

Arctic System Science Conference 2026

Report of Contributions

Contribution ID: 5

Type: **Oral**

Airborne in situ aerosol and turbulence measurements in the Arctic and Antarctica with Polar 6

Thursday 26 March 2026 11:15 (13 minutes)

We present three aircraft campaigns conducted with the research aircraft Polar 6, each using similar configurations for in situ aerosol and turbulence observations. Two of the campaigns, Boundary layer and Aerosol and Cloud Study in the Arctic (BACSAM) I and BACSAM II, were carried out in the Arctic from Longyearbyen, Svalbard, in autumn 2022 and spring 2024, respectively. The third campaign, Spatial distribution of ANtarctic Aerosol and Trace gases (SANAT), will take place in early 2026 and will be based at Neumayer III Station in Antarctica. These measurements provide one of the first aerosol profile datasets collected in the vicinity of Neumayer III.

A comprehensive set of high-accuracy aerosol instruments on board Polar 6 enables measurements of parameters such as aerosol number concentration and size distributions. In addition, the aircraft is equipped with a nose boom providing high-frequency (100 Hz) meteorological and turbulence observations. During all three campaigns, we also deploy the Turbulence-Bird (T-Bird), which can be towed up to 80 m below the aircraft. The T-Bird carries additional aerosol and turbulence sensors, allowing for simultaneous observations at two altitudes—on the aircraft and on the T-Bird—a configuration particularly valuable for boundary-layer studies.

This unique measurement setup enables, for example, the investigation of particle fluxes, as demonstrated in. We present the three campaigns, describe the aircraft configuration, and provide examples of the diverse atmospheric conditions encountered.

Session Chair

no

On-site Session Chair

no

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Session Classification: Oral Session

Track Classification: 8. Remote Sensing, Autonomous Technologies, and Polar Observing

Contribution ID: 6

Type: **Oral**

Sea-ice ridges are a major component of Arctic sea-ice export through the Fram Strait

Wednesday 25 March 2026 09:00 (13 minutes)

This study presents seven years (2012-2019) of Arctic sea-ice draft observations from upward-looking sonars combined with coincident observations of ice drift velocity from four moorings located across the Arctic outflow in the Fram Strait at 78.83°N. The data set covers in total about 150 000 km of drifting Arctic sea ice, at a 1m spatial resolution. Using a variable-threshold ridge detection algorithm, we identify and quantify the sizes of sea-ice ridges, including shallow ridges with keel drafts less than 5m deep, often overlooked by traditional methods using a fixed threshold. The study highlights ice ridges as a significant component of the sea-ice cover, with keels covering some 20–30% of the ice bottom and contributing 28–55% of the total sea-ice volume. The typical spatial density varies from 6 to 9 individual ridges per kilometer of sea-ice, with approximately 3000 to 5500 ridges per month at each site. A westward increase in ridge frequency and coverage was associated with the differences in the origin of sea ice arriving at the mooring locations. We show that shallow (less than 5 m keel draft) ridges comprise up to 80% of all ridges and 35–45% of the ridged ice volume, and thus play an important role in the sea-ice volume budget. Thus, shallow ridges deserve greater attention, especially given the ongoing changes in the Arctic sea-ice cover.

Session Chair

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On-site Session Chair

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Session Classification: Oral Session

Track Classification: 1. Arctic Interfaces: Leads, Ridges, and Fractures

Contribution ID: 7

Type: **Oral**

UAV-LiDAR-derived snow depth mapping for analysing snow-ecosystem interactions on Svalbard

Thursday 26 March 2026 10:30 (13 minutes)

Snow depth is a crucial climate variable in Arctic terrestrial ecosystems. Acting as an insulating layer, snow depth regulates subnivean temperature and active layer thickness, protects vegetation from exposure to harsh conditions, and impacts water and soil nutrient availability during melt. Thereby, it affects vegetation dynamics and influences resource availability for wildlife such as reindeer. Simultaneously, snow depth can constrain forage accessibility for herbivores and increase energetic costs of moving and feeding during winter. However, local ecological effects of snow remain poorly understood, largely due to lack of snow depth data at ecologically relevant spatio-temporal scales. In this study, we investigate the potential of spatially continuous UAV-derived snow depth data for analysing snow-ecosystem interactions on Svalbard. We use a fixed-wing, LiDAR-enabled Uncrewed Aerial Vehicle (UAV) to derive snow depth as the difference between surface elevations recorded under snow-covered and snow-free conditions. Employing Real Time/Post Processing Kinematics (RTK/PPK), we achieve a spatial resolution of 2.5 cm for 216.5 ha at cm-scale positional accuracy. Extensive in situ validation temporally synchronous to UAV acquisitions shows high UAV-derived snow depth estimation accuracy ($R^2=0.93$, $n=340$). Using semi-variogram and autocorrelation function thresholding, we analyse spatial scales of snow depth variation, quantifying folding frequencies at or below 2.5 metres. Additionally, we find that UAV-derived snow depth shows no spatially stable correlation with standard proxies conventionally used in Arctic ecology research when spatially continuous snow data are unavailable. Our findings suggest that UAV-derived snow depth data at cm scale have high potential to improve the understanding of snow depth impacts on Arctic ecosystem dynamics.

Session Chair

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On-site Session Chair

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Session Classification: Oral Session

Track Classification: 4. Biodiversity, Species Distributions, and Ecological Networks

Contribution ID: 8

Type: **Oral**

Arctic Vegetation Mapping in Svalbard using Multispectral and LiDAR UAS Data

Thursday 26 March 2026 12:30 (13 minutes)

The vegetation found in Arctic ecosystems is often highly heterogeneous, as plant community composition is strongly linked to small-scale patterns of moisture availability, terrain, and snow conditions. While large-scale landcover mapping is necessary to understand pan-Arctic trends in vegetation changes, signal mixing can negatively affect classification results when using satellite data. Due to the high heterogeneity of vegetation on small spatial scales, remote sensing data at cm-level is needed to understand the distribution of vegetation communities in High Arctic ecosystems. In this study, we show the potential of mapping vegetation communities at a study site in Svalbard using data obtained with an uncrewed aerial system (UAS). Using multispectral and LiDAR UAS data at a resolution of 10cm, we computed several spectral indices and terrain features that are linked to factors affecting plant community composition, such as topographic wetness or slope. Model training and validation were performed using data from in situ vegetation plot analysis and visual inspection of orthomosaics. Using a random forest classifier, we mapped 13 land cover types commonly found at our study site in Bjørndalen. The resulting map covers 140ha and shows the fine-scale distribution of several ridge, heath, snowbed, and wetland vegetation communities. Our classification model achieved a class-weighted F-score of 74%, demonstrating the suitability of using UAS data to perform land cover classification in Svalbard. Comparisons to existing land cover products for Svalbard show high agreement for coarse aggregated classes, while also revealing high sub-pixel land cover diversity in maps based on satellite data. This highlights the importance of matching classification scheme granularity to spatial resolution and shows the need for cm-level data to map Arctic vegetation.

Session Chair

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On-site Session Chair

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Session Classification: Oral Session

Track Classification: 8. Remote Sensing, Autonomous Technologies, and Polar Observing

Contribution ID: 9

Type: **Oral**

Changes in Arctic sea ice drift speed over the past 130 years

Wednesday 25 March 2026 09:30 (13 minutes)

The Arctic transpolar sea ice drift speed shows a pronounced increase over past decades, one of many manifestations of Arctic climate change. However, little is known so far how the drift changed in earlier periods. Here I use data from historical drift expeditions, in particular from the Fram in 1893-96, the Sedov in 1937-40, the Tara in 2007-08, and the Polarstern during MOSAiC in 2019-20, as well as from USSR/Russian North Pole drift stations, to derive a 130-year record of Arctic transpolar drift speed. The transpolar drift speed already increased significantly during the early 20th century warming, followed by a period of slowing drift in the 1950s –70s. Multifractal analysis of the scale dependence of the drift trajectories sheds further light on the causes of the changing Arctic sea ice drift speed.

Session Chair

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On-site Session Chair

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Contribution ID: 10

Type: Oral

Modeling Ocean –Sea Ice Interactions Using the E3SM Arctic-Refined Eddy-Resolving Ocean and Sea Ice (AEROSI) Model Forced with Atmospheric Reanalysis

Tuesday 24 March 2026 11:15 (13 minutes)

Numerous and often common ocean and sea ice biases in the Pan-Arctic region persist in simulations with state-of-the-art Earth System models (ESMs), including in those participating in the Coupled Model Intercomparison Project Phase 6 (CMIP6) as well as in ocean reanalyses, and operational ocean and sea ice prediction systems. Some of these biases are related to model limitations in resolving land geometry and bathymetry (including narrow and/or shallow Arctic-Subarctic gateways), small-scale processes (e.g., mesoscale eddies, coastal and boundary currents, or sea ice deformations), their contribution to coupling with the atmosphere, and impact on time-varying states of the Arctic and global ocean, and sea ice.

The E3SM-AEROSI model aims to provide a process-level baseline of the Arctic Ocean and sea ice time-varying states not readily available from observations, connection to the lower latitude oceans, and a guidance for future observations and development of improved parameterizations of Arctic-relevant processes missing or under-represented in coarser resolution models. Its configuration is based on the standard E3SM high-resolution (6km to 18km) grid in the southern hemisphere, while it incorporates a regionally refined mesh with 3km-width cells throughout the pan-Arctic region and along the western boundary currents, increasing to 6 km in the northern mid-latitudes, up to 18 km within the equatorial zone. The model has been forced at the surface with the Japanese 55-year atmospheric reanalysis (JRA55-do). This talk will present selected results on the evolution of the Arctic sea ice, eddy kinetic energy field, Arctic-Subarctic exchanges, and potential impacts on the global ocean circulation.

Session Chair

yes

On-site Session Chair

yes

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Session Classification: Oral Session

Track Classification: 7. Modeling Arctic Processes: Integrating Scales and Observations

Contribution ID: 11

Type: **Poster**

IceBird Summer 2025 –Joint Surveying Activities with RV Polarstern Cruise CONTRASTS

Monday 23 March 2026 18:35 (5 minutes)

Airborne observations of thickness and surface properties are a key component of Arctic sea ice research, particularly during summer melt season when melt ponds influence both ice mass balance and remote-sensing retrievals. The AWI IceBird program conducts annual surveys to obtain such key data sets. In 2025, the IceBird aircraft campaign was conducted in coordination with the RV Polarstern cruise CONTRASTS, which carried out in situ measurements in three distinct sea ice regimes. This coordination enabled targeted grid surveys with aircraft Polar 6 over CONTRASTS ice stations in second-year and multi-year ice.

Polar 6 was equipped with the EM-Bird electromagnetic induction system, a topographic and bathymetric laser scanner, the MACS camera system, and additional optical sensors. Measurements provided a comprehensive, multi-sensor dataset that can be directly compared with ground-based, helicopter-borne, and drone-based observations acquired during CONTRASTS. To achieve accurate coregistration across platforms, ground targets visible from all measurement systems were deployed on the ice. A stable local coordinate system was established for each ice regime, with at least two targets remaining in place during Polarstern's absence. Ground-based measurements were referenced in situ using a tachymeter, and all datasets were transformed into the common coordinate framework.

We present first results from the multi-platform colocation, including a preliminary assessment of positional accuracy and consistency between measurement systems. Furthermore, we compare ice thickness distributions derived from ground-based, helicopter-borne, and airborne surveys, and provide initial insights into the seasonal evolution of sea ice thickness in selected CONTRASTS regions between winter and summer 2025.

Session Chair

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On-site Session Chair

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Session Classification: Poster

Track Classification: 8. Remote Sensing, Autonomous Technologies, and Polar Observing

Contribution ID: 12

Type: **Poster**

Assessment of Circulation Weather Types around Svalbard and their Impact on the Ny-Ålesund atmospheric column

Monday 23 March 2026 17:40 (5 minutes)

The meteorological conditions in Ny-Ålesund (NYA) are strongly shaped by the prevailing large-scale weather regime, such as southerly, northerly, cyclonic, or anticyclonic weather patterns. To systematically classify these regimes, we applied the Jenkinson–Collison (JC) algorithm to the Svalbard region, generating a set of characteristic circulation weather types (CWT) that affect the NYA atmospheric column. Using hourly ERA5 850hPa geopotential height (GEOP) reanalysis data, we constructed a 40+ year CWT catalogue and investigate composites and trends in key thermodynamic variables, derived from AWIPEV observations such as radiosonde (RS) launches and Baseline Surface Radiation Network (BSRN) measurements.

Session Chair

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On-site Session Chair

no

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Contribution ID: 13

Type: **Poster**

Sea-ice ridges and their role in the Arctic sea-ice ecosystem –new findings from the MOSAiC expedition

Monday 23 March 2026 18:25 (5 minutes)

Sea-ice ridges (or more precisely, deformed ice) constitute a large fraction of the Arctic sea-ice volume, probably order of 30-50%. Yet, we know disproportionately little about their role in the coupled system. In situ studies of ridges are logistically challenging, and as a result, most research has focused on level sea ice. Here, we highlight findings from the MOSAiC expedition that showcase the dynamic nature of the sea-ice physical environment and this the ridge as habitat and their potential contributions to sea-ice biomass and biodiversity.

Unique habitats within ridges, including surfaces of ice blocks in association with water-filled voids, showed distinct differences in biological properties compared to level ice bottom and pelagic biota. These ridge-specific habitats had unique protist and bacterial assemblages contributing to the high diversity and richness found in Arctic sea ice. Winter observations indicate that ridge formation can release organic material from level ice to the water column, a potential energy source for pelagic grazers during the polar night. In summer, ridges can be hotspots of protist biomass and can contain $80 \pm 20\%$ of sea-ice algal biomass - a contribution not considered in Arctic assessments. During the melt season, consolidation (the freezing of water-filled voids), reduced habitable space inside ridges for algae and larger biota, transforming species assemblages while simultaneously increasing bacterial activity with unknown consequences for the role of ridges in the Arctic carbon cycle.

We argue that sea-ice ridges must be included in assessments of Arctic Ocean biodiversity and biogeochemistry to fully understand the Arctic sea-ice ecosystem and its response to ongoing changes. Future efforts should not only investigate the complex physical and biological processes within sea-ice ridges but also integrate these processes into models. Only then we can predict how the changes in the Arctic icescape will affect atmosphere-ice-ocean-ecosystem interactions.

Session Chair

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On-site Session Chair

no

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Session Classification: Poster

Track Classification: 1. Arctic Interfaces: Leads, Ridges, and Fractures

Contribution ID: 14

Type: **Poster**

Assessing the Ability of CMIP6 Models to Capture Northern Hemisphere Circulation Patterns: A Data-Driven Analysis

Monday 23 March 2026 17:35 (5 minutes)

The accelerated warming of the Arctic relative to the rest of the globe has sparked ongoing debate about its influence on Northern Hemisphere atmospheric circulation. Many studies suggest that this warming may alter large-scale circulation through changes in temperature gradients, storm tracks, and planetary wave dynamics. Global climate models (GCMs) are the main tools used to explore these changes, yet uncertainties in their formulation and resolution can affect simulated circulation patterns. Assessing how well current models reproduce present-day circulation regimes is therefore essential. In this study, we evaluate the ability of CMIP6 GCMs to reproduce observed large-scale Northern Hemisphere circulation patterns analysed from ERA5 reanalysis data. Our analysis focuses on mean sea level pressure (MSLP) and employs a physically informed convolutional autoencoder combined with k-means clustering, as data-driven climate classification workflow using unsupervised deep learning that reduces the dimensionality of spatiotemporal climate simulation data into compact representations. The results show that CMIP6 models generally capture the frequency and persistence of Northern Hemisphere MSLP patterns seen in ERA5, particularly during winter and spring, although performance varies across models. The ensemble mean slightly underestimates the amplitude of MSLP anomalies in all seasons, most notably in summer. Despite this bias, the main circulation patterns and their seasonal characteristics are reasonably well reproduced. Overall, these findings support the use of CMIP6 models to investigate potential shifts in atmospheric circulation under Arctic Amplification and their associated impacts.

Session Chair

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On-site Session Chair

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Contribution ID: 15

Type: **Poster**

The effect of improved turbulence parametrization in ICON-NWP on simulations of Arctic winter stable-boundary layers during MOSAiC

Monday 23 March 2026 16:30 (5 minutes)

During Arctic winter conditions turbulent fluxes play a major role coupling the sea-ice surface with the atmosphere aloft. Since climate models often struggle to accurately model this turbulent exchange in the predominantly stably stratified Arctic boundary layer it is still a major source of model uncertainty [1]. Therefore, we implemented an improved turbulent flux parametrization [2] into ICON-NWP based on observations from the SHEBA campaign in 1997 and evaluate the results with observations from the MOSAiC expedition [3]. The new parametrization is tested in a limited-area set-up with 2.5 km resolution as well as in a Pan-Arctic set-up with 11km resolution. The simulations are forced with ERA-5 and use an adapted sea-ice scheme [3]. The new parametrization improves fluxes in very stable situations by strongly reducing turbulent heat flux. This leads to stronger near-surface stability and slightly higher wind speeds while revealing general model deficiencies. These effects are also evident in the Pan-Arctic set-up and show significant changes over all sea-ice covered areas with regional varying patterns that are further investigated.

This work was supported by the DFG funded Transregio-project TRR 172 “Arctic Amplification (AC)3”.

References

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- [2] V. Gryanik u. C.Lüpkes, „New Modified and Extended Stability Functions for the Stable Boundary Layer Based on SHEBA and Parametrizations of Bulk Transfer Coefficients for Climate Models“, Journal of Atmospheric Science Vol.77, 8, (2020), DOI 10.1175/JAS-D-19-0255.1.
- [3] D. Littmann, „Eddy Simulations of the Arctic Boundary Layer around the MOSAiC Drift Track“. Dissertation, Universität Potsdam (2024), DOI 10.25932/PUBLISHUP-62437

Session Chair

no

On-site Session Chair

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Session Classification: Poster

Track Classification: 7. Modeling Arctic Processes: Integrating Scales and Observations

Contribution ID: 16

Type: **Poster**

Year-round assessment of sea ice pressure ridges using multi-frequency electromagnetic induction sounding

Monday 23 March 2026 16:55 (5 minutes)

The thickness and consolidation state of pressure ridges are key variables for sea ice mass balance, melt processes, and ecosystem habitats. We demonstrate that both can be detected using multi-frequency electromagnetic induction (EMI) sounding, based on data collected during MOSAiC. We validate EMI results using collocated sea ice topography from an airborne laser scanner, underwater topography from multibeam sonar, and ice thickness and structure from drill holes and ice-mass-balance buoys. Low-frequency channels provide reliable estimates of total ridge thickness, while high-frequency channels resolve the consolidated layer thickness. The MOSAiC EMI dataset covers numerous ridge systems formed between freeze-up and break up, with nine ridge transects capturing seasonal evolution. The footprint size and sensitivity of EMI make it suitable for detecting ridges up to 10 m thick. Where available, independent ridge structure measurements agree with our other measurements. The extensive temporal and spatial coverage of the MOSAiC EMI data reveal a gradual reduction of total thickness toward the consolidated layer thickness. Notably, the consolidated layer is 1.6–2 times thicker than level ice and, for some ridges, shows a seasonal decrease, possibly linked to the thin snow cover during MOSAiC. Overall, multi-frequency EMI is a promising non-intrusive method for pressure ridge surveying with strong potential for expanding ridge datasets.

Session Chair

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On-site Session Chair

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Session Classification: Poster

Track Classification: 1. Arctic Interfaces: Leads, Ridges, and Fractures

Contribution ID: 17

Type: **Poster**

Significant snowfall trends throughout Antarctica detected in station observations

Monday 23 March 2026 18:30 (5 minutes)

Variability in the amount and phase of precipitation over Antarctica is of high relevance for the Antarctic sea-ice cover and ice sheets, which are crucial components of the global climate system. However, reliably quantifying the amount of precipitation over Antarctica is challenging, both from an observational and a modelling perspective.

A comparatively sound yet not extensively utilized source of precipitation data consists of meteorological synoptical observations conducted by station personnel across Antarctica. Based on these manual observations, we deduce timeseries of monthly snowfall frequencies for 10 different stations throughout Antarctica spanning the years 1986-2024 and detect significant trends in snowfall frequency for various stations. This reveals a regionally contrasting picture: I) an increase in snowfall frequency at Neumayer station in Dronning Maud Land, at Mc Murdo station at the coast of the Ross Sea, and at Amundsen-Scott station at the geographic south pole; and II) a decrease in snowfall frequency at the majority of the stations situated on the Antarctic peninsula, which is also found for overall precipitation (snow and rain).

Taken together, these results point to a poleward shift of Antarctic precipitation, with enhanced snowfall at the Antarctic coast and continent, and reduced snowfall at the Antarctic peninsula. Throughout the analysis period, we further find a significant poleward shift of storm tracks around the Antarctic continent, which could be an explanation for the changes in snowfall frequency. At Neumayer station, this hypothesis is supported by a decomposition of daily snowfall events into cyclone and non-cyclone related precipitation. Ongoing work consists of extending this analysis to the remaining Antarctic stations.

Session Chair

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On-site Session Chair

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Session Classification: Poster

Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 18

Type: **Poster**

Contrasting Optical Properties in Different Sea Ice Regimes

Monday 23 March 2026 17:45 (5 minutes)

The Arctic Ocean and its sea ice cover are undergoing rapid changes. Solar radiation plays a key role in controlling sea ice melt processes. This study quantifies the transmission of solar radiation through sea ice across three distinct ice regimes during the Arctic summer.

The data were collected during the German research icebreaker Polarstern expedition CONTRASTS (PS149, July–August 2025). Three ice floes representing different ice regimes were revisited three to four times. Under-ice radiation and sea ice draft were measured on a 200 m × 200 m grid using the under-ice remotely operated vehicle "Beast".

Light transmission was strongly modulated by short-term weather events such as snow- and rainfall, as well as by medium-term evolutions such as progressive melting/thinning, melt pond growth/drainage and surface evolution. For example, a snowfall event reduced transmission in Regime 1 by approximately 35%, temporarily reversing the seasonal brightening and causing it to transmit less light than Regime 2. Snowfall and freeze-up exert comparable effects on transmission statistics, including mean values, entropy, and spatial variability.

Large inter-regime differences in mean transmission were evident, particularly in early July, when Regime 3 transmitted only up to 26% and Regime 2 about 42% of the radiation observed in Regime 1. These differences strongly influenced the energy absorbed by the upper ocean and the resulting basal melt rates. Comparisons with in situ measurements indicate that transmitted solar radiation alone cannot explain observed basal melting, highlighting the importance of additional processes such as oceanic and atmospheric heat fluxes and lateral processes.

Session Chair

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On-site Session Chair

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Session Classification: Poster

Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 19

Type: Oral

Retrieving Arctic Summer Sea Ice Thickness below Melt Ponds from Hyperspectral Optical Measurements

Thursday 26 March 2026 11:30 (13 minutes)

This study demonstrates how to retrieve the sea ice thickness beneath Arctic melt ponds from optical measurements. Analysis of an extensive new dataset of hyperspectral melt pond measurements agree with previous model studies that melt pond reflectance - especially between 400–500 nm - exhibits a distinct relationship with pond-bottom ice thickness. Building on this relationship, we present a new retrieval concept designed for both optical field observations and satellite applications.

In future, satellite sea ice thickness retrievals based on this approach could add crucial information for the sparsely observed summer melt season. Surface melt and wet snow disrupt microwave radar penetration and alter passive microwave emissivity, hindering standard satellite sea ice thickness products based on altimetry and radiometry during melt. While numerous modelling studies have highlighted a clear link between melt pond reflectance and pond-bottom ice thickness, and have broadly suggested its potential for remote sensing, this study provides an extensive observational dataset to test these simulations and explicitly targets the development of a satellite retrieval concept for summer sea ice thickness beneath melt ponds.

The relationship between reflectance and under-pond ice thickness is derived from an in-situ dataset of 67 hyperspectral optical images (400–1000 nm) with co-located ice thickness and melt-pond depth measurements, collected during the *CONTRASTS* expedition on RV *Polarstern* (PS149, July–August 2025). Physical forward simulations of melt pond reflection agree well with the observed empirical relation. These simulations also support the significant differences observed in reflectance spectra between homogeneous pond-bottom structures and pond bottoms containing enclosed air bubbles.

Session Chair

no

On-site Session Chair

no

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Presenter: RINGEL, Maximilian Harald (University of Bremen, Institute of Environmental Physics (IUP))

Session Classification: Oral Session

Track Classification: 8. Remote Sensing, Autonomous Technologies, and Polar Observing

Contribution ID: 20

Type: Oral

The vertical distribution of the water vapor impacts the surface radiation in the Arctic

Wednesday 25 March 2026 12:00 (13 minutes)

Water vapor mixing ratio (WVMR) profiles are available from continuous measurements by a Raman lidar which were performed during the MOSAiC expedition on board the icebreaker Polarstern in the Central Arctic from October 2019 to February 2020. To take into account the vertical distribution of the water vapor, we defined a vertically representative temperature T_{rep} of each WVMR (lidar) profile by calculating the water vapor-weighted mean temperature using the radiosonde temperatures (Seidel et al. (2025)). The downward, broadband thermal-infrared irradiance at the ground (DTIR) was measured at the bow crane during MOSAiC. The Stefan-Boltzmann law is used to retrieve the temperature T_{rad} from the DTIR.

7 periods of long-lasting measurements in cloud-free and low-aerosol conditions were identified, during which the air mass over the ship varied only slowly. For the 7 cases, T_{rad} is related to T_{rep} with a coefficient of determination of the linear correlation of 0.92. A linear regression of the DTIR as a function of vertically integrated water vapor (IWV) shows a coefficient of determination larger than 0.95 for 5 out of the 7 cases (0.77 and 0.84 for the remaining 2 cases). The slope of the linear regression ranges between 8.24 and 10.99 W kg⁻¹ for the 5 cases.

Further on, individual WVMR profiles from 53 independent air mass events revealed that T_{rad} is related to T_{rep} with a coefficient of determination of the linear correlation of 0.71. For the 53 independent profiles, a slope of the linear regression of DTIR as a function of IWV of 19.95 W kg⁻¹. This fits with the results of Ghatak & Miller (2013).

References:

Seidel et al., [<https://doi.org/10.1029/2024JD042378>] (2025)

Ghatak & Miller, [<https://doi.org/10.1002/jgrd.50578>] (2013)

Session Chair

yes

On-site Session Chair

yes

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Presenter: ALTHAUSEN, Dietrich

Session Classification: Oral Session

Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 21

Type: Oral

Physical properties of ice beneath melt ponds and consequences for optics, bulk salinity, and freeboard

Tuesday 24 March 2026 09:00 (13 minutes)

Melt ponds occupy approximately 30% of the area of Arctic sea ice in the summer. However, the physical properties of the ice beneath melt ponds is rarely studied. Consequently, many models and remote sensing retrievals assume that the ice beneath ponds has the same properties as unponded ice. Some models do distinguish the inherent optical properties (IOPs) of ice beneath ponds from unponded ice, however even these models typically assume that all ice under ponds have the same IOPs. We measured vertical profiles of sea ice salinity, density, and microstructure beneath ponds and in unponded ice on the recent CONTRASTS expedition. We find that ice under ponds is less saline and less dense than bare ice. We also explore the relationships between the physical properties of ice beneath ponds and the apparent optical properties (spectral albedo and transmittance). Finally we consider the impacts of pond ice properties on floe-scale quantities such as bulk salinity and freeboard.

Session Chair

yes

On-site Session Chair

yes

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Presenter: CLEMENS-SEWALL, David (University of Colorado Boulder)

Session Classification: Oral Session

Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 22

Type: **Oral**

Not All Sea Ice Melts Alike: Distinct Summer Albedo Regimes in Arctic Sea Ice

Tuesday 24 March 2026 09:15 (13 minutes)

Sea ice albedo plays a crucial role in the Arctic energy balance between the ocean, ice, and atmosphere. As the Arctic sea ice cover transitions from thick, hummocked multi-year ice to thin first-year ice, the albedo evolution of the melt season is also changing. Understanding how the albedo of distinct sea ice regimes differ is needed to improve model representation of sea ice and subsequent energy balance in past, current, and future climate states. CONTRASTS was an international, interdisciplinary expedition on the icebreaker R/V Polarstern focused on how atmosphere-ice-ocean-ecosystem processes in different sea ice regimes evolve over the melt season and early freeze-up under similar large-scale forcing. Using albedo measurements collected on CONTRASTS, we find first-year ice, deformed first-year ice, and multi-year ice each had a unique albedo evolution, especially in melt pond development. Multi-year ponds developed fastest but had the least change throughout the melt season, with a minimum and maximum mean broadband albedo of 0.27 and 0.32. Melt ponds on deformed first-year ice had slower darkening evolution than other first-year ice, but all first-year floes reached a similar mean pond albedo by late summer (broadband 0.17-0.18). We also investigate the physical properties that govern albedo variability, particularly ice thickness, snow/surface scattering layer depth, and pond size. Short-term variability is dominated by precipitation events, moderated by the largely unaffected melt ponds. We find pond albedo is more directly related to underlying ice thickness than pond depth. These results demonstrate that sea ice physical properties can be used to understand melt season albedo evolution in diverse sea ice regimes, which can help support model development.

Session Chair

no

On-site Session Chair

no

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Presenter: GREENWOOD, Nora

Session Classification: Oral Session

Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 23

Type: **Poster**

Ranking the importance of solar zenith angle, surface albedo, and clouds in the surface solar energy budget during the MOSAiC expedition

Monday 23 March 2026 18:55 (5 minutes)

The relevant parameters that are most relevant to solar radiative energy budget (REB) at the Arctic surface are cloud total water path (TWP), surface albedo (α) and solar zenith angle (SZA).

Using a coupled regional atmosphere-ocean-sea ice for Arctic climate studies, we analysed the dependence of changes in net surface solar irradiance (F_{net}), which quantifies the REB at the surface, on typical variations in TWP, α and SZA. These simulations covered the period of polar day during the MOSAiC expedition in 2020. We then applied a machine learning algorithm to a trained prediction model to estimate the importance of each of the three parameters ($\mathcal{I}$, $\mathcal{I}_{\text{TWP}}$, $\mathcal{I}_{\text{SZA}}$).

We identified regional and temporal differences. Generally, $\mathcal{I}$ showed the greatest variability in its spatial distribution, with high values in the central Arctic and the Beaufort Sea, and low values in the Greenland and Barents–Norwegian Seas. The temporal evolution of the three components of feature importance was found to be driven by the seasonal cycle of the variation and absolute values of cloud TWP, α and SZA.

We give estimates under which conditions either the cloud TWP or surface albedo is more relevant to changes in F_{net} .

Given the prospect of a warmer Arctic in the future, it is reasonable to assume that the role of clouds in the surface solar radiative energy budget will become more significant during the sunlight season.

Session Chair

no

On-site Session Chair

no

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Presenter: JÄKEL, Evelyn (Leipzig Institute for Meteorology, Leipzig University)

Session Classification: Poster

Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 24

Type: Oral

Snow in focus: How does snow cover variability affect the sea-ice energy balance? A multiscale measurement approach in McMurdo Sound, Antarctica

Tuesday 24 March 2026 11:30 (13 minutes)

Snow strongly controls sea-ice thermodynamics, yet spatial variability and nonlinear processes remain poorly measured and understood, especially in Antarctica. We investigate how snow influences the sea-ice energy balance and evolution in McMurdo Sound, Antarctica, using high-resolution airborne and ground-based observations combined with process-focused modeling in SNOWPACK. Our measurement strategy is closely aligned with snow observations from the MOSAiC expedition, enabling direct process-level comparison with Arctic datasets.

We map snow surface temperature and topography at 10-cm resolution over four $\sim 100 \text{ m} \times 100 \text{ m}$ test fields using Uncrewed Aerial Vehicle (UAV) surveys and integrate these data sets with ground-based snow depth and sea-ice thickness measurements following MOSAiC-consistent protocols. We then combine Digital Elevation Models (DEMs) with measured radiation time series to model irradiance and quantify variability in radiative forcing arising from snow redistribution and surface topography.

We run the sea-ice version of SNOWPACK to examine the heterogeneity of snow surface temperature, snow depth, and irradiance, focusing on nonlinear processes such as lateral heat transfer driven by depth and temperature gradients and the insulating effect of snow on conductive heat fluxes between ocean, ice, and atmosphere.

By linking fine-scale snow variability to modeled energy fluxes and ice thickness evolution, we assess how snow distribution drives sea-ice growth and melt, providing insights that support comparison with Arctic observations and contribute to improved representation of snow-driven processes in sea-ice models.

Session Chair

no

On-site Session Chair

yes

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Session Classification: Oral Session

Track Classification: 7. Modeling Arctic Processes: Integrating Scales and Observations

Contribution ID: 25

Type: **Oral**

A Brighter Arctic Ocean: Trends in Solar Partitioning in the Arctic Sea Ice - Ocean System from 1984-2022

Tuesday 24 March 2026 09:30 (13 minutes)

Sunlight is the primary energy source for the ocean. In the Arctic, the presence of sea ice limits how much sunlight reaches the ocean because sea ice is highly reflective. In this work, we determined the amount of sunlight that: (1) gets reflected by the ice, (2) gets absorbed by the ice, and (3) reaches the ocean in the Arctic. We used a combination of satellite and model products, along with a simple model to examine the fate of sunlight during the 1984-2022 period. We found that less sunlight is being reflected ($-0.022 \text{ decade}^{-1}$ or $-78.4 \text{ MJ m}^{-2} \text{ decade}^{-1}$ solar heat) and absorbed by sea ice ($-0.012 \text{ decade}^{-1}$ or $-37.1 \text{ MJ m}^{-2} \text{ decade}^{-1}$ solar heat). The end-result is that more sunlight is reaching the Arctic Ocean, with an increasing trend of $0.031 \text{ decade}^{-1}$ ($79.2 \text{ MJ m}^{-2} \text{ decade}^{-1}$ solar heat). These changes are attributed to less sea ice coverage, except for in areas where ice concentrations remain high. In those areas, thinning sea ice is the primary driver. Overall, the Arctic Ocean has become brighter and warmer, with an additional $\sim 300 \text{ MJ m}^{-2}$ of solar heat over 1984-2022. These changes are largest in the most southerly regions of the Arctic, but contribute to Arctic warming and may have significant effects on the marine food web.

Session Chair

yes

On-site Session Chair

no

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Contribution ID: 26

Type: Oral

Radiative Forcing of Black Carbon in Snow: Insights from the MOSAiC Expedition

Tuesday 24 March 2026 10:30 (13 minutes)

Snow and ice play a key role in the Earth's radiation balance due to their high albedo. However, when light-absorbing aerosols such as Black Carbon (BC) are deposited on snow surfaces, its' reflectivity is reduced, which can substantially accelerate melting.

To quantify BC in salt-contaminated snow on sea ice, a newly developed, artefact-free method based on measurements with a Single Particle Soot Photometer (SP2) and a nebuliser was applied. This method was used to analyse snow samples collected during the year-round MOSAiC expedition, resulting in the first nearly year-long continuous dataset of BC concentrations in snow from the central Arctic. Observed BC concentrations ranged from 0.03 to 75.11 ng/g, providing a robust basis for assessing seasonal and spatial variability as well as potential impacts on snowmelt processes.

These concentrations were subsequently used as input for the SNICAR (Snow, Ice, and Aerosol Radiative) radiative transfer model to quantify the impact of BC on snow albedo and melt. The highest BC values, which were likely affected by local sources, produced peak instantaneous radiative forcings exceeding 6 W/m^2 at maximum solar elevation. This is markedly higher than the forcing calculated for the majority of samples ($0.05\text{--}1.86 \text{ W/m}^2$). Consequently, melt amounts exceeding 20 cm of water equivalent were obtained for the highest BC concentrations, whereas simulations using mean concentrations produced substantially lower melt values. These findings raise important questions about the current state of the Arctic and its future evolution.

Session Chair

yes

On-site Session Chair

yes

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Contribution ID: 27

Type: **Poster**

A Novel Artefact-Free Method for Quantifying Black Carbon in Snow: Results from Arctic and Antarctic Case Studies

Monday 23 March 2026 17:20 (5 minutes)

Snow albedo strongly influences the Earth's radiation balance and can be reduced by light-absorbing aerosols such as black carbon (BC), thereby enhancing melt. Reliable quantification of BC in polar snow remains challenging, particularly on sea ice, where dissolved salts cause severe matrix effects and systematic underestimation of BC when using a Single Particle Soot Photometer (SP2) coupled with a nebuliser.

An artefact-free method for quantifying BC in saline snow samples is presented. Conductivity-related matrix effects are addressed through a combination of empirically derived correction functions and a dedicated desalination procedure for samples exceeding the operational limits of the instrument. This approach enables unbiased BC measurements across a wide range of salinities typically encountered in polar snow on sea ice.

The methodology was applied to snow samples from both, the Arctic and Antarctica. A nearly year-long series collected during the MOSAiC expedition illustrates applicability to saline Arctic snow. Samples obtained during the REBCASA campaign at Neumayer Station III, East Antarctica, exhibit BC concentrations two to three orders of magnitude lower and substantially reduced spatial variability, indicating pronounced hemispheric differences in BC loading.

Measured BC concentrations were subsequently used as input for the SNICAR radiative transfer model to illustrate the implications for snow albedo reduction and instantaneous radiative forcing, and to estimate associated melt effects.

Overall, the presented methodology provides a transferable framework for artefact-free BC measurements in polar snow and strengthens the basis for quantifying BC-related cryospheric feedbacks.

Session Chair

yes

On-site Session Chair

yes

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Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 28

Type: **Poster**

First Insights from the CONTRASTS Expedition: Sea Ice Surface Heterogeneities and Their Impact on the Arctic Near-Surface Atmosphere in Summer

Monday 23 March 2026 18:45 (5 minutes)

Accurately quantifying atmospheric turbulent fluxes over Arctic sea ice remains challenging also due to inadequate representation of small-scale surface-atmosphere interactions in mesoscale models. The complexity arises from pronounced surface heterogeneity—including melt ponds, leads, and pressure ridges—combined with incomplete knowledge of how these features affect near-surface turbulent heat exchange.

During the summer 2025 CONTRASTS expedition, we collected an extensive observational dataset to investigate how surface heterogeneity influences turbulent heat exchange. Our research focus was to capture potential differences in fluxes across heterogeneous surfaces, such as melt ponds, leads and pressure ridges. We set up two mobile towers to measure turbulent fluxes of latent and sensible heat. The measured turbulent heat fluxes mostly ranged between -20 W/m^2 and $+20 \text{ W/m}^2$ with spatial differences on the order of 0-40% over different surface morphologies. In the lee of ridges, we observed fluxes of opposite sign at 1m and 2m heights, which we attribute to flow separation.

Additionally, we set up thin synthetic screens vertically across transitions in surface morphology. The screens are thin enough to quickly adapt to ambient air temperature. By filming the screens with a thermal infrared camera, we obtain cm-scale and sub-second resolution information of the near-surface boundary layer thermodynamics all the way down to the lowest layer of air adjacent to the surface. First results at the transition from ocean to ice show a warming of the air adjacent to the ice by 0.2°C within 3m of horizontal distance and a resulting slight decrease in atmospheric static stability.

Our dataset is complemented by aerial measurements of surface albedo with an Unmanned Aerial Vehicle (UAV) flying horizontal grids at 5m height and vertical profiles up to 100m.

In this contribution, we show a first analysis of the new dataset assessing the effect of differences in surface morphology on the atmospheric turbulent fluxes near the sea ice surface.

Session Chair

no

On-site Session Chair

no

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Session Classification: Poster

Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 29

Type: **Oral**

Observations of snow accumulation and melt on sea ice ridges

Wednesday 25 March 2026 09:15 (13 minutes)

Sea ice ridges constitute a substantial fraction of the total sea ice area and volume, with moored sonar observations suggesting that they account for roughly 30% of the ice-covered area. Owing to their enhanced surface roughness, ridges accumulate two to three times more snow than level ice. Their porous internal structure, combined with a thick snow cover, creates distinct habitats for diverse biological communities by seasonally modifying the under-ice light field. Owing to their enhanced surface roughness, snow accumulation alters the above-water morphology of ridges, complicating satellite and airborne retrievals of their total ice volume.

In this study, we examine the seasonal evolution of three individual ridges using colocated observations of ice draft from underwater sonar and snow freeboard from airborne laser scanning. The apparent above-water width and area of ridge sails increase steadily throughout winter and spring due to snow accumulation, followed by a rapid reduction during summer associated with snowmelt. Despite differences in formation timing, all three ridges exhibit similar sail-to-keel ratios. Extending the analysis to the full 40 km² laser-scanner survey area, we further show that the mean ridge sail width gradually doubles over the winter season, in parallel with a threefold increase in ridge frequency.

These results can support improved parameterizations of the under-ice light field, leading to more accurate representations of sea ice mass balance and biogeochemical processes. Moreover, insights into the thickness and seasonal evolution of ridge snow cover may help link readily observable above-water ridge dimensions to their otherwise poorly constrained total ice volume.

Session Chair

yes

On-site Session Chair

yes

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Presenter: SALGANIK, Evgenii (Alfred Wegener Institute for Polar and Marine Research)

Session Classification: Oral Session

Track Classification: 1. Arctic Interfaces: Leads, Ridges, and Fractures

Contribution ID: 30

Type: Oral

Impact of surface mixed-layer coupling on ice formation in Arctic mixed-phase clouds during MOSAiC

Wednesday 25 March 2026 11:45 (13 minutes)

Shallow mixed-phase clouds are frequent in the Arctic with significant climate impacts on the local climate. These clouds occur either coupled or decoupled from the surface mixed-layer (SML). The respective coupling state influences the clouds microphysical properties. These implications are especially prominent at slight supercooling temperatures, where the conditions for ice formation in mixed-phase clouds is strongly controlled by the available ice nucleating particles (INP). The annual cycle of Arctic mixed-phase cloud ice-formation temperatures is presented for the year-long Arctic expedition MOSAiC in 2019 and 2020. From October 2019 through March 2020 no clouds with minimum temperatures above -10°C were observed. From April to September 2020 an increased fraction of ice-containing clouds was observed for clouds with minimum temperatures between -7.5°C and -5°C . The clouds were separately analyzed by their SML-coupling state. The fraction of ice-containing clouds with a minimum temperature above -7.5°C under SML-coupled situations was enhanced from April to September. SML-coupled clouds from April to July showed a 2–3 times higher probability to contain ice at temperatures above -15°C . In August and September this ratio was reduced to 1.3. The found correlation between occurrence of ice in SML-coupled clouds and surface-based INP measurements suggests that the observed phenomena can likely be attributed to the presence of INPs active above -15°C at the surface. Analysis of sea-ice concentration in the surrounding region, the distance to the ice edge, and back-trajectories of the observed clouds support this finding. Free-tropospheric cloud statistics for MOSAiC indicate that these decoupled, ice-containing clouds at $T > -10^{\circ}\text{C}$ in August + September are likely still influenced by surface processes and a clear separation from the surface is only reached in higher altitudes.

Session Chair

yes

On-site Session Chair

yes

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Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 31

Type: Oral

Viral Alchemy in the Arctic: How Polar Viruses Reprogram Microbial Metabolism and Respond to Climate Change

Thursday 26 March 2026 09:30 (13 minutes)

The Arctic Ocean is warming at approximately three times the global average, profoundly altering microbial communities that regulate marine biogeochemical cycles. Viruses are central to these processes by controlling host populations and reprogramming cellular metabolism through auxiliary metabolic genes (AMGs), yet their taxonomic diversity and functional roles in polar oceans remain insufficiently resolved. Improving our understanding of Arctic viral–host interactions is therefore critical for predicting ecosystem responses to rapid environmental change.

We performed viral metagenomic analyses on five Fram Strait samples collected in July 2024, using FeCl₃ flocculation, Illumina paired-end sequencing, and a comprehensive bioinformatic workflow. We recovered 10,882 high-quality viral contigs (87.08 Mbp), dominated by dsDNA viruses (87.8%) but with an unexpectedly high contribution of ssDNA viruses (12.2%). Clustering yielded 6,198 viral operational taxonomic units (vOTUs), indicating extensive species-level diversity. Network-based taxonomic classification revealed that most vOTUs belong to Caudoviricetes within Duplodnaviria, yet more than one third could not be confidently assigned beyond high taxonomic ranks, reflecting deep evolutionary novelty. Identified lineages include diverse members of Kyanoviridae, Straboviridae, Demerecviridae, and Zobellviridae, alongside numerous novel orders and families, and the presence of giant algal viruses (Mimiviridae, Phycodnaviridae) and virophages.

Protein annotation identified 366 AMGs indicative of complex metabolic reprogramming. These include 131 putative 2-oxoglutarate–Fe(II)-dependent oxygenases, ferredoxins, Fe–S cluster assembly proteins, and porphyrin/heme biosynthesis enzymes that enhance redox capacity and redirect central carbon and energy fluxes toward viral replication. Glycosyltransferases and anti-restriction proteins modify host surface structures and suppress defense systems, while ribosomal and stress-response genes may prolong infected cell viability.

Together, these results reveal an exceptionally diverse and taxonomically novel Arctic virome with sophisticated metabolic manipulation strategies. This comprehensive Fram Strait viral survey provides a critical baseline for assessing how climate-driven environmental change may reshape viral diversity, function, and ecosystem-level impacts in polar oceans.

Session Chair

no

On-site Session Chair

no

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Presenter: POPA, Ovidiu-Nicolae

Session Classification: Oral Session

Track Classification: 4. Biodiversity, Species Distributions, and Ecological Networks

Contribution ID: 32

Type: **Oral**

From Time Series to Ecological Forecasts: Linking Microbial Interactions and Predictability in the Fram Strait

Thursday 26 March 2026 09:15 (13 minutes)

Long-term time series are essential for understanding and anticipating ecosystem responses to rapid Arctic change, yet translating observational data into predictive ecological insight remains challenging. Here, we present an integrative framework that combines multi-year microbial time series, interaction networks, and ecological forecasting to explore the predictability of Arctic marine communities. Using a seven-year (2016–2023) dataset from the Fram Strait derived from autonomous Remote Access Samplers, we analyze coupled 16S and 18S rRNA gene data spanning Arctic-influenced, Atlantic-influenced, and transitional water masses.

Building on approaches developed for the MOSAiC dataset, we link seasonal community dynamics across trophic and taxonomic levels using co-occurrence networks (CON), convergent cross mapping (CCM), and ecological niche analyses (ELA). These methods allow us to identify co-occurring communities, infer directional interactions, and assess environmental preferences across seasons and regions. We then evaluate how these interaction structures constrain or enhance predictability by applying multiple time-series forecasting models (SARIMAX, Prophet, XGBoost) to seasonal community aggregates.

Our results show that microbial communities exhibit region-specific interaction architectures and forecast horizons. Atlantic-influenced systems display gradual seasonal transitions and higher predictability, while Arctic-dominated regions show abrupt regime shifts, complex causal coupling, and limited forecast skill during bloom-driven periods. Despite poor absolute abundance forecasts, directional trends and interaction-informed forecasts remain robust during stable states.

This study demonstrates how combining long-term observations with interaction-based methods enables mechanistic ecological forecasting, providing a pathway to anticipate future Arctic ecosystem trajectories under ongoing Atlantification and climate change.

Session Chair

no

On-site Session Chair

no

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Track Classification: 3. Ocean Dynamics, Tracers, and Biogeochemical Cycles

Contribution ID: 33

Type: **Oral**

Obtaining Melt Water storage in Melt Ponds from airborne optics and LiDAR sensors through the reconstruction of the three-dimensional Melt Pond Bathymetry

Thursday 26 March 2026 11:45 (13 minutes)

The ice-albedo feedback is a major driving force behind sea ice melt with melt ponds playing a critical role through the reduction of surface albedo. Pond depth is a crucial part of this process by determining how the existing meltwater volume is distributed on the sea ice as shallower ponds increase the horizontal extend given a similar volume, and thus, affect the albedo. Recent years have brought new, higher-resolution methods with wider spatial coverage for determining melt pond depth. However, a comprehensive accuracy assessment remains lacking for these new, but also historically used techniques as many large-scale approaches were only recently developed and are subject to imprecise collocation. Further, uncertainty remains about the accuracy of earlier volume estimation methods, such as averaging depths along transects. Here, we present the results from a comprehensive, multi-platform survey on the observation of melt pond depth conducted throughout the RV Polarstern cruise CONTRASTS (UAV, Helicopter) and the aircraft campaign IceBird in summer 2025. Achieved optical datasets are first drift-corrected and then postprocessed using stereo photogrammetry and bundle adjustment. A comprehensive ground truth was observed through Magna Probe, Snow Probe, a foldable meter, and Tachymeter measurements. To achieve a collocation between all sensors, ground targets visible from all platforms were deployed. We compare the varying airborne platforms and sensors with each other and provide respective observation accuracies estimated from the ground truth. We will furthermore provide an estimation of the order of magnitude of errors of earlier methods.

Session Chair

no

On-site Session Chair

no

Author: BLEI, Torben (Alfred-Wegener-Institute)**Co-authors:** BIRNBAUM, Gerit (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung); Dr FUCHS, Niels (University of Hamburg); Dr NECKEL, Niklas (Alfred-Wegener-Institute)**Presenter:** BLEI, Torben (Alfred-Wegener-Institute)**Session Classification:** Oral Session**Track Classification:** 8. Remote Sensing, Autonomous Technologies, and Polar Observ-

ing

Contribution ID: 34

Type: **Poster**

Flaw lead trends and fast-ice stability in the Siberian Arctic and their relation to atmospheric circulation.

Monday 23 March 2026 17:55 (5 minutes)

Flaw leads are recurring and semi-permanent features in regions such as on the Siberian shelf and in coastal areas. Both flaw leads and fast ice are critical for ocean–atmosphere energy exchange, sea ice dynamics, and provide essential habitats that support high biological productivity and key ecosystem functions. Additionally, they underpin traditional subsistence activities for Indigenous peoples and serve as sensitive indicators of climate change. Previous studies have indicated that the stability and extent of fast ice in the Arctic have significantly decreased over the past four decades. Using an updated sea-ice lead climatology with a spatial resolution of 1 km², we present detailed meridional shifts in mid-winter (January–April) flaw lead positions during the period from 2002 to 2024. Trends and changes in spatial lead patterns also suggest the extent and stability of land-fast ice regions. We demonstrate how the Arctic Oscillation (AO) influences the formation and position of flaw leads and how this relationship has triggered changes in fast ice and flaw leads over the past 22 years. The results are discussed in the context of potential regime shifts in Arctic sea ice.

Session Chair

no

On-site Session Chair

no

Author: WILLMES, Sascha**Co-author:** Prof. HEINEMANN, Günther**Presenter:** WILLMES, Sascha**Session Classification:** Poster**Track Classification:** 1. Arctic Interfaces: Leads, Ridges, and Fractures

Contribution ID: 35

Type: **Poster**

Characterizing dimensionless sea-ice heterogeneity parameters in the Arctic boundary layer

Monday 23 March 2026 16:50 (5 minutes)

Heterogeneity in sea-ice cover strongly influences the Arctic climate, with leads affecting e.g. regional temperature. This heterogeneous surface causes complex nonlinear surface-atmosphere exchanges of momentum and scalars. Therefore, the surface exchanges cannot be quantified using solely the ice fraction within a numerical grid cell, as in standard Earth System Models (ESMs). This study aims to identify dimensionless heterogeneity parameters to subsequently determine scaling relations relating surface heat or momentum fluxes to selected surface heterogeneity characteristics and atmospheric stability based on observations [1].

We extend the thermal heterogeneity parameter [2], which defines the ratio between buoyancy effects of surface thermal contrasts to the inertia of the mean flow. This extension incorporates factors such as temperature difference between the sea-ice and water surfaces, the angle between geostrophic wind and lead orientation and typical length scales. Data are used from the MO-SAiC campaign and BACSAM II flight campaign, where turbulence was measured at two different heights simultaneously: on the aircraft and 60 m below the aircraft using a passive trailing body called T-bird. The aircraft data are analysed with a wavelet transform, enabling a multiscale decomposition to extract a mesoscale contribution to the fluxes. Surface temperature characteristics are obtained from the Modis global Level-2 product (resolution: 1 km). A case study reveals a strong correlation between thermal heterogeneity parameters and mesoscale flux contributions for 20 km subintervals with 1 km rolling steps along the flight legs. The correlation is enhanced for leads oriented normal to wind, and when fetch-dependent downstream effects are included.

[1] Calaf, Marc & Vercauteren, Nikki & Katul, Gabriel & Giometto, Marco & Morrison, Travis & Margairaz, Fabien & Boyko, Vyacheslav & Pardyjak, Eric. (2022). Boundary-Layer Processes Hindering Contemporary Numerical Weather Prediction Models. *Boundary-Layer Meteorology*. 186. 10.1007/s10546-022-00742-5.

[2] Margairaz, Fabien & Pardyjak, Eric & Calaf, Marc. (2020). Surface Thermal Heterogeneities and the Atmospheric Boundary Layer: The Thermal Heterogeneity Parameter. *Boundary-Layer Meteorology*. 177. 1-20. 10.1007/s10546-020-00544-7.

Session Chair

no

On-site Session Chair

no

Author: STAUDINGER, Ilga**Co-author:** VERCAUTEREN, Nikki**Presenter:** STAUDINGER, Ilga**Session Classification:** Poster

Track Classification: 1. Arctic Interfaces: Leads, Ridges, and Fractures

Contribution ID: 36

Type: Oral

Microphysical Processes Behind Cloud Phase Partitioning Issues in Arctic Mixed-Phase Clouds in a Regional Model

Wednesday 25 March 2026 12:15 (13 minutes)

Regional models struggle to accurately simulate cloud water content and phase partitioning, with large inter-model discrepancies. Most models substantially underestimate supercooled liquid water compared to in situ observations. Both cloud water content and phase partitioning govern cloud radiative effects, together with cloud lifetime, and thus have a strong impact on the Arctic frozen surface. Identifying the processes that drive changes in phase partitioning is key to understanding the observed discrepancies and to informing potential model improvements.

Here, we investigate the microphysical mechanisms responsible for the cloud phase partitioning in the regional Weather Research and Forecasting (WRF) model, using different two-moment microphysics scheme. The model is evaluated during marine cold-air outbreak events identified in the context of the national (MPC)² project, during which low-level mixed-phase clouds have been observed over the Arctic sea ice, the marginal ice zone and the open ocean. These case studies are drawn from the AFLUX and HALO-AC3 campaigns, which provide aircraft-borne observations of phase-resolved cloud microphysical and optical properties used to assess model performance.

We specifically analyze the formation and dissipation rates of the mixing ratios of the different hydrometeors (liquid droplets, ice crystals, rain drops, snowflakes, graupel) to identify the key processes controlling the simulated cloud phase partitioning, with the aim of adjusting these processes to represent the observed cloud phase partitioning. Our results provide insight into the microphysical mechanisms governing cloud persistence and phase transitions in the polar environment, with implications for improving the representation of Arctic clouds in the WRF model.

Session Chair

no

On-site Session Chair

yes

Author: LE GARS, Yaël (Sorbonne Université)**Co-authors:** Mr RAUT, Jean-Christophe (Sorbonne Université); Mr MARELLE, Louis (Sorbonne Université - CNRS)**Presenter:** LE GARS, Yaël (Sorbonne Université)**Session Classification:** Oral Session

Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 37

Type: **Oral**

A Dynamical View of Arctic Sea Ice: Sea Ice Deformation and Its Changes Over the Last Four Decades

Wednesday 25 March 2026 09:45 (13 minutes)

Sea ice deformation is defined in terms of spatial velocity gradients, including horizontal opening, closing (divergence and convergence), and shearing. These dynamic processes of sea ice, (a) shape its surface by ridging and thereby influence the distribution of sea ice thickness and change its drag coefficients, (b) can create cracks and leads, and (c) regulate thermodynamic ice growth. In recent decades, Arctic sea ice has undergone significant changes, including increased speed and deformation. Changes in ice deformation can either be caused by changes in the atmosphere and/or ocean forcing, i.e., winds and ocean currents, or by changes of the sea ice itself, i.e., weakening of the ice by thinning or roughening (more ridges), which makes it more susceptible to wind and ocean forcing. Previous studies generally conclude that winds do not dominate changes in ice dynamics during earlier decades, whereas ice thinning has contributed. However, during the about last decade, Arctic sea ice volume has fluctuated around a new low state, and the relative impacts of different factors on sea ice dynamics remain less clear. A detailed analysis and attribution of the processes contributing to ice deformation variability is still lacking.

In this presentation, we will present an introduction to sea ice deformation and our recent results, which mainly focus on obtaining deformation based on passive microwave satellite data (European OSISAF sea ice drift products). Comparisons with deformation derived from Copernicus Sentinel-1 High Resolution SAR Sea Ice Drift will also be presented. In addition, the spatio-temporal distribution of sea ice deformation and its long-term variability will be shown. These results will provide new insight into Arctic sea ice dynamics and contribute to a better understanding of the processes governing sea ice deformation.

Session Chair

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On-site Session Chair

no

Author: ZHANG, Linxin (Institute of Environmental Physics)**Co-author:** SPREEN, Gunnar (University of Bremen, Institute of Environmental Physics (IUP))**Presenter:** ZHANG, Linxin (Institute of Environmental Physics)**Session Classification:** Oral Session**Track Classification:** 1. Arctic Interfaces: Leads, Ridges, and Fractures

Contribution ID: 38

Type: **Poster**

VAMPIRE dataset - Arctic clouds, water vapor and sea ice emissivity

Monday 23 March 2026 18:05 (5 minutes)

The increased warming in the Arctic greatly impacts its atmospheric water cycle [1]. Particularly in the Arctic, where data are scarce, water vapor, clouds, and precipitation present significant challenges for weather and climate models, and are essential components of feedback mechanisms that affect the Arctic amplification. Satellites provide much-needed measurements of clouds and water vapor properties and their variability in the Arctic. However, retrievals are affected by the unknown and highly variable surface emissivity. The VAMPIRE dataset contributes reference measurements for surface emissivity in addition to providing insight into key variables of the water cycle: properties of mixed-phase clouds, atmospheric water vapor, and precipitation.

The VAMPIRE dataset was collected in the summers of 2024 and 2025 during four months in total in the Central Arctic Ocean on the research vessel R/V Polarstern. On board was a large suite of remote sensing instruments: a dual wavelength G-band radar, a W-band cloud radar, two microwave radiometers spanning from 22.24 GHz to 340 GHz, and scanning between atmosphere and surface. Alongside these instruments, wind and precipitation instruments were installed on board, as well as surface and sky cameras in the visual and infrared, and 6-to 12-hourly radiosondes were launched every day. At each ice station, in-situ surface snow and ice measurements were conducted in the microwave radiometers' footprint. As such, this unique dataset provides cloud and precipitation macro- and microphysical properties as well as continuous water vapor profiles in all sky conditions and sea ice ground truth data for radiative transfer models. The contribution will present the dataset, discuss retrievals and synergies applied to the data, and illustrate the possibilities the dataset offers for investigating the Arctic water cycle and surface characteristics.

References

[1] Mellat M., M. Werner, C. F. Brunello, D. Bauch, E. Damm, D. Nomura, A. D'Angelo, J. M. Welker, M. Schneebeli and H. Meyer, Isotope measurements of the Arctic water cycle and exchange processes between seawater, sea ice, and snow during MOSAiC, 2022, DOI 10.5194/egusphere-egu22-7062.

Session Chair

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On-site Session Chair

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Presenter: BÜHLER, Linnu (University of Cologne)

Session Classification: Poster

Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 39

Type: **Poster**

Changes in the Arctic melt pond fraction during atmospheric rivers

Monday 23 March 2026 17:50 (5 minutes)

Melt ponds play a critical role in the Arctic sea-ice system by reducing surface albedo, enhancing solar absorption, and accelerating ice melt. The study of atmospheric conditions that trigger melt pond formation is therefore crucial for a better understanding of the seasonal sea ice variability. Atmospheric rivers (ARs) are narrow, elongated atmospheric features that transport large amounts of water vapor into the Arctic, where they can induce surface warming and modify the surface energy budget through changes in radiative and turbulent fluxes. This excess energy at the surface could potentially lead to melt pond formation. In a warming climate, ARs could become more frequent and intense, suggesting a potentially increasing influence on sea-ice processes. Despite this, the direct impact of ARs on melt pond formation and evolution remains poorly documented. In this study, we investigate the response of Arctic melt ponds to AR events using a combination of case studies and statistical analysis. We combine melt pond fraction from the Melt Pond Detector 2 (MPD2) dataset based on Sentinel-3 observations with atmospheric river occurrences from the Guan and Waliser catalog, derived from ERA5 reanalysis data. We analyze temporal changes in melt pond fraction following AR events and examine associated surface temperature evolution and radiative flux patterns to explore the underlying physical mechanisms. A case study from July 2020 shows a positive correlation between an increase in melt pond fraction and persistent atmospheric river conditions.

Session Chair

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On-site Session Chair

no

Authors: Dr RINKE, Annette (Alfred-Wegener-Institute, Helmholtz Centre for Polar and Marine Research, Potsdam, Germany); TIEDECK, Sofie; CHORNA, Valeriia

Presenter: CHORNA, Valeriia

Session Classification: Poster

Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 40

Type: **Poster**

Optical Determination of Snow Microstructure Parameters

Monday 23 March 2026 18:00 (5 minutes)

Extensive and reliable ground-truth measurements of snow properties play a crucial role in environmental science to validate models and remote-sensing products. Among the available methods, optics-based approaches offer a good compromise between measurement accuracy and sufficiently large coverage.

In this poster, we present the technical details of the SnowImager as well as its data products. The SnowImager is a novel, rugged yet portable field instrument that uses near-infrared (NIR) imaging to determine physical snow properties. It enables fast, accurate, and standardized retrieval of two-dimensional specific surface area (SSA) images as well as vertically resolved density profiles, both with millimetre-scale resolution. The SnowImager can be used on vertical snow profiles as well as on the surface scattering layer of sea ice. It was jointly developed by the Swiss federal institute for snow- and avalanche research SLF and Davos Instruments AG.

Providing enhanced snow microstructure characterization, the SnowImager allows better understanding of the processes influenced by the physical properties of snow as well as of their spatial variability. Examples of such fields of use include snow physics, avalanche science and forecasting, meltwater runoff modelling and water storage management, energy balance analysis in climatic models and permafrost studies and albedo observations in systems including snow or a surface scattering layer on sea ice.

Session Chair

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On-site Session Chair

no

Authors: ZOLLY, Adrian Marvin; Mr WALTER, Benjamin; Mr LÖWE, Henning; Mr MEWES, Lars-Hendrik; SCHNEEBELL, Martin; DADIC, Ruzica (WSL Institute for Snow and Avalanche Research SLF)

Presenter: DADIC, Ruzica (WSL Institute for Snow and Avalanche Research SLF)

Session Classification: Poster

Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 41

Type: Oral

The microstructure of snow and the sea ice surface during the CONTRASTS expedition

Tuesday 24 March 2026 10:00 (13 minutes)

The microstructure of snow and the sea ice surface determines sea ice's optical properties. Additionally, snow can also insulate the sea ice underneath keeping it cooler. In July-August 2025, we collected surface snow samples during the CONTRASTS expedition, from three distinct ice floes representing different sea ice regimes, namely, first-year, second-year, and multi-year ice. While the conditions during CONTRASTS were generally melting, there were repeated snow-fall and rain events, as well as rain-on-snow events. Here, we will present a first evaluation of the microCT (micro computer tomography) measurements of the collected samples and compare the characteristics of new-ish snow, old melting snow, the melting sea ice surface, and the surface scattering layer (SSL). We will further discuss the seasonal evolution of the microstructural characteristics of the SSL, as well as comment on the differences between the three sea ice regimes.

Session Chair

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On-site Session Chair

no

Author: FULSTER, Melanie (ETH Zürich / SLF Davos)**Co-authors:** Prof. WERNLI, Heini; Dr THURNHERR, Iris; Dr JAGGI, Matthias; Dr HAUGENEDER, Michael; Prof. LEHNING, Michael; Dr PIRAZZINI, Roberta; Dr DADIC, Ruzica**Presenter:** FULSTER, Melanie (ETH Zürich / SLF Davos)**Session Classification:** Oral Session**Track Classification:** 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 42

Type: **Poster**

Marine carbohydrates in Arctic aerosol particles – connections to oceanic emissions and in-situ processing

Monday 23 March 2026 16:45 (5 minutes)

Carbohydrates are a relevant component of marine organic aerosol particles with potential impacts on Arctic clouds, yet their sources and processing are poorly understood. We present the first year-round measurements of combined and free carbohydrates in Arctic aerosol particles from the MOSAiC expedition (2019–2020). Combined carbohydrates were detected year-round (0.5–17 ng m⁻³), showed pronounced summer maxima potentially linked to biological activity after sea ice melt, and exhibited a largely stable molecular composition dominated by glucose, xylose, and galactose. Their seasonal behavior differed from that of primary marine tracers such as sodium, which reflected direct oceanic emissions in summer and blowing snow in winter. This indicates that, although carbohydrates likely originate from marine biological sources, their atmospheric signal is strongly altered by subsequent processing. The strong correlation between combined carbohydrates and low-molecular-weight organic acids points to photochemical oxidation as an important pathway of secondary carbohydrate transformation. In addition, combined carbohydrate in aerosol particles followed seasonal trends similar to those of warm ice-nucleating particles and hyper-fluorescent aerosol particles, suggesting their association with a broader Arctic bioaerosol population. Overall, our findings show that marine ecosystems act as a continuous source of atmospheric carbohydrates, whose composition is substantially modified by both biological and physicochemical processes, especially during summer.

Session Chair

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On-site Session Chair

no

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Presenter: ZEPPENFELD, Sebastian (Leibniz-Institut für Troposphärenforschung)

Session Classification: Poster

Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 43

Type: **Poster**

Extending the Surface Energy Budget View on Arctic Atmospheric Rivers: Climatological Classifications and Dependence on the Flavor

Monday 23 March 2026 16:35 (5 minutes)

Atmospheric rivers (ARs) significantly impact the Arctic climate, for example, by modifying the surface energy budget (SEB) and thus impacting sea ice and the Greenland ice sheet. Based on the ERA5 reanalysis, we present new aspects of ARs' impact on the SEB in the central Arctic ($>65^{\circ}\text{N}$, 1979–2021). We extend the statistical investigation of AR-related SEB anomalies by a percentile-based analysis quantifying the commonness of these anomalies, and ARs' relevance for the seasonal mean SEB. Further, we distinguish between two AR flavors: moisture- and wind-dominated. Their differences in moisture, wind speed, and liquid water path are linked to differences in the SEB impact. Three factors primarily dominate the climatological SEB impact of ARs: surface type, season, and AR flavor. The largest anomalies occur during moisture-dominated winter ARs over open ocean, where also the largest climatological contribution of ARs occurs. Conversely, the statistically rarest impact manifests in winter over sea ice.

Session Chair

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On-site Session Chair

no

Author: TIEDECK, Sofie**Co-author:** RINKE, Annette (Alfred-Wegener-Institute, Helmholtz Centre for Polar and Marine Research, Potsdam, Germany)**Presenter:** TIEDECK, Sofie**Session Classification:** Poster**Track Classification:** 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 44

Type: **Poster**

Modeling emission and transport of smoke aerosol from boreal wildfires to the Arctic across scales

Monday 23 March 2026 16:40 (5 minutes)

Weather conditions favoring wildfires are expected to occur more often globally, which is likely to lead to stronger wildfire activity especially in moderately moist, biomass-rich biomes such as boreal forests (Jones et al., 2022). Due to their ability to emit large quantities of smoke that can be lofted up to the stratosphere (Ohneiser et al., 2021) and the black carbon contained in the emissions, which is one of the strongest-warming short-lived climate forcers (Thornhill et al., 2021), boreal wildfires are of great interest to the Arctic climate. Yet, the role of aerosol from high-latitude wildfires in Arctic warming remains unclear.

The contribution of boreal forest fire smoke to the total Arctic aerosol burden was calculated using 5-year simulations (2016–2021) with the global aerosol-climate model ECHAM6.3.0-HAM2.3 (Tegen et al., 2019). In the model setup, aerosol emissions associated with boreal wildfires were separated from wildfire emissions in other regions, allowing for a distinct analysis of smoke from the boreal biome. It was found that, during summer, boreal wildfires account for only a small part of global aerosol emissions but dominate the Arctic aerosol composition, while in winter, anthropogenic sources dominate.

While global models can give valuable insights into large-scale transport patterns of wildfire smoke, high-resolution, convection-resolving models are needed to study the smoke's transport and climate impact more realistically. They can explicitly represent convective mixing and thus provide detailed information on the resulting smoke layering. First results from kilometer-scale simulations of fires in Alaska/Yukon in June 2025 with the ICON-HAM-lite model (Weiss et al. 2025) are presented.

This work was supported by the DFG funded Transregio project TRR 172 "Arctic Amplification (AC)3".

References:

Jones M. W. et al., 2022: Global and regional trends and drivers of fire under climate change. *Reviews of Geophysics*, **60**, <https://doi.org/10.1029/2020RG000726>.

Thornhill, G. D. et al., 2021: Effective radiative forcing from emissions of 15 reactive gases and aerosols - a multi-model comparison. *Atmospheric Chemistry and Physics*, **21**, 853–874, <https://doi.org/10.5194/acp-21-853-2021>.

Ohneiser, K. et al., 2021: The unexpected smoke layer in the High Arctic winter stratosphere during MOSAiC 2019–2020. *Atmospheric Chemistry and Physics*, **21**, 15783–15808, <https://doi.org/10.5194/acp-21-15783-2021>.

Tegen, I. et al., 2019: The global aerosol-climate model ECHAM6.3-HAM2.3 - Part 1: Aerosol evaluation. *Geoscientific Model Development*, **12**, 1643–1677, <https://doi.org/10.5194/gmd-12-1643-2019>.

Weiss, P., Herbert, R., and Stier, P., 2025: ICON-HAM-lite 1.0: simulating the Earth system with interactive aerosols at kilometer scales. *Geoscientific Model Development*, **18**, 3877–3894, <https://doi.org/10.5194/gmd-18-3877-2025>.

Session Chair

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On-site Session Chair

no

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Presenter: PAUL, Swetlana (Leibniz Institute for Tropospheric Research (TROPOS))

Session Classification: Poster

Track Classification: 7. Modeling Arctic Processes: Integrating Scales and Observations

Contribution ID: 45

Type: **Oral**

Snow on sea ice: Spatial variability, redistribution, and pathways for improved modeling and prediction

Tuesday 24 March 2026 11:45 (13 minutes)

Snow profoundly influences the sea-ice system, regulating sea-ice thermodynamics, mass balance, and remote sensing retrievals. Acting as both an insulator and a reflector, snow exerts dual and often competing effects on sea-ice evolution. Its highly variable spatial distribution remains one of the greatest sources of uncertainty in sea-ice modeling and remote sensing applications.

Our work focuses on the role of snow redistribution in model biases. Sensitivity experiments using 1D thermodynamic sea-ice models demonstrate that neglecting snow redistribution leads to systematic overestimates of snow depth on level ice and corresponding underestimates of level ice thickness. Adjusting level-ice snow depth downward by ~40% brings simulations into closer agreement with observations, with airborne radar confirming a linear link between snow retention and sea-ice deformation at the end of winter. This finding emphasizes the importance of accounting for snow capture by ice deformations when modeling ice mass balance and interpreting satellite altimetry.

In parallel, we are exploring the potential of machine learning approaches to integrate numerical models, in-situ observations, atmospheric reanalyses, airborne surveys, and satellite products into improved snow parameterizations. Such methods offer opportunities to reduce computational times of sophisticated, high-resolution numerical models that account for snow redistribution and deliver flexible tools for next-generation sea-ice models.

Session Chair

yes

On-site Session Chair

yes

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Presenter: MERKOURIADI, Ioanna (Finnish Meteorological Institute)

Session Classification: Oral Session

Track Classification: 7. Modeling Arctic Processes: Integrating Scales and Observations

Contribution ID: 46

Type: **Oral**

Spatial variability of the physical properties of summer snow and melting summer sea ice surfaces

Tuesday 24 March 2026 10:15 (13 minutes)

During the last few decades, the decrease in sea ice cover has been the dominant radiative feedback in the climate system, and there is a pressing need to improve the model representation of snow on sea ice, and in particular, the representation of the highly unpredictable spatial and temporal variability of the sea ice surface during the melt season. In July-August 2025, we embarked on the RS Polarstern to participate in the CONTRASTS expedition. The general aim of the expedition was to characterize the key processes that determine the observed sea ice, ocean, and ecosystem changes in the Central Arctic Ocean during the melt season. Over a two-month period, we repeatedly visited three distinct ice floes representing first-year, second-year, and multi-year ice. One of our team's objectives was to quantitatively describe the physical properties of summer snow and the surface scattering layer, including the statistical spatial variability at aim to 100s of m scales. Here, we will present first results from our expedition using the SnowImager instrument and discuss the highly heterogeneous nature of the melting sea ice surfaces and the surface scattering layer (melt crust) that covers it.

Session Chair

yes

On-site Session Chair

yes

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Presenter: DADIC, Ruzica (WSL Institute for Snow and Avalanche Research SLF)

Session Classification: Oral Session

Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 47

Type: **Poster**

Uncovering Arctic Microbial Activity: A Metatranscriptomic Approach Using MOSAiC Expedition Data

Monday 23 March 2026 18:50 (5 minutes)

The Arctic Ocean is undergoing rapid environmental changes, yet its microbial communities - key drivers of biogeochemical cycling - remain understudied, particularly regarding gene expression patterns and microbial functional responses.

We apply a metatranscriptomic approach to the RNA extracted from environmental samples collected during the MOSAiC expedition, including water samples of different ocean layers. The primary goal is to assess seasonal shifts in microbial gene expression and uncover how Arctic microbes functionally respond to changing conditions such as temperature, light availability, ice coverage, and nutrient fluxes.

The data for this analysis was pre-processed and made available by the Joint Genome Institute (JGI) using their Integrated Microbial Genomes & Microbiomes (IMG/M) system. The resulting functional and taxonomic annotations serve as a critical reference for mapping transcripts and interpreting patterns of metabolic activity.

Although final results are pending, preliminary analyses using KEGG Ortholog annotation show seasonal expression patterns consistent with shifts in light

availability and ice coverage, hinting towards seasonal trends in microbial activity. Therefore, we expect elevated transcripts for carbon fixation and phototrophy during periods of increased sunlight in spring and summer (especially in surface ocean layers), and stress-response related genes and heterotrophic pathways during the polar night.

By integrating high-resolution metatranscriptomic data with IMG-based annotations, this study seeks to reveal the ecological roles and functional adaptability of Arctic microbial communities, while establishing a framework for multi-omic analysis using the IMG/M platform.

Session Chair

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On-site Session Chair

no

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Session Classification: Poster

Track Classification: 4. Biodiversity, Species Distributions, and Ecological Networks

Contribution ID: 48

Type: **Poster**

Investigating Snow Redistribution on Arctic Sea Ice

Monday 23 March 2026 17:15 (5 minutes)

Snow cover plays a critical role in the Arctic sea ice system, regulating surface energy balance and ice growth. Yet research on the sub-grid distribution and redistribution of snow cover remains limited. Wind-driven snow redistribution and the influence of ice topography on snow removal and accumulation are rarely represented, leading to uncertainties in simulated snow mass and depth, and consequent sea ice thickness. To simulate the redistribution and evolution of snow on a drifting sea-ice floe, we apply a new version of SnowModel, the Floating Islands simulation, which combines the Lagrangian parcel tracking (SnowModel-LG; Liston et al., 2020) with the three-dimensional, spatially distributed snow evolution model (SnowModel; Liston and Elder, 2006). We use the ice topography of Floe-1 from the Norwegian young sea ICE (N-ICE2015) campaign along parcel trajectories satellite backtracked from AWI IceBird 2017 and 2019 flight data from the western Arctic ocean. MERRA-2 data is used for meteorological forcing on the high-resolution (~1m) ice topography moving along the trajectories through time. We investigate how wind, precipitation, and temperature interact with ice roughness to redistribute and accumulate snow on both deformed and level ice. Our simulations aim to quantify how snow is removed from level ice and accumulates in rough or deformed areas, providing insight into snow redistribution. Previous modeling sensitivity studies suggest that up to 40% of snow is removed from level ice due to wind redistribution by the end of winter (Merkouriadi et al., 2025). This work provides a refined approach for evaluating snow parametrizations in sea-ice and climate models with direct applications to ice growth, satellite-derived snow products, and Arctic energy balance.

Liston, G. E., & Elder, K. (2006). A Distributed Snow-Evolution Modeling System (SnowModel). *Journal of Hydrometeorology*, 7(6), 1259–1276. <https://doi.org/10.1175/jhm548.1>.

Liston, G. E., Itkin, P., Stroeve, J., Tschudi, M., Stewart, J. S., Pedersen, S. H., Reinking, A. K., & Elder, K. (2020). A Lagrangian Snow-Evolution System for Sea-Ice Applications (SnowModel-LG): Part I—Model Description. *Journal of Geophysical Research: Oceans*, 125(10), e2019JC015913. <https://doi.org/10.1029/2019jc015913>.

Merkouriadi, I., Jutila, A., Liston, G. E., Preußner, A., & Webster, M. A. (2025). Investigating snow sinks on level sea ice: A case study in the western Arctic. *Journal of Glaciology*, 71, e66. <https://doi.org/10.1017/jog.2025.34>.

Session Chair

no

On-site Session Chair

no

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Presenter: KOIVUSALO, Taru (Finnish Meteorological Institute)

Session Classification: Poster

Track Classification: 7. Modeling Arctic Processes: Integrating Scales and Observations

Contribution ID: 49

Type: **Oral**

Water Vapor Feedback: On the relation of water vapor and atmospheric temperature in Arctic winter

Wednesday 25 March 2026 10:00 (13 minutes)

Water vapor, a greenhouse gas, contributes to Arctic Amplification through positive water vapor feedback. As temperatures rise, atmospheric integrated water vapor (IWV) increases, provided water vapor sources are not limited. Here, we aim to answer a seemingly simple question: What is the observed relationship between IWV and increasing atmospheric temperatures in the Arctic winter?

Initially, one might expect a Clausius-Clapeyron (CC) relationship, where IWV increases by about 7% per 1 K temperature rise. However, Ridley et al. (2023) showed that in climate model data, water vapor availability is limited by Arctic sea ice, leading to a lower IWV increase than the CC rate in winter. Once the Arctic becomes ice-free in the future, this rate equals the CC rate.

Additionally, Arctic IWV is influenced by transport from lower latitudes. It is possible that, at least regionally, IWV increases at the CC rate even when, due to sea-ice presence, there is no local moisture source.

This study investigates whether and where IWV increases at rates lower than the CC rate based on observational data and how this relates to sea-ice cover. If these areas become ice-free, we may expect a stronger increase in IWV with temperatures and potentially stronger water vapor feedback than currently observed.

We use observational data from satellites combined with atmospheric reanalysis. Both sources have uncertainties regarding the spatio-temporal distribution of IWV over sea ice, which may limit our ability to answer these questions. By analyzing the consistency between different datasets, we will evaluate and estimate these uncertainties.

Session Chair

no

On-site Session Chair

no

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Session Classification: Oral Session

Track Classification: 2. Arctic Amplification and Climate Feedbacks: Regional and Global Perspectives

Contribution ID: 50

Type: **Poster**

Ocean-to-Ice Heat Flux in the Central Arctic: Results from the MOSAiC Expedition (2019-2020)

Monday 23 March 2026 17:10 (5 minutes)

The Arctic has experienced a temperature increase well above the global average over the past decades. Despite these rapid changes, studies of ocean-to-ice heat flux (OHF) in the Arctic remain limited due to the unique environment, complicating the understanding of heat exchange processes. To address this gap, our study estimates OHF in the central Arctic using a parameterization method that improves the representation of ocean heat flux. We use temperature, salinity, and turbulent dissipation from the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) from October 2019 to May 2020 to calculate and interpret the parameterized OHF and the diffusive vertical heat flux (DHF) across the mixed-layer base. During winter, the ice-covered upper ocean was supercooled, and the conventional bulk parameterization for the OHF yielded a net downward heat flux. At the same time, the estimated DHF into the mixed layer was nearly zero, which is inconsistent with a downward OHF. Thus, we suggest the net heat flux to the ice was zero during this period. From March, as the ice floe drifted south towards the western Gakkel Ridge, an upward DHF developed, followed by a delayed increase in OHF. The DHF rise is mainly associated with an increased temperature gradient and a reduced stratification. Potential contributions from increased dissipation beneath the mixed layer appear to be influenced by topographic roughness and sea ice velocity. Our study highlights the spatiotemporal variability of upper-ocean processes and surface supercooling as key drivers of the complexity in improving OHF parameterizations.

Session Chair

no

On-site Session Chair

no

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Contribution ID: 51

Type: Oral

Continuous measurements of surface meteorology, radiation, and turbulent fluxes over the melting Arctic sea ice during CONTRASTS in summer 2025

Wednesday 25 March 2026 11:15 (13 minutes)

During the CONTRASTS expedition in July-August 2025, three autonomous Met stations were installed on the melting Arctic bare sea ice in distant regions representing (R1) first year ice, (R2) Transpolar drift ice, and (R3) multiyear ice. The stations provide continuous records of temperature & humidity from a 10m Met tower, up- and downwelling solar and thermal radiation and turbulent sensible and latent heat fluxes. Here, we present the resulting data set which allows to study the full surface energy balance (SEB). The three stations cumulatively provide 92 days of data and reflect synoptic and regional variability. As expected for the melt season, near surface temperatures remain between $[-2.5 + 1]$ °C, with static stability in the lowermost 10 m rarely exceeding ± 0.3 K. While LWnet radiation occurrence peaks around 0 Wm⁻² for all three sites resembling opaquely cloudy conditions, only R3 reveals a secondary peak around -70 Wm⁻² resembling clear sky radiative heat loss. At all three sites, albedo fluctuations between 0.4 and at least 0.8 are observed. These can be attributed to individual rain, snow or surface draining events, which significantly darken/brighten the surface, respectively. The net radiative balance is predominantly positive, consistent with melt. Occurrence of negative net radiative balance is 0.4% at R1, 6.2% at R2, and 13.4% at R3, respectively. This reflects both the longer operation of R3 until end of August close to freeze-up, and a higher occurrence of radiatively clear conditions there. Combination with additional data sets will allow investigating further atmosphere-ocean-ice process relationships and drivers of SEB variability.

Session Chair

yes

On-site Session Chair

yes

Author: DAHLKE, Sandro**Co-authors:** Dr SCHULZ, Alexander; Mrs JÖRSS, Anna-Marie; Prof. THOMAS, Christoph; Mr GEBHARDT, Florian; Mr SPAKOWSKI, Lars; Mr EISENHUTH, Phillip**Presenter:** DAHLKE, Sandro**Session Classification:** Oral Session**Track Classification:** 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 52

Type: **Poster**

The T-Bird –A new aircraft-towed instrument platform to measure turbulence and aerosol properties close to the surface

Monday 23 March 2026 18:20 (5 minutes)

Aerosols play a critical role in Earth's radiative energy balance and climate by scattering and absorbing solar radiation. However, obtaining detailed observations of aerosol and turbulence properties near the surface, especially over sea ice and open water in polar regions, remains challenging. To address this, we introduce the T-Bird system, a novel, passive, aircraft-towed measurement platform designed to capture high-resolution data in these environments. Operated by the Alfred Wegener Institute's Polar aircraft, T-Bird enables measurements at altitudes as low as ~10 m while the aircraft remains above its minimum operational altitude. This platform facilitates simultaneous multi-level observations of aerosol and turbulence properties, providing valuable insights into boundary layer processes.

Equipped with specialized aerosol instrumentation, T-Bird measures particle number concentration, size distribution, and absorption coefficient, while also collecting filter samples for further analysis. Its performance was first tested under Arctic conditions during the BACSAM (Boundary Layer and Aerosol and Cloud Study in the Arctic) campaign in October 2022 and a second campaign took place in 2024 (BACSAM II). Initial results demonstrated the system's ability to capture key aerosol parameters, even in areas previously inaccessible to conventional aircraft. A comparison of T-Bird's onboard aerosol instruments with the aircraft's standard instrumentation showed strong correlation in particle number concentration, validating its functionality and measurement accuracy. Additionally, the ability to conduct simultaneous two-level measurements offers new opportunities to study vertical aerosol distribution and turbulent boundary layer processes, which are crucial for understanding Arctic atmospheric dynamics.

Session Chair

no

On-site Session Chair

no

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Presenter: KÖHLER, Laura (Alfred-Wegener-Institut)

Session Classification: Poster

Track Classification: 8. Remote Sensing, Autonomous Technologies, and Polar Observing

Contribution ID: 53

Type: **Oral**

Atmospheric Methane Variability at Arctic Sea-Ice Interfaces: Ship-Borne Observations from MOSAiC

Thursday 26 March 2026 10:00 (13 minutes)

The sparse network of Arctic land-based stations results in significant data gaps for atmospheric methane (CH₄), particularly in sea-ice-covered regions. Ship-based measurements can complement these data, improving understanding of regional and seasonal CH₄ variability. We present continuous atmospheric ship-borne recordings of CH₄ concentration and stable carbon isotopic composition above the open ocean and sea-ice surfaces in the central Arctic during Legs 4 (June–July 2020) and 5 (August–September 2020) of the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC) expedition.

To enhance process understanding at the atmosphere–surface interface, we applied air-mass backward trajectories and analyzed residence times within the atmospheric boundary layer to distinguish terrestrial and marine air masses and to assess the influence of open-ocean versus sea-ice-covered conditions along transport pathways. Comparison with nearby land-based stations indicates that CH₄ variability is shaped by air masses influenced by both open ocean and sea-ice-covered regions. Low variability near the North Pole under persistent ice contrasts with enhanced variability near the sea-ice edge, reflecting the role of dynamic sea-ice conditions, sea-ice melt, and associated exchange processes at the ocean–ice–atmosphere interface.

These findings underscore the importance of surface heterogeneity, air-mass transport, and boundary-layer processes in shaping central Arctic CH₄ variability. Integrating ship-borne measurements with trajectory analysis provides a framework to address observational gaps in remote, ice-covered regions and supports regional process understanding at Arctic interfaces, offering insights for improved representation of atmosphere–ocean interactions in Arctic models.

Session Chair

yes

On-site Session Chair

yes

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Session Classification: Oral Session

Track Classification: 3. Ocean Dynamics, Tracers, and Biogeochemical Cycles

Contribution ID: 54

Type: **Oral**

SeaIce-3D: Resolving Snow-Controlled Spatial Variability in Sea Ice Growth

Tuesday 24 March 2026 12:00 (13 minutes)

The spatial distribution and properties of snow on sea ice strongly control its thermal insulating ability and thereby regulate wintertime ocean–atmosphere heat exchange and sea ice growth. As snow cover changes in response to global warming, it is an increasingly important factor in Arctic amplification, yet snow-on-sea-ice processes in large-scale sea ice and Earth System Models are often represented using unphysical oversimplifications. Meters-scale snow bedforms on sea ice (e.g., dunes, sastrugi) influence heat fluxes and ice growth, but these are generally accounted for through ad-hoc tuning of snow thermal conductivity or effective snow depth.

Here, we present SeaIce-3D, a physics-based thermodynamic sea-ice model that explicitly resolves three-dimensional heat fluxes through high-resolution snow bedforms and sea ice. By simulating the underlying physics of three-dimensional heat transport, SeaIce-3D reproduces spatial variability in sea ice growth without need of physically unrealistic parameterizations.

We applied SeaIce-3D to level sea ice during the MOSAiC 2019/2020 drift, using its rich observations of snow properties, ice growth, and meteorological forcing. Snow depth variability was modeled by SnowDunes –a probabilistic snow dune model –using evolving snow bedform patterns driven by precipitation events and constrained by observed bedform characteristics (e.g., wavelength and lag) measured during MOSAiC. SeaIce-3D produces three-dimensional fields of sea-ice thickness, temperature, and heat fluxes, showing spatial variability in ice growth arising from spatiotemporal snow depth and thermal property variations and the resulting heat-flux heterogeneity.

Results are compared to a one-dimensional thermodynamic configuration (SeaIce-1D) with uniform snow cover, representative of current modeling assumptions. The comparison highlights the consequences of neglecting lateral heat fluxes and snow bedform variability in sea ice evolution simulations. The insights gained provide guidance for improving snow parameterizations in climate models and advances our understanding of how changing snow-on-sea-ice influences sea-ice growth in a warming climate.

Session Chair

no

On-site Session Chair

no

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Presenter: SCHON, Annabel (Finnish Meteorological Institute, Colorado State University)

Session Classification: Oral Session

Track Classification: 7. Modeling Arctic Processes: Integrating Scales and Observations

Contribution ID: 55

Type: **Poster**

Spectrum of sea ice dependency and flexibility within the pelagic food web of the Central Arctic Ocean

Monday 23 March 2026 18:15 (5 minutes)

The Central Arctic Ocean (CAO) is rapidly approaching sea ice-free summers, with ice algal seeding populations already being scarce. While some studies predict major disruptions to the Arctic food web, others project an overall increase in secondary production and carbon export from expanding pelagic algae. Here we show an unexpected prominence of sea ice-associated food sources (ice algae, the filamentous diatom *Melosira arctica*, terrigenous detritus) in mid- and deep-water taxa such as filter-feeding ostracods, raptorial copepods, amphipods and chaetognaths in the CAO in 2019/2020. These taxa switched to flagellates or a more carnivorous diet when ice algae were less available. The pelagic diet often led to higher levels of polyunsaturated fatty acids (PUFA), but a decrease in food web efficiency. However other species such as the ice amphipod *Apherusa glacialis* and the copepod *Calanus glacialis* showed less flexibility in their diet and no increase in PUFA, indicating that these species are threatened by food shortage and competition in entirely pelagic regimes. To support global biodiversity, an upmost priority is to identify and protect Arctic habitats rich in ice algae that provide refuge for this specialised fauna.

Session Chair

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On-site Session Chair

no

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Contribution ID: 56

Type: **Poster**

Analysis of albedo evolution over a melt pond during the onset of freezing at MOSAIC

Monday 23 March 2026 17:30 (5 minutes)

Between August 26 –September 19 during MOSAiC, the albedo of an 8 m x 20 m meltpond was measured continuously in 2 second resolution using a CNR4 netradiometer. Since the sensor extended 130 cm into- and 50 cm above- the pond area, the measurement footprint only reflects part of the pond. The investigated period showcases the albedo change during the freeze-up, from low albedo values of 0.1 in the end of August, when the pond had a dark open water surface, towards high albedo values of 0.9-1.0 in mid-September, when a snow-covered ice layer prevailed. However, the transition was not linear, and three case studies highlight (1) the still open pond in the beginning of September with a slowly developing thin ice layer that had only marginal impact on albedo, (2) a sudden albedo increase from 0.1 to 0.9 on September 09, when snowfall accumulated on the already firm but dark ice layer, and (3) a rain event at melting temperatures during a warm intrusion on September 13, that melted and darkened the surface dramatically and reduced pond albedo from 0.9 to 0.1 within 24 hours. Afterwards from mid-September, the lake reached permanent freeze-up with albedo around 0.9, but the measurement reached its limits due to low solar angles. Joint analyses with further data sets such as temperature, humidity and wind speed from Met City, as well as precipitation and sub-daily photographs of the pond surface are presented and are necessary to understand and interpret the unique albedo data set.

Session Chair

no

On-site Session Chair

no

Author: Mrs SCHIFFER, Alex**Co-authors:** SCHULZ, Alexander; DAHLKE, Sandro**Presenter:** DAHLKE, Sandro**Session Classification:** Poster**Track Classification:** 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 57

Type: **Poster**

Microphysical and Ice Crystal Habit Properties of Low-Level Arctic Mixed-Phase Clouds from Four Airborne Campaigns near Svalbard

Monday 23 March 2026 17:25 (5 minutes)

This study presents an extensive characterization of the microphysical and ice crystal morphological properties of low-level Arctic mixed-phase clouds (MPCs), based on in situ observations from four airborne campaigns conducted around Svalbard. The in situ dataset comprises 46 hours of cloud sampling. During these flights, 731,600 ice crystal images were collected and classified using a convolutional neural network, providing an unprecedented statistical view of Arctic ice crystal habits. Using the Marine Cold Air Outbreak index, four meteorological regimes were identified—Cold Air Outbreak (CAO), Warm Air Advection (WAA), and two transitional states—revealing strong contrasts in cloud structure and phase partitioning. CAO conditions are characterized by cold and moist environments supporting well-developed mixed-phase layers with enhanced riming and precipitation, while WAA conditions produce thinner, mostly liquid layers capped by strong temperature inversions. Weak inversions favor deeper, more turbulent clouds with larger droplets and higher ice water contents. Surface conditions also exert a major control: over open ocean, enhanced heat and moisture fluxes promote turbulence and glaciation efficiency, leading to higher ice water content and rimed ice crystals, whereas over sea ice, clouds remain shallower and are dominated by pristine or weakly aggregated crystals. This work provides the first large-scale statistical analysis of ice crystal habits in Arctic MPCs. The results show that rimed particles dominate during CAO, while columnar and aggregated habits prevail during WAA. Over open ocean, stronger vertical motions further enhance riming efficiency. These findings highlight the strong coupling between surface fluxes, thermodynamic stability, and synoptic forcing in controlling the structure and evolution of Arctic mixed-phase clouds.

Session Chair

no

On-site Session Chair

no

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Presenter: DZIDUCH, Aymeric (Université Clermont Auvergne, LaMP, CNRS, F-63000 Clermont–Ferrand, France)

Session Classification: Poster

Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 58

Type: **Oral**

Investigating Arctic Ocean Mixing and Heat Transport Using High-Resolution FESOM2 Simulation

Thursday 26 March 2026 10:15 (13 minutes)

The Arctic Ocean plays a significant role in amplifying regional climate warming, with ocean heat transport (OHT) and vertical mixing influencing surface temperature and sea-ice evolution. Yet, the pathways and timescales of heat redistribution remain poorly constrained due to limited observations and coarse model resolution. We employ simulations of the Finite-volume Sea ice-Ocean Model version 2 (FESOM2) using coarse- and high-resolution meshes to investigate OHT and mixing conditions in the Arctic Ocean. Passive and idealised tracers are implemented in FESOM2 to evaluate the simulated circulation in the Arctic Ocean and to quantify water-mass mixing within the Inverse Gaussian Transit Time Distribution framework. The high-resolution FESOM2 substantially reduces tracer biases from the matching in-situ measurements compared to the coarse-resolution FESOM2 and other models, indicating improvements in the representation of mixing, advection pathways, and ventilation structures. High-resolution model results highlight distinct regional trends in the Arctic Ocean's upper-ocean mixing and heat content during 1979–2018. Most of the Eurasian sector shows increased mixing and warming, thinning of the cold halocline, and pronounced sea-ice reduction. Conversely, the Canadian sector exhibits reduced mixing and heat content, halocline thickening, and weaker ice reduction. These contrasting patterns may indicate enhanced OHT from Atlantic and Pacific waters into the Eurasian upper-ocean layers, whereas the Canadian sector experiences comparatively limited heat penetration. These contrasting regional dynamics highlight the role of altered mixing driven by OHT in amplifying surface warming in the Eurasian sector, helping to explain why this region experiences faster surface warming compared to the Canadian sector.

Session Chair

no

On-site Session Chair

no

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Contribution ID: 59

Type: **Poster**

Effects of compensating the underestimated Sea Ice Albedo at Freezing Point Temperatures in ICON on the modelled Arctic Atmosphere.

Monday 23 March 2026 18:40 (5 minutes)

Climate models have difficulties accurately representing Arctic mid-latitude linkages. This might partly be caused by surface parametrizations that are unable to accurately represent Arctic surface conditions. As a result, large uncertainties arise in the modelled energy exchange between the surface and the atmosphere, since sea ice surface albedo (SIA) controls the energy input in the Arctic region. The present study aims to identify error sources in the SIA parameterization scheme of the Icosahedral Nonhydrostatic (ICON) circulation model and gain insights in how these errors can influence the modelled Arctic atmosphere.

To identify the sources of error in the SIA parameterization, the scheme is evaluated against Arctic observational data. The data includes both on-ice measurements to capture the SIA temporal evolution (MOSAiC), as well as airborne measurements from several flight campaigns performed within the (AC)3 project to capture larger spatial variability. An offline evaluation, in which the SIA parametrization is isolated from the ICON model and observations are used as input for the parametrization, shows that the biggest disagreement between the scheme and the observations occurs at freezing point temperatures.

Inspired by this outcome and to better understand how SIA parametrization can control the Arctic atmosphere, a simulation with increased SIA at freezing point temperatures is performed. With this long term, limited area, pan-Arctic simulation, changes in energy exchange between surface and atmosphere are analysed.

Session Chair

no

On-site Session Chair

no

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Contribution ID: 60

Type: Oral

“If you can’t beat them, join them –Film, Outreach & Wikipedia”

Wednesday 25 March 2026 10:15 (13 minutes)

I spent the summer of 2020 on MOSAiC leg 4 as cinematographer and interviewer. My Arctic “research credentials” beforehand consisted mainly of having been born in Finland. So, before the expedition, I spent weeks learning as much as possible about the High Arctic. There was very little information for non-scientists, I ended up reading a lot on Wikipedia. The English Wikipedia was not always correct, sometimes outright weird, but mostly felt useful, the German Wikipedia was pretty sketchy, same as the French, Finnish ...

Our film project covered the whole expedition, broadcasters created different versions, which were sold to about 170 territories and created a lot of exposure. Good, but ... while film is great to show the scenery, the people and the atmosphere, film is not a very good medium to convey complex issues. You can get about a thought and a half into a film, and that’s it. With books or text, it’s different: people can read at their own speed, re-read, pause and come back. With film you don’t have that luxury.

On the way back from the Arctic Ocean, I suggested organizing an introductory session for scientists on how to write in Wikipedia –and nobody was interested. So I propose this brilliant idea again here.

Why? There is a huge gap between the available scientific knowledge on the cryosphere and information available for lay audiences (English speakers are better than others, but ...) For the general public, the Arctic and the Antarctic are full of question marks. Is the Arctic Ocean going to be ice free in 2050? Is Greenland the ice sheet going to melt? Should I build my Noah’s Ark tomorrow afternoon? It’d be great to have more layman-compatible information more widely available. And there is a new argument: AI tools are spreading fast. They come with disclaimers “this was compiled by AI, please don’t trust it,” but people will trust them anyway. Where do these tools get their information from? Often, AI tools lean heavily on Wikipedia, which translates to: Polar researchers can - with relatively little effort - add knowledge “for the rest of us” at a point on the internet where both, humans and machines keep going to for reference.

I would like to offer a 5-minute intro for Arctic system scientists on how to improve and expand Wikipedia entries related to the Arctic and their own work. I write in Wikipedia as a hobby - it’s a game (aka “world’s largest online role player game”) and I have given Wikipedia several introductions for female filmmakers to help create more exposure (which seems to work.)

The side benefits of playing the Wikipedia game are not trivial: projects and papers become part of the public knowledge backbone, you gain a visible point of reference outside paywalled journals, and –frankly –you may even gain an unfair advantage because your work is what future readers (and AIs) will encounter first. Why let that opportunity slip?

Session Chair

no

On-site Session Chair

no

Author: SALONEN, Susanna (author, cinematographer, filmmaker)

Presenter: SALONEN, Susanna (author, cinematographer, filmmaker)

Session Classification: Oral Session

Track Classification: 10. Communication, Education, and Capacity Building for Arctic (Polar) Science

Contribution ID: 61

Type: **Poster**

Ephemeral Weather-Driven Albedo Variability

Monday 23 March 2026 17:00 (5 minutes)

Understanding sea ice optical properties is essential for quantifying shifts in solar energy partitioning and for understanding the Arctic response to warming. The CONTRASTS field campaign compared three sea ice regimes (young thin ice, intermediate age ice, and multiyear ice) by conducting repeat ice stations in each regime in the summer of 2025. The research summarizes measurement techniques used in the campaign to examine the impact of short-lived weather events, such as snow or rain, on the surface albedo and the heat and mass budgets of the ice cover. Seasonal transitions, especially during summer melt, create heterogeneity as surface conditions change. We observed that a rainfall event reduced ice albedo by approximately 20%. This rapid albedo drop on young ice led to an increase of absorbed solar radiation in sea ice and the underlying ocean. These findings highlight that the possible increase of ephemeral weather events may fundamentally alter the Arctic's energy budget by changing the albedo and influencing the ice-albedo feedback. We explore whether such events need to be considered in sea ice models.

Session Chair

no

On-site Session Chair

no

Author: BYRON, Savannah (Dartmouth College)**Co-authors:** LIGHT, Bonnie (University of Washington); Dr POLASHENKSI, Christopher (Dartmouth College); CLEMENS-SEWALL, David (University of Colorado Boulder); PEROVICH, Don (Dartmouth College); WEBSTER, Melinda (University of Washington); GREENWOOD, Nora**Presenter:** BYRON, Savannah (Dartmouth College)**Session Classification:** Poster**Track Classification:** 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 62

Type: Oral

Tracing Terrestrial Dissolved Organic Carbon and Contaminants in the Central Arctic Ocean Using Direct Seawater Analysis

Thursday 26 March 2026 09:45 (13 minutes)

Global warming is likely to further increase the input of terrestrial dissolved organic carbon (tDOC) and contaminants into the Central Arctic Ocean (CAO), thereby affecting the ecosystem and altering biogeochemical cycles through increased light attenuation, microbial respiration, and CO₂ release. Yet, the amount, distribution, and characteristics of terrestrial dissolved organic matter (tDOM) in the CAO remain poorly constrained. Here, we applied a novel analytical approach using mass spectrometric enables direct analysis of DOM in original seawater and the quantification of tDOC. Within the Transpolar Drift, tDOC concentrations were 82.8% higher ($26.5 \pm 4.2 \mu\text{mol L}^{-1}$) compared to neighbouring waters ($14.5 \pm 1.0 \mu\text{mol L}^{-1}$). Upscaling to the basin scale revealed that tDOC in the CAO contributed at least $0.97 \pm 0.05 \text{ Pg C}$ (16.4%) to the total DOC inventory of $5.93 \pm 0.09 \text{ Pg C}$, and 15.0% to the total DOC in deep water ($7.9 \pm 0.4 \mu\text{mol L}^{-1}$). Chemically distinct from marine and sea ice derived DOM, tDOM was dominated by less-polar, highly unsaturated, aromatic, nitrogen-poor and low-oxidized compounds. These molecular signatures provide semi-quantitative insights into organic carbon bioavailability, and turnover. In addition, our analytical approach enabled suspect screening for anthropogenic contaminants of emerging concern. Verified by a comparison with established methods using solid-phase extraction, we found a variety of anthropogenic pollutants that extended into the CAO. Together, our results provide a molecular formula resolved baseline for tracking terrestrial carbon and contaminants in a rapidly warming Arctic Ocean and for improving their representation in future climate and biogeochemical models.

Session Chair

yes

On-site Session Chair

yes

Author: KOCH, Boris Peter (Alfred-Wegener-Institut Helmholtz Zentrum für Polar- und Meeresforschung)

Co-authors: Prof. STEDMON, Colin (National Institute of Aquatic Resources, Technical University of Denmark); Mr BUSSMANN, Frederik (Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung); Mr KAESLER, Jan (Helmholtz Centre for Environmental Research); Prof. FARRÉ, Marinella (Institut de Diagnosi Ambiental i Estudis de l'Aigua); Dr LLORCA, Marta (Institut de Diagnosi Ambiental i Estudis de l'Aigua); Dr GRAEVE, Martin (Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung); GRANSKOG, Mats (Norwegian Polar Institute); Dr LECHTENFELD, Oliver (Helmholtz Centre for Environmental Research); Mrs GORNIK, Rebecca (University

of Bremen); Dr KONG, Xianyu (Alfred-Wegener-Institut Helmholtz Zentrum für Polar- und Meeresforschung)

Presenter: KOCH, Boris Peter (Alfred-Wegener-Institut Helmholtz Zentrum für Polar- und Meeresforschung)

Session Classification: Oral Session

Track Classification: 3. Ocean Dynamics, Tracers, and Biogeochemical Cycles

Contribution ID: 63

Type: **Oral**

Spatial variability of light partitioning of sea ice and its impact in energy partitioning during the MOSAiC expedition

Tuesday 24 March 2026 09:45 (13 minutes)

In recent decades, the Arctic sea ice shows a strong change with thinner thickness, longer melt season, and more predominate spatial heterogeneity. This results in more solar radiative energy to be deposited into and through the thinning ice, fueling for ice melt and ice-associate biological activities.

Here, we show the changes of sea ice spatial variability on the distribution of solar radiative partitioning and its impact on the partitioning of radiative energy. We investigate the seasonal evolution of solar radiative partitioning and sea ice absorptivity during the 2020 melt and freeze-up seasons using observations from the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC). High-resolution two-dimensional maps of under-ice light transmittance were obtained with a remotely operated vehicle (ROV) beneath different sea ice and surface types, with a particular focus on the influence of melt ponds. These measurements are combined with coincident sea ice draft and surface brightness, used as a proxy for albedo, to estimate absorptivity and construct three-dimensional radiative flux maps.

In addition, normalized difference indices (NDIs) derived from L-arm measurements was compiled and compared with chlorophyll-a concentrations from sea ice cores to explore links between radiative partitioning and biological signals. Results show that sea ice absorptivity peaks during the mid-melt season across all surface types and decreases toward freeze-up, while melt ponds strongly enhance spatial contrasts in light transmission and energy deposition. This work advances the up-scaling of sea ice optical properties and improves representation of radiative–biological coupling in Arctic sea ice systems.

Session Chair

yes

On-site Session Chair

yes

Author: TAO, Ran (alfred wegenger institut)**Co-authors:** HAAS, Christian; KATLEIN, Christian (Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research); NICOLAUS, Marcel (Sea Ice Physics (Alfred-Wegenger-Institut))**Presenter:** TAO, Ran (alfred wegenger institut)**Session Classification:** Oral Session**Track Classification:** 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 64

Type: **Poster**

Continuous Observations of Sea Ice Evolution Using Autonomous Buoys During the CONSTAST Expedition

Monday 23 March 2026 18:10 (5 minutes)

Autonomous buoy systems provide a unique opportunity for long-term, continuous observations of sea-ice surface processes, internal structure, and under-ice conditions. During the CONTRACT expedition, we deployed a coordinated network of autonomous buoys across multiple ice floes to establish a buoy network, in conjunction with MetCity, enabling continuous monitoring of sea-ice evolution both during transit between stations and after the expedition.

At each ice floe, we deployed a set of instruments including Radiation Stations, Snow Buoys, Camera Buoys, and Seasonal Ice Mass Balance buoys (SIMBA). Radiation stations measured incident, reflected, and transmitted irradiance, providing hyperspectral observations from 320–950 nm and broadband shortwave fluxes, from which albedo and transmittance were derived. Snow buoys recorded surface elevation changes using echo pingers, while camera buoys documented surface and under-ice conditions. SIMBA buoys measured temperature profiles through heating cycles to identify interfaces between atmosphere, snow, ice, and ocean, allowing ice thickness and melt processes to be quantified when combined with radiative energy fluxes.

Here we present first results from three contrasting ice floes. Light partitioning reveals that the thinner first-year ice floe exhibits higher broadband and spectral transmittance and is more sensitive to short weather events, such as snowfall, as confirmed by camera observations. Most transmitted irradiance occurred below 600 nm, with a noticeable shift in peak wavelength around late July. Snow buoy data show a general decrease in surface elevation, particularly at one floe where lower albedo was also observed. Together, these observations demonstrate distinct sea-ice regimes and rapid surface evolution. Combined with SIMBA data and larger-scale measurements such as under-ice ROV observations, this buoy network provides an integrated view of the life cycle and fate of Arctic sea ice.

Session Chair

no

On-site Session Chair

no

Author: TAO, Ran (alfred wegenger institut)

Co-authors: HAAS, Christian; KATLEIN, Christian (Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research); SALGANIK, Evgenii; ZIMMER, Florian (Sea Ice Physics (Alfred-Wegener-Institut)); NICOLAUS, Marcel (Sea Ice Physics (Alfred-Wegener-Institut))

Presenter: TAO, Ran (alfred wegenger institut)

Session Classification: Poster

Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 70

Type: **Oral**

Time series of phytoplankton groups during 2002-2025 in the Fram Strait under the changing Arctic Ocean

Thursday 26 March 2026 09:00 (13 minutes)

In the Arctic Ocean, phytoplankton are highly influenced by sea ice conditions and brine release. Phytoplankton dynamics are subject to the timing of nutrient and light-dependent biological production. Fram Strait (located between Svalbard and Greenland) as an important gateway to the Arctic, is a region where the cold ice-covered Arctic water exits from the western side and the warm Atlantic water enters the Arctic Ocean through the eastern side of the Strait. The two contrasting water masses interact in the central Fram Strait leading to complex phytoplankton dynamics especially under a rapidly changing Arctic climate. Within the framework of the Copernicus Marine Service Evolution Program, we have generated global chlorophyll-a products of several phytoplankton groups (PGs) derived from multi-sensor ocean color data from satellites, for a consistent long-term monitoring of the surface ocean PGs. The 24-year long observations enable us to study the inter-annual variation and analyze the trend of the surface phytoplankton community structure on different scales. Focusing on the Fram Strait, the satellite PFT data are evaluated with in situ data from AWI established LTER Observatory HAUSGARTEN area, which includes data sets of pigment composition and phytoplankton taxonomic data from expeditions in the past years. We further investigate the current state and the two-decade trends of the major PGs; present and interpret their phenological patterns, inter-annual changes and the potential connections between the PG shifts/trends and physical/biogeochemical drivers for different water masses in the Fram Strait.

Session Chair

no

On-site Session Chair

no

Author: XI, Hongyan (OZE, AWI)**Co-authors:** Dr PEEKEN, Ilka (Alfred Wegener Institute, Helmholtz-Centre for Polar and Marine Research); Dr ZEISING, Moritz (Alfred Wegener Institute, Helmholtz-Centre for Polar and Marine Research); Prof. BRACHER, Astrid (Alfred Wegener Institute, Helmholtz-Centre for Polar and Marine Research)**Presenter:** XI, Hongyan (OZE, AWI)**Session Classification:** Oral Session**Track Classification:** 3. Ocean Dynamics, Tracers, and Biogeochemical Cycles

Contribution ID: 71

Type: **Oral**

Extending Sea Ice Observation Networks with Floe-Scale Remote Sensing

Thursday 26 March 2026 12:00 (13 minutes)

In situ networks of autonomous observatories such as the MOSAiC Distributed Network provide invaluable measurements of the spatiotemporal, multi-scale variability of sea ice. However, these observations are sparse in space and time, as Arctic buoy deployments are costly and it is difficult to maintain buoys in seasonal ice. Furthermore, traditional approaches to remote sensing of ice motion are less effective in the marginal ice zone, particularly during the melt season. These challenges result in a data gap for small-to-moderate scale ice motion in the spring and summer seasonal and marginal ice zones.

To address this gap, we present Ice Floe Tracker (IFT): long term observations of sea ice floe trajectories derived from MODIS imagery. IFT identifies, characterizes, and tracks distinct sea ice floes across image sequences, and provides estimates of ice floe rotation rate and floe size. These measurements are not typically available from buoy observations. We demonstrate the utility of the Lagrangian IFT floe trajectories for extending and contextualizing drifting buoy observations through analysis of floe shapes and trajectories in the Greenland Sea. The IFT floe-scale observations show coherent, spatially-dependent seasonal changes in floe shapes and color, indicating differing roles for fracture and melt in controlling the FSD. From the floe trajectories, we observe seasonal changes in rotation and deformation rates. These joint observations of floe properties and motion from the IFT enable novel analysis of the coupled air-ice-ocean system.

Session Chair

yes

On-site Session Chair

yes

Author: WATKINS, Daniel (Brown University)**Co-authors:** Dr HUTCHINGS, Jennifer (Oregon State University); Dr WILHELMUS, Monica M. (Brown University)**Presenter:** WATKINS, Daniel (Brown University)**Session Classification:** Oral Session**Track Classification:** 8. Remote Sensing, Autonomous Technologies, and Polar Observing

Contribution ID: 72

Type: **Oral**

The Role of Inversion Strength and Large-Scale Subsidence on Arctic Mixed-Phase Cloud Properties: Results from MOSAiC

Wednesday 25 March 2026 12:30 (13 minutes)

The region inside the Arctic Circle is warming faster than any other region of the globe, and resultant long-term changes to Arctic mixed-phase clouds must be fully understood to continue improving regional and global climate models. This study investigates two key meteorological controls on observed Arctic low-level mixed-phase clouds. Shipborne meteorological (temperature, pressure, humidity, etc.) and cloud observation data from the Multidisciplinary drifting Observatory for the Study of Arctic Climate (MOSAiC; 84-88°N) field campaign is used. European Centre for Medium-Range Weather Forecasting (ECMWF) reanalysis (ERA-5) data provide climatological context for MOSAiC measurements. Lower tropospheric stability (LTS) and estimated inversion strength (EIS) imply a “quasi-permanent” inversion and a highly stable lower troposphere throughout the Arctic driven by persistent large-scale subsidence. Although these meteorological controls would imply unfavorable conditions for cloud formation, median cloud fraction over the Arctic Circle is approximately 90%. To understand how low-level clouds persist –especially low-level mixed-phased cloud –two idealized cloud scenarios observed during MOSAiC –a “steady-state” cloud case and a “transition” cloud case –are modeled using a Lagrangian LES model. These two cases represent “typical” cloud observations during the MOSAiC campaign, each respectively representing (1) a shallow PBL cloud with mixed-phase cloud particles near the cloud top and (2) a shallow PBL cloud changing slowly with the approach of a baroclinic eddy. Initial results show that subsidence dissipates these clouds quickly, with rapid cloud-top longwave cooling likely extending the cloud’s lifetime. Other processes possibly explaining why mixed-phased cloud cover persists under unfavorable conditions is discussed.

Session Chair

yes

On-site Session Chair

yes

Authors: DZAMBO, Andrew (CIWRO / University of Oklahoma - Norman); MCFARQUHAR, Greg (CIWRO / University of Oklahoma - Norman); MORRISON, Hugh (NSF National Center for Atmospheric Research); CHANDRAKAR, Kamal Kant (NSF National Center for Atmospheric Research)

Presenter: DZAMBO, Andrew (CIWRO / University of Oklahoma - Norman)

Session Classification: Oral Session

Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 73

Type: Oral

Feasibility and Challenges of 3D Reconstruction for Under-Ice Morphology and Ecosystem Mapping

Thursday 26 March 2026 12:15 (13 minutes)

As the Arctic transitions toward a seasonally “ice free” state, understanding the complex morphology of submerged sea ice is critical for modeling ocean-ice-atmosphere heat exchange and monitoring under-ice habitats. Current under-ice mapping relies primarily on acoustic sensors (multi-beam sonar), which provide reliable geometry but lack the spectral and textural detail necessary for identifying biological communities or validating radiative transfer models. Visual photogrammetry offers a pathway to capture these environments as high-fidelity 3D reconstructions which can then be used for downstream tasks such as training sensor-fusion models to reconstruct underwater ice using opti-acoustic methods. However, the use of optical methods in the texture-poor, scattering-heavy underwater Arctic environment remains largely unproven.

This work evaluates the efficacy of modern computer vision architectures for reconstructing submerged ice, utilizing remotely operated vehicle (ROV) data collected during the MOSAiC expedition. We benchmark two visual reconstruction paradigms: (1) Explicit Structure-from-Motion (SfM) using Agisoft Metashape and COLMAP, and (2) Implicit Neural Rendering via 3D Gaussian Splatting (3DGS). To quantify reliability, we utilize coincident Multibeam Sonar data as a geometric “ground truth”, allowing us to measure the drift and deformation inherent to visual methods in feature-sparse waters.

Our preliminary results highlight a critical trade-off: while visual methods succeed in generating photorealistic assets that reveal surface roughness and optical properties inaccessible to sonar, they suffer from significant geometric drift (non-metric scaling) when acoustic constraints are absent. We identify turbidity and “visual blindness” (lack of distinct features) as the primary limiters for autonomous visual mapping. By quantifying these failure modes, we define the operational envelope where optical reconstruction can reliably augment acoustic surveys, paving the way for future hybrid sensor networks that capture both the structural geometry and biological signatures of the changing Arctic ice.

Session Chair

no

On-site Session Chair

no

Authors: NEDUNGADI, Ashwin (Rostock University); ORBÁN, Klára (Babes-Bolyai University)

Co-authors: CIEPLY, Bastian (Rostock University); KOGĂLNICEANU, Ana-Ştefania (Babes-Bolyai University); SAVA, Bianca-Marcela (Babes-Bolyai University); SIMON, Raul-Alexandru (Babes-Bolyai University); LUDTKE, Stefan (Rostock University); BENȚA, Kuderna-Iulian (Babes-Bolyai University)

Presenter: CIEPLY, Bastian (Rostock University)

Session Classification: Oral Session

Track Classification: 8. Remote Sensing, Autonomous Technologies, and Polar Observing

Contribution ID: 74

Type: **Oral**

The Arctic Inversion Boundary-Layer (AIBL) Paradigm: Description and Observations of Key AIBL Features and their Modulation during MOSAiC

Wednesday 25 March 2026 11:30 (13 minutes)

Studies suggest that the atmospheric boundary layer over Arctic sea ice can be conceptualized 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 its stability is modified by various internal mixing features. These features include 1) the Arctic boundary layer (ABL) nearest the surface produced through traditional boundary-layer local frictional or buoyant processes; 2) the cloud-forced mixed layer (CML) aloft forced by cloud-top radiative cooling of clouds (often strato-cumulus); and 3) well-mixed layers produced by vertical wind shear in the vicinity of low-level jets (LLJs). When the forcing within the near-surface 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 with each other, producing an apparent well-mixed (near-neutral) layer from the surface to cloud top. This coupled SML-CML may allow significant vertical mixing of heat, moisture, momentum, aerosols, and trace gases.

Data from the year-long MOSAiC field program over the Arctic sea ice in 2019-2020 has been used to evaluate the various features of this Arctic inversion boundary-layer (AIBL) paradigm. The AIBL features are identified and characterized with sounding data and with the extensive suite of surface-based remote sensors and in-situ surface-based atmospheric and surface. In this presentation, the AIBL concept will be introduced, and key structural characteristics of the AIBL features and their temporal variability will be presented.

Session Chair

no

On-site Session Chair

no

Author: PERSSON, Ola (University of Colorado)**Co-authors:** Dr SOLOMON, Amy (University of Colorado); Dr TURNER, David (NOAA); Prof. BROOKS, Ian (University of Leeds); Dr SHUPE, Matthew (University of Colorado); Dr LOPEZ GARCIA, Vania (University of Leeds)**Presenter:** PERSSON, Ola (University of Colorado)**Session Classification:** Oral Session**Track Classification:** 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 75

Type: **Poster**

Spatial and Temporal Variability of Arctic Sea Ice Growth and Melt

Monday 23 March 2026 17:05 (5 minutes)

In recent decades, the Arctic sea ice cover has undergone reductions in ice extent, thickness, and age. Sea ice mass balance observations help to differentiate the relative contributions of atmospheric and oceanic forcing to the observed losses. Autonomous ice mass balance buoys measure time series of snow accumulation and ablation; ice growth and surface and bottom melt; and vertical profiles of air, snow, ice, and ocean temperature. Observations from different sites in the Beaufort Sea show large interannual and spatial variability in mass balance, with surface melt ranging from 0.2 to 0.9 m and bottom melt from 0.1 to 2.2 m. There is more bottom than surface melt. In most cases, there was a net thinning of the ice over an annual cycle. Mass balance buoys also determined the onset dates of melt and freezeup for the surface and bottom. Surface melt onset has the greatest variability in timing and bottom melt has the smallest. The onset of snow melt and bottom melt typically occurs at about the same time. In contrast, surface melt typically ends by mid-August while bottom melt continues into mid-September on average. Incident solar radiation obtained from reanalysis products and ice concentration from satellites were used to calculate solar heat input to the ice and to the upper ocean. The contribution of solar heating to surface and bottom melt was investigated.

Session Chair

no

On-site Session Chair

no

Author: PEROVICH, Don (Thayer School of Engineering, Dartmouth College)

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Presenter: BYRON, Savannah (Thayer School of Engineering, Dartmouth College)

Session Classification: Poster

Track Classification: 5. Sunlight, Optical Properties, and Energy Budget

Contribution ID: 76

Type: **Oral**

Properties of a moist haze layer by lidar

Wednesday 25 March 2026 12:45 (13 minutes)

In this work high resolution Raman lidar data (7.5m / 85sec) and contemporary radio-sonde are used to study a repetitive formation / disintegration of a cloud-like haze layer (COD ~0.05 at 532nm) under moist conditions over Ny-Ålesund in winter.

We found that: - this haze layer did not correlate to absolute humidity (Raman Lidar) or wind (wind lidar) –this haze layer showed consistently very high (>100sr) lidar ratios at 532nm –change in color ratio and lidar ratio as a function of COD (haze formation and disintegration) seems symmetrical and that within 85sec the backscatter coefficient can change by 1 order of magnitude.

Further we performed an inversion of the lidar data to retrieve a size distribution of the particles. Due to the prevailing moist conditions we found already large aerosol (Reff ~ 0.3 µm) outside the haze layer. Inside this layer the mode of particles separated into a weakly hygroscopic mode (Reff grew to ~0.4µm) and a stronger hygroscopic one (Reff grew to ~ 0.8µm). Coarse mode particles > 2µm were present, but in very low concentration only and not decisive for the haze formation. Hence, while the formation of optically noticeable haze is apparently quick, the growth into a real cloud may take longer time.

Session Chair

yes

On-site Session Chair

no

Authors: Prof. BÖCKMANN, Christine; Dr RITTER, Christoph (AWI); Dr SCHNITT, Sabrina

Presenter: Dr RITTER, Christoph (AWI)

Session Classification: Oral Session

Track Classification: 6. Air-Ice-Ocean Coupling, Clouds, Moisture, and Precipitation

Contribution ID: 77

Type: **Oral**

Arctic size distribution observations reveal structural error in UKESM cloud-forming aerosols

Tuesday 24 March 2026 12:15 (13 minutes)

Aerosol-cloud interactions are a substantial source of uncertainty in Global Climate Models (GCMs), particularly in rapidly evolving regions such as the Arctic where aerosol populations are expected to change in the future. Improving the representation of cloud-forming aerosols in GCMs is essential to address these uncertainties, which can be informed through evaluation with in-situ aerosol observations.

Here, we identify and recommend parameters to better constrain and improve representations of Arctic cloud-forming aerosols in a GCM, with the goal of informing future observational field campaigns. We also demonstrate the ability of a dual observational constraint method to reveal structural biases within the model.

This study utilises size distribution observations from several Arctic sites to evaluate and constrain size and number terms of simulated accumulation-mode aerosols in the UK Earth System Model (UKESM), coupled with UKCA (United Kingdom Chemistry and Aerosols) and the aerosol micro-physical scheme GLOMAP (Global Model of Aerosol Processes). A Generalised Additive Model was used to quantify the relative importance of aerosol-cloud-relevant parameters within a Perturbed Parameter Ensemble (such as deposition processes, anthropogenic, sea spray and biogenic emissions). We present the dominant parameters which control accumulation-mode aerosol terms, and how the role of these parameters varies spatially and temporally across the Arctic. Using a dual-constraint method, we identify optimal parameter ranges that yield observationally representative size distributions at each Arctic site.

Comparisons between observationally- constrained parameter ranges reveal clear inconsistencies spatially and temporally across the Arctic, with little to no shared parameter space between winter-spring and summer-autumn months across all Arctic sites. This research suggests areas for future model development to further constrain natural and anthropogenic emissions, and physical process in the Arctic.

Session Chair

yes

On-site Session Chair

yes

Authors: WADLOW, Imogen (National Centre for Atmospheric Science, University of Leeds); WADLOW, Imogen (Institute for Atmospheric Science, University of Leeds)

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LOW, Imogen (Institute for Atmospheric Science, University of Leeds)

Session Classification: Oral Session

Track Classification: 7. Modeling Arctic Processes: Integrating Scales and Observations

Contribution ID: 78

Type: **Oral**

Welcome

Monday 23 March 2026 10:00 (15 minutes)

Presenters: REX, Markus (Alfred-Wegener-Institute, Helmholtz Center for Polar and Marine Research, Potsdam, Germany); SCHULZ, Alexander (Alfred-Wegener-Institute, Helmholtz Center for Polar and Marine Research, Potsdam, Germany)

Session Classification: PLENARY: Keynotes

Contribution ID: 79

Type: **Oral**

Atmosphere Overview

Monday 23 March 2026 12:25 (30 minutes)

Session Chair

On-site Session Chair

Author: DAHLKE, Sandro (Alfred-Wegener-Institute, Helmholtz Center for Polar and Marine Research, Potsdam, Germany)

Presenter: DAHLKE, Sandro (Alfred-Wegener-Institute, Helmholtz Center for Polar and Marine Research, Potsdam, Germany)

Session Classification: PLENARY: Keynotes

Contribution ID: 80

Type: Oral

Probing the Arctic from Bedrock to Boundary Layer: opportunities and challenges for understanding and quantifying turbulent aerial heat and mass transport using fiber-optic distributed sensing

Monday 23 March 2026 14:15 (25 minutes)

The Arctic system is particularly rich in aerial motions and processes contributing to the exchange of heat and mass from the permafrost, through the snow and surface all the way to the atmospheric boundary layers and beyond: turbulent isotropic eddies resulting from the energy cascade, gravity waves in stably stratified fluids and their interaction with turbulence, submeso-scale motions such as cold-air drainages and valley flows, and intermittent anisotropic convective eddies originating from surface heterogeneity all contribute to often non-linear coupling and transport across millimeters to tens of kilometers at time scales of sub-seconds to hours. Lending to their transient and intermittent nature, capturing and understanding these requires motions requires continuous observations. This fundamental requirement poses challenges for point-based sensors even when arranged in networks as the station spacing often exceeds the scales of the transport phenomena and are thus sparse. Here, fiber-optic distributed sensing (FODS) can fill a large portion of the observational gap by providing accurate measurements of temperature (in air, water, snow, ground), air and water flow speed and to some degree direction, and soil moisture at scales from decimeters to kilometers sampled at seconds along millimeter-thick fiber-optic cables with minimal observer effect (Thomas and Selker, 2021). Coil-wrapped geometries can capture even steep gradients over millimeters.

First, the presentation introduces the fundamentals of the fiber-optic distributed temperature sensing technique and its derivatives across classic passive and actively heated variations. Typical choices of cable materials, sampling geometries, and calibration needs are discussed alongside measurement uncertainty and sampling artifacts. Next, applications from two Arctic FODS deployments in the atmospheric surface (Huss and Thomas, 2024) and boundary layers (Mack et al., 2025) over snow during the polar night using high-resolution columns and cables suspended from tethered balloons highlight its utility for identifying processes, quantifying heat fluxes, advancing similarity theory, and evaluating synoptic forecast models.

References:

Thomas, C.K., Selker, J.S., 2021. Optical fiber-based distributed sensing methods, in: Foken, T. (Ed.), Springer Handbook of Atmospheric Measurements. Springer Handbooks, Springer Nature Switzerland AG 2021, pp. 609–631. https://doi.org/10.1007/978-3-030-52171-4_20

Huss, J.-M., Thomas, C.K., 2024. The impact of turbulent transport efficiency on surface vertical heat fluxes in the Arctic stable boundary layer predicted from similarity theory and machine-learning. J. Atmos. Sci. <https://doi.org/10.1175/JAS-D-24-0063.1>

Mack, L. et al. , 2025. Stable Boundary Layers in an Arctic Fjord-Valley System: Evaluation of Temperature Profiles Observed From Fiber-Optic Distributed Sensing and Comparison to Numerical Weather Prediction Systems at Different Resolutions. J. Geophys. Res. Atmos. 130, e2024JD042825. <https://doi.org/10.1029/2024JD042825>

Session Chair

On-site Session Chair

Author: THOMAS, Christoph (Micrometeorology Group, University of Bayreuth, Bayreuth, Germany)

Presenter: THOMAS, Christoph (Micrometeorology Group, University of Bayreuth, Bayreuth, Germany)

Session Classification: PLENARY: Keynotes

Contribution ID: **81**

Type: **Oral**

The CONTRASTS Expedition

Monday 23 March 2026 14:40 (25 minutes)

Session Chair

On-site Session Chair

Author: NICOLAUS, Marcel (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven)

Presenter: NICOLAUS, Marcel (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven)

Session Classification: PLENARY: Keynotes

Contribution ID: 82

Type: **Oral**

Arctic Airmass Transformations: Quasi-Lagrangian Observations and Model Results

Monday 23 March 2026 15:05 (25 minutes)

Session Chair

On-site Session Chair

Author: WENDISCH, Manfred (Leipzig Institute for Meteorology (LIM), Leipzig University, Leipzig, Germany)

Presenter: WENDISCH, Manfred (Leipzig Institute for Meteorology (LIM), Leipzig University, Leipzig, Germany)

Session Classification: PLENARY: Keynotes

Contribution ID: 83

Type: **Oral**

Indigenous Knowledge and Rights in Arctic System Science: Advancing Co-Design Approaches

Monday 23 March 2026 15:30 (25 minutes)

Session Chair

On-site Session Chair

Author: RACHOLD, Volker (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Potsdam)

Co-author: SCHULZ, Lia (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Potsdam)

Presenters: RACHOLD, Volker (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Potsdam); SCHULZ, Lia (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Potsdam)

Session Classification: PLENARY: Keynotes

Contribution ID: 84

Type: **Oral**

Sea Ice & Snow Overview

Monday 23 March 2026 11:15 (30 minutes)

Session Chair

On-site Session Chair

Author: NICOLAUS, Marcel (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven)

Presenter: NICOLAUS, Marcel (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven)

Session Classification: PLENARY: Keynotes

Contribution ID: 85

Type: **Oral**

Ecosystem Overview

Monday 23 March 2026 11:50 (30 minutes)

Session Chair

On-site Session Chair

Author: HOPPE, Clara (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven)

Presenter: HOPPE, Clara (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven)

Session Classification: PLENARY: Keynotes

Contribution ID: 87

Type: **Oral**

Ocean Overview

Monday 23 March 2026 10:15 (25 minutes)

Session Chair

On-site Session Chair

Author: SCHULZ, Kirstin (Oden Institute for Computational Engineering and Sciences, The University of Texas at Austin, Austin, TX, United States)

Presenter: SCHULZ, Kirstin (Oden Institute for Computational Engineering and Sciences, The University of Texas at Austin, Austin, TX, United States)

Session Classification: PLENARY: Keynotes

Contribution ID: 88

Type: **not specified**

1. CONTRASTS side meeting part 1

Wednesday 25 March 2026 14:15 (1h 45m)

Presenter: NICOLAUS, Marcel (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven)

Session Classification: FLEX Time

Contribution ID: 89

Type: **not specified**

1. CONTRASTS side meeting part 2

Wednesday 25 March 2026 16:30 (1h 45m)

Presenter: NICOLAUS, Marcel (Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung, Bremerhaven)

Session Classification: FLEX Time

Contribution ID: **90**

Type: **not specified**

1. Early Career Researchers

Tuesday 24 March 2026 14:15 (1h 45m)

Session Classification: FLEX Time

Contribution ID: **91**

Type: **not specified**

Antarctica InSync

Friday 27 March 2026 09:30 (25 minutes)

Presenter: REX, Markus (Alfred-Wegener-Institute, Helmholtz Center for Polar and Marine Research, Potsdam, Germany)

Session Classification: PLENARY

Contribution ID: 92

Type: **not specified**

TARA Polar Station

Friday 27 March 2026 09:55 (25 minutes)

Presenter: NICOLAUS, Marcel (Alfred Wegener Institute (AWI), Bremerhaven, Germany)

Session Classification: PLENARY

Contribution ID: 93

Type: **not specified**

FLEX session summaries

Friday 27 March 2026 11:15 (1h 35m)

Session Classification: PLENARY

Contribution ID: 94

Type: **not specified**

Summary and vision of ECR session

Friday 27 March 2026 10:20 (25 minutes)

Presenter: TDB

Session Classification: PLENARY

Contribution ID: 95

Type: **not specified**

Concluding Remarks

Friday 27 March 2026 12:50 (10 minutes)

Presenters: REX, Markus (Alfred-Wegener-Institute, Helmholtz Center for Polar and Marine Research, Potsdam, Germany); SCHULZ, Alexander

Session Classification: PLENARY

Contribution ID: 96

Type: **Poster**

Evaluating Satellite-Derived Sea-Ice Drift in a Changing Arctic Using In-Situ Buoy Observations from the CONTRASTS Expedition

Monday 23 March 2026 16:30 (5 hours)

Rapid Arctic warming is accompanied by thinning and increasingly dynamic sea-ice cover, enhancing export through gateways such as Fram Strait. Reliable observations of sea-ice drift are essential to accurately determine freshwater fluxes, sea-ice redistribution, and feedbacks within the Arctic climate system. Satellite-derived sea-ice motion products provide basin-scale coverage but remain challenging in highly dynamic regions and during the summer melt season.

Here we evaluate the performance of the OSI SAF Global Low Resolution Sea-Ice Drift product (OSI-405-d) using in-situ observations from Surface Velocity Profiler (SVP) buoys deployed during the RV Polarstern expedition PS149 (CONTRASTS) in summer 2025. Buoy-derived drift was compared with satellite-derived drift vectors over 48-hour intervals across three sea-ice regimes: seasonal ice, first- and second-year ice, and multi-year ice drifting toward Fram Strait.

Overall, the satellite product reproduces observed drift magnitude and direction well. Agreement is highest in the first- and second-year ice regime (bias $\approx 0.04\text{km}$, RMSE $\approx 5\text{km}$ per 48h), while larger deviations occur in seasonal ice (RMSE $\approx 10\text{km}$). The largest discrepancies occur in the multi-year ice regime and increase toward Fram Strait, where higher drift velocities and spatial variability result in RMSE $\approx 21\text{km}$ and differences of up to $\sim 40\text{ km}$ per 48 hours. These discrepancies likely reflect the coarse spatial resolution and temporal averaging of the satellite product, smoothing small-scale ice motion captured by in-situ measurements.

Our results demonstrate that satellite drift products provide a robust large-scale representation of Arctic sea-ice motion while highlighting limitations in highly dynamic export gateways such as Fram Strait. Further validation is essential for improving observational products used to quantify Arctic sea-ice transport and its role in the changing Arctic system.

Session Chair

On-site Session Chair

Author: BRECHTELSBAUER, Stefanie (1 The University Centre in Svalbard (UNIS), Longyearbyen, Norway 2 Department of Meteorology, Stockholm University, Stockholm, Sweden 3 Alfred Wegener Institute (AWI), Bremerhaven, Germany)

Co-authors: KRUMPEN, Thomas (Alfred Wegener Institute (AWI), Bremerhaven, Germany); NICOLAUS, Marcel (Alfred Wegener Institute (AWI), Bremerhaven, Germany); RINNE, Eero (The University Centre in Svalbard (UNIS), Longyearbyen, Norway); RICKER, Robert (NORCE Norwegian Research Centre, Tromsø, Norway)

Presenters: BRECHTELSBAUER, Stefanie (1 The University Centre in Svalbard (UNIS), Longyearbyen, Norway 2 Department of Meteorology, Stockholm University, Stockholm, Sweden 3 Alfred Wegener Institute (AWI), Bremerhaven, Germany); KRUMPEN, Thomas (Alfred Wegener Institute (AWI), Bremerhaven, Germany); NICOLAUS, Marcel (Alfred Wegener Institute (AWI), Bremerhaven, Germany); RINNE, Eero (The University Centre in Svalbard (UNIS), Longyearbyen, Norway); RICKER, Robert (NORCE Norwegian Research Centre, Tromsø, Norway)

Session Classification: Poster

Track Classification: 8. Remote Sensing, Autonomous Technologies, and Polar Observing

Contribution ID: 97

Type: **Poster**

Modern Northwestern American terrestrial pollen relationship to climate and vegetation

Monday 23 March 2026 21:25 (5 minutes)

One of the major problems facing society today is the rapid change of our natural environment caused by climate change. Since the Arctic is recognized as one of the most sensitive regions, it is becoming increasingly important to understand the relationship between present vegetation, pollen spectra, and environmental factors. However, necessary field reference data for terrestrial pollen deposition is limited.

To study these relationships, we present a new dataset consisting of pollen samples from 30 field sites across Northwest Canada and Alaska. A cluster analysis was performed on the pollen data. Boxplots, Redundancy Analysis (RDA) and permutation tests were used to determine relationships between the pollen dataset and environmental variables. Furthermore, procrustes rotation analysis and protest significance tests were conducted. Finally, a simulation approach was designed to investigate possible discrepancies caused by relative pollen productivity (RPP).

A total of 18 pollen taxa from plants and six spore taxa were found. The distribution of pollen taxa reflects typical patterns found in pollen spectra, where woody species are overrepresented. PCA results show that division into three clusters is meaningful. Boxplots and RDA results show that temperature variables have the greatest influence on pollen distribution. Furthermore, the simulation shows that pollen values are adjusted to RPP of the taxa. We can also establish that the changes in the pollen composition cause major improvements in Procrustes results. This study provides a new reference dataset and our analyses revealed important insights into understanding the relationship between vegetation cover, environmental factors and pollen data.

Session Chair

On-site Session Chair

Presenter: LEHMANN, Linnéa (Alfred Wegener Institute)

Session Classification: Poster

Track Classification: 4. Biodiversity, Species Distributions, and Ecological Networks