Abstracts and Biographies

Arctic Prediction in a Changing Climate: Understanding Key Processes and Challenges

Chasing the source of the AMOC (Atlantic Meridional Overturning Circulation) - atmosphere-ocean coupling in the Iceland and Greenland Seas?

Ian Renfrew, University of East Anglia (UEA)

Abstract : A coordinated meteorological and oceanographic field campaign over the Iceland and southern Greenland Seas took place in February and March 2018. The aim being to characterise the atmospheric forcing and the ocean response of coupled atmosphere-ocean processes; in particular cold-air outbreaks in the vicinity of the marginal-ice-zone, and their triggering of oceanic heat loss and the generation of dense water masses. We observed the spatial structure and variability of surface flux fields in the region and the weather systems that dictate these fluxes, through the first meteorological field campaign in the Iceland Sea. This was done as part of a coupled atmosphere-ocean field campaign in winter 2018 involving a rare wintertime research cruise, airborne observations and a host of ocean and atmosphere observing systems. We made in-situ observations of air-sea interaction processes from several platforms. In this talk, I will present some highlights from the field campaign and discuss early findings from our research.

Biography: Ian Renfrew is a Professor in the School of Environmental Sciences, at the University of East Anglia, which he joined as a Lecturer in 2004. Before then he was a research scientist at the British Antarctic Survey for 6 years and a postdoctoral research fellow in the Department of Physics at the University of Toronto for 3 years. His research is on dynamical and physical processes that are important for weather forecasting and climate prediction; in particular mesoscale dynamical meteorology, air-sea interaction, atmospheric forcing of the ocean and North Atlantic climate. He has particular expertise on these processes in the polar regions. He has published more than 70 peer-reviewed articles in the leading journals in the field and been the Principle Investigator in numerous NERC research grants.

Mixing it up: What connects Arctic clouds and sea ice?

Ian Brooks, University of Leeds

Abstract: The single largest source of uncertainty in climate models results from the representation of clouds; this is particularly so in the Arctic, where for much of the year low-level boundary-layer clouds dominate control of the surface energy budget. The time-evolution and properties of these clouds are intimately linked with their interactions with the surface and boundary layer structure. The properties of both clouds and boundary layer (and indeed the surface) are sub-grid-scale in climate and weather forecast models, and many important features are poorly represented by current parameterizations. Notably, observations show that the summer time boundary-layer over sea ice is often decoupled below cloud, inhibiting turbulent mixing – and hence the transport of aerosols and water vapour – between cloud and the surface. This decoupling is not reproduced by models. The controls on this turbulent structure are poorly understood. Here we will review the state of knowledge, and some of the recent research on Arctic boundary layer processes and its impact on clouds and the surface energy budget, and thus ultimately on the evolution of sea ice.

Biography: Ian Brooks started his research career studying thunderstorm electrification processes for a PhD at UMIST. He moved to San Diego and Scripps Institution of Oceanography and post-doctoral research in marine boundary layer meteorology, including surface atmosphere interactions and stratocumulus cloud processes. In 2002 he moved back to the UK and a research fellowship at the University of Leeds, where he is now Professor of Boundary Layer Processes. His research is split between the fields of air-sea interaction and Arctic boundary layer processes and their links to polar climate – almost all of which is based on direct measurements of these processes in the field.

What are the challenges and priorities for improved prediction and climate monitoring of the Arctic?

Irina Sandu, ECMWF

Abstract: In order to improve both predictions in the Arctic on timescales from a few hours to seasons and reanalyses, which constitute a great tool for climate monitoring of the Arctic, work is needed in three areas: (i) enhanced coupled modelling, (ii) data assimilation methods and (iii) the effective use of observations in the numerical weather prediction systems. Arctic regions pose specific challenges for each of these three areas because model errors are large, in-situ observations are sparse, and satellite observations are difficult to use in data assimilation because of ambiguous signal properties, despite large data volumes.

Furthermore, the current data assimilation systems are mostly tuned to perform optimally in mid-latitudes, and we first need to understand their suitability around the poles. The challenges and priorities in each of these three areas will be discussed, using concrete examples from efforts to improve predictions in the Arctic and beyond made in the framework of the YOPP modelling activities and the H2020 project APPLICATE. Compared to previous similar initiatives, YOPP is indeed putting additional emphasis on numerical experimentation, in a concerted effort to exploit observations for model improvement and drive developments in data assimilation and the design of observing systems.

Biography: Irina Sandu is the Team Leader of Physical Processes in the Research Department of ECMWF. Before joining ECMWF in 2010, Irina obtained a Phd from Université Paul Sabatier, Toulouse (2007), and was an Alexander von Humbolt postdoctoral fellow at the Max Planck Institute for Meteorology in Hamburg. Her research has so far covered boundary layer clouds and the factors controlling their distribution, aerosol-cloud interactions, turbulent diffusion in stable conditions, land-atmosphere coupling and impacts of surface, and more particularly orographic drag, on the large-scale circulation.

The view from above Arctic snow at 89-325 GHz: What can surface emissivity on these channels tell us about snowpack stratigraphy?

Chawn Harlow, Met Office

Abstract: In March 2018, the Met Office carried out an airborne campaign focussing on evaluation of snow microwave emission models in the 89-325 GHz frequency range: Measurements of Arctic Cloud, Snow and Sea Ice in the Marginal Ice ZonE (MACSSIMIZE). The campaign collected ground-based snow pit measurements collated with airborne radiometric measurements that are being used to improve snow physical models for use in future NWP models. This presentation will (1) motivate the measurement campaign from both the snow remote sensing and the atmospheric data assimilation points of view and (2) discuss emissivity retrievals obtained during the campaign at 89, 118, 157, 183.3, 243, and 325 GHz. The plan to evaluate the snow thermodynamic and emissivity models using the observations from MACSSIMIZE will also be discussed.

Biography: Chawn Harlow completed his early studies at the University of Arizona, where he obtained a degree in Physics and Astronomy followed by a PhD in Hydrology and Water Resources, with a Minor in Atmospheric Sciences. His PhD thesis focused on passive L-band remote sensing retrieval algorithms of soil moisture supported by laboratory measurements of dielectric properties at same frequency. Much time was spent measuring dielectric properties of wet sand and vegetation in the lab with the goal to understand how L-band emissivity changes with changes in soil and vegetation water content.

In 2005 Chawn joined the Met Office where he was asked to study snow surface emissivities at much higher frequency (20-200 GHz). This led to Chawn’s first airborne campaign, CLPX-II, in 2008. In January 2011, Chawn became manager of the OBR Radiation Group at the Met Office, and his interests became much more diverse. During this time, he led various airborne campaigns: SALSTICE in 2012, COSMICS in 2015 and now MACSSIMIZE in 2018. In October 2017, Chawn moved to the Met Office Satellite Applications group where he is currently Manager of the Satellite Radiance Assimilation Group.

Why tundra snow is upside down in models, and why it matters

Richard Essery, University of Edinburgh

Abstract: Earth System and Numerical Weather Prediction models are beginning to use more sophisticated representations of snow on the ground, drawing on snow physics models that were first developed for avalanche prediction. These models have mostly been evaluated for deep mid-latitude mountain snow, however, and they neglect important physical processes occurring in shallow Arctic snow subjected to high winds and low temperatures. Understanding these processes is important for representing the thermal properties of Arctic snow and exploiting information from microwave remote sensing over snow-covered surfaces. In this talk, relevant results will be presented from the ground component of the YOPP-endorsed MACCSIMIZE campaign in Northwestern Canada.

Biography: Richard Essery is Professor of Cryosphere-Atmosphere Interactions in the School of GeoSciences at the University of Edinburgh and has previously worked at the Met Office Hadley Centre, the Canadian National Hydrology Research Institute and the Centre for Glaciology at the University of Aberystwyth. He combines modelling with Arctic and alpine field studies.

What are the limitations of Arctic sea ice remote sensing products, and what opportunities can they provide for improving predictive skill of Arctic forecasts?
Ed Blockley, Met Office

Abstract | In response to declining sea-ice cover, human activity in the Arctic is increasing, and access to the Arctic Ocean is becoming more important. Such activities include commercial ventures like tourism, mineral and oil extraction, fishing, and shipping, along with activities of importance to local communities such as subsistence hunting and fishing, search and rescue, and community re-supply. Additionally, the presence of sea ice can considerably modify the exchange of heat and moisture between the ocean and atmosphere with consequences for near-surface meteorology and boundary-layer evolution. Accurate forecasts of Arctic sea ice – on a variety of different timescales – are therefore becoming increasingly important for the safety of human activities in the Arctic.

In this talk, we shall provide a brief overview of how sea ice has been traditionally initialised in short-range NWP and seasonal prediction systems. We shall provide an overview of the passive microwave remote sensing products typically used for initialisation of sea ice concentration, as well as the, relatively new, satellite-derived sea ice thickness products currently available. Information shall be provided about how these observations are derived, what the uncertainties and limitations are, and what new avenues of research are currently underway to improve measurements of Arctic sea ice from space. Finally we shall illustrate the impact (or potential impact) of assimilating these products in our operational prediction systems. In particular, using the Met Office's GloSea seasonal prediction system, we show how using sea ice thickness, inferred from the CryoSat-2 satellite altimetry, within the initialisation can considerably improve our ability to forecast Arctic summer sea ice on seasonal timescales.

Biography | Ed Blockley leads the Polar Climate Group of the Met Office Hadley Centre **-** a group with considerable experience in the development and evaluation of coupled climate models and a focus on understanding climate change in high latitude regions.

Within the UK, under the auspices of the UK's Joint Weather and Climate Research Programme, Ed leads development of the Global Sea Ice (GSI) configurations that are used within all the Met Office/UK coupled climate models, and more widely for forecasting and prediction across all timescales from hours to seasons. He also co-leads development of the Sea Ice modelling Integrated Initiative (SI3): the new unified NEMO sea ice model.

Prior to taking on the leadership of the Polar Climate Group in 2014, Ed worked in the Ocean Forecasting Research and Development team where he led development and evaluation of the Met Office's FOAM near-real-time operational ocean-sea ice analysis and forecasting system.

Before joining the Met Office, Ed was based at the University of Exeter where he obtained a MMath and PhD in applied mathematics, studying fluid flow in rapidly rotating spherical geometries.