Lagrangian sea ice parcel tracking dataset matched with MOSAiC to allow for coincident measurements of ice, snow and atmospheric conditions. First, a comparison between MOSAiC and surrounding ice is carried out to determine how representative MOSAiC observations are of surrounding areas, and how representative MOSAiC's drift track is of other years. Next, we determine the impact of radiative fluxes on sea ice growth/melt and the influence of episodic weather events on local radiation balance. The combination of satellite, MOSAiC in situ observations and the Lagrangian perspective offers new insights on the cumulative effects of atmospheric forcing on sea ice survivability throughout the lifecycle of a parcel.

154	Bin	Cheng	Finnish Meteorological Institute	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	P2 (41)	in-person	Bin Cheng; Tuomas Naakka, Timo Vihma	Impact of sea ice drift speed on thermodynamic snow and ice mass balance along an idealized transpolar drift trajectory: a modelling investigation	Arctic sea ice has reduced significantly in recent decades in both extent and thickness. Thinning of sea ice, and enhanced variability of snow conditions affect many physical, chemical, and biological processes in the polar climate system through air-sea ice-ocean interactions. The Arctic Amplification (AA) has played an essential role in reducing ice thickness and concentration and consequently increasing sea ice drift speed. The transpolar drift of sea ice has become several times faster than the Fram expedition 130 years ago. In this study, we investigate the impact of sea ice drift speed on thermodynamic snow and ice mass balance. A snow and ice thermodynamic model is applied to simulate snow depth and ice thickness utilizing meteorological conditions extracted from ERA5 reanalysis along a predefined idealized transpolar drift trajectory, analogous to the MOSAiC ice drift trajectory. Ice drift started at the beginning of each month between October 2019 and September 2020. The entire ice drift between starting position (eastern Amundsen Basin) and the ending position (Fram Strait) was assumed to be 2y, 1.5y, 1 and 0.8y. The modelled snow depth and ice thickness in terms of the seasonal and annual cycle under different ice drift speeds are compared and qualified.
39	Ruzica (Martin)	Dadic (Schneebeli)	Te Herenga Waka - Victoria University of Wellington, New Zealand	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	P2 (40)	virtually	Ruzica Dadic, Martin Schneebeli, Henna-Reetta Hannula, Roberta Pirazzini, Melinda Webster, Amy Macfarlane, Michael Gallagher, Marcel Nicolaus, Mario Hoppmann, Julia Regnery, Ola Persson, Henning Löwe, Huw Horgan, Lucille Gimenes, Matthias Jaggi, David Wagner, Linda Thielke, Gunnar Spreen, Julienne Stroeve, Polona	Evolution of the snow surface layer during the sea-ice freeze-up phase on the MOSAiC expedition	Snow cover dominates the variability of the thermal and optical properties of sea ice. During the freeze-up phase of sea ice in autumn, the thickness of the snow cover and its physical properties are key to understanding the sea ice growth rate. Snow thermally insulates the sea ice, inhibiting its growth, or in case of warming events, it can prevent the intermittent warming of the sea ice. We observed the physical properties of snow during the transition from summer melt to autumn freeze-up (August to October 2020) of the MOSAiC expedition. Here, we will present the evolution of the snow cover during the freeze-up phase using a suite of unprecedented state-of-the-art measurements (Î¼m-cm-scale) of physical snow properties, including snow microstructure, specific surface area, density, thermal structure, water percolation observations, and surface roughness. Our measurements show a highly spatially and temporally variable snow cover affected by a) the different underlying ice surfaces (existing ice, frozen melt ponds, and new ice), b) highly irregular topography, and c) typical temporally varying autumn atmospheric conditions (positive and negative net energy fluxes; snowfall; and rain on snow after the freeze onset). This complex snow cover was associated with variable thermal resistance of the snow cover.
181	Allison	Fong	Alfred-Wegener-Institut Helmholtz Zentrum für Polar-und Meeresforschung	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09B-6	in-person	Allison A. Fong, Clara J. M. Hoppe, Marc Oggier, Mats A. Granskog, Robert Rember, Sinhué Torres-Valdes, Oliver Müller, John-Paul Balmonte, Anders Torstensson, Ulrike Dietrich, Emelia J. Chamberlain, Elise Droste, Jessie Gardner, Evgenii Salganik, Daiki Nomura, Jeff Bowman, Jessie Creamean, Maria van Leeuwe, Laura Whitmore, Martina Vortkamp, Rolf Gradinger, Gunnar Bratbak, Pauline Snoeijs-Leijonmalm, Aud Larsen, MOSAiC Sea Ice Coring Consortium	Insights into the evolution of ecological properties from first-year and second-year sea ice during the MOSAiC Expedition	Examining the development of coupled physical and ecological properties of sea ice is historically challenging due to limited durations for observation. However, it's critical to observe how sea ice properties interact and develop in response to changing environmental conditions. During the MOSAiC Expedition, we followed the temporal evolution of physical and ecological properties of first-year (FYI) and second-year sea ice (SYI) derived from discrete samples collected via routine coring. We tracked a suite of properties from these ice types for 9 (FYI) and 7 (SYI) months to describe the dynamics in both sea ice ecosystems over the course of the drift. Our joint efforts resolve changes in microbial activity rates, microbial community composition, and photosynthetic biomass in respect to changes in physical and geochemical properties of sea ice. Here we present first insights on how key ecological properties changed in time and between FYI and SYI. Our primary focus will be on changes in chlorophyll, nutrients, and bacterial production. However, we draw from a large suite of measured properties, including cell counts, pigment biomarkers, and sequence-based data to understand which physical and biological factors may have contributed to the observed seasonal changes in the sea ice habitats.
123	Polona	Itkin	UiT The Arctic University of Norway	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09A-4	in-person	Polona Itkin, Glen Liston	Combining observational data with numerical models to obtain a seamless high temporal resolution seasonal cycle of snow and ice mass balance for the MOSAiC Central Observatory	Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) observations span over the entire seasonal cycle of Arctic snow and sea ice cover. However, the measurements of atmospheric and ocean forcing, as well as distributed measurements of snow and ice properties are occasionally interrupted for logistic reasons. The most prolonged interruption happened right during the onset of summer melt season. Here were present a novel modeling tool that can assimilate the relevant observational data to provide continuous high temporal resolution time series of snow and sea ice parameters. We use this tool to analyze differences between ice types found in the MOSAiC Central Observatory: relatively deformed second year ice, second year ice with extensive smooth refrozen melt pond surfaces and first year ice. We demonstrate how the preferential accumulation of snow in deformed ice types influences the ice growth, timing of the melt onset and melt of different ice types.
40	Daniela	Krampe	AWI	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	P2 (39)	in-person	Daniela Krampe, Andreas Herber, Frank Kauker	MOSAiC snow modelling: An outlook	Detailed snow models like "Crocus" developed for the European Alps can be used to simulate continuous time series and to investigate linkages between snow variables and meteorology. However, parametrisations need to be adapted for Arctic conditions. During MOSAiC, we conducted various snow measurements within the Central Observatory on regular basis. This data can be used to evaluate the performance of existing snow models and allows to develop and evaluate new parametrisations. During previous work, new parametrisations for newly fallen snow density and the impact of wind on snow density were developed and implemented in Crocus. Thereby, data from Villum Research Station located in Northeast Greenland had been used. In a next step, these parametrisations can be further evaluated using MOSAiC physical snow measurements. After evaluating the newly developed parametrisations for the snow model Crocus, the model will be used to simulate black carbon concentration within the snowpack and its effects on radiative snow properties. Furthermore, the model will help to analyse the seasonal cycle of black carbon during MOSAiC and the transport processes of black carbon within the snowpack. The modifications of the model and the outline of future work will be presented.

84	Amy	Macfarlane	WSL Snow and Avalanche research SLF	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	P2 (38)	in-person	Amy R. Macfarlane, Lucille Gimenes, David N. Wagner, Ruzica Dadic, Rafael Ottersberg, Henning Löwe, Martin Schneebeli	Thermal Resistance of Snow on Arctic Sea Ice	The thermal conductivity of snow on Arctic sea ice was measured for the first time using direct numerical simulations of the heat flux through the snow structure using micro-computed tomography. It has been proven that this is currently the most precise method to determine thermal conductivity. Approximately 200 samples (approx. 10 cm high, 6.6 or 7.8 cm diameter) of snow were segmented into volumes of 5.83 cm3. These sub-volumes show the relationship between thermal conductivity and density for snow on Arctic sea ice. The parameterisation is generally well categorised from previous studies that have measured snow in other alpine and cryosphere regions, but some samples have a large vertical anisotropy. The spatial variability of thermal conductivity is prominent throughout the season and within individual profiles. However, the average remains constant, increasing from 0.2 to 0.3 W m-1 K-1 over the whole winter season, irrespective of underlying ice type. The thermal resistance, which takes the thickness of the snowpack into account, remains constant for snow on first-year ice (~500 K m2 W-1) and second-year ice (~600 K m2 W-1) and shows three times more thermal resistance on ridges (~1500 K m2 W-1) due to varying snow thickness distributions.
117	Amy	Macfarlane	WSL Snow and Avalanche research SLF	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09B-4	in-person	Amy Macfarlane, Moein Mellat, Hanno Meyer, Ruzica Dadic, David N. Wagner, Daniela Krampe, Matthias Jaggi, Stefanie Arndt, Martin Schneebeli	Metamorphism of snow on Arctic sea ice: What does this mean for MOSAiC snow chemical analysis?	We investigated post-depositional snow processes on sea ice using measurements of stable water isotopes and physical snowpack properties. This study took place in the high Arctic for the entire winter period, where high-temperature gradients (average 100 K m-1) produce large water vapour fluxes through the snowpack. Due to this, Arctic snow experiences extreme metamorphism, which alters its microstructure and physical properties. All the snow isotope profiles displayed a clear trend from the ice interface towards the surface, where the snow at the ice interface was close to the isotopic composition of sea ice and the surface to the isotopic composition of atmospheric precipitation. Unlike studies in areas of high precipitation, the isotopic composition of snow on sea ice is less associated with isotopic differences between individual precipitation events and more due to vapour exchange with the sea ice surface. We found that sublimation of the sea ice surface is a dominant process affecting the isotopic signature of snow on sea ice and could contribute to up to 6 cm of "sea-ice sourced" snow. This finding has many ramifications for our understanding of snow chemistry on Arctic sea ice and will shift the discourse of future snow on sea ice research.
21	Ioanna	Merkouriadi	Finnish Meteorological Institute	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09A-5	virtually	Ioanna Merkouriadi, Glen E. Liston	Quantifying the effect of snow-ice formation on SnowModel-LG snow depth and density product	This study quantifies the snow loss in snow-ice formation, and its effect in SnowModel-LG snow depth and density product. We coupled SnowModel-LG, a snow modeling system adapted for snow depth and density reconstruction over sea ice, with HIGHTSI, a 1-D sea ice thermodynamic model, to simulate snow-ice and thermal ice growth: SnowModel-LG_HS. We assumed that all negative freeboard would result in snow-ice formation. Pan-Arctic model simulations were performed over the period 1 August 1980 through 31 July 2021, and they were guided by observations (including MOSAiC) where available. In SnowModel-LG_HS, snow depth was lower (domain average: 18%), and snow density was higher (2.3%) compared to SnowModel-LG. The differences were much larger in the Atlantic sector. Our simulations suggest that when snow models do not account for snow and ice interactions, snow depth can be significantly overestimated. In this talk we will discuss the magnitude of this overestimation in relation to the sub-grid parameterization of sea ice dynamics and their effect in snow redistribution over the ice floes. Sea ice dynamics (e.g. deformed ice formation), are likely an additional important snow sink that is not yet accounted for in the snow models.
177	Marc	Oggier	International Arctic Research Center, University of Alaska Fairbanks, Fairbanks, USA	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09B-2	in-person	Marc Oggier, Robert Rember, Allison A. Fong, Dmitry V. Divine, Hajo Eicken, Mats A. Granskog, Evgenii Salganik, Knut V. Høyland, Sønke Maus, and MOSAiC Sea-Ice Coring Team	How to reconcile ice core profiles of different lengths: a framework to generate standardized composite ice core property profiles	Physical processes in Arctic sea ice regulate the energy exchange and biogeochemistry within the ice matrix. For decades ice coring and sampling methodologies have varied between different disciplines. Thus, data resulting from various core sectioning schemes are challenging to compare. During the MOSAiC expedition, approximately 1500 cores were collected during ~30 coring events at the two main sites of First Year Ice (FYI) and Second Year Ice (SYI) sites. While ice thicknesses across all cores collected early in the growth period were often similar (within 2 cm), ice thicknesses became increasingly different over the year. These differences in length are problematic, when data profiles from several cores need to be combined and relate physical property (e.g., brine volume fraction from salinity, temperature, and density) to biogeochemical properties. In addition, rafting events at the FYI site, and unevenly distributed thickness of the first-year-ice layer in SYI further complicate analysis. We developed a standardized framework to aggregate ice core data and reconcile profiles of different lengths based on physical processes and stratigraphy, which account for non-linear profiles. The key outcome successfully generates composite profiles for physical properties, and enables more robust linkages with biological and biogeochemical processes and sea ice physical characteristic.
141	Ian	Raphael	Dartmouth College, Thayer School of Engineering	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	P2 (37)	in-person	Ian A. Raphael, Donald K. Perovich, David Clemens-Sewall, Christopher M. Polashenski, Anne Sledd, Ruibo Lei	Into the un(s)known: estimates of effective thermal conductivity of snow on MOSAiC	The thermal conductivity of snow is a critical parameter in the Arctic system. Snow is an excellent thermal insulator and governs heat transfer between sea ice and the atmosphere, directly controlling ice growth. For snow on Arctic sea ice, heat is likely transported vertically through a combination of conduction, convection, and water vapor advection. We combine the effects of all three mechanisms when estimating the "effective" thermal conductivity for a particular column of snow. Here, we present estimates of the effective thermal conductivity of snow on MOSAiC, which we derived from temperature and ice mass balance measurements. We used several methods to estimate the effective thermal conductivity, including instantaneous and time-averaged estimates from flux continuity/energy balance methods, as well as finite-difference solutions to the heat equation. The energy balance method worked best when air temperatures were stable and temperature gradients in the snow and ice were approximately linear. We compare MOSAiC effective snow thermal conductivities to those observed at SHEBA and autonomous mass balance buoys and discuss possible explanations for the observed variability.

191	Evgenii	Salganik	Norwegian University of Science and Technology	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	P2 (36)	in-person	Evgenii Salganik, Benjamin A. Lange, Dmitry Divine, Polona Itkin, Christian Katlein, Marcel Nicolaus, Mario Hoppmann, Knut V. Høyland, Mats A. Granskog	Snow-slush refreezing as a mechanism of sea ice ridge consolidation	After winter, the consolidated part of sea ice ridges is usually just up to 1.6-1.8 times thicker than the surrounding level ice, while during the melt season, ridge keels are often observed fully consolidated. This transition is not fully understood. Here, we present a winter-to-summer evolution of the morphology and temperature of a first-year ice ridge studied during MOSAiC. From October to May 2020, the draft of first-year ice at the main MOSAiC coring site increased from 0.3 m to 1.5 m, while from January to July, the ridge consolidated layer thickness reached 3.9 m. We observed several types of ridge consolidation. From the beginning of January until mid-April, the ridge consolidated slowly by heat loss to the atmosphere with a total consolidated layer growth of 0.7 m. From mid-April to mid-June, there was a rapid increase in ridge consolidation rates despite no increase in conductive heat fluxes. In this period, the mean thickness of the consolidated layer increased by 2.2 m. Our observations suggest that this sudden change could be related to the transport of snow-slush to the ridge keel via adjacent open leads, leading to a decrease in ridge macroporosity and resulting in more rapid consolidation.
182	Anne	Sledd	University of Colorado-Boulder	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	P2 (35)	in-person	Anne Sledd, Matthew Shupe, Amy Solomon, Donald Perovich, Christopher Cox, Ruibo Lei	Estimating snow thermal conductivity and conductive flux variability during the MOSAiC winter	In order for sea ice to grow in the Arctic, energy must be conducted from the bottom of the ice and released to the atmosphere. This conductive flux depends on both temperature gradients through sea ice and snow as well as their thermal conductivities. While snow thermal conductivity can vary in both space and time, most forecast and climate models that include snow on sea ice use a single value for snow thermal conductivity. In a short sensitivity study using a regional coupled forecast model, varying the snow thermal conductivity impacts not only the conductive flux but also the upwelling longwave and turbulent heat fluxes and their sensitivity to atmospheric forcing. Novel observations the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition are used to derive estimates of snow thermal conductivity and conductive fluxes. The temporal variability of conductive fluxes is largely driven by atmospheric conditions, namely the presence of clouds. Differences in thermal conductivity combined with sea ice and snow thickness differences create spatial variability in conductive fluxes, and these spatial differences further modulate the sensitivity of conductive fluxes to atmospheric forcing across sites.
6	Tim R.	Sperzel	Institute for Meteorology, Leipzig University, Germany	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09A-2	in-person	Tim R. Sperzel, Evelyn Jäkel, Falk Pätzold, Astrid Lampert, Hannah Niehaus, Gunnar Spreen, Sophie Rosenburg, Gerit Birnbaum, Niklas Neckel, Marcel Nicolaus, Ran Tao, Manfred Wendisch	Broadband Albedo Measurements and Surface Type Classification from helicopter-based observations during MOSAiC	Global climate change is a significant societal and political challenge. The rapid increase in the mean ground-level air and ocean temperatures leads to a sea ice decrease, which climate models typically underestimate. The data collected during MOSAiC will help to further understand the processes and effects of the changes happening in the Arctic. This work considers observations from 24 helicopter flights (June - September 2020) and five additional flights with the helicopter-towed probe HELiPOD (May - July 2020). The overflown distributions of the surface types (white ice/snow, bright melt ponds, dark melt ponds, open water, and bare ice) were determined using fisheye camera images. They were related to collocated broadband irradiance measurements to analyse the temporal and spatial change of the surface albedo. Multiple linear regression was applied to divide the measured areal albedo into the surface-type specific contributions. This approach was validated using simulations of a Monte-Carlo radiative transfer model. The final dataset includes surface-type fractions and corresponding albedo measurements of several flights throughout the melting and refreezing season.
78	Mark	Stephens	Florida International University	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09B-3	in-person	Stephens, M.P., C.S.Buck, W. Geibert, W.M. Landing, C.M. Marsay, M. Schneebeli	7Be as a tracer of snow accumulation and redistribution on the MOSAiC ice floe	Snow cover on sea ice plays an important role in the Arctic Ocean. While snow falls uniformly over an ice floe, blowing and drifting can result in a heterogeneous snow cover characterized by erosion from level ice, enhanced accumulation on deformed sea ice (e.g. ridge flanks), and loss of snow through open leads. In this study, we use a tracer method involving the cosmogonic radioisotope beryllium-7 to follow the deposition and fate of snow on the MOSAiC ice floe during winter 2019-20. In the atmosphere, 7Be is rapidly adsorbed to aerosols, and falling snow is tagged with 7Be. A linear relationship for 7Be flux as a function of precipitation rate, based on data from SHEBA and MOSAiC, is used to model total 7Be inventories (the sum of sea, ice and snow inventories). The fluxes and distribution of 7Be on the floe yields an estimate of snow redistribution (mass on level versus deformed sea ice). Snow mass lost through open leads is estimated from changes in seawater concentrations. The topic of using 7Be to date snow layers on different ice types is also explored. 7Be appears to be a useful tracer to understand redistribution of snow on sea ice.
213	David	Wagner	WSL Institute for Snow and Avalanche Research SLF	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09A-6	virtually	David N. Wagner, David Clemens-Sewall, Christopher Cox, Océane Hames, Matthias Jaggi, Mahdi Jafari, Daniela Krampe, Amy R. Macfarlane, Adrien Michel, Christopher Polashenski, Ian Raphael, Martin Schneebeli, Matthew D. Shupe, Taneil Uttal and Michael Lehning	Towards a fully physical representation of snow on Arctic sea ice using a 3D snow-atmosphere model	Snow is an excellent insulating material with a thermal conductivity that, in the case of snow on Arctic sea ice in winter, is about one-eighth that of pure ice. Therefore, it is crucial to understand snow processes which relate to the magnitude and location of the melt of the underlying sea ice. The Central Arctic is characterized by high average wind speeds close to the snow surface, thus resulting in large horizontal snow mass flux which leads to a strongly modified snow stratigraphy on level sea ice and around ridges. We use the 3D snowpack-atmosphere model ALPINE3D with wind fields generated with OpenFOAM to study and quantify snow transport. The setup allows us to investigate how wind-induced snow transport relates to detailed layered snow cover quantities, such as density, grain properties or temperature. We show that the model predicts the timing of snow transport with high accuracy and reproduces accumulation and erosion very well in some cases, especially along pronounced pressure ridges. However, it shows weaknesses for less pronounced irregularities in the surface. We also show that the model is very susceptible to changes in snow properties, which can therefore influence the snow surface mass balance very significantly.

194	Laura	Whitmore	International Arctic Research Center	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09B-5	in-person	Laura Whitmore, Marc Oggier, Mette Kaufman, Sinhué Torres-Valdes, Allison Fong, Kyle Dilliplaine, Channing Bolt, Meibing Jin, Hajo Eicken, Robert Rember, Ana Aguilar-Islas	Macronutrient Evolution of Sea Ice During the Spring Melt	We investigated changes in macronutrient (nitrate, phosphate, and silicate) distributions over an annual cycle. This study leverages samples obtained from a floe on a weekly basis from October 2019 - Sept 2020 as a part of the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) Campaign in the central Arctic Ocean. Conditions during spring will be compared to a time series conducted in Utqia¡vik, AK between late April and mid-June of 2021. During the spring melt in Utqia¡vik, AK, macronutrient concentrations were high April - May in the bottom 5 cm of the core and declined rapidly when the brine drained; this timing was concomitant with the cessation of microalgae growth. By combining physical and biogeochemical data, we aim to understand sea ice biogeochemical cycling and its connectivity to the water column and improve model parameterizations. Observations in Utqia¡vik, AK on Inupiat lands were permitted and supported by the North Slope Borough, the Barrow Whaling Commission, and the Ukpea¡vik Inupiat Corporation (UIC). Research during the MOSAiC Campaign was conducted in international waters, nutrient samples were collected and analyzed by helpful and collaborative field participants, the program is supported by a multi-national consortium of researchers.
145	Lorenzo	Zampieri	National Center for Atmospheric Research	09: Evolution and Interaction of Sea Ice and Snow Properties Across Time and Space	S09A-3	in-person	Lorenzo Zampieri, Nils Hutter, and Marika Holland	Revising the description of the sea ice and snow heat conduction in models through the lens of the MOSAiC dataset	The parameterization of the heat conduction through sea ice and snow remains simple in state-of-the-art models. Specifically, it relies on prescribed conductivity parameters constant in time and space, therefore neglecting the substantial heterogeneity of these mediums down to the unresolved subgrid scale. This assumption clashes with robust observational evidence, which indicates that snow and ice conductivities can vary greatly depending on the environmental conditions and the history of the sea ice. The winter observations collected during the MOSAiC expedition are unique tools for advancing the quantitative understanding of heat conduction in sea ice and improving the realism of the thermodynamic parameterizations in models. Our investigation utilizes gridded helicopter-borne thermal infrared imaging, laser scanner (ALS) elevation observations, and meteorological measurements to assess the model bias and diagnose the importance of unresolved processes and topographic heterogeneity on heat conduction. We evidence different heat conduction regimes depending on the ice thickness, type (i.e., ridged or level ice), and snow patchiness. In light of these results, we will discuss strategies for an effective parametrization of these unresolved processes in sea ice models, and their harmonization with the preexisting model infrastructure.
36	Dorothea	Bauch	Leibniz-Laboratory, University of Kiel	11: Vertical and Lateral Transport in the Ocean	S11-1	in-person	Dorothea Bauch, Nils Andersen, Ellen Damm, Alessandra D'Angelo, Ying-Chih Fang, Ivan Kuznetsov, Georgi Laukert, Moin Mellat Ardakani, Hanno Meyer, Benjamin Rabe, Janin Schaffer, Kirstin Schulz, Sandra Tippenhauer, Myriel Vredenborg	Variability of sea-ice and river water signals in the upper Arctic Ocean during winter 2019/2020	Our aim is to better understand how local winter modification and advected signals from the Siberian Shelf affect the structure of the upper Arctic Ocean along the Transpolar Drift (TPD). Hereto we use stable oxygen isotopes in combination with salinity to quantify river water contributions (fr) and changes due to sea-ice formation or melting (fi) in the upper ~150m of the water column during the MOSAIC drift. We observe salinification and deepening of the mixed layer due to sea-ice related brine release together with interleaving waters at its base and within the main halocline at varying depth and salinities. Sources are: (A) summer remnants with distinct fi/fr ratios attributed to shallow Siberian Shelf waters, and (B) locally modified waters resembling advected shelfbreak waters. Fractions of fr identify a drift into and out of the freshwater-rich TPD in December 2019 and February/March 2020, respectively. On April 1, the drift crossed the Gakkel Ridge entering the Atlantic regime. Nevertheless, an enhanced sea-ice related brine content remained visible within the water column. In June/July 2020, the drift reached the East Greenland Current, the extension of the TPD, where an overall reduction of sea-ice related brine was observed.
89	Torsten	Kanzow	Alfred-Wegener-Institute	11: Vertical and Lateral Transport in the Ocean	S11-2	in-person	Torsten Kanzow, Benjamin Rabe, Markus Janout, Christian Haas, Luisa von Albedyll, Ivan Kuznetsov, Mario Hoppmann, Sandra Tippenhauer, Myriel Vredenborg, Lars Kaleschke, Volker Mohrholz, Kirstin Schulz, Ruibo Lei, Timothy Stanton, Tao Li, Janin Schaffer	Salt budget of the wintertime ocean mixed layer observed during MOSAIC	In wintertime, the Arctic Ocean mixed layer (ML) regulates the transport of oceanic heat to the sea ice, and transfers momentum and salt between the ice and the stratified ocean below. During the first three legs of MOSAIC from late October 2019 to mid-May 2020 we recorded continuous time series of wintertime ML-relevant properties from both the Central Observatory and the Distributed Network. We synthesize these data sets to quantify the different processes affecting the ML salinity. Overall, brine rejection associated with thermodynamic ice growth represents the largest salt flux term. Horizontal salt transport (advection) is the second-most important flux term, actually representing a sink of salt, thus counteracting brine release. It displays larger temporal variability than brine release, due to the variable ocean currents and horizontal salt gradients. Upward salt transport by turbulent mixing across the ML base represent another important salt source, showing elevated values during storms, when ocean turbulence is triggered. The results are interpreted in the context of both the overall mixed layer salt change, and the atmospheric and sea ice properties encountered during the observational period. Finally, the results are placed in the context of historical ML observations in the central Arctic Ocean.
93	Ivan	Kuznetsov	Alfred Wegener Institute for Polar and Marine Research	11: Vertical and Lateral Transport in the Ocean	S11-5	virtually	Ivan Kuznetsov, Benjamin Rabe, Alexey Androsov, Ying-Chih Fang, Mario Hoppmann, Alejandra Quintanilla Zurita, Sven Harig, Sandra Tippenhauer, Kirstin Schulz, Volker Mohrholz, Ilker Fer, Vera Fofonova, Markus Janout	Upper-ocean eddy dynamics in the central Arctic during winter: an observational model-assisted reanalysis of the MOSAiC expedition.	An analysis of observational data to estimate dynamics within the upper ocean is particularly challenging when the measurement platforms drift with the ice pack. This work presents an ocean reanalysis of the MOSAiC experiment. Data nudging provides an opportunity to reconstruct 3D water properties and velocity by constraining a numerical model that resolves the dynamics of the (sub-)mesoscale. The model setup covers the first part of the MOSAiC drift. For our study, we used the FESOM-C model. We set the model up with a horizontal resolution of up to 250 meters, and with a vertical resolution of up to 1 meter, which enables us to resolve near-surface- and deep submesoscale processes. Overall the model can reproduce the lateral and vertical structure of the temperature and salinity fields, which allows projecting dynamically consistent features of these fields on a regular grid. The simulation suggests the existence of two separate depth ranges of enhanced eddy kinetic energy, which are located around the halocline depth and the depth of the Atlantic Water. The model resolves several stationary eddies and provides insights into the associated dynamics, which underlines the complications in the interpretation of observational data.

4	Alejandra	Quintanilla Zurita	Alfred Wegener Institute for Polar and Marine Research	11: Vertical and Lateral Transport in the Ocean	P2 (83)	in-person	Alejandra Quintanilla Zurita, Benjamin Rabe, Ivan Kuznetsov, Enric Pallas Sanz	Intrahalocline Eddy in the central Arctic	Subsuperficial Eddies have been studied in different regions of the Globe in the past and have shown their impact on the connectivity of the mixed-layer with the rest of the water column and the transport of water from different regions. However, in the Arctic Ocean, the related processes have been difficult to study due to accessibility of observations, in particular the central Arctic. In this work, we are going to show a detailed description of the physical characteristics of an eddy observed by hydrographic observations from the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition (2019-2020). This intrahalocline anticyclonic eddy, with a radius close to 15 km, extended vertically from the base of the mixed-layer to ~120 m depth and showed horizontal velocities of up to 3.0 m/s. We are, further, going to present vertical-velocity fields, obtained by applying the generalized OMEGA equation in geostrophic form. We will show how the mixed-layer change by the pass of the Eddy, and the potential generation mechanism.
3	Kirstin	Schulz	University of Texas at Austin	11: Vertical and Lateral Transport in the Ocean	S11-3	in-person	Kirstin Schulz, Ilker Fer, Volker Mohrholz, David Kadko, Mark Stephens	Vertical diffusion rates and heat fluxes in the upper ocean	Ocean turbulent mixing is a key process affecting the uptake and redistribution of heat, carbon, nutrients, oxygen and other dissolved gasses. During MOSAiC, we profiled the upper ocean down to ~300m depth on a near-daily basis to measure ocean stratification and turbulent dissipation rate, from which we derive vertical turbulent diffusivity used to calculate vertical fluxes, e.g. of heat. Here, we compare upper ocean vertical diffusivities in winter, derived from the 7Be tracer-based approach to those estimated from these direct turbulence measurements. We found that diffusivity estimates from both methods agree well, but estimates obtained from dissipation rate profiles are sensitive to the exact way of forming averages, which therefore has to be carefully chosen. Our findings indicate low characteristic diffusivities around 10-6 m2 s-1 and correspondingly low vertical heat fluxes in the upper winter halocline, underlining the notion that this halocline effectively isolates the surface ocean and sea ice from the layers below, and vertical transport in this region is limited. Further along the drift, however, the surface mixed layer salinity successively increased, weakening the upper ocean stratification until the halocline disappeared completely in April. Hence, upper ocean vertical transport thereafter might have been of greater importance.
87	Myriel	Vredenborg	Alfred Wegener InstituteHelmholtz Center for Polar and Marine Research, Bremerhaven, Germany	11: Vertical and Lateral Transport in the Ocean	S11-6	virtually	Myriel Vredenborg, Wiebke Körtke, Benjamin Rabe, Maren Walter, Sandra Tippenhauer, Oliver Huhn and Team MOSAiC OCEAN	Lower halocline and warm Atlantic Water properties and pathways during MOSAiC	Circulation pathways in the Arctic Ocean have been found to change in recent decades, likely in response to changes in sea ice, surface fluxes, and advection of air masses under Arctic amplification. We use hundreds of hydrographic profiles obtained with the ship´s CTD and Ocean City CTD to investigate the properties of the lower halocline and warm Atlantic Water in the Amundsen Basin during the MOSAiC campaign. Additionally, we analyse chemical tracers (noble gases and CFCs) measured from water samples taken with both CTD/Rosette systems. We find a shoaling and thickening of the Atlantic Water layer compared to historical observations, as well as signatures of interleaving at the core of the warm Atlantic Water that slowly get eroded during the drift. Our data show convective lower halocline waters that are typically formed north of Fram Strait and further downstream, as well as advective-convective lower halocline waters typically formed in the Barents Sea. We see a change in lower halocline properties in the eastern Amundsen Basin compared to historical observations, that could either be caused by local formation or a change in circulation. To further investigate possible pathways and formation regions of the observed water masses we use chemical tracers.
33	Hualing	Wang	Shanghai Jiao Tong University	11: Vertical and Lateral Transport in the Ocean	S11-4	in-person (?)	Hualing Wang, Hailong Liu, and Guokun Lyu	Spatial and Temporal Characteristics of Vertical Heat Flux in the Arctic Ocean	Oceanic vertical heat flux is one of the key factors in deciding ocean heat budget in containing the advective term and diffusive term. With the rapid change of the Arctic, vertical heat flux has the potential to exert significant impact on the interaction between upper ocean and atmosphere/ice, and also the change of internal hydrographic structure in the Arctic. Therefore, to explore the temporal and spatial variations of Arctic vertical heat flux is needed. Due to the lack of long-term dataset of Arctic, it still remains poorly understood. Based on the Arctic ocean-sea ice reanalysis INTAROS from 2007-2021 and in-situ data from MOSAiC, this research presents the spatial and temporal variability of vertical heat flux, and its association with the major climate modes.
45	Héléne	Angot	Ecole Polytechnique Federale de Lausanne	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12B-3	in-person	Angot Héléne, Dada Lubna, Bourgeois Ilann, Beck Ivo, Bergner Nora, Heutte Benjamin, Archer Stephen, Bariteau Ludovic, Blomquist Byron, Boyer Matthew, Bucci Silvia, Creamean Jessie, Dahlke Sandro, Gros-Daillon Jules, Helmig Detlev, Howard Dean, Jacobi Hans-Werner, Jokinen Tuija, Laurila Tiia, Pernov Jakob, Posman Kevin, Quévléver Lauriane, Stohl Andreas, Schmale Julia	Chemical and microphysical characterization of warm and moist air-mass intrusions into the Arctic	Warm and moist air-mass intrusions (WAMIs) into the Arctic have been shown to affect the near-surface energy budget. While most studies deal with transport pathways and moisture content, here we focus on the chemical and microphysical characterization of WAMIs in an effort to better understand pollution transport into the Arctic and the associated direct and indirect climate impacts. Building on the greenhouse gases and aerosol datasets collected during the winter and spring legs (Nov-Apr) of the MOSAiC expedition, we show that the origin, timing, and meteorological conditions all affect the composition of advected air-masses. Of the WAMIs identified during the study period, 60% were associated with significant pollution transport into the Arctic. In addition, 80% of the extreme (> 95th percentile) cloud condensation nuclei number concentrations were observed during WAMIs, highlighting the potentially significant impact on cloud radiative properties. We further use datasets collected at several coastal Arctic sites to scale up to a multi-year and pan-Arctic perspective. We show that, in addition to being the most frequent, WAMIs originating from the European sector are also the most frequently polluted. Finally, we use the chemical transport model GEOS-Chem to quantify the relative contribution of WAMIs to Arctic Haze.

67	Lars	Aue	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Potsdam, Germany	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12A-6	in-person	Lars Aue, Timo Vihma, Petteri Uotila, Leonie Röntgen, Wolfgang Dorn, Gunnar Spreen, Annette Rinke	Cyclone Impacts on the Sea Ice Cover and Underlying Mechanisms: Analysis for the Atlantic Sector of the Arctic Ocean in Winter	We quantify cyclone impacts on Arctic sea ice concentration (SIC) and thickness (SIT) in winter by combining a statistical analysis spanning several years of reanalysis data with a detailed analysis of MOSAiC cyclone cases utilizing high-resolution coupled modelling and in-situ observations. Statistically, a reduction in SIC is found prior to and during cyclones, while an increase in SIC is observed during the days following the cyclone passage. The net effect from 3 days prior to 5 days after each cyclone consists of a regional difference between an increase in SIC in the Barents Sea and a decrease in SIC in the Greenland Sea. In both regions, largest SIC changes occur during intense cyclones, particularly when preconditioned by locally low to medium SIC. Decomposing the sea ice impacts of a sequence of three intense cyclones that occurred in February 2020 into dynamic and thermodynamic contributions reveals that changes in SIT are dominated by dynamic processes, while changes in SIC are initially dominated by dynamics and later by thermodynamics. This indicates that the statistically significant net gain in SIC following cyclones is driven by thermodynamic refreezing of openings in the sea ice in regions with divergent ice drift during the cyclone passages.
103	Camilla F.	Brunello	Alfred Wegener Institute for Polar and Marine Research, Bremerhaven	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12B-4	in-person	Camilla F. Brunello, Moein Mellat, Hanno Meyer, Silvia Bucci, Marina Dütsch, Amy R. Macfarlane, Martin Schneebeli, Ruzica Dadic, Stefanie Arndt, Ben G. Kopec, Jeffery M. Welker, Martin Werner	Stable water isotopes on the MOSAiC floe: integrated tracers of moisture sources, transport and deposition in the Arctic.	Continuous isotopic observations of near-surface atmospheric water vapour were obtained onboard RV Polarstern during MOSAiC. By combining these observations to the particle dispersion model FLEXPART, we show that contrasting spatio-temporal scenarios reflect changes in origin of the air masses. Furthermore, simulation results from an Atmosphere General Circulation Model (ECHAM6-wiso) enabled for stable water isotope diagnostic show that the evaporative processes from the ocean surface explain the isotopic signal of the summer atmospheric water vapour, but are not sufficient to reproduce our winter observations. We propose that non-equilibrium fractionation with ice crystals during transport is key to modulating the water isotopes in winter. To further investigate this hypothesis: (i) we track the modification that the air masses undergo during their advection to the central Arctic in the course of synoptic warm air intrusions under different sea ice conditions, and (ii) we investigate the isotopic changes of deposited snow with respect to changes in vapour isotopes. The results reflect the transition from a sublimation regime in winter to an evaporative regime in summer. With this work, we aim to better understand the moisture exchange processes between the ocean-sea ice-atmosphere continuum in the Arctic and their contribution throughout the year.
59	Christopher	Cox	NOAA Physical Sciences Laboratory	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12A-4	in-person	Christopher J Cox, Zachary D Lawrence, Sandro Dahlke	Linkages between anomalous mid-April warming at MOSAiC and the evolution of the 2020 polar vortex	An anomalous warming event occurred during MOSAiC in mid-April 2020 following record strength in the stratospheric polar vortex. The associated high-pressure ridge penetrated deeply into the Arctic, leading a split of the stratospheric vortex by ~1 week. This was the product of increased sinuosity following a resurgence of upward wave activity flux after a dormant period in mid-winter that other studies have attributed to the vortex extreme. Coincidentally, we identify a minor sudden stratospheric warming (SSW) in mid-March. The buoyancy component of the wavenumber 1 flux was reflected by the stratosphere and reached the troposphere at the end of March, coincident with the record positive Arctic Oscillation (AO) abruptly returning to neutral and a slow descent and weakening of the Northern Annular Mode. Using an ensemble of 46-day European Centre for Medium Range Weather Forecasting (ECMWF) forecasts initialized March 9-12, we find a statistically-significant correspondence between ensemble members that accurately predicted the stratospheric reflection and those that also predicted a tendency of the AO to return to neutral. Furthermore, in accordance with the less positive AO, those same members also predicted a pattern of warming in April consistent with increased blocking over Greenland and Alaska, similar to that which occurred.
114	Alena	Dekhtyareva	Geophysical Institute, and Bjerknes Centre for Climate Research, University of Bergen, Bergen, Norway	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12B-5	virtually	Alena Dekhtyareva, Kerstin Ebell, Marion Maturilli, Aina Johannessen, Andrew W. Seidl, Marius O. Jonassen, Ove Hermansen, Jeffrey M. Welker, Marvin Kähnert, Iris Thurnherr, Harald Sodemann	Cloud characteristics and stable water isotopes in Svalbard during the ISLAS 2020 campaign and MOSAiC	Stable water isotopes can be used to trace the atmospheric water cycle and improve its representation in numerical models. We performed water vapour and precipitation measurements during the ISLAS campaign in spring 2020 on Svalbard to study the isotopic signal of cold-air outbreaks (CAOs) and warm air intrusions (WAIs). The thermodynamic conditions during several CAO and WAI regimes were studied using ground-based measurements, Cloudnet and radiosonde profiles and compared with output of the numerical weather prediction models AROME Arctic and COSMOiso. From 03.03.2020 to 08.03.2020, we observed a strong WAI that led to a fivefold increase in vertically integrated water vapour and a rise of surface air temperatures by 20°C. Despite the presence of elevated multi-layer mixed-phased clouds, the isotopic signal was similar in vapour and precipitation due to enhanced mixing creating uniform specific humidity profiles and facilitating spontaneous riming of supercooled droplets on the ice particles in the lower cloud level. This case study illustrates the preconditioning of moisture during a WAI at the sea ice edge before the system enters central Arctic. Characterising these conditions provides a Lagrangian reference for moisture measurements during MOSAiC and helps to identify processes affecting moisture during the transport over the sea ice.
178	Andrew	Dzambo	CIWRO / University of Oklahoma - Norman	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12A-1	in-person	Andrew Dzambo, Kamal Kant Chadrakar, Greg McFarquhar, Hugh Morrison, Wojciech Grabowski, Matthew Shupe, Israel Silber and Jian Wang	Climatology of Synoptic-Scale Subsidence During MOSAiC	The Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) program's Multidisciplinary Drifting Observatory for the Study of Arctic Climate (MOSAiC) field campaign fills a critical observation gap in sea ice, meteorological, and cloud property measurements. Observational datasets collected aboard the Polarstern during MOSAiC represent conditions over the sea ice to represent how air masses and clouds evolved downstream. One of the key meteorological drivers of Arctic cloud cover are occluding (decaying) synoptic-scale weather systems, many of which originate from the northern Hemisphere mid-latitudes. In this study, a climatology of synoptic scale weather systems occurring during the MOSAiC campaign is presented, with a focus and emphasis on meteorological conditions promoting large-scale subsidence. Large-scale subsidence is known to promote higher Arctic boundary layer cloud fraction. The goal of this study is to understand the role observed subsidence has in interpreting Polarstern-based measurements, such that surface fluxes and aerosol conditions can be appropriately contextualized. Findings from this present study will guide future Lagrangian cloud modeling activities, where cloud processes can be more rigorously studied and evaluated knowing the synoptic-scale weather conditions.

149	Jari	Haapala	Finnish Meteorological Institute	12: Storms and airmass instrusions to the Arctic during MOSAiC	P2 (16)	virtually	Jari Haapala, Luisa von Albedyll, Jenny Hutchings, Polona Itkin, Thomas Krumpen, Ola Persson, Chris Polaschenski, Gunnar Spreen and Matias Uusinoka	Anatomy of major sea ice deformation events	Formation of sea ice fractures, cracks, leads and linear kinematic features, have a large impact on exchanges of energy and matter between the ocean and atmosphere, surface heterogeneity, and sea ice mass balance. Fracturing also weakens the dynamic strength of pack ice. Based on ice radar, satellite images, and ice drift and stress buoy data we have identified the most significant local ice dynamics events at the Central Observatory. In this presentation, we will provide an anatomy of events that occurred in 15th - 25th November 2019 and 20th March - 4th April 2021. The analysis shows where and when large-scale shearing, lead opening and compression occur, with ridging often under shear. In a single spot, these modes of deformation are occurring consecutively but within a few km2 areas, all these modes occur simultaneously. Furthermore, old shear zones, leads, and ridges are reactivated throughout the winter.
35	Michail	Karalis	Department of Meteorology and Bolin Centre for Climate Research, Stockholm University, Stockholm,Sweden	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12B-6	in-person	Michail Karalis, Gunilla Svensson	Lagrangian simulations of warm air intrusions using AOSCM.	During warm air intrusion (WAI) episodes, moist air masses are advected poleward through the large-scale meridional flow and are transformed along the way, due to processes that are yet not well-understood and often misrepresented in numerical models. Here, we study the transformation of the air masses that reach the MOSAiC site in April 2020 from a Lagrangian view-point, using the Atmosphere Ocean Single Column Model (AOSCM). Backward trajectories initialized at different heights appear to line up vertically for up to 48-hours before the air-masses reach Polarstern, which indicates that advection could be represented by temporally varying surface boundary conditions. Analysis of observations collected from observation stations along the air-mass path, as well as ERA5 reanalysis data are used in addition to the Lagrangian simulations in order to help distinguish the timescales of the transformation and its driving mechanisms.
20	Benjamin	Kirbus	Leipzig Institute for Meteorology, University of Leipzig, Germany	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12B-1	in-person	Benjamin Kirbus, Sofie Tiedeck, Andrea Camplani, Jan Chylik, Susanne Crewell, Sandro Dahlke, Kerstin Ebell, Irina Gorodetskaya, Hannes Griesche, Dörthe Handorf, Ines Höschel, Melanie Lauer, Roel Neggers, Matthew D. Shupe, Andreas Walbröl, Manfred Wendisch, Annette Rinke	Warm and moist air intrusions into the Arctic: New insights from a case observed during MOSAiC in mid-April 2020	Events of warm and moist air intrusions (WMAIs) from mid-latitudes have pronounced impacts on the Arctic climate via modifications of the surface energy budget (SEB), atmospheric structure, and precipitation. We present an in-depth analysis of a record-breaking WMAI observed in mid-April 2020 during MOSAiC. We combine Eulerian and Lagrangian frameworks with simulations across different scales (LES, ICON-LAM, ERA5) to offer a comprehensive analysis of this intrusion. Two air mass transport pathways, Siberian and Atlantic, characterized this event, inducing anomalous energy transport into the Arctic. Observations at RV Polarstern showed a rapid transition from radiatively clear to cloudy states. This transition was accompanied by increased moisture as well as ice and liquid bearing clouds, generating significant precipitation. Calculated backward trajectories indicate that the WMAI event reached Polarstern first near the tropopause, and only later at lower altitudes. The Lagrangian LES shows the impact of CCNC on the vertical distribution of cloud water, thermodynamic coupling and inversion height. ICON-LAM was used to quantify the impact of lateral moisture inflow on cloud evolution along the trajectory. Results indicate that reduced moisture inflow into the Arctic mainly impacts the SEB over the marginal ice zone, while precipitation effects extend further into the Arctic.
79	Ben	Kopec	University of Alaska Anchorage	12: Storms and airmass instrusions to the Arctic during MOSAiC	P2 (14)	virtually	Ben G. Kopec, Eric S. Klein, Kyle S. Mattingly, Camilla F. Brunello, Martin Werner, Hannah Bailey, Kaisa-Riikka Mustonen, Timo Vihma, Tiina Nygård, Jeffrey M. Welker	Contrasting Arctic Oscillation phases during and after MOSAiC: Comparing moisture transport patterns observed from the Pan Arctic Water Isotope Network (AWIN)	The record positive Arctic Oscillation (AO) in February 2020 (during MOSAiC) was followed in 2021 by an extreme negative phase of the AO. This contrasting behavior provides our pan Arctic Water Isotope Network (AWIN) an exceedingly unique ability to compare and contrast atmospheric configurations and moisture transport into, around, and out of the Arctic using water vapor and precipitation isotope forensics. In this study, we examine the synoptic organization of the Arctic and moisture transport variations across the extreme differences in AO conditions prior to, during, and after MOSAiC through isotopic (Î´18O, Î´D, deuterium excess) measurements of water vapor from the AWIN. These AWIN observations, which include measurements on the Polarstern during MOSAiC, comprehensively track water vapor from its sources to sinks, thereby demonstrating how it varies simultaneously across the entire Arctic Basin, under divergent sea ice and atmospheric conditions. With isotopic data from AWIN covering these two extreme winter years and some measurement stations going back to late 2017, we have a unique opportunity to trace moisture transport and local moisture injections across the full spectrum of AO phases and their related transport patterns.
71	Sonja	Murto	Stockholm University	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12A-5	in-person	Sonja Murto, Gunilla Svensson, Lukas Papritz, Gabriele Messori, Heini Wernli, Rodrigo Caballero	Winter and springtime extreme surface energy budget anomalies in the high Arctic	Arctic extreme events are detected based on temporally and spatially connected regions of extreme positive surface energy budget (SEB) anomalies over sea ice using ERA5 reanalysis data. In winter, most of these events are associated with large-scale inflow from the Pacific and Atlantic and backward trajectories reveal that near-surface air has Arctic origin, whereas air aloft originates from the mid-latitudes. The SEB events obtain largest anomalies at their onset near the ice edge. As time passes the SEB anomalies weaken whereas skin temperature anomalies increase. Statistical analysis reveals that variations in SEB anomalies are driven by turbulent fluxes, whereas downward longwave radiation determines variations in the temperature anomalies. Associating spring SEB events with satellite-derived melt onset dates reveal that early melt onset dates display opaque conditions, a higher frequency of SEB events prior melt and airflow from the Pacific. Late melt onset is favoured by continental airmass origin, a low frequency of SEB events and clear-sky conditions. Two episodes of warm-air pulses reaching the MOSAiC site in mid-May are presented to illustrate the importance of meridional warm-air transport for the transition towards a springlike condition in the Arctic.
215	Ola	Persson	University of Colorado	12: Storms and airmass instrusions to the Arctic during MOSAiC	P2 (15)	in-person	Ola Persson, Christopher Cox, Michael Gallagher, Matthew Shupe, Don Perovich, Marion Maturilli	Arctic Cyclone Mesoscale Features Producing Thermodynamic Impacts during MOSAiC	MOSAiC was a rare opportunity to obtain observational data on Arctic cyclones (ACs), with at least 22 ACs sampled. This presentation will provide an overview of the ACs impacting the MOSAiC domain, and provide structural details that appear to be key to their impacts on sea ice. While significant work has been done on dynamic interactions between the atmosphere, sea ice, and upper ocean during these ACs, this presentation will focus on the mesoscale and microphysical AC features that provide thermodynamic interactions. The broad relevance of features, such as low-level jets, warm-sector warm-air advection, and cloud macro- and microphysical structure, to the sea-ice thermodynamic environment is illustrated with several case studies. These will include cyclones from mid-November, early February, mid-April, and mid-September, and will discuss the relative surface thermodynamic impacts of warm-air advection and cloud-driven longwave radiation in various mesoscale sectors of these ACs. This distinction is of particular relevance to ACs occurring when the surface temperature reaches the melting point, as for the last two cyclones.

195	Ola	Persson	University of Colorado	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12A-2	in-person	Ola Persson, Christopher Cox, Matthew Shupe, and Michael Gallagher	Thermodynamic Impacts of Deep Clouds Associated with Cyclones	Arctic clouds enhance downwelling longwave radiation (LWD) and lead to surface warming, and supercooled liquid water (SLW) in common low-level stratocumulus clouds are a key characteristic determining LWD. Because of the large number of cyclones, MOSAiC provides an excellent opportunity to assess radiative impacts of deeper clouds associated with cyclones. Other field programs have suggested that these deeper clouds have less SLW, and may therefore produce slightly less LWD enhancement. On the other hand, LWD from deeper clouds in warm sectors of cyclones may have greater enhanced because of the warm air. An objective of this work is to understand the balance of these two effects, and how they impact the surface energy budget (SEB) during cyclone events. This presentation will use the recently completed, quality-controlled, SEB measurements combined with analyses of remote sensor data and soundings to quantitatively examine the SEBs during several cyclones throughout the year, including a mid-September cyclone that produced a brief, 12-h return to surface melt. Interestingly, rain-on-snow occurring during this event has been suggested to cause the surface melt; preliminary analysis suggests that the change in sign in the SEB caused by enhanced LWD may actually have been its cause.
126	Sofie	Tiedeck	Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Potsdam, Germany	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12B-2	virtually	Sofie Tiedeck, Benjamin Kirbus, Irina Gorodetskaya, Susanne Crewell, Annette Rinke	Atmospheric River during MOSAiC in Mid-November 2019: Transformation Processes and Impact on the Surface Energy Budget	Atmospheric Rivers (ARs) can carry anomalously high amounts of water vapor into the Arctic. It has been shown that the associated enhanced moisture in the atmosphere leads to increased downward longwave radiation and related surface warming. In this work we focus on an event which occurred in mid-November 2019, where an AR penetrated the Arctic from the northern North Atlantic and passed over the RV Polarstern during the MOSAiC expedition. We provide a comprehensive study of this AR event, its spatiotemporal structure and impact on the surface energy budget (SEB) with respect to the surface type. We use ERA5 reanalysis data and model output from limited area simulations of ICON (ICON-LAM). The Eulerian view is complemented by Lagrangian trajectories to evaluate the transformation of air masses. Furthermore, a sensitivity study with reduced moisture inflow at the lateral boundary using ICON-LAM is used to evaluate the change in SEB and to analyze the relative importance of water vapor and cloud water on the SEB.
19	Cheng	You	AWI	12: Storms and airmass instrusions to the Arctic during MOSAiC	S12A-3	in-person	Cheng You, Annette Rinke, Ralf Jaiser	A case study of the mid-November 2019 cyclone north of Greenland during MOSAiC	We present a case study of a cyclone in mid-November 2019 during the MOSAIC expedition. During this case, a cyclone formed on the 15th November north of Greenland and triggered a strong warm-moist air intrusion from the North Atlantic into the Arctic, leading to a significant impact on the surface energy-budget. Based on limited area model (LAM) simulations with ICON (ICON-LAM), we study the processes, which contribute to the genesis, intensification and persistence of this selected case. To determine the relative role of surface and upper-level contributions, sensitivity simulations with modified Greenland topography have been conducted. Our results show that the topography strongly impacts the cyclones propagation northwards along the Baffin Bay/west coast of Greenland. As this northward flow encounters the steep terrain at the north edge of Greenland, strong positive potential vorticity (PV) develops and contributes to the cyclone development. Meanwhile, a blocking develops downstream over the Barents Sea and pumps large amounts of warm air into the Arctic. Without topography, neither the cyclone nor the blocking could form. The coupling between stratosphere and troposphere seems to play a minor role for cyclogenesis and further intensification of the cyclone, but our analysis is ongoing with regard to this aspect.
66	Elisa F.	Akansu	Leibniz Institute for Tropospheric Research, Leipzig, Germany	14: Atmospheric Boundary Layer: Structure and Processes	S14A-1	in-person	Elisa F. Akansu, M. Lonardi, H. Siebert, Sandro Dahlke, Ralf Jaiser, and M. Wendisch	Observations of the Arctic Atmospheric Boundary Layer During Polar Night Using a Tethered Balloon-Borne Instrument Payload	The vertical structure of the atmospheric boundary layer (ABL) influences the evolution and longevity of clouds and, thus, has a significant impact on the surface radiative energy budget in the Arctic. This also influences the thermodynamic structure and turbulent processes in the Arctic ABL. To characterize these effects, a helium-filled tethered balloon (volume of 9 m3) was operated between December 2019 and May 2020 during the yearlong MOSAiC expedition. It provided vertically highly resolved in-situ measurements of turbulent parameters. Two typical distinct states of the Arctic ABL were observed: cloud-free situations with a shallow and stable ABL, and cloudy conditions maintaining a mixed ABL. We have used the balloon-borne turbulence observations to characterize the (mostly) stable Arctic ABL in both winter and spring 2019/2020. The vertical profile measurements of turbulence parameters are used to define the depth of the surface mixed layer and to understand the influence of clouds on the vertical structure of the lower atmosphere. We will present results of the analysis of the transition between both states. Further, a bulk Richardson number criterion approach for defining the mixing layer depth is applied and compared to the turbulence method enabling the extension of the analysis to radiosonde data.
226	Phil	Anderson	Scottish Association for Marine Science	14: Atmospheric Boundary Layer: Structure and Processes	S14B-1	in-person	Phil Anderson	Hunting the Bore: Possible coherent events hiding in MOSAiC data?	Coupled climate and forecast models require accurate physical descriptions of atmosphere-surface turbulence exchange; residual errors in such models will likely exacerbate when running future unprecedented scenarios, where mere data fitting is not possible. Turbulent exchange is least understood whenever stable stratification exists, which suppress vertical turbulence. In the case of heat transfer in the atmosphere, said suppression has a positive feedback, that is, it enhances surface cooling and thereby enhances stratification. This problematic issue is known, and studies of the stably stratified lower atmosphere have been made for decades, primarily in polar regions, including MOSAiC, but progress in the science has been slow. The difficulty in measurement and suitable analysis may be masking a separate phenomenon of "coherent structures"; within the stratified turbulence. These phenomena are theoretically possible and have been observed, but their effect on the flow and fluxes, if any is virtually unknown, although, theoretically at least, such structures can transfer momentum vertically (as waves), and trace gases horizontally (with rotor cores). This presentation provides evidence for such structures from a previous Antarctic ice-shelf campaign (via sodar, micro-barograph and sonic anemometer) and presents observed signature that might be observed, if the sites are equivalent, within MOSAiC sonic-anemometer data. By hunting for these signatures during MOSAiC, and comparing to similar (and dis-similar) polar data, the possible mechanism of generation, maintanence and propagation of these phenomena may be further explored.

									and thickness, and the percentage of open sea water within the sea ice increases strongly. The associated ice albedo feedback accelerates the decline of sea ice and provides an increased exchange of energy and humidity between surface / ocean and atmosphere caused by turbulent fluxes of energy and humidity. This process intensifies the Arctic amplification. To quantify these turbulent energy fluxes over the heterogeneous Arctic surface airborne flux measurements were performed during the MOSAiC expedition. The helicopter borne probe HELiPOD is equipped with extensive measurement devices to observe the exchange of energy, humidity and trace gases between the surface and atmosphere. The probe conducted flights during the MOSAiC expedition in summer 2020 to investigate the spatial variability of turbulent fluxes and their relation to surface properties. These airborne measurements put the local meteorological observations and flux measurements in the vicinity of the research vessel Polarstern into a regional perspective. This study presents the turbulent energy fluxes, measured by the HELiPOD during the MOSAiC expedition 2020. It evaluates the spatial variety in observed fluxes and its relationship to surface properties.
113	Magnus Ole	Asmussen	Technische Universität Braunschweig, Institute of Flight Guidance, Germany	14: Atmospheric Boundary Layer: Structure and Processes	P2 (62)	in-person	Magnus Ole Asmussen, Falk Pätzold, Tim Sperzel, Evi Jäckel, Inge Wiekenkamp, Torsten Sachs, Astrid Lampert	Spatial airborne flux measurements by the HELiPOD during the MOSAiC expedition in summer	
159	Sébastien	Blein	Météo-France	14: Atmospheric Boundary Layer: Structure and Processes	S14B-5	virtually	Sébastien Blein, Virginie Guemas, Ian M. Brooks, Andrew D. Elvidge, Ian A. Renfrew	Uncertainties of drag coefficient estimates from field data above sea-ice	Transfer coefficients are key issues for turbulent surface flux parameterizations in numerical models. The development of parameterizations of the momentum transfer coefficient (drag coefficient) often uses, as a reference, indirect estimates (not directly measured by a sensor) of neutral drag coefficients from field data. This study assesses the uncertainties of these neutral drag coefficient estimates. Both random error and systematic bias are considered and are mainly attributed to the propagation of measurement random errors and to the use of potentially non-adequate stability functions. A total random error and a systematic bias are associated to each estimate of neutral drag coefficient and are used to build an objective data screening criterion in addition to, for instance, turbulent flux quality control. This additional criterion produces cleaner datasets and may contributes to the improvement of future parameterizations. The proposed analysis is applied to different datasets from Arctic field experiments such as the SHEBA experiment. The same analysis procedure is being conducted on the MOSAIC dataset and preliminary results will be presented.
29	Donald	Cummins	Centre National de Recherches Météorologiques, Toulouse, France	14: Atmospheric Boundary Layer: Structure and Processes	S14B-6	in-person	Donald Cummins, Virginie Guemas, Sébastien Blein, Ian Brooks, Ian Renfrew, Andrew Elvidge	Reducing parametrization errors for polar surface turbulent fluxes using machine learning	Heat exchanges between sea ice and atmosphere are known to influence the Arctic melting rate, the development of atmospheric circulation anomalies, and potentially teleconnections between the Arctic and non-polar regions. And yet, large model errors remain in parametrizations of turbulent heat fluxes over sea ice in GCMs. Fluxes are typically calculated using bulk formulas, based on the Monin-Obukhov similarity theory, which were initially developed using data from the tropics or mid-latitudes and which require specific tuning to Arctic conditions. Parametrizations developed specifically for polar conditions (i.e. representing form drag, or the presence of ridges) rely on sparse observations. Recent observational campaigns promise to provide new observations of turbulent fluxes in the Arctic, enabling validation of existing bulk formulations developed for polar conditions, and raising the possibility of entirely data-driven parametrizations. Machine learning has already been used outside the polar regions to provide accurate and computationally inexpensive estimates of surface turbulent fluxes. To investigate feasibility of this approach in the Arctic, we have used a reference dataset (SHEBA) to develop data-driven flux parametrizations. Predictive performance has been tested using other observational campaigns and is found to be comparable to and in some cases substantially better than that of state-of-the-art bulk formulations.
12	Gijs	de Boer	University of Colorado	14: Atmospheric Boundary Layer: Structure and Processes	S14A-3	in-person	Gijs de Boer, Ulrike Egerer, John J. Cassano, Matthew D. Shupe, Dale Lawrence, Abhiram Doddi, Holger Siebert, Gina Jozef, Radiance Calmer, and Jonathan Hamilton	Estimating turbulent energy flux vertical profiles from the DataHawk UAS: Results from MOSAiC	This study analyzes turbulent energy fluxes in the Arctic atmospheric boundary layer (ABL) using measurements with a small Uncrewed Aircraft System (sUAS). Turbulent fluxes constitute a major part of the atmospheric energy budget and influence the surface heat balance by distributing energy vertically in the atmosphere. However, only few in-situ measure- ments exist of the vertical profile of turbulent fluxes in the Arctic ABL. The study presents a method to derive turbulent heat fluxes from DataHawk2 sUAS turbulence measurements, based on the flux gradient method with a parameterization of the turbulent exchange coefficient. This parameterization is derived from high-resolution horizontal wind speed measurements in combination with formulations for the turbulent Prandtl number and anisotropy depending on stability. Measurements were taken during the MOSAiC expedition in the Arctic sea ice during the melt season of 2020. For three example cases from this campaign, vertical profiles of turbulence parameters and turbulent heat fluxes are presented and compared to balloon-borne, radar and near-surface measurements. The combination of all measurements draws a consistent picture of ABL conditions and demonstrates the unique potential of the presented method for studying turbulent exchange processes in the vertical ABL profile with sUAS measurements.
204	Michael	Gallagher	Research Scientist	14: Atmospheric Boundary Layer: Structure and Processes	S14B-4	in-person	Michael R. Gallagher, Christopher J. Cox, David W. Clemens-Sewall, Matthew D Shupe, Byron Blomquist, Ola Persson	Turbulence, boundary layer structure, and surface topography; research on roughness	Bulk models and eddy covariance methods provide insight into the deposition of energy by turbulent eddies in the atmosphere, however the role of the physical topography of sea-ice in those measurements and calculations has yet to be studied comprehensively. Using novel MOSAiC lidar timeseries' and detailed data of turbulent energy deposition, we present an investigation into the properties of turbulence over sea ice through the lens of relationships between aerodynamic roughness and the physical surface.

									Surface-coupled Arctic summertime clouds show a higher probability of ice formation at temperatures above -15 °C. The reason behind this is likely a larger reservoir of marine INPs of biogenic origin in the Arctic surface-coupled marine boundary layer. The increased number of INPs then lead to a higher freezing efficiency in the clouds which have at least their base in the boundary layer. However, the data basis of this study is so far limited to a two-month expedition in the Arctic summer 2017 in the marginal sea-ice zone. Observations from the MOSAiC campaign were analyzed for similar effects based on the same approach. The cloud phase was identified based on the lidar depolarization signal. The cloud top was derived using the cloud radar reflectivity. The cloud top temperature and the coupling state was identified based on the temporal closest radiosonde profile. In the summer months liquid precipitating clouds frequently prevented a correct phase detection based on the lidar signal. Excluding these periods from the analyzed data, the MOSAiC observations revealed similar effects during spring and summer. During these months, enhanced ice occurrence was found in surface-coupled clouds, especially at low supercooling temperatures (>-15 °C).
105	Hannes	Griesche	TROPOS	14: Atmospheric Boundary Layer: Structure and Processes	S14A-6	in-person	Hannes Griesche, Patric Seifert, Ronny Engelmann, Martin Radenz, Julian Hofer, Dietrich Althausen, Albert Ansmann	Examination of surface-coupling effects on heterogeneous ice formation at low supercooling temperatures in mixed-phase clouds during MOSAiC	
107	Cristofer	Jimenez	Leibniz Institute for Tropospheric Research (TROPOS)	14: Atmospheric Boundary Layer: Structure and Processes	S14A-5	virtually	Cristofer Jimenez, Albert Ansmann, Ronny Engelmann, Hannes Griesche, Martin Radenz, Julian Hofer, Dietrich Althausen, and Patric Seifert	Characterization of liquid-water-dominated top layers of mixed-phase clouds during MOSAiC by means of Dual-FOV polarization lidar: first results and perspectives.	During MOSAiC, the recently introduced dual field-of-view (Dual FOV) polarization lidar technique was applied to mixed-phase clouds for the first time. The technique allows us to exploit and characterize liquid-water-dominated cloud layers in terms of cloud extinction, droplet effective radius, droplet number concentration, and liquid-water content. We analyzed 22 cases of mixed-phase clouds (13 during winter half year from October 2019 to April 2020, 9 during the summer half year from May to September 2020). Most of the cloud layers formed between 2 and 3 km height. In 10 cases, the stratiform mixed-phase cloud layers could be continuously observed for more than 10 hours, and in 2 cases even over 30 hours. On average, the effective droplet radius was 6 µm (typical range from 4-9 µm) and the droplet number concentration was 120 cm-3 (typical range from 50-250 cm-3). We will discuss several long-lasting case studies with permanently forming liquid-water top layers and ice falling out of these shallow top layers and provide an overview of our entire data analysis. In the next step the findings will be used in closure studies, i.e., closure between CCN, INP, cloud droplet number, and ice crystal concentrations. First case studies may be shown.
25	Gina	Jozef	University of Colorado Boulder	14: Atmospheric Boundary Layer: Structure and Processes	P2 (61)	in-person	Gina Jozef, John Cassano, Sandro Dahlke, Mckenzie Dice, Gijs de Boer	An overview of the Vertical Structure of the Atmospheric Boundary Layer in the Central Arctic during MOSAiC	The structure of the central Arctic atmospheric boundary layer (ABL) dictates the transfer of energy, moisture, and momentum between the Earth's surface and overlying atmosphere. The ABL is characterized by its height and stability, and interacts with low-level jets (LLJs), temperature inversions (TIs), and atmospheric moisture and radiation. Using radiosonde, DataHawk2, meteorological tower, ceilometer, and microwave radiometer data from MOSAiC, we reveal the annual climatology of these atmospheric thermodynamic and kinematic features. A self-organizing map (SOM), which determines the different features present in the training data and groups the data into a user-specified number of patterns, is used to reveal the range of ABL structures (height and stability) in the central Arctic, and their relative frequencies. We then analyze the atmospheric features of interest in the context of the stability regimes identified by the SOM patterns. In this presentation we share the observed profile structures revealed by the SOM, as well as a summary of ABL features (height, stability, various turbulence metrics), LLJ features (frequency, height, speed, depth, strength), TI features (frequency, height, intensity, depth), and moisture features (cloud frequency, cloud base height, mixing ratio, liquid water path, precipitable water vapor) observed in the presence of the various stability regimes.
24	Gina	Jozef	University of Colorado Boulder	14: Atmospheric Boundary Layer: Structure and Processes	S14A-2	in-person	Gina Jozef, John Cassano, Sandro Dahlke, Mckenzie Dice, Gijs de Boer	Thermodynamic and Kinematic Drivers of Atmospheric Stability in the Central Arctic during MOSAiC	Central Arctic atmospheric boundary layer (ABL) stability is impacted by mechanical and radiative forcings, where fast wind speeds and high amounts of downwelling radiation work to weaken atmospheric stability. Using radiosonde, DataHawk2, meteorological tower, ceilometer, microwave radiometer, and radiation station data from MOSAiC, we determine the dominant forcing mechanism leading to different ABL stability regimes, and how these processes may differ by season. In this presentation, we share how wind speed and radiation components contribute to various stability regimes, and how storms and atmospheric moisture (clouds and fog) contribute to the wind and radiation observed. The key results show that strongly and moderately stable ABLs only occur in low wind and radiation environments for most of the year, but can also occur in the presence of warm air advection in summer; very shallow mixed ABLs occur in high radiation, low wind environments; weakly stable ABLs occurs in low radiation, high wind environments; and near-neutral ABLs occurs in high radiation, high wind environments. Additionally, a self-organizing map, which determines the different features present in the training data and groups the data into a user-specified number of patterns, is used to compare ABL height to low-level jet speed and cloud base height.
121	Michael	Lonardi	Leipzig Institute for Meteorology	14: Atmospheric Boundary Layer: Structure and Processes	S14A-4	in-person	Michael Lonardi, Christian Pilz, Elisa F. Akansu, André Ehrlich, Matthew D. Shupe, Holger Siebert, Birgit Wehner, Manfred Wendisch	The effect of cloud top cooling on the evolution of the Arctic boundary layer observed by balloon-borne measurements	The presence of clouds significantly affects Arctic boundary layer dynamics. However, the accessibility of clouds over the Arctic sea ice for in-situ observations is challenging. Measurements from tethered balloon platforms are one option to provide high-resolution data needed for model evaluation. The tethered balloon system BELUGA (Balloon-bornE moduLar Utility for profilinG the lower Atmosphere) was deployed to profile the boundary layer at the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC), and in Ny-Ãlesund. A set of scientific payloads for the observation of broadband radiation, turbulence, aerosol particles, and cloud microphysics properties were operated to study the interactions in the cloudy and cloud-free boundary layer. Measurements obtained under various cloud conditions, including single-layer and multi-layer clouds, are analyzed. Heating rates profiles are calculated to validate radiative transfer simulations and to study the temporal development of the cloud layers. The in-situ observations display the importance of radiation-induced cloud top cooling in maintaining stratocumulus clouds over the Arctic sea ice. Case studies also indicate how the subsequent turbulent mixing can lead to the entrainment of aerosol particles into the cloud layer.

38	Vania	Lopez Garcia	University of Leeds	14: Atmospheric Boundary Layer: Structure and Processes	P2 (60)	in-person	Vania López-García, Ian M. Brooks, Ryan Neely III, Sandro Dahlke	Forcing mechanisms of low-level jets in the central Arctic	Climate models fail to reproduce the vertical structure of the arctic boundary layer. One key model weakness is the turbulent mixing, which can be produced aloft by low-level jets (LLJ). Here, we analyse the most common LLJ forcing mechanisms using observational data from the radiosonde program and meteorological mast in MOSAiC, and ERA5 reanalysis. We investigate the relation between forcing mechanisms and basic LLJ properties, speed and height, and the ability of ERA5 to reproduce different types of LLJs.
60	Zakaria	Mostafa	Leibniz University Hannover	14: Atmospheric Boundary Layer: Structure and Processes	P2 (59)	virtually	Zakaria Mostafa M. Gryschka	Impact of Sea-ice Leads on the Polar Boundary Layer: A Large Eddy Simulation Study	Leads play an important role for heat transfer from ocean to the atmosphere in the Arctic, even though they represent only 1% to 5% over the sea ice area. The (surface) heat flux depends on certain parameters like temperature difference between water and near surface air above ice, thermal stability of the boundary layer, background wind and lead width. With Large Eddy Simulations (PALM model) we are investigating the dependency of the lead averaged surface heat flux on these parameters with the focus on the dependency on lead width for a wide range for widths between a few meters and several kilometers. First results will be shown in this contribution. The benefit of Large Eddy Simulations is, that the relevant scales of turbulence are explicitly resolved and therefore the results are almost independent on the subgrid scale parameterization - just the resolution needs to be high enough, to resolve the relevant scales. Especially for small leads its a challenge, as the grid size should smaller the 1/100 of the lead width. The results will help to develop parameterization for non-lead resolving models like local climate models.
196	Ola	Persson	University of Colorado	14: Atmospheric Boundary Layer: Structure and Processes	P2 (58)	in-person	Ola Persson, Ian Brooks, Matthew Shupe, Amy Solomon, and David Turner	The Arctic Atmospheric Boundary-Layer Structure and Its Interactions with the Free Troposphere and Surface	The atmospheric boundary layer over Arctic sea ice can conceptually be described as an ubiquitous Arctic inversion (AI) separating the free troposphere above from the sea-ice boundary below and extending to heights of 1000-1500 m. This typically stable AI inhibits vertical mixing, but is modified by the Arctic boundary layer (ABL) nearest the surface through local frictional or buoyant processes and the cloud-forced mixed layer (CML) aloft forced by cloud-top radiative cooling. When the forcing of the ABL is sufficiently strong, the ABL becomes a surface-based mixed layer (SML). While the CML and SML are generally distinct, they at times appear to couple producing a layer from the surface to cloud top with a near-neutral lapse rate throughout. Hence, during these periods, significant transport of heat, moisture, momentum, aerosols, and trace gases could occur. The formation of low-level wind jets (LLJs) within the AI also modifies its turbulent structure and enhances vertical transport. This recently funded project aims to evaluate, explore, and advance this conceptual model using the MOSAiC data set and select modeling experiments. This poster may show preliminary results, but its primary purpose is to stimulate discussion of this conceptual model and analyses needed to evaluate it.
54	Christian	Pilz	TROPOS	14: Atmospheric Boundary Layer: Structure and Processes	S14B-3	in-person	Christian Pilz, John J. Cassano, Matthew D. Shupe, Gijs de Boer, Birgit Wehner, Mira Pöhlker, Michael Lonardi, Holger Siebert	Aerosol particle vertical distribution affected by Atmospheric Boundary Layer structure and processes	Aerosol particles have direct and indirect radiative effects that can contribute to Arctic amplification. Long-range transported particles in the free troposphere affect atmospheric stability and the surface radiation budget through light scattering or absorption. By serving as cloud condensation nuclei (CCN), aerosol particles are a precondition for forming low-level clouds that affect the lower Arctic atmosphere. Locally formed particles within the ice-covered area are essential for the CCN budget; however, favored altitudes for particle formation and growth to CCN sizes remain unknown. In this context, the atmospheric boundary layer (ABL), the interface between the free troposphere and the sea ice, has to be considered to evaluate vertical aerosol abundance. Persistently prevailing temperature inversions and atmospheric stability hamper atmospheric mixing, thus fostering aerosol layering. Frequently occurring stratocumulus clouds with cloud tops below or inside the temperature inversion promote droplet activation and vertical particle exchange by radiation-driven turbulence at the cloud top. Whether or not cloud-driven turbulence reaches down to the surface dictates the mixing within the ABL and influences the vertical distribution of aerosols. This contribution presents an analysis of aerosol vertical distributions affected by ABL structure and processes based on balloon-borne observations combined with ship-based remote sensing during MOSAiC leg4.
72	Clara	Seidel	Leibniz Institute for Tropospheric Research Leipzig	14: Atmospheric Boundary Layer: Structure and Processes	S14B-2	virtually	Clara Seidel, Dietrich Althausen, Albert Ansmann, Manfred Wendisch, Ronny Engelmann, Hannes Griesche, Martin Radenz, Julian Hofer, Sandro Dahlke, Marion Maturilli	Impact of the vertical distributed water vapour on the downward longwave radiation at the surface during clear-sky conditions in the central Arctic	For the first time, measurements of water vapour profiles with a high temporal resolution are available for the central Arctic winter, performed with the Raman lidar PollyXT during the MOSAiC-campaign. The vertical profiles of the water vapour mixing ratio are used to derive the integrated water vapour (IWV) of the covered atmospheric column or specified layers. The IWV values are correlated to the downward thermal-infrared radiation (TIR), measured by the OCEANET-Atmosphere pyrgeometer at Polarsterns bow crane. Collocated radiosonde measurements deliver the opportunity to consider the impact of the temperature of the vertical distributed water vapour on the correlation. Linear correlations between the IWV and the TIR are found on daily scales for selected clear-sky cases, with a strong impact of the temperature and the vertical distribution of the water vapour. The evaluation of 49 independent water vapour profiles distributed over the winter 2019/20 confirms the linear correlation between the IWV and the TIR and the influence of the temperature and the water vapour profile on a larger time scale. The results indicate the need for the consideration of water vapour and temperature profiles with a high temporal and vertical resolution in radiative transfer

122	Andrew W.	Seidl	Geophysical Institute, University of Bergen, Norway and Bjerknes Centre for Climate Research, Bergen, Norway	14: Atmospheric Boundary Layer: Structure and Processes	P2 (57)	in-person	Andrew W. SEIDL, Alena DEKHTYAREVA, Iris THURNHERR, Jannis-Michael HUSS, Christoph THOMAS, Alexander SCHULZ, Harald SODEMANN	High-resolution, near-surface profiles of stable isotopes in water vapour over snow-covered tundra and fjord water	Understanding the physical exchange mechanisms in the surface layer is fundamental to constrain fluxes between the atmosphere and surface. We can use stable water isotopes (SWIs) to study these processes, but detailed, in-situ observations of the lowermost atmosphere in the Arctic are rare and remain a challenge. The ISLAS2020 measurement campaign during Feb-Mar 2020 in Ny-Ãlesund focused on the SWI signal of evaporation and vapour deposition. During a three-week period, at average temperatures below -20C we obtained near-surface, high-resolution (~20 cm) SWI profiles in the lowermost 5 m over open water and snow-covered tundra using a new profiling system. Fiber-optic distributed sensing columns at both locations supplied continuous, high-resolution (~2 cm) temperature profiles above both locations, providing detailed stability context for our SWI profiles. At both sites, our near-surface profiles show that incomplete mixing establishes strong vertical gradients in the SWIs, including in the derived deuterium excess. Over snow, we find evidence that ice supersaturation plays a central role in the kinetic fractionation of the SWI signal. These vertically-resolved surface-atmosphere exchanges can be used to assist in the interpretation of SWI measurements over the ice as conducted during MOSAiC, which conducted measurements over a longer timespan.
99	Sjoerd	Barten	Wageningen University	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16A-6	in-person	Johannes G.M. Barten, Laurens N. Ganzeveld, Gert-Jan Steeneveld, Maarten C. Krol	Polar-WRF-Chem simulations of the April warm air intrusion event	The warm air intrusion event observed during the MOSAiC campaign, April 2020, brought two periods of warm and moist air with increased concentrations of trace gases to the observatory. We have simulated the warm air intrusion event with the coupled meteorology and atmospheric chemistry model Polar-WRF-Chem. Here, we evaluate the model simulations with MOSAiC observed meteorology and surface trace gas concentrations. Furthermore, we will show the sensitivity of the model results with respect to model resolution and, particularly, representation of boundary layer dynamics. We show that the Polar-WRF-Chem model is able to accurately simulate the warm air intrusion in terms of meteorology. The simulations of trace gas concentrations show two distinctly different advection regimes during the two different phases reflected by ozone, carbon monoxide and nitrogen oxides. The sensitivity of the model results to the model resolution (27 km vs. 3 km) appears to be low and suggests that these dynamic events can be reproduced on relatively coarse model resolutions of large-scale meteorological and atmospheric composition reanalysis data also used to constrain local-scale model analysis of the MOSAiC observations.
94	Ivo	Beck	EPFL	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16A-2	virtually	Ivo Beck, Kevin Barry, Nora Bergner, Jessie Creamean, Benjamin Heutte, Thomas Hill, Tuija Jokinen, Tiia Laurila, Alireza Moallemi, Lauriane Quéléver, Julia Schmale	Sources and seasonality of fluorescent aerosols in the Arctic	Aerosol-cloud interactions play an important role in the Arctic climate but remain poorly understood. Ice nucleating particles (INPs) contribute to the formation of ice crystals at temperatures above -38 °C in mixed phase clouds, which are predominant in the Arctic. Therefore, investigating INP sources in the Arctic is crucial to understanding cloud occurrence, phase, and lifetime. One potential and very efficient source of INPs is primary biological aerosol particles (PBAPs). They can be long-range transported or be emitted from local sources. PBAPs can be measured through their fluorescent properties. We present results of one year of fluorescent particle data, measured in the central Arctic during the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) by a Wideband Integrated Bioaerosol Sensor (WIBS-NEO). The observed, distinct seasonal cycle of fluorescent aerosol (FA) fraction and composition indicates different natural and anthropogenic sources throughout the year. We investigate how events, such as warm air mass intrusions, influence the FA population. Furthermore, we investigate co-occurrences of FA and INP concentrations. This study provides valuable insights regarding the occurrence and sources of fluorescent particles in the high Arctic and their potential contributions to biogenic INP abundance.
115	Nora	Bergner	Extreme Environments Research Laboratory, EPFL, Switzerland	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16B-4	virtually	Nora Bergner, Ivo Beck, Kerri Pratt, Jessica Mirrielees, Jessie Creamean, Markus Frey, Benjamin Heutte, Hélène Angot, Stephen Arnold, Jakob Pernov, Janek Uin, Stephen Springston, Sergey Matrosov, Tiia Laurila, Lauriane Quéléver, Tuija Jokinen, Julia Schmale	Characterization of blowing snow aerosol events in the central Arctic	Sea salt aerosol plays a critical role in the radiation budget and salty blowing snow has been hypothesized as an important source of sea salt aerosol in polar regions. The snow over sea ice can become salty by upward brine migration or oceanic sea spray emissions. Wind-driven resuspension and sublimation is hypothesized to leave salty aerosol particles behind. While our understanding of aerosol emissions from blowing snow arises mainly from modelling studies, direct observations to validate this process are sparse. The MOSAiC expedition, with its integrated measurements, is well suited to enhance our process understanding. Here, we focus on the impact of blowing snow and high wind speed events on aerosol number concentrations, size distributions, optical properties and cloud condensation nuclei (CCN) concentrations. Total aerosol number concentrations are significantly higher during high-wind speed periods, also concurrently increasing scattering aerosol coefficients and CCN concentrations. We further present a process-based characterization of the blowing snow events during MOSAiC and identify the influence of environmental variables on aerosol emissions. Our observations provide new insights into wind-driven aerosol in the central Arctic and may help to validate modelling studies and inform parameterization improvement particularly with respect to aerosol direct and indirect radiative forcing.
73	Ronny	Engelmann	Leibniz Institute for Tropospheric Research, TROPOS, Leipzig, Germany	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16A-1	in-person	Albert Ansmann, Kevin Ohneiser, Ronny Engelmann, Hannes Griesche, Martin Radenz, Julian Hofer, and Dietrich Althausen	MOSAiC annual cycle of vertical aerosol layering: Profiles of light extinction and CCN and INP estimates	We completed the data analysis of our OCEANET-Atmosphere Raman lidar measurements during MOSAiC. This dataset includes the optical aerosol parameters (backscatter, extinction, depolarization, Angström exponent), cloud products (especially low-level stratus detection) as well as the high-resolution water-vapor profiles. The highlight is the observed strong and persistent UTLS smoke layer throughout the winter half year that originated from the Siberian wildfires in summer 2019. Besides this extraordinary smoke event, a strong decrease of the aerosol concentration with height was observed in the troposphere during the winter and spring months (Arctic-haze season). We found an order of magnitude more aerosol during winter compared to summer. From this dataset, we were able to derive a one-year time series of CCN and INP estimates at different height levels. We will present the results for the PBL, the lower free-troposphere, and close to the tropopause and compare them with in-situ data from surface measurements. The tropopause smoke-related INP observations will be used in smoke-cirrus closure studies based on the combination of Polarstern lidar-radar data. First case studies of smoke-cirrus interaction will be presented as well.

131	Markus	Frey	British Antarctic Survey	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16B-6	virtually	Markus Frey, Amélie Kirchgäßner, Floortje van den Heuvel, Tom Lachlan-Cope, Frank Stratmann, Heike Wex, Amy MacFarlane, Jessica Mirrielees, Kerri Pratt, Ivo Beck, Julia Schmale, Kouichi Nishimura, Ian Brooks	Sea salt aerosol and ice nucleating particles (INP) in the Central Arctic during Winter/Spring â€" a discussion of the blowing snow source	Arctic clouds are poorly represented in climate models partly due to a lack of understanding of source and nucleating capability of natural aerosol in the high Arctic. Recent field campaigns provided evidence of a source of sea salt aerosol (SSA) from blowing snow above sea ice, which can account for SSA winter/spring maxima observed in the polar regions. SSA emissions from sea ice sources can potentially influence regional climate via the indirect radiative effect, but contributions to cloud-forming particles in particular ice-nucleating particles (INP) are not known. Here we report the first online spring-time observations of INPs in the Central Arctic. INPs concentrations were on the order of a few tens [particle m-3] activating between -38 and -15°C and were often associated with high wind speeds. Initial offline droplet assay analysis of snow on sea ice indicates the presence of potential INPs in winter/spring activating at -29 to -25ºC. We discuss the role of sea ice sources of coarse SSA and INPs with a focus on blowing snow. To do this we consider the comprehensive set of MOSAiC observations including aerosol size and composition, airborne snow particles, chemical and physical properties of both aerosol and snow on sea ice.
176	Xianda	Gong	Washington University in St. Louis	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16A-5	in-person	Xianda Gong, Jiaoshi Zhang, Xin Yang, Markus Frey, Chongai Kuang, Arthur J. Sedlacek, Janek Uin, Maria A. Zawadowicz, Matthew Shupe, Julia Schmale, Jian Wang	Annual Variability of Cloud Condensation Nuclei and Particle Hygroscopicity in the Central Arctic	Aerosol properties and sources remain poorly understood in the central Arctic, where observations are scarce. Here we present the seasonal variations of central Arctic aerosol properties observed during the MOSAiC campaign. CCN concentration (NCCN) during the springtime was often the highest (~110 cm-3 at a supersaturation of 0.30%). In comparison, NCCN during summer and fall was substantially lower (~ 20 cm-3) except when (1) there was a substantial contribution from long-range transported large particles or (2) newly formed particles grew through condensation and reached a sufficiently large size to act as CCN. Particle hygroscopicity (expressed as a single parameter, Îº) was low (~0.2 to 0.3) during summer and fall due to the strong contributions of organics to particle composition. During winter and spring, Îº values showed a larger variation from ~0.2 to 1.2. The larger values (>0.8) were attributed to sea salt particles generated from open leads/blowing snow, which can contribute substantially to the aerosol population in the Arctic. In long-range transported biomass-burning plumes, Îº values decreased to about 0.2-0.4. Aerosol sources and transport, and their effects on CCN population and cloud properties need to be further studied to improve our understanding of Arctic climate change.
51	Benjamin	Heutte	EPFL / EERL	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16B-3	virtually	Benjamin Heutte, Lubna Dada, Héléne Angot, Imad El Haddad, Gang Chen, Kaspar R. Dällenbach, Ivo Beck, Lauriane Quéléver, Tiia Laurila, Tuija Jokinen, Julia Schmale	Aerosol source identification in the spring and summertime central Arctic Ocean using high-resolution mass spectrometry during MOSAiC.	The Arctic region is experiencing considerable changes and is warming at a rate three to four times as fast as the rest of the world. Aerosols, which can be from natural or anthropogenic sources, locally emitted or long-range transported, play a crucial role in the Arctic radiative balance by directly absorbing or scattering incoming solar radiation or indirectly changing cloud properties and modulating cloud formation mechanisms. Here, we investigate the sources and climate-relevant characteristics (e.g. degree of oxygenation and cloud condensation nuclei number concentrations) of anthropogenic and natural aerosols in the central Arctic Ocean, using data collected during the MOSAiC expedition with a high-resolution time-of-flight aerosol mass spectrometer. Using positive matrix factorization on the organic fraction of aerosols during spring and summertime (March - July), we identified six chemical sources of organic aerosols (OA): a hydrocarbon-like factor, a Haze factor, two factors related to two extreme events of warm air mass intrusions in mid-April, an Arctic oxygenated factor and a Marine factor. Together, these results suggest that OA from anthropogenic origin dominate the central Arctic OA budget until at least the month of May, where episodic spikes in naturally-sourced marine OA, originating from the marginal ice-zone start to become important.
207	Hans-Werner (Detlev)	Jacobi (Helmig)	Institute for Geosciences and Environmental Research; Université Grenoble Alpes / CNRS / Grenoble INP / IRD	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16A-3	in-person	Hans-Werner Jacobi, Katya Tkachenko, Detlev Helmig, Dean Howard, Hélène Angot, Jacques Hueber, Steve Archer, Ludovic Bariteau, Kevin Posman, Johannes G.M. Barten, Laurens Ganzeweld, Marion Maturilli, Jürgen Graeser, Ralf Jaiser, Peter von der Gathen, and Byron Blomquist	Vertical distribution of springtime ozone during MOSAiC	At arctic costal stations, ozone at the surface regularly decreases during springtime to very low concentrations with important implications for the chemical composition and oxidation pathways in the atmosphere. The ozone loss is caused by halogen compounds produced mainly over or on the sea ice of the Arctic Ocean. Nevertheless, the interplay between chemical and dynamical atmospheric processes driving the destruction of ozone and its recovery are still under debate. The MOSAiC expedition offered a unique opportunity to perform detailed observations of the vertical distribution of ozone in the atmosphere. While ozone sondes delivered information on the ozone column in the entire troposphere, additional profiles were observed with a tethered balloon. During springtime, ~50 profiles are available covering the lowest few 100m of the atmosphere confirming that the depletion of ozone does not only occur in the boundary layer, but can also affect higher atmospheric layers. Nevertheless, the majority of the profiles indicate lowest ozone concentrations close to the surface implying that surface processes are the drivers of the activation of the halogen chemistry. Using meteorological observations, we will further analyze the meteorological and surface conditions that contribute to the destruction and replenishment of ozone above the Arctic Ocean.
142	Anna-Marie	Jörss	PhD student	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16B-1	virtually	Anna-Marie Jörss, Andreas Herber, Zsófia Juranyi	Sea salt correction for MOSAiC snow sampling of Black Carbon	Black carbon (BC) is one of the predominating drivers related to modifications in the radiation budget of snow surfaces and its ability to reduce its albedo. Therefore, it might lead to accelerated melting and modify feedback mechanisms between components of the cryosphere and the atmosphere. To investigate and quantify in detail these BC-induced processes in the central Arctic, snow samples collected during the MOSAiC campaign are going to be analyzed in the laboratory employing a Single Particle Soot Photometer (SP2) and the nebulizer Marin 5. Doing so, it was found that prevalent saline character of the snow on sea ice influences the results of SP2 analysis in a way that BC concentrations become significantly underestimated. We present here a method that was developed for quantification and correction of those effects as a significant number of the MOSAiC samples include such sea salt impurities. Applying the methods to the whole MOSAiC data set will allow for the first time to quantify year-round human-caused pollution in the central Arctic and related changes of the surface energy budget.

74	William	Landing	Florida State University	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16A-4	in-person	William M. Landing, Chris Marsay, Clifton Buck, Mark Stephens	Defining the atmospheric deposition of trace elements into the Arctic ocean-ice ecosystem during the year-long MOSAiC ice drift	We wanted to estimate the deposition fluxes of aerosol trace elements, both total and soluble, including those of biogeochemical importance as well as pollutant species. We focused on the winter and spring seasons because aerosol data from the central Arctic during these periods are sparse. We collected bulk aerosol samples on 26 weekly deployments from 20-DEC-2019 to 02-JUN-2020. We measured total trace element concentrations, the water-soluble fraction, and the less-reactive fraction that may become soluble in the upper ocean. Elements with significant crustal sources were well correlated (Al, Ti, Mn, Fe) and showed low seasonality and no enrichment. Modest enrichment was found for V and Co; significant enrichment was found for Cr, Ni, Cu, Zn, Cd, and Pb. The concentrations we found are consistent with aerosol data from Alert (1980-2000), where pollutant metal concentrations and enrichments are higher in winter and lower in summer. This is associated with Eurasian and North American pollutant sources, longer air-mass residence times in winter, and low precipitation washout. Aerosol sources are investigated using inter-element ratios and air-mass back trajectory analysis. Fluxes of total and soluble bio-essential trace elements are estimated using aerosol bulk deposition velocities derived from aerosol concentrations and seawater/ice/snow inventories of Be-7.
111	Christian	Pilz	TROPOS	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	P1 (47)	in-person	Christian Pilz, Birgit Wehner, Matthew Boyer, Vania Lopez Garcia, Ian Brooks, Matthew D. Shupe, Dominic Hesslin-Rees, Radovan Krejci, Jakob Pernov, Daniel Charles Thomas, Andreas Massling, Henrik Skov, Michael Lonardi, Holger Siebert	A balloon-borne observational perspective on the effects of atmospheric boundary layer dynamics and long-range transport on aerosol properties at the sea-ice surface	Aerosol particles have direct and indirect radiative effects that potentially contribute to Arctic amplification. Long-range transported particles in the free troposphere affect atmospheric stability and the surface radiation budget through light scattering or absorption. By serving as cloud condensation nuclei (CCN), aerosol particles are a prerequisite for the formation of low-level clouds that affect the lower Arctic atmosphere. Locally formed particles within the ice-covered area are important for the CCN budget; however, favored altitudes for particle formation and growth to CCN-relevant size ranges remain unknown. We present two case studies based on balloon-borne observations during MOSAiC in July 2020. One study focuses on the transport of nucleation mode particles from the open ocean to the pack ice. Local wind-driven dynamics affected a surface mixed layer below a decoupled cloud layer and the downward mixing of aerosol particles from aloft. The second case study analyzes a long-range transported aerosol plume with an enhanced concentration of accumulation mode and black carbon particles. An atmospheric river enabled wildfire smoke to be transported from western Siberia across Ny-Ã…lesund Zeppelin Observatory, RV Polarstern, and Villum Research Station. Observations at the three sites were analyzed to investigate the transport of aerosol particles to the sea-ice surface.
82	Julia	Schmale	EPFL, Switzerland	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16B-5	in-person	Julia Schmale, Hélène Angot, Benjamin Heutte, Nora Bergner, Ivo Beck, Jakob Pernov, Matthew Boyer, Lauriane Quéléver, Tiia Laurila, Tuija Jokinen, Markus Frey, Kerri Pratt	Wind-driven particle generation â€“ a hitherto underestimated source of particulate mercury in the central Arctic	Understanding the mercury cycle in the Arctic is important due to the harmful bioaccumulation of its toxic form, methylmercury. Gaseous elemental mercury (Hg(0)) is relatively well-mixed across the northern hemisphere. Hg(0) can be oxidized, especially in the Arctic spring during halogen-driven depletion events. The resulting gaseous reactive mercury (Hg(II)) is relatively quickly deposited onto snow, either directly or via condensing onto particles, forming particulate mercury (PHg). It is generally assumed that most of the deposited Hg(II) and PHg is photoreduced to Hg(0) and re-emitted to the atmosphere. Mercury remaining in the snowpack till melt can become bioavailable. There is a severe lack of Hg(II) and PHg observations in the Arctic, limiting our understanding of the mercury cycle in that region. Here, we show observations of PHg during MOSAiC, measured in fall and spring. In both seasons, PHg concentrations correlate strongly with wind speed and chloride, suggesting a mechanical process behind atmospheric PHg related partly to blowing snow. This has hitherto not been reported, is different from observations at land-based stations, and has implications for the mercury content of snow and re-deposition after atmospheric transport. There are significant differences between fall and spring observations, suggesting that various processes are at play.
76	Xin	Yang	British Antarctic Survey	16: Dynamical and Chemical Controls on Arctic Atmospheric Composition and Aerosols	S16B-2	in-person	Xin Yang, Ananth Ranjithkumar, Markus M. Frey, Xianda Gong, Nora Bergner, Tom Lachlan-Cope, Julia Schmale, Jian Wang & MOSAiC team	Using the unique MOSAiC winter/spring observations to evaluate the mechanism of sea salt aerosol production from blowing snow	The mechanism of sea salt aerosol (SSA) production from blowing snow on sea ice has been proposed over a decade ago. The first direct field evidence came from the Weddell Sea, Antarctica. However, due to the lack of fine mode data, the SSA production mechanism was not fully evaluated, leaving a knowledge gap to fill. The full spectrum of aerosol data, particularly in ultrafine mode (diameter range 10-1000 nm), collected during the year-long MOSAiC campaign in 2019-20 provided a unique opportunity to fully evaluate the mechanism and pin-point the possible micro-physical processes involved in the SSA production from blowing snow. Furthermore, the year-round data set also allowed us to constrain important key parameters used in the production scheme, such as the blowing snow particle size distribution factors and the threshold wind speed for the onset of drifting and blowing snow above sea ice. Together with other snow chemistry data collected in the Arctic, we update the SSA production mechanism for the Arctic and apply it to a global chemistry transport model p-TOMCAT. We then demonstrate that our model could reproduce most of the aerosol enhancement events observed during and after storms in winter and spring during the MOSAiC expedition.
157	Kevin	Barry	Colorado State University	19:Carbon transformations and fluxes and their dependency on biodiversity	P1 (31)	in-person	Kevin Barry, Thomas Hill, Camille Mavis, Sonia Kreidenweis, Paul DeMott, and Jessie Creamean	Characterizing ice nucleating particles in the central Arctic during the MOSAiC experiment	The Arctic is critical for studying due to release of greenhouse gases from thawing permafrost, melting glaciers contributing to sea level rise, and a darker overall surface (from melting snow and ice) contributing to a positive ice-albedo feedback. One avenue that may affect the magnitude of surface warming feedbacks in the Arctic comes from the prevalence of clouds. Cloud formation is inherently dependent on aerosols, however, observations of aerosols and specifically ice nucleating particles (INPs) that are crucial for ice formation in mixed-phase clouds are limited in this region. The Multidisciplinary drifting Observatory for Study of Arctic Climate (MOSAiC) provided the first full year of INP measurements conducted in the central Arctic, as well as the first data in this region during the winter and spring. Here, we build upon previous MOSAiC work that show airborne INPs have a strong seasonal cycle, by discussing results of DNA analyses and treatments to discern INP type (i.e., biological, organic, or inorganic) and comparing with coincident water and ice samples. Work thus far indicates high levels of biological and organic aerosol INPs, and preliminary aerosol bacterial results indicate a mixture of terrestrial and marine taxa and seasonal variability in alpha diversity.

49	William	Boulton	University of East Anglia	19:Carbon transformations and fluxes and their dependency on biodiversity	S19-2	in-person	William Boulton, Johanna Winder, Sarah Lena Egger, Sinhue Torres-Valdez, Kerstin Korte, Anja Nicolaus, Swantje Rogge, Katja Metfies, Asaf Salamov, Vincent Moulton, Thomas Mock	Using metagenomic data to reveal key biological processes: a case study into ice-binding proteins	The MOSAiC EcoOmics project will generate a significant amount of sequence data, including diverse genes across a range of sea-ice and seawater habitats. This talk will not only provide guidelines for as to how these data can be used by a broad scientific audience, but it will also provide a case study for ice-binding proteins (IBPs), which constitute a biotechnologically important protein family protecting polar organisms against freezing. Despite their significance, these proteins have neither been surveyed across a range of metagenomes from different polar habitats, nor in the central Arctic Ocean. Here, we use metagenomic approaches as a tool for revealing the taxonomic origin of IBPs and their associated structural diversity in prokaryotes. The methods used exemplify how metagenomes can be used to identify important genes for the survival under polar conditions, and to place these genes within an appropriate environmental context.
203	Robert	Campbell	University of Rhode Island	19:Carbon transformations and fluxes and their dependency on biodiversity	S19-5	in-person	Robert Campbell, Carin Ashjian, Cecilia Gelfman, Katyanne Shoemaker, Giulia Castellani, Nicole Hildebrandt, Serdar Sakinan, Katrin Schmidt, Barbara Niehoff, Hauke Flores and the Ecosystem Team	The Role of Zooplankton in Carbon and Nitrogen Transformations in the Central Arctic	Fluxes and transformations of carbon (C) and nitrogen (N) between atmosphere, ice, and ocean are mediated by physical and biological processes and take place at the ocean-ice-boundary. Conditions in the near-surface ocean are influenced also by ecological characteristics from deeper in the water column, in the upper mixed layer, in the euphotic zone, or, for zooplankton, over the depth habitat of key species. Understanding of C and N ocean-ice-atmosphere fluxes requires a broad focus on lower trophic level processes near the ice and in the underlying water column and the linkages between the two systems. Transformations of C and N by the lower planktonic trophic levels in the upper water-column and near the sea ice-ocean boundary were studied over an annual cycle during the course of the MOSAiC drift. Zooplankton rate processes for key species, including respiration, feeding, reproduction and growth, were quantified in terms of C and N, and their seasonal cycles fully described. This study is novel in that it is the first quantification of the planktonic food web dynamics in the central Arctic through direct measurement of the important
90	Emelia	Chamberlain	Scripps Institution of Oceanography, University of California San Diego	19:Carbon transformations and fluxes and their dependency on biodiversity	P1 (32)	in-person	Emelia J Chamberlain, Alessandra D'Angelo, Ellen Oldenburg, Jessie Creamean, Katja Metfies, Ovidiu Popa, Allison A. Fong, Clara J. M. Hoppe, Hendrik Schäfer, Jacqueline Stefels, Laura Wischnewski, Katyanne Shoemaker, Brice Loose, Jeff Bowman	Patterns in taxonomic and functional prokaryotic community structure over the MOSAiC Drift	Marine microbial communities are major contributors to polar biogeochemical cycles. They can serve as sensitive indicators of rapid environmental change and be key predictors of ecological function. Using observations of microbial community structure from 1,276 environmental samples collected during the MOSAiC Expedition, we are investigating patterns in both taxonomic and functional prokaryotic diversity over an Arctic annual cycle (Oct 2019 - Oct 2020). Community structure was first analyzed through 16S rRNA gene amplicon sequencing, yielding 22,579 unique bacterial and 858 unique archaeal amplicon sequence variants (ASVs). Preliminary analyses indicate depth, latitude, and date as strong indicators of sample similarity in the taxonomic structure of seawater communities. To determine likely metabolisms and estimate community growth rates, we also carried out metabolic inference. We then applied machine learning algorithms to these data to extract successional patterns and biogeochemical signatures from sequence information. For example, using self-organizing maps to partition the surface seawater community into functionally distinct â€œmodesâ€, we isolated 10 recurrent community ecotypes which align well with seasonal and ecological transitions - such as the onset of the late summer mode, associated with biological oxygen supersaturation in the surface ocean and characterized by high abundances of copiotrophic taxa like Polaribacter.
77	Alessandra	D'Angelo	University of Rhode Island	19:Carbon transformations and fluxes and their dependency on biodiversity	S19-3	in-person	Alessandra D'Angelo, Emelia J. Chamberlain, Jeff Bowman, Jessie Creamean, Brice Loose	THE ROLE OF THE MICROBIAL CONTROLS ON THE METHANE CYCLE IN THE ARCTIC OCEAN	Arctic amplification threatens to destabilize subsea methane reservoirs. The aim of our research is to assess whether the Arctic Ocean behaves as a sink or a source of methane, by studying methane metabolism and its potential to alter the Arctic budget of this gas. Methane-oxidizing microbes (methanotrophs) can utilize methane as an energy source, converting it into carbon dioxide and biomass, mitigating methane release into the atmosphere. We collected data on potential microbial methane oxidation rates from 139 in-vitro incubations during the MOSAiC (Multidisciplinary drifting Observatory for the Study of Arctic Climate) expedition. Here, we show the methane budget (N=216) and microbial oxidation rates during the full MOSAiC year. The water column showed methane supersaturation with respect to the atmospheric methane saturation capacity (av. 3.6±0.02 nM) in 57% of the samples, mostly before crossing the Gakkel Ridge and along the Fram Strait (November 2019 and Summer 2020, respectively). Microbial oxidation potential was recorded in more than 60% of the experimental samples, with higher oxidation rates recorded during Summer 2020, between 100 and 300m depth. This dataset allows us to map the biogeography of methane cycling and potential hotspots of this climate-relevant gas in an understudied region of the Arctic Ocean.
180	Mike	DeGrandpre	University of Montana	19:Carbon transformations and fluxes and their dependency on biodiversity	P1 (28)	in-person	Michael DeGrandpre, Nicholas Roden, Elise Droste, Mario Hoppema, Are Olsen	Pan Arctic comparison of in situ pCO2 time-series	The Arctic Ocean is a net sink for atmospheric CO2 but the processes that control the uptake are not well understood. Polar oceans have unique conditions and processes that could result in similar seasonal cycles of pCO2 from region to region. Ice formation and melting, long-periods of darkness, low nutrients and strong stratification all could play a role in regulating sea surface pCO2 levels. In the Canada Basin, we have observed that ice melt drives CO2 undersaturation leading to uptake of CO2 during the low ice period. It is possible that the same process controls the seasonal magnitude and variability of sea surface CO2 in the other Arctic Ocean basins but we have lacked the data to make this comparison. From 2019-2021, simultaneous pCO2 time series were collected on drifting buoys (ice-tethered profilers) in the Canada Basin and in the central Arctic Ocean during the MOSAiC expedition. In this presentation, we compare these pCO2 time-series and other data (temperature, salinity, ice extent). This evaluation could help improve model development and lead to a better understanding of the complex processes that control air-sea CO2 flux in the Arctic
104	Elise	Droste	University of East Anglia	19:Carbon transformations and fluxes and their dependency on biodiversity	S19-1	in-person	Droste, E., Nomura, D., Tazowa, M., Roden, N., Ulfsbo, A., Chamberlain, E., Fong, A. A., Lee, G. A., Bakker, D. C. E., Hoppema, M., Leg 5 Field Teams	Drivers of the marine carbonate system in the central Arctic Ocean at the onset of freeze-up	The Arctic Ocean freeze-up period is characterised by rapid changes in surface ocean physical and surface biogeochemical properties that affect the marine carbonate system. Delayed timing of freeze up, as shown in records, can have implications for the surface CO2 (carbon dioxide) pool and sea ice-atmosphere exchange. We take a closer look into which processes drive the surface marine carbonate system in this important transition period. During Leg 5 of the MOSAiC expedition (12 August - 12 October 2020) in the data-arid central Arctic Ocean, we collected data on dissolved inorganic carbon (DIC), total alkalinity (TA), and/or fugacity of CO2 (fCO2) from the ship's underway system, directly underneath the sea ice, and from the water column. Near-surface fCO2 increased by ~50 uatm (from 280 to 330 uatm) during the Leg 5 drift, but the surface ocean remained a continuous atmospheric CO2 sink. Much of the variability can be explained by spatial differences in seawater properties, which we disentangle from temporal changes due to seasonal transition, storm-driven mixing events, net respiration, and sea ice formation. These observational data give valuable insights into the net effect of opposing processes driving the surface carbonate system and its role in feedback

133	Hauke	Flores	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research	19:Carbon transformations and fluxes and their dependency on biodiversity	P1 (29)	in-person	Astrid Cornils, Barbara Niehoff, Nicole Hildebrandt, Nadine Knüppel, Carin Ashjian, Robert Campbell, Giulia Castellani, Celia Gelfman, Sakinan Serdar, Katrin Schmidt, Fokje Schaafsmaa, Katyann Shoemaker, Martina Vortkamp, Hauke Flores and TEAM ECO & TEAM OCEAN	Seasonal succession of zooplankton species in the epipelagic Arctic Ocean	Less and thinner sea ice characterizes the new Arctic, but our knowledge on zooplankton dynamics in relation to the seasonal cycle of environmental parameters in the Central Arctic Ocean is scarce, especially during the Polar night. To investigate the seasonal dynamics of the zooplankton in the epipelagic Arctic Ocean we sampled zooplankton with a multinet net (150 µm mesh, opening 0.25 m2). In approximately weekly intervals, we conducted vertical tows at the standard depth strata 0 - 50 m and 50 - 200 m. All net samples were preserved in 4% formalin onboard. At AWI, they were size-fractionated, split into aliquots and scanned with the ZooScan, yielding >200k of images presenting single objects. These images were uploaded to the web-based application EcoTaxa and classified according to taxonomical criteria. Here, we will present the zooplankton species composition and abundances in the epipelagial, and we will discuss the impact of environmental parameters for zooplankton population dynamics.
139	Hauke	Flores	AWI	19:Carbon transformations and fluxes and their dependency on biodiversity	S19-6	in-person	Pauline Snoeijs-Leijonmalm, Hauke Flores, Serdar Sakinan, Nicole Hildebrandt, Anders Svensson, Giulia Castellani, Kim Vane, Felix Mark, Céline Heuzé, Sandra Tippenhauer, Barbara Niehoff, Joakim Hjelm, Jonas Hentati Sundberg, Fokje Schaafsma, Ronny Engelmann, Carin Ashjian, Robert Campbell, Jessie Creamean, Lena Eggers, Allison Fong, Julia Große, Clara Hoppe, Sören Krägefsky, Musheng Lan, Sarah Maes, Susa Niiranen, Lasse Mork Olsen, Robert Rember, Jian Ren, Susanne Spahic, Sinhue Torres-Valdes, Anders Torstensson, Adam Ulfsbo, Filip Volckaert, Martina Vortkamp	Unexpected fish and squid under the MOSAiC ice floe	Crossing the Eurasian Basin, we documented an uninterrupted 3170-kilometer-long deep scattering layer (DSL) with zooplankton and small fish in the Atlantic water layer at 100 to 500 m depth. During MOSAiC, we deployed longlines, gillnets and an underwater camera to find evidence of fish. Unexpectedly, we found Atlantic cod, along with lanternfish, black seasnail, walleye pollock, and armhook squid deep in the CAO during leg 1-3. More fish, including haddock and redfish, were caught near the Yermak Plateau during leg 3 and leg 4. The Atlantic cod originated from Norwegian spawning grounds and had lived in Arctic water temperatures for up to 6 years. This is an indication that Atlantic cod are already much further north than anticipated in recent literature. Most fish were feeding on macrozooplankton, a largely under-studied fraction of the Arctic zooplankton community. The finding of unexpected nekton in the Central Arctic Ocean shows that the structure and carrying capacity of the food web are still far from understood. This presentation summarizes already published findings, and shares some new results. We will discuss implications for the structure of the high-Arctic food web and for management and conservation.
97	Jessie	Gardner	UiT The Arctic University of Norway	19:Carbon transformations and fluxes and their dependency on biodiversity	P1 (30)	in-person	Jessie Gardner, Marit Reigstad, Rolf Gradinger, Lasse M. Olsen, Oliver Müller, Benjamin Lange, Evgenii Salganik, Philipp Assmy, Nicole Aberle, Mats A. Granskog and the MOSAiC science consortium	Are particle fluxes below pressure ridges greater than below first-year ice?	Thicker multi-year ice is being replaced by thinner first-year ice (FYI) in the central Arctic Ocean because of climate change, contributing to a more dynamic ice cover with a higher probability of pressure ridge formation. Pressure ridges have been identified as possible hotspots for biological activity in comparison to FYI. Therefore, we hypothesise that the production and processing of sinking organic material is greater below pressure ridges than underneath level FYI. During MOSAiC, short-term ice-tethered sediment traps were deployed below level FYI and pressure ridges throughout the winter and the summer legs at 5, 15, and 50 meters. A suite of parameters was sampled from the traps to estimate vertical flux of particulate organic carbon and nitrogen, faecal pellets, particle composition and microbial diversity. Previously, the winter was considered to have low biological activity however, surprisingly high carbon flux and evidence of particle interactions were found. The variation of parameters over time, and with depth, meant there were no clear trends when comparing particle fluxes beneath pressure ridges and level FYI. This work contributes to understanding the role of pressure ridges for ice associated ecosystems in the thinner ice pack predicted in the future
116	Mollie	Passacantando	University of Rhode Island	19:Carbon transformations and fluxes and their dependency on biodiversity	S19-4	in-person	Mollie Passacantando, Xiaomei Lu, Clara J. M. Hoppe, Brice Loose	A feasibility study into measuring Arctic phytoplankton communities using active imaging remote sensing.	Space-based ocean color measurements enabled the observation of global ocean primary producer biomass with unprecedented detail. However, persistent cloud cover, ice cover, and the logistical challenges of collecting in-situ measurements in a high-latitude environment have restricted these observations in the Arctic region. For the first time, active-imaging space-based LiDAR poses the potential to see through many of those intervening features to observe the upper water column of the Arctic ocean. This research examines the feasibility in adapting these methods to peer beneath or between Arctic ice floes to observe phytoplankton populations captured from backscattering profiles obtained by the ICESat-2. Here, we develop a benchmark test using previously-analyzed ICESat-2 shots from the Antarctic marginal ice zone to validate our methodological steps. Next, we apply this procedure to the Chukchi Sea, during ice retreat to confirm the approach in the Northern hemisphere. The last step will be to compare the processing method for ICESat-2 backscatter against in-situ chlorophyll concentrations that were carried out during the MOSAiC Arctic Drift. Chlorophyll estimates are compared with existing passive-sensing products to examine the feasibility of using LiDAR to examine sub-ice phytoplankton populations.

227	Phil	Anderson	Scottish Association for Marine Science	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	P2 (22)	in-person	Phil Anderson, Mats Granskog, Clara J. M. Hoppe, David McKee, Ilaria Stollberg, Finlo Cottier, Jorgen Berge	Seasonality and abrupt local changes in measurements of sub-ice PAR during MOSAiC	Sub-surface Photosynthetic Active Radiation (PAR) is the primary energy source of life in oceans. PAR drives photosynthesis and is the primary source of close to 100% of the ocean's food chain via the route of enabling algal growth. "Local" PAR is not necessarily the source of local algae, however; both divergence (sources and sinks) and advection (flow) constrain any active tracer such as the growing, multiplying, dying and mobile algae. To constrain even the simplest of dispersion models requires co-temporal time series of measurement at a selection of depths and at different locations. A preliminary attempt at such a study was deployed during MOSAiC, being three autonomous sub - sea-ice PAR chains deployed at different locations in the MOSAiC Central Observatory measuring PAR every hour at 12 different depths (down to 50 m depth). These units identify the overall seasonal and kilometer scale evolution of PAR(t,z) whilst also showing that there are sudden (< hour scale) and local (< 10 m scale) changes in PAR within this background. Some indication of in-water algal concentration can be inferred from chain-derived absorption profiles, but the key will be in synthesis of these PAR data with measurements and models of algal growth/death/advection. This talk will provide an introduction to the three PAR(z,t) data sets and invite collaboration and discussion on this synthesis.
69	Radiance	Calmer	CIRES/NSIDC, University of Colorado, Boulder	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	S20-6	in-person	Gijs de Boer, Jonathan Hamilton, John Cassano, Dale Lawrence, Christopher Cox, Matthew Shupe, Maddie Smith, Melinda Webster, Nicholas Wright, Niels Fuchs, Patrick Taylor, Michael Lonardi	Spatial scale of surface albedo from surface-based, airborne and satellite measurements during the melting season	Surface albedo measurements collected during MOSAiC are available across a variety of spatial scales, from surface-based measurements with a footprint of ~20 m diameter, to satellite data products gridded to 1° resolution. In between these extremes are measurements from airborne platforms: helicopter, tethered balloon, uncrewed aerial systems (UAS). These datasets are complementary to each other, providing valuable information on the spatial scaling of surface features that govern the Arctic sea ice albedo. In this work, we investigate a case study of surface albedo heterogeneity from upward and downward broadband solar radiation observed from a variety of different platforms during summer 2020. Specifically, this includes the ASFS flux station, albedo lines, HELiX UAS, BELUGA tethered balloon, MOSAiC helicopter and satellite data products. We will review how these platforms independently view distributions (spatial and temporal variability) of albedo and offer insight into how the different data products can best be used and merged. Ultimately, we anticipate that this work can support the evaluation of satellite-based products and inform the development of new parameterizations on albedo across a variety of model scales.
130	Niels	Fuchs	Center for Earth System Sustainability, Institute of Oceanography, University of Hamburg, Germany	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	S20-2	in-person	Niels Fuchs, Leif Riemenschneider, Jakob Deutloff, Steven Fons, Christian Katlein, Bonnie Light, Marcel Nicolaus, Marc Oggier, Ran Tao, Dirk Notz	The path of light through the Arctic sea ice cover	Measurements of light partitioning in the sea ice cover are scarce, yet important to quantify solar radiation that contributes to the energy budget of the sea ice system and stimulates biological activity. During MOSAiC, we successfully deployed the newly developed lightharp system, and thus obtained in-ice light intensity measurements from multiple depths along the vertical transmission path of the light, observed from polar night to the end of July 2020 (Leg 2-4). We present methods to derive optical properties from the up- and downward facing light intensity sensors and evaluate the resulting profile timeseries with respect to the observed and simulated evolution of sea ice properties, indicating key drivers. Furthermore, we present an absolute calibration of vertically resolving in-ice light sensors, including PAR, allowing us to infer the radiative transport from the snow surface to the iceâ€”ocean interface with co-deployed sensors and highlight the variable contribution of light attenuation in sea ice to the total
85	Henna-Reetta	Hannula	Finnish Meteorological Institute	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	P2 (19)	in-person	Henna-Reetta Hannula, Roberta Pirazzini, David Brus, Ruzica Dadic, Martin Schneebeli	Surface albedo during the sea ice freeze-up season: observations from scales of few meters to hundred meters	Sea ice albedo observations from ground-based and UAV-based platforms were carried out during the MOSAiC expedition in August-September 2020, which represents the transition from summer melting to winter freezing. The hemispherical albedo observations have a footprint of about 3 m when taken with ground-based instruments at ~1.5 m above the surface, and footprints from 10 to 100 m when taken from a UAV flying at 5m to 30m above surface. The ground-based and UAV-based observations are compared to identify the impact of melt ponds, leads and white ice on the areal averaged albedo observed from flights at high elevations. The albedo observations are supported by UAV-based photo-mosaics of the surface, from which the fraction of melt ponds, ridges, leads, and white ice are calculated. The aim of this analysis is to compile observations during the snow-free and melting sea-ice and during the various phases of the sea-ice freeze up, to identify the contribution of the various surface features to the areal averaged albedo during the crucial summer-to-winter transition period.
172	Bonnie	Light	Polar Science Center, Univ Washington	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	P2 (20)	in-person	Bonnie Light, Madison Smith, Niels Fuchs, Marc Oggier, Marcel Nicolaus, Don Perovich, Melinda Webster, Mats Granskog	MOSAiC ice in the lab: ice cores, optical experiments, and the quest for improved simulation of the shortwave radiation budget	As part of the MOSAiC sea ice coring effort, twenty cores extracted April - September were dedicated for shore-based laboratory optical analysis. The cores include first-year and second-year ice from over the seasonal cycle, as well as ice from underneath melt ponds. The optical analysis includes the measurement of light transmittance through 10 cm thick subsamples taken throughout the length of the core. Transmittance observations are compared with results from a 2D Monte Carlo radiative transfer model for the purpose of estimating vertically-resolved inherent optical property (IOP) profiles for each core. The ultimate goal of this work is to improve the representation of sea ice IOPs in radiative transfer schemes employed by models. This is accomplished by describing the seasonal evolution of vertically-resolved optical properties, refining structural-optical relationships derived from synthesis of the estimated IOPs with detailed ice microstructure measurements, and the execution of manipulative experiments such as controlled melt scenarios. We present preliminary results from these measurements, and describe the outlook for reconciling these results with in situ apparent optical property measurements (albedo, transmittance, in-ice irradiance) for informing future sea ice modeling activities.
146	Don	Perovich	Thayer School of Engineering, Dartmouth College	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	P2 (21)	in-person	Don Perovich, Madison Smith, Melinda Webster, Bonnie Light, David Clemens-Sewall, Ian Raphael, Chris Polashenski, Marika Holland, Felix Linhardt, Amy McFarland, Chris Cox, Matthew Shupe	Solar heat partitioning at the MOSAiC Central Observatory	The partitioning of incident solar irradiance between reflection to the atmosphere, absorption in the ice, and transmission to the ocean impacts the surface heat budget, upper ocean heating, and the magnitude of the surface, internal, bottom, and lateral ice melt. Solar partitioning at the MOSAiC Central Observatory was estimated by assimilating observations with a two stream radiative transfer model. Data sources include observations of incident solar irradiance, albedo, surface state, snow depth, ice thickness, and pond depth. The temporal evolution of solar partitioning at specific sites and the spatial variability along transect lines were determined. There was a slow increase in absorption during spring due to increasing incident solar irradiance and a steady albedo. The largest amount of absorbed solar heat was in summer due to increasing incident solar irradiance and decreasing albedo due in large part to melt pond formation. There was a rapid decrease in absorbed solar heat during late summer as incident irradiance decreased and albedo increased from freezeup and snowfall. Ponds absorbed more than twice as much solar heat as bare ice. On 25 July, ponds covered about 18% of the area and contributed roughly 50% of the absorbed solar heat.

83	Roberta	Pirazzini	Finnish Meteorological Institute	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	S20-5	in-person	Roberta Pirazzini, Henna-Reetta Hannula, David Brus, Petri Räisänen, Ruzica Dadic, Martin Schneebeli	Interaction of radiation with the sea ice surface microstructure during the Arctic freeze-up in the MOSAiC expedition	The high contrasts in surface albedo and heat conductivity that characterize the Arctic sea-ice surface at the start of the ice freeze-up period pose a challenge to the modelling of the sea ice evolution during winter. Heat transfers vertically and horizontally between ice, melt ponds, ocean and atmosphere, generating temperature gradients that affect the snow/ice microstructure and the surface scattering properties. Observations of shortwave and longwave radiative fluxes collected during the MOSAiC expedition in August-September 2020 as well as detailed snow and sea ice microstructure properties are analyzed to provide insight into their mutual relationships. The broadband and spectral albedo measured at various horizontal scales from drones and surface-based instruments enable the derivation of the bulk microstructure properties of the uppermost ice/snow layer through inverse radiative transfer modelling. We will validate the optically derived bulk microstructure properties using ice/snow microstructure derived from X-ray microtomography. We will use the microstructure data, together with density and temperature profiles in the uppermost scattering layer and surface roughness measurements to couple the radiative and the heat transfer in snow and ice. We anticipate that our results will provide insight into the processes governing the Arctic sea-ice freeze-up.
62	Maddie	Smith	Woods Hole Oceanographic Institution	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	S20-3	in-person	Maddie Smith, Ran Tao, Bonnie Light, Don Perovich, Marcel Nicolaus, Philipp Anhaus, Melinda Webster	Spatio-temporal evolution of sea ice optical properties from co-located albedo and transmittance measurements	Throughout the melt season, the sea ice surface undergoes a dramatic physical evolution, including the formation of dark melt ponds and bright, reflective surface scattering layer. These features have distinct optical properties that impact the fate of sunlight temporally and spatially. We present colocated observations of surface albedo and below-ice transmittance. The presented observations were collected over the ROV-observation area during summer and autumn 2020 (MOSAiC Legs 4 and 5), and cover hundreds of meters that were surveyed at regular intervals during the melt and freeze-up seasons. As a result, these observations provide insight on the spatial and temporal variability of the partitioning of solar energy in the ice-upper ocean system. These datasets are used to calculate the inherent optical properties of sea ice over time, which are key inputs for radiative transfer models used in regional and coupled climate models. The analysis includes the impact of episodic events, such as rain-on-snow and mid-summer snowfall. The partitioning of sunlight in the sea ice system is key to understanding mass balance evolution, while the penetration of sunlight into the upper ocean is further essential to understanding solar heating in the upper ocean and primary productivity in the ice and water column.
127	Ran	Tao	Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven, Germany	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	S20-1	virtually	Ran Tao, Marcel Nicolaus, Christian Katlein, Philipp Anhaus, Mario Hoppmann, Christian Haas	Light availability and variability under the Arctic sea ice during the MOSAiC expedition	Light transmittance through sea ice controls many physical and biological processes. It provides energy for sea ice thermodynamics and shapes habitat conditions. Under-ice studies are even more limited observation areas and periods than surface studies. During MOSAiC, we acquired an extensive dataset of optical properties under sea ice on grids larger than 100mx50m based on a remotely operated vehicle (ROV) on 21 dive days from March to September 2020. The results show light transmittance before melt onset, during melt season and during freeze-up in the Central Arctic. First, snow melt caused higher light transmittance and increased spatial variability, before melt pond formation further enhanced the heterogeneity, resulting in a multi-modal light distribution. Different from common assumptions, the measurements show a strongly non-linear, non-continuous, but event-driven seasonality. Single events impacted the annual energy budget significantly. For instance, a melt ponding event allowed a 30-fold larger heat deposit into the ocean than the adjacent bare ice. This study allows quantifying such events and their impact for the entire season, controlling the light availability for the ecosystem and the surface energy budget.
43	Melinda	Webster	University of Washington	20: Optical Properties and Processes in the Arctic Air-Ice-Ocean-Eco System	S20-4	virtually	Melinda, Webster, Marika Holland, Chris Polashenski, and Hannah Chapman-Dutton	Atmospheric drivers of temporal variability in melt pond coverage and albedo: a model-observation synthesis	Melt ponds on sea ice play an important role in the Arctic climate system. Their presence alters the partitioning of solar radiation: decreasing reflection, increasing absorption and transmission to the ice and ocean, and enhancing ice melt. The spatiotemporal properties of melt ponds thus modify ice albedo feedbacks and the mass balance of Arctic sea ice. In this work, we combine climate modeling, MOSAiC observations, and satellite products to investigate key atmospheric drivers of the temporal variability in melt pond coverage and albedo. The analysis begins with an inter-comparison between two configurations of Version 2 of the Community Earth System Model (CESM2): one with and one without tuned parameterizations of snow albedo and melt onset temperature. The tuned version was optimized for improved realism of the mean sea-ice state. We investigate the different sensitivities of the sea-ice surface response to summer snowfall events and cold air outbreaks between model configurations, and assess potential model biases using local scale MOSAiC observations and pan-Arctic scale satellite observations. The scaling, synthesis, and inter-comparison of model and observational results are used to pinpoint atmosphere-ice processes that warrant improved representation, which, in turn, can aid accurate simulations of albedo feedbacks in a warming climate.
91	Emelia	Chamberlain	Scripps Institution of Oceanography, University of California San Diego	23: Interdisciplinary processes across strong physical gradients	S23-5	in-person	Emelia J Chamberlain, Alessandra D'Angelo, Sebastian Rokitta, Alison Webb, Hendrik Schäfer, Björn Rost, Brice Loose, Allison A. Fong, Elise Droste, Daiki Nomura, Jeff Bowman	Metabolic activity across summer salinity gradients: a first look into community structure	The persistent meltwater lens observed during the summer months of the MOSAiC Expedition was additionally accompanied by spatial variability in visible biomass, particularly in open lead environments. Here, we investigate the role such strong salinity gradients had in structuring microbial microhabitats and impacts on community structure, as determined by 16S (prokaryotic) and 18S (eukaryotic) rRNA gene amplicon sequencing, and metabolic activity, as estimated from biological oxygen and methane production/uptake. In early July, stratification was characterized by a visible algal bloom at the seawater-freshwater interface, dominated by pico-eukaryotes (pelagophytes and dinoflagellates). This visible mixed layer and subsequent bloom dissipated as the meltwater layer shoaled near the marginal ice zone in mid-July. After re-establishing the ice camp at the new floe on Aug 22 at 89º N, stratification was again observed into September, but with no visible active algal bloom - only suspended, bleached particulate organic matter. However, in situ observations indicate that before freeze-up, these water masses remained ecologically distinct from one another with their own unique microbial assemblages and metabolic potential, where the surface freshwater was characterized by methane supersaturation relative to atmospheric capacity and a significant reduction in net metabolic balance (DO_2/Ar) than in the underlying seawater.

15	Christopher	Cox	NOAA Physical Sciences Laboratory	23: Interdisciplinary processes across strong physical gradients	P2 (78)	in-person	Christopher J Cox, Amy Solomon, Ola Persson, Matthew D Shupe, Michael Gallagher, Von P Walden, Mike Town, Don Perovich	Melt onset at MOSAiC: Resiliency of the ice column to preconditioning by warming extremes	The timing of melt onset affects the duration and total amount of seasonal melt. At MOSAiC, onset was at 83.3ºN on 25 May, triggered by prolonged enhanced longwave radiative forcing, consistent with the prevailing theory. Previous studies postulate that atmospheric warming events in the weeks prior to onset precondition the ice by accelerating the warming of the ice. We argue that this preconditioning potential is limited and that warming individual events is a less important precursor to onset than the date of persistent positive atmospheric forcing. An extreme warming event due to southerly advection in mid-April was responsible for 37% of the total warming L2 underwent prior to onset. To assess preconditioning, we apply counterfactual forcing using a coupled regional model where the advection has been suppressed at the model boundary to a 1d finite-volume diffusion model representing the ice. We find the decorrelation of the event's memory has an e-folding time of just 5.4 days. The warming leads to a reduction in the temperature gradient within the ice column, which acts to suppress the future heating rate, constituting a negative feedback. Consequently, the net thermodynamic energy uptake within the ice in the factual and counterfactual forcings merge over time.
183	Allison	Fong	Alfred-Wegener-Institut Helmholtz Zentrum für Polar-und Meeresforschung	23: Interdisciplinary processes across strong physical gradients	P2 (77)	in-person	Allison A. Fong, Clara J. M. Hoppe, Sinhué Torres-Valdes, Oliver Müller, John Paul Balmonte, Jessie Gardner, Ulrike Dietrich, Emelia J. Chamberlain, Elise Droste, Katrin Schmidt, Anders Torstensson, Mats A. Granskog, Marc Oggier, Madison Smith, Jeff Bowman, Laura Whitmore, Martina Vortkamp, MOSAiC ECO Team Consortium	Microbial process investigations and a cup of coffee at ECO Lodge	Microbial processes are potentially subject to strong environmental gradients and rapid changes in conditions at habitat interfaces. However, the small-scale spatial and short-term temporal dynamics of these processes along the freshwater to seawater gradient beneath the Arctic ice pack remains poorly understood. In this study, we aimed to capture potential changes in microbial activity in direct under-ice waters in response to short-time scale fluxes of nutrients, light, and organisms during periods of melt and re-freezing. We measured a small suite of physical and ecological properties at the interface between the bottom of the ice pack and underlying seawater, every 2-3 hours for 20 - 30 hour periods on several occasions during July and September 2020. We will present bacterial production (BP) rates from simulated temperature and light and in situ conditions. Whereas BP rates are typically measured from samples incubated in the dark, our measurements reflect varying light intensities over diel cycles. Therefore, we also address whether light plays a role in Arctic summertime BP. Our results have implications for cryopelagic carbon cycling and how we quantify bacterial contributions to the Arctic food web. Bacteria were not supplemented with caffeine during measurements, but scientists were routinely provided cups of coffee.
125	Clara J M	Hoppe	Alfred Wegener Institute - Helmholtzcenter for Polar and Marine Research	23: Interdisciplinary processes across strong physical gradients	S23-2	in-person	Clara J.M. Hoppe, Anders Torstensson, Adam Ulfsbo, Lasse M. Olsen, Giulia Castellani, Jeff Bowman, Philip Anderson, Alexandra Kraberg, Agnieszka Tatarek, Jozef Wiktor, Laurent Oziel, Julienne Stroeve, Niels Fuchs, Oliver Müller, Benoit Lebreton, GaÃ«l Guillou, Allison Fong, Mats Granskog, Marc Oggier, Dirk Notz, Eva Leu, Bernhard Schartmüller, Aud Larsen, Gunnar Bratbak, Philipp Assmy, Rolf Gradinger, Sinhué Torres-Valdes, Björn Rost and the MOSAiC ice coring team	Low threshold irradiances allow re-initiation of primary production at the end of the Polar Night	Identifying the compensation point for photosynthesis, i.e. the low light threshold for photosynthetic biomass production, is a key prerequisite for the estimation of global net primary production and the depth distribution of the euphotic zone of the world's oceans. MOSAiC gave us the unprecedented opportunity to study the threshold of the compensation point for photosynthesis in the water and ice under extreme low light conditions in the high Arctic, combining in-situ sampling of biological parameters with state-of-the-air sensor-based irradiance measurements in and under the ice. Here we report resumption of photosynthesis and biomass buildup in surface waters and bottom sea ice from the central Arctic Ocean (86°N) as early as end of March, corresponding to daily average irradiances close to the previously suggested theoretical minimum energy requirement of photosynthesis (0.02 µmol photons m-2 s-1). Our data indicates that the resumption of photosynthesis at the end of the Polar Night occurs much earlier than previously thought, suggesting a paradigm shift regarding bloom phenology, food availability and biogeochemical dynamics in the ice-covered Arctic Ocean.
31	Benjamin	Lange	Norwegian Polar Institute	23: Interdisciplinary processes across strong physical gradients	S23-3	in-person	Benjamin A. Lange, Ilkka Matero, Evgenii Salganik, Karley Campbell, Janina Osanen, Christian Katlein, Philipp Anhaus, Philipp Assmy, Jessie Gardner, Rolf Gradinger, Clara J.M. Hoppe, Eva Leu, Oliver Müller, Marcel Nicolaus, Lasse M. Olsen, Maria Van Leeuwe, and Mats A. Granskog	Characterizing spatio-temporal variability of bio-physical sea ice properties using an Underwater Hyperspectral Imager	The replacement of older multi-year ice by first-year ice (FYI) has contributed to a more dynamic ice cover with a higher probability of forming sea ice ridges, which have been identified as potential ice-algal hotspots. Assessing spatio-temporal dynamics of bio-physical sea ice habitat properties remains challenging due to logistical difficulties of sampling the under-ice habitat. Improved technologies can overcome limitations intrinsic to existing sea ice sampling techniques and fill some of the spatio-temporal knowledge gaps. During June to Aug 2020 (leg 4) of the year-long Arctic Ocean drift study MOSAiC we deployed an underwater hyperspectral imager (UHI) mounted on a remotely operated vehicle to characterize the biophysical properties of different under-ice habitats. We present a comparison of UHI surveys of the sea ice bottom covering both level FYI and an adjacent ridges conducted during July. The UHI surveys indicated a higher fraction of ice surfaces inhabited by algae in the ridged compared to the level ice. We will also present spatial and temporal variability of biophysical spectral signatures in relation to possible changes in environmental conditions (e.g. ice thickness) and algal pigment composition and/or physiology by comparing to samples extracted from the nearby FYI coring site.
58	Hailong	Liu	Shanghai Jiao Tong University	23: Interdisciplinary processes across strong physical gradients	S23-1	in-person	Hailong Liu, Christian Haas, and Ocean Team	The Presence of Barrier Layer in the Arctic	Barrier layer (BL) is an important representative variable reflecting salinity stratification. It is defined as the difference between mixed layer depth and isothermal layer depth (Lukas and Lindstrom 1991). Its existence not only weakens the warming effect of entrainment on the upper layer due to a roughly consistent lower temperature within BL than subsurface temperature above warm Atlantic water layer, but also limits the kinetic energy in the upper layer by salinity-induced stratification. Much attention has been paid to the role of halocline in the Arctic in the previous research. By using MOSAiC hydrographic observations and introducing multiple metrics, we focus on the evolution of barrier layer and associated mechanism in this present study. Our results show that BL demonstrates strong seasonal variation and potential role in modulating the interface interaction.

120	Camille	Mavis	Colorado State University	23: Interdisciplinary processes across strong physical gradients	S23-4	in-person	Camille Mavis, Kevin Barry, Emelia Chamberlain, Tom Hill, Paul DeMott, Sonia Kreidenweis, Jeff Bowman, Jessie Creamean, Marc Oggier, Clara Hoppe, Karl Adam Ulfsbo, John Paul Balmonte, Allison A. Fong	Evaluating central Arctic marine biological sources of ice nucleating particles	The Arctic is warming up to four times faster than the global average from feedbacks associated with sea ice loss. Arctic mixed-phase clouds have significant yet variable impacts on these feedbacks depending on phase partitioning between water and ice. This partitioning is highly sensitive to the number of Ice Nucleating Particles (INPs), including dust and biological particles. A recent study from the MOSAiC expedition suggested local marine and long-range transported land sources influenced central Arctic immersion freezing INP populations. However, more observations are necessary to better understand and parameterize how local sources of INPs change over the year in the new Arctic regime. Here, we investigate local sources of INPs in bulk Arctic seawater (BSW), melt ponds, and lead water. Preliminary measurements of INPs present per unit volume in BSW show significant annual concentration fluctuations where high-level days coincide with storms and high winds, potentially from the mixing of the freshwater layer. Preliminary results of melt pond and lead INP concentrations are an order of magnitude greater than BSW-sourced. These results suggest that the onset of melt and increased mixed-ice zone may be important influences for the production of INPs, one that may have significant impacts for the changing Arctic.
34	Alison	Webb	University of York / University of Warwick	23: Interdisciplinary processes across strong physical gradients	S23-6	in-person	Webb, A.L., Nomura, D, Hoppe, C.J.M., Chamberlain, E.J., Droste, E., Angot H., Stefels, J., Bowman, J., Chen, Y., Todd, J.D., van Leeuwe, M.A., Bozzato, D., Delille, B., Muller, S., Schäfer, H.	Late Summer Arctic meltponds act in a key role for carbon, sulfur and nitrogen cycling between the Ocean and Atmosphere	Meltponds on the sea-ice surface are a feature of the summertime Arctic, however their importance in many biogeochemical cycles between ocean and atmosphere are relatively unknown. A survey of 12 meltponds determined salinity and temperature profiles to cover the heterogeneity of meltpond physicochemical structure, alongside a longer-term time-series in two meltponds to determine the processes driving changes in biogeochemical parameters (chlorophyll a, CO_2, DMS, N_2O, O_2) during the seasonal change from summer to autumn. In late summer (August 2020), low salinity meltwater (<5 psu) formed a 60cm layer across the surface of all meltponds, where pCO_2 (315 µatm), DMS (<1 nmol L-1) and N_2O (7.8 nmol L-1) concentrations were lower than the atmosphere, and corresponded with low chlorophyll a concentrations (<0.1 µg L-1). Meltponds were confirmed as a sink of atmospheric CO_2 (-3.9 mmol C m-2 d-1) and potentially N_2O. During seasonal progression to autumn, the meltwater layer thinned (30-40 cm), as surface ice formation increased, forming a strong gradient with the seawater (>30 psu) below. Higher biomass, CO_2 and DMS and low O_2 levels were identified below the halocline, before mixing broke down stratification prior to freeze-up. A near zero flux of CO_2 was observed over the frozen pond surface.
136	Magnus	Asmussen	Technische Universität Braunschweig, Institute of Flight Guidance	24: General Session (Poster Only)	P2 (55)	in-person	Barbara Harm-Altstädter, Magnus Ole Asmussen, Christian Pilz, Falk Pätzold, Lutz Bretschneider, Ralf Käthner, Birgit Wehner, Astrid Lampert	Observations of the spatial distribution of aerosol particles based on the helicopter-borne system HELiPOD	ssessing detailed information about formation, mixing and transport of aerosol particles is of vital importance in the Arctic atmospheric boundary layer, but due to lacking measurement methods, we are far away from a profound understanding of the role of aerosol particles and their spatial distribution. For this purpose, the helicopter-borne system HELiPOD was deployed for field activity during the MOSAiC expedition during five measurement flights in summer 2020. The system is equipped with meteorological instrumentation and aerosol sensors for measuring the aerosol particle number concentration of different sizes (e.g. nucleation and accumulation mode), as well as for identifying black carbon mass concentration (BC) via particle light absorption coefficient. HELiPOD was mainly applied for investigating the horizontal variability close to the surface under varying sea ice conditions during transects of 45-60 km lengths, thus the measurements allow to better understand the origin of aerosol particles and their interaction with atmosphere and sea ice. This study introduces the measurement devices installed in HELiPOD and shows first results of the measured high variability of aerosol particles and their horizontal and vertical distribution.
128	Niels	Fuchs	Center for Earth System Sustainability, Institute of Oceanography, University of Hamburg, Germany	24: General Session (Poster Only)	P2 (34)	in-person	Niels Fuchs, Torbjörn Kagel, Phil Anderson, Mats A. Granskog, Ruibo Lei, Marcel Nicolaus, Marc Oggier, Don Perovich, Evgenii Salganik, Dirk Notz	The MOSAiC sea ice profile data product MOSiP	The collection and recent public release of the interdisciplinary and cross-project MOSAiC field data from the central Arctic strongly motivates the compilation of harmonized and unified data products that facilitate long term data access and interoperability. Creating the MOSAiC Sea ice Profile data product MOSiP, we compile a collection that contains autonomously measured physical sea ice property profiles and link them to boundary conditions and manual measurements, such as ice cores. We present the data product and developed standardization procedures, including the challenges of vertical alignment of profiles. Ultimately, we anticipate that the data product will support future studies of air-ice-sea and ecosystem interactions and their parametrization in models. The poster is intended to be a launch pad for follow-up discussions during the workshop about incorporating additional data and to get user input that will strengthen future utilization.
52	Benjamin	Heutte	EPFL / EERL	24: General Session (Poster Only)	P2 (56)	virtually	Benjamin Heutte, Nora Bergner, Ivo Beck, Héléne Angot, Lubna Dada, Lauriane Quéléver, Tiia Laurila, Matthew Boyer, Kaspar R. Dällenbach, Tuija Jokinen, Julia Schmale	Aerosol microphysics and chemical composition in the central Arctic atmosphere during the MOSAiC expedition.	The Arctic environment is transforming rapidly due to climate change. Aerosols' abundance and physicochemical characteristics play a crucial, yet uncertain, role in these changes due to their influence on the surface energy budget, and aerosol properties are also changing in response. Despite their importance, year-round measurements of such characteristics are sparse in the Arctic and often confined to lower latitudes at Arctic land-based stations and/or during short high-latitude summertime measurements campaigns. Here, we present the unique aerosols microphysics and chemical composition datasets collected in the central Arctic Ocean during the year-long Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition. These datasets, which include aerosol particle number concentrations, size distributions, cloud condensation nuclei concentrations, fluorescent aerosol concentrations and properties and aerosol bulk chemical composition (black carbon, sulfate, nitrate, ammonium, chloride and organics) will serve to greatly improve our understanding of high-Arctic aerosol processes, with relevance towards improved modelling of the future Arctic (and global) climate.

17	Matthew Ross	Jones	University of York	24: General Session (Poster Only)	P2 (33)	in-person	Matthew R. Jones, Amy R. Macfarlane, Héléne Angot, Stephen D. Archer, Ludovic Bariteau, Byron W. Blomquist, Rosie Chance, Markus M. Frey, Laurens N. Ganzeveld, Detlev Helmig, Dean Howard, Jacques Hueber, Hans-Werner Jacobi, Daniela Krampe, Megan Pond, Kevin M. Posman, Martin Schneebeli, Alison Webb, and Lucy J. Carpenter	Iodine speciation in snow on the central Arctic Ocean sea ice	Recent observations suggest that iodine chemistry in the Arctic plays a significant role in the surface ozone budget and the formation of new particles, potentially leading to cloud condensation nuclei. However, spatial and temporal emission source/s of polar iodine are highly uncertain. Condensed phase reactions on snowpack have been shown to release iodine, but a lack of knowledge of snowpack iodine concentration and speciation hinders the assessment of potential atmospheric emissions. Here we present the first central Arctic Ocean sea ice snow profiles of iodine species (iodate, iodide and organic iodine). Through most of the profiles, iodine's dominant form was iodate. However, the upper snow layers contained high contributions of iodide and organic iodine, indicating an atmospheric deposition of these species or a conversion from iodate during upward water vapour migration. From mid-winter through to spring, iodate at the sea-ice interface decreased from >150 to ~15 nM. A significant component of this loss appears to occur during removal of the upper snow pack following wind driven processes, suggesting iodate is liberated to the atmosphere. Interpretation of these iodine speciation profiles, including the origin of the condensed phase iodine and the implications for atmospheric iodine, is a subject of active investigation.
44	Salar	Karam	University of Gothenburg	24: General Session (Poster Only)	P2 (86)	in-person	Salar Karam, Céline Heuzé	Bottom temperature data from observed autonomous buoys deployed during MOSAiC	During MOSAiC, a total of 20 autonomous buoys, called T-pops, were deployed throughout the drift across the Arctic Ocean. These T-pops were moored to the sea floor for over a year, collecting ocean temperature data at an hourly resolution. Here we present first results from the T-pops deployed during Leg 4, where a total of four T-pops were deployed in Fram Strait, the only deep connection between the Arctic Ocean and the rest of the World Ocean. The proximity to a mooring array that has been maintained in Fram Strait since 1997 allows for an evaluation in long-term trends in temperature in one of the major oceanic gateways into the Arctic. Preliminary results show a sustained linear warming trend of 0.09 °C per decade since 1997 at a depth of 2500 metres. Additionally, the high sensitivity of the temperature sensor enables considerable dynamics to be observed, even at tidal timescales. Work is ongoing to elucidate dynamics from decadal to tidal timescales. As the Arctic is rapidly changing, it is becoming increasingly important to investigate the role of the deep ocean and how it is connected to the upper ocean.
225	Kirstin	Schulz	University of Texas at Austin	24: General Session (Poster Only)	P2 (85)	in-person	Kirstin Schulz, Till Baumann, Morven Muilwijk, Christian Mohn	You spin me right 'round, baby….	During leg 4 of MOSAiC, more precisely starting on July 24, our previously irrotational floe revolved exactly twice around its own center over the course of two days, before continuing its journey with again steady heading. Not only did these rotations greatly increase the variety of views from our cabin windows, but also left some of us puzzled as to what the reason for this sudden spinning motion was (M. Rex, pers. comm.). After ruling out atmospheric forcing as a prime suspect, team Ocean looked beneath the sea surface: The onset of the floe rotation coincided with the drift passing the around 1000m high and 20km wide Koldewey Seamount. Investigations regarding the physical details are still ongoing, but the dimensions of the seamount and the ambient ocean physics are favorable for the formation of a Taylor column; and tidal velocities in this region are greatly enhanced, maybe pointing to a rectification of tides in the vicinity of the seamount. Seamounts are generally known to be regions of enhanced vertical mixing, productivity and oftentimes harbor distinct ecosystems. Additionally, the ocean dynamics around this seamount obviously impacted the local sea ice dynamics. To further investigate how all these systems are connected and to probe the scientific relevance of this event, we would like to gather your input: Sea ice, biogeochemistry, ecology, oceanography - anything inexplicable or fancy in your data after July 24 or near 80°N; 1°W is very welcome!
214	Jonah	Shaw	University of Colorado, Boulder	24: General Session (Poster Only)	P2 (54)	in-person	Jonah K. Shaw, Jennifer E. Kay	Fall before Spring: Processes driving large monthly differences in the time-to-emergence of Arctic Longwave Radiation.	Rapid loss of Arctic sea ice and increases in surface temperature modify outgoing longwave radiation (OLR) at the top of the atmosphere. With the Arctic climate strongly controlled by seasonal cycles in solar insolation, sea ice extent, and cloud properties, seasonal trends in OLR capture changes in climate processes active at different times of the year. Using a single model initial condition large ensemble, we investigate when seasonal trends in Arctic OLR will emerge from internal climate variability. Comparing the emergence of OLR trends across all months, we find that seasonal differences in climate variability are as important as differences in the strength of the forced response to anthropogenic emissions. By additionally examining the contributions of the surface, atmosphere, and clouds to the forced response and internal variability, we connect predictions of emergence to specific Arctic climate processes that mediate longwave radiation. We find that low OLR variability in September, characterized by the absence of sea ice, accelerates the expected time to emergence relative to April by nearly two decades. In the context of in-situ observations of the Arctic surface, these results highlight the importance of understanding how Arctic surface processes mediate forced trends and internal variability in longwave radiation.

64	Sandra	Tippenhauer	Alfred Wegener Institute	24: General Session (Poster Only)	P2 (84)	in-person	Sandra Tippenhauer, Myriel Vredenborg, Céline Heuzé, Benjamin Rabe and the MOSAiC CTD/rosette Team	CTD-Rosette Data from MOSAiC	During the MOSAiC expedition two conductivity, temperature, depth (CTD) rosette systems where operated in parallel, one from the ship and one from Ocean City, a shelter on the ice about 300 m away with access to the water. Both CTD were equipped with duplicate sensors for temperature, conductivity and oxygen. Additionally, sensors for chlorophyll and Coloured Dissolved Organic Matter (CDOM) fluorescence, beam transmission, Photosynthetically Active Radiation (PAR), Nitrate, Rhodamine, and Methane were mounted to the CTDs. This dataset is rather diverse compared to other CTD-datasets as different challenges arose during different legs and operating personnel was changed in-between. During quality control data and metadata was homogenized to meet the same standards and formats for all legs. Here we present the quality-controlled data from both, the Polarstern and the Ocean City CTD Rosette. Temperature, Salinity and Oxygen data are post-cruise calibrated while auxiliary data is calibrated with pre-cruise calibration coefficients. The auxiliary data is processed and averaged to the same vertical resolution as temperature, salinity and oxygen and will be post-cruise calibrated by the respective sensor experts within MOSAiC. Furthermore, we compare this CTD dataset with historical data and discuss the potential influence of the technical clean-water released from Polarstern.
221	Radiance	Calmer	University of Colorado	25: Outreach and Education around MOSAiC (Poster only)	P1 (09)	in-person	Radiance Calmer, Zoe Brasseur, Lianna Nixon, Alexandra Rose and Kathryn Penzkover	Sharing the MOSAiC experience with different audiences, three examples in diverse contexts	Following the MOSAiC expedition, several opportunities occurred to share the experience on the sea ice and the science conducted during the project. Different communication approaches were used depending on the audience and the place. The first outreach event occured in Boulder in a library for K-12 students. Hands-on activities were organized for the families to experiment by themselves. Materials were made available to introduce the ice-ocean albedo feedback loop and pictures taken during the MOSAiC expedition. The second outreach opportunity took place in a bookstore in a French rural area for a conference opened to the general public. This event raised some challenges in choosing the presentation's content, for we did not know the audience's initial knowledge of polar research. The third discussions about MOSAiC occured at a College of Engineering (INSA de Toulouse) in France with students oriented toward the industry but keen to learn about climate change research. The poster presents the supports and contents selected for each outreach opportunity and the feedback received from the audience. Introducing these three events aims to engage with the MOSAiC community, share our experiences, and improve our respective interactions when we wish to communicate about scientific polar expeditions and climate change.
220	Emelia	Chamberlain	Scripps Institution of Oceanography, University of California San Diego	25: Outreach and Education around MOSAiC (Poster only)	P1 (12)	in-person	Emelia Chamberlain, Shailja Gangrade, Anya Stajner, Anjali Narayanan, Hannah Adams	Broadening the SCOPE of MOSAiC outreach through the Scripps Community Outreach for Public Education program	STEM outreach is recognized as an important component of science education, yet there is little communication training within the academic setting. Scripps Community Outreach for Public Education (SCOPE) is a student-led program at Scripps Institution of Oceanography (SIO) that serves as a replicable model for incorporating outreach into graduate training and increasing local awareness of scientific research. What started as a grassroots movement is now a thriving, self-sustaining program, hosting over 100 outreach events each year. Our volunteer-driven model provides a rewarding, yet practical, avenue for SIO scientists to share their work, engage broader audiences, and improve their science communication skills. It also provides a direct pipeline for community members, primarily school-aged children, to see how science operates first-hand and meet enthusiastic young scientists from diverse backgrounds — encouraging interest in the scientific process and promoting respect for the environment. As a co-coordinator and volunteer of the SCOPE program for the last 4 years, I have shared my experiences on the MOSAiC Expedition with many K-12 groups and given lectures at several public events. Each event has both brought MOSAiC science to a broader public audience, and further shaped my enthusiasm for, and general approach to, Arctic science outreach and education.
224	Mariama	Dryak	University of Colorado	25: Outreach and Education around MOSAiC (Poster only)	P1 (03)	in-person	Mariama C. Dryak, Rebecca Batchelor, Bradley Markle, Anne Gold	PSECCO: A New Community Office for Supporting Early Career Scientists and Advancing Equiity and Inclusion in the Polar Sciences	While the polar sciences offer unique opportunities for international, transdisciplinary research as well as connections with Indigenous knowledge systems, the US polar science community remains unrepresentative of the diversity of the country itself. While there are many reasons for this, including those familiar throughout STEM as well as the explicit historical exclusion of certain groups in polar science specifically, early career scientists in the polar community are driving efforts to broaden participation in polar research. The newly launched Polar Science Early Career Community Office (PSECCO) seeks to empower, elevate and give agency to the early career polar scientists who are leading the charge to make the polar sciences more welcoming, inclusive and diverse. The office will foster community among early career polar scientists, provide funding, training and travel opportunities, partner with other organizations to share opportunities, resources and support leadership development, while working together towards a more just, inclusive, diverse, equitable and accessible polar science environment. Launching in 2022, we invite all current and future polar scientists to join PSECCO in building community together.
137	Allison	Fong	Alfred-Wegener-Institut Helmholtz Zentrum für Polar-und Meeresforschun g	25: Outreach and Education around MOSAiC (Poster only)	P1 (07)	in-person	Allison A. Fong, Lianna Nixon, Amy Lauren Richman, Marc Oggier, Matthew Shupe	Storytelling partnerships â€" honing the craft and sharing the joy of MOSAiC adventures in science	MOSAiC is built on strong partnerships. MOSAiC science would not have been possible without cooperation, and the same is true for the stories we tell about our time in the Arctic. It's rare to have such extensive creative arts documentation of scientific work, but it's one of the most captivating and inspiring products generated from MOSAiC. Storytelling, and more importantly, how we tell stories, impacts us and our audiences on how we connect and see our place in the world. Through the combined use of narrative, still images, and explorative film, we can weave stories about who we are and what drives us to pursue questions which require deep commitment and sustained focus to tackle. Our partnerships with creative artists, storytellers themselves, pushed us as scientists to seek deeper meaning in our work and find ways to share both the challenges and joys of our adventures in science. Here we present highlights of our joint efforts to capture and share our stories across diverse arenas.

147	Katie (Anne)	Gavenus (Gold)	Center for Alaskan Coastal Studies	25: Outreach and Education around MOSAiC (Poster only)	P1 (02)	in-person	Janet Warburton, Anne U. Gold	Interconnected: An Educator's Perspective of a Teacher Research Experience with the MOSAiC Expedition	"I've heard a lot of superlatives thrown around by media covering the MOSAiC Expedition: 'biggest', 'most ambitious', 'most massive', 'largest', 'one-of-a-kind', and 'once in a generation seem to be the most common. In lieu of those grandiose adjectives, I'd like to suggest something a little bit different: interconnected." Katie Gavenus, PolarTREC educator. In the fall of 2019, Cooperative Institute for Research in Environmental Sciences partnered with the Arctic Research Consortium of the U.S. to find an educator through PolarTREC, a Teacher Research Experience (TRE) program, that places educators with polar researchers on field-based science expeditions. In this instance, informal science educator, Katie Gavenus, was selected to participate in the MOSAiC expedition. The goal was to have the educator join the MOSAiC scientists during the first expedition leg on board the Federov and to share the science story. While aboard the ship, Katie learned about the science and then shared it with classrooms and students throughout the U.S. In this poster presentation, the authors will share how participating in this expedition equipped the educator to better understand, communicate, and teach about the emerging Arctic science and climate science now and in the future.
37	Anne	Gold	Director of CIRES Education and Outreach	25: Outreach and Education around MOSAiC (Poster only)	P1 (01)	in-person	Anne Gold, Jonathan Griffith, Lynne Harden, Matthew Shupe, Byron Blomquist, Kathy Bogan, Radiance Calmer, John Cassano, Dave Costa, Chris Cox, Gijs de Boer, Michael Gallagher, Sean Horvath, Katy Human, Gina Jozef, Jennifer Kay, Sara Morris, Lianna Nixon, Jackson Osborn, Ola Persson, Amy Richman, Mark Serreze, Amy Solomon, Sandy Starkweather, Taneil Uttal, Ryan Vachon, Katie Weeman	MOSAiC Expedition Education & Outreach: Reaching Broader Audiences With Collaborative Design	The CIRES-based MOSAIC education and outreach team in collaboration with scientists, filmmakers, photographers, educators, and curriculum developers from CIRES and institutions around the world developed a number of expedition-related resources to connect the public to the science and story of MOSAiC. Utilizing a collaborative approach to MOSAiC outreach resource design - and thus allowing for input from a variety of perspectives and expertise - has allowed us to reach a wide range of target audiences. Photographers, scientists, and curriculum designers collaborated to construct immersive virtual reality tours, which allow people of all ages to see and feel what it's like to be a MOSAiC scientist. More than 30 people with diverse expertises - scientists, indigenous peoples, geographers, etc. - joined forces with the CIRES outreach team and filmmakers around the world to create Frozen in the Ice: Exploring the Arctic, a massive open online course (MOOC) about MOSAiC that is geared towards adult learners. Middle and high school curricular units about MOSAiC and the Arctic were written by the CIRES education and outreach team and tested by teachers in classrooms around the country. In our poster, we'll share these MOSAiC outreach efforts and describe why it is important to engage scientists and others in collaborative outreach efforts.
223	MacKenzie	Jewell	Oregon State University	25: Outreach and Education around MOSAiC (Poster only)	P1 (08)	in-person	MacKenzie Jewell, Jennifer K. Hutchings, Jay Well, Ignatius Rigor and Daniel Watkins	Using Buoy Drift to Spark K-12 Math Interest	Bringing research and real-world data into the classroom highly engages students with core math and science concepts. During the MOSAiC campaign we participated in the International Arctic Buoy Program "Float your Boat" school activities. The large number of buoys in the distributed network presented unique data for tracking ice, which we could do in near-real time. For example the Sea Ice Dynamics Forecasting Experiment provided projections of ice drift for MOSAiC planning. We gave children an opportunity to participate in forecasting ice drift during the MOSAiC campaign. In collaboration with Oregon State SMILE program we developed lesson plans for elementary, middle and high school students that engage grade appropriate mathematics curriculum. Navigation and forecasting are introduced through tracking and predicting buoy trajectories. Math skills, from fractions to trigonometry to the concept of differentiation, are explored in the context of their use in our research. The lessons were tested in Oregon schools and SMILE clubs. Lesson plans are freely available, use the IABP/IPAB archive and can be integrated into polar ocean research activities. We encourage you to engage with children in your local schools. Can they forecast ice drift better than persistence?
14	Sebastian	Mieruch	AWI	25: Outreach and Education around MOSAiC (Poster only)	P1 (10)	in-person	Merret Buurman, Marcus Paradies, Mohamed Chouai, Arne Osterthun, Felix Reimers, Irfan Khan, Ingrid Linck Rosenhaim	M-VRE - The MOSAiC virtual research environment	The aim of the M-VRE project (https://mosaic-vre.org) is to provide online software tools for the easy and efficient exploration, analysis and visualization of MOSAiC data. MOSAiC data, archived at PANGAEA, are compiled, harmonized and aggregated to allow an user-friendly access for the science community, the interested public, as well as other areas e.g. government, NGO's, arts, schools, museums, industry etc. The technical backbone of the M-VRE is based on AWI's cloud computing environment, where we aim to setup a Kubernetes system for the deployment, scaling and managing of the following web services: Â·webODV: Interactive data extraction, exploration, analysis, visualization Â·DIVAnd: Data-Interpolating Variational Analysis in n dimensions Â·DataCube: Unified access to n dimensional data in Python Â·AutoQC: Machine Learning support for quality control of ocean temperature and salinity profiles
153	Lianna	Nixon	CU Boulder	25: Outreach and Education around MOSAiC (Poster only)	P1 (05)	in-person	Anne Gold, Amy Lauren, Lianna Nixon, Matthew Shupe	Science Communication as an Act of Co-Creation and Collaborative Storytelling	How can immersive storytelling and new modes of narrative experience facilitate learning about climate science "that calls for engagement and participation in the natural world rather than disinterested contemplation or an impractical withdrawal from it?" Amy Lauren and Lianna Nixon are artists and educators motivated by a passion for transformative storytelling to bridge gaps between lived experiences and learned knowledge. They were hired as a team of graduate students to create a trailer and two planetarium feature films designed to capture the MOSAiC story. Through their lens as filmmakers on the MOSAiC expedition, Lauren and Nixon explore what makes authentic science outreach and how the collision of art and science can cultivate community and shared research and learning experiences.

168	Daniela	Pennycook	UC Boulder	25: Outreach and Education around MOSAiC (Poster only)	P1 (06)	in-person	Daniela Pennycook, Lianna Nixon, Jonathan Griffith, Anne Gold, Matthew Shupe, Katy Human, Briana Ingermann, John Keller	The Drifting North Polar Planetarium Experience, engaging elementary and middle school students with the MOSAiC Expedition	The 2019-2020 MOSAiC (Multidisciplinary Drifting Observatory for the Study of Arctic Climate) research expedition was one of the most extensive multinational expeditions conducted in the Central Arctic. The expedition was a testament to what can be achieved through teamwork and collaboration, creative problem-solving, perseverance, and curiosity. Members of the CIRES Education & Outreach (E&O) team share three key lessons learned from our efforts on how to engage both students and scientists in science learning and outreach: 1) Expeditions like MOSAiC can be compelling hooks for engaging students in science learning, especially when students can make authentic connections to people and places; 2) The nature and process of science are about more than the scientists and successes. This is important to teach in the classroom; 3) Variety is the spice of life for both science students and scientists. We will expand on these lessons learned by sharing examples of the MOSAiC outreach resources and opportunities we developed, facilitated, and shared after the expedition, including the Polar Planetarium field trip which features the film, Drifting North: Arctic Pulse and immerses students in the experience through activities and classroom curriculum.
222	Madison	Smith	Woods Hole Oceanographic Institution	25: Outreach and Education around MOSAiC (Poster only)	P1 (04)	in-person	Maddie Smith, Bonnie Light, Don Perovich, Marika Holland, Chris Polashenski, Laura Landrum	MOSAiC: A year in the classroom and on the ice	A 2021 survey found that most Americans cannot name a living scientist. Building a sustained connection with a group of students, compared to the typical one-off guest visit, provides the opportunity for those students to get to know a scientist and understand the work that they do. As part of a collaborative US-based MOSAiC project, ongoing relationships were developed with classrooms in Seattle, WA, Boulder, CO, and Hanover, NH over the 2019-2020 school year. Each classroom visit involved a short lecture and hands-on activity introducing a scientific concept including weather and climate, temperature versus heat, sea ice versus fresh ice, and measurement tools. Each school was outfitted with a mini-MOSAiC met station measuring air temperature, barometric pressure, and precipitation depth. Students learned about real-time updates from MOSAiC. Data analysis comparing observations from their local weather stations with those being made on MOSAiC were planned but were not completed due to disruption from COVID. Nonetheless, students demonstrated an increased understanding of and appreciation for the Arctic system and physical changes. This outreach framework can easily be adapted to other locations and topics for high-impact outreach and student engagement.
119	Adnan	Softic		25: Outreach and Education around MOSAiC (Poster only)	P1 (11)	in-person	Adnan Softic, Nina Softic, Thies Mynther, Mario Hoppmann, Sebastian, Mieruch, Giulia Castellani, Sandra Tippenhauer	Klimaton - arctic 2020 - generative music instrument	We are exploring the problem of communicability of scientific facts in the context of climate change in the form of a generative sound work. The extensive and complex MOSAiC data archive reveals, in our opinion, one of the greatest paradoxes of our epoch: On the one hand, the human ability to detect invisible changes with the help of highly complex measurements and, on the other hand, the inability and unwillingness of the global community to trust these measurements. In this sense, the climate problem is also a communication problem. In the digital space we are no longer talking about remembering, but about memory. However, collective responsibility is not thinkable without remembering. What is missing here are techniques that generate a breathing of life into "dead" information (data archives). Such processes cannot be left to the sciences alone. We wonder if the discredited emotions might encourage us to "listen to the earth"? Together with a group of scientists from the MOSAIC team we are currently developing a sound instrument which outputs MOSAiC data and can be used as a new kind of musical instrument. Together with Mario Hoppmann and Sebastian Mieruch we would like to introduce our project.