2019 **ARCTIC FRONTIERS SCIENCE**

TUESDAY 22 JANUARY UNTIL THURSDAY 24 JANUARY

CALL FOR PAPERS

Arctic Frontiers Science 2019 will address the following four themes:

- Plastics in the Ocean
- The Future of Governance and handling Vulnerability in Arctic Ecosystems
- State of the Arctic
- A Smart Arctic Future

On behalf of the Arctic Frontiers Science Committees, we have great pleasure in inviting you to submit one or more abstracts to any of the four themes named above. We kindly ask you to do so in accordance with the instructions provided on the Call for Papers page. All abstracts are reviewed by scientific experts.

Abstract submission closes on Tuesday 25 September 2018, 23:59, CET.

PLASTICS IN THE OCEAN

A growing number of recent scientific investigations conclude that there are considerable concerns about plastic pollution in the Arctic. This urgency has set off a series of management decisions and policy processes. Still, more data and a deeper knowledge of plastic pollution in the Arctic are required to understand the full scope of the problem, and develop sensible mitigation strategies which take into account research results.

Marine debris reaches the Arctic from various sources: marine litter breaks down into microplastics, manufactured microplastics enter the environment, and offshore industries such as tourism, oil & gas and aquaculture also contribute to plastic pollution. Once in the environment, these plastics move north and add to local pollution. The pathways of microplastics from land via air and freshwater systems into the Arctic Ocean are, however, virtually undocumented. Transformation of plastic debris through processes such as weathering, leaching and adsorption of contaminants and biofouling is poorly understood, but results in a ubiquitous presence of microplastics in all arctic habitats, also as a vector of harmful chemicals, of concern also for human health. Hence, biota of all trophic levels and functional groups can encounter plastic litter of various sizes and characteristics, with unknown impacts and consequences for ecosystem function.

Due to the all-encompassing nature of the problem, societal measures are urgently required. These include reducing the amount of litter produced by activities on land and at sea, including plastic production, handling, recycling and disposal, and incentives for reducing the amount of resources/nature used for plastic production.

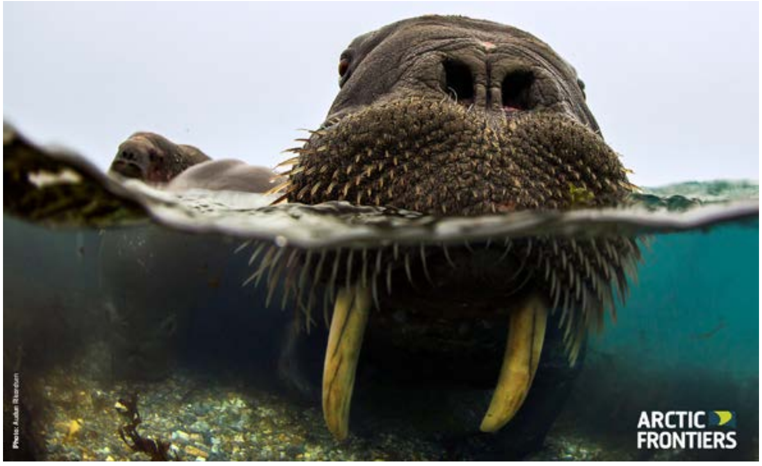
This session aims to address these knowledge gaps. We welcome contributions that consider the properties, fate, and ecological impacts of plastic debris, as well as studies working towards better policy implementation and incentives to reduce further emissions into arctic and sub-arctic systems.

We welcome abstracts from studies that look at one or more of the topics named above.

Scientific committee members:

- Dorte Herzke, NILU, Norway (lead)
- Albert Koelmans, Wageningen University, Holland
- Amy Lusher, NIVA, Norway
- Claudia Halsband, Akvaplan-niva AS, Norway
- Geir Wing Gabrielsen, Norwegian Polar Institute, Norway
- Heidi Rapp Nilsen, NORUT, Norway
- Jenna Jambeck, University of Georgia, USA
- Secretary: France Collard, Norwegian Polar Institute, Norway

THE FUTURE OF GOVERNANCE AND HANDLING VULNERABILITY IN ARCTIC ECOSYSTEMS



Vulnerabilities and challenges in maintaining Arctic Ecosystems

- Key ecosystem functions and vulnerabilities that need particular attention
- Understanding how changes in the ecosystems and their vulnerabilities affect human welfare and communities
- Risks and opportunities related to ecosystem services in the Arctic
- Defining and delineating ecosystems (social-ecological systems) at different scales

Governance systems in the Arctic – meeting rapid change in Arctic ecosystems

- Best practices, lessons learned and challenges related to governance and management of Arctic ecosystems, at the national level, across borders (bilateral and regional) and in areas beyond national jurisdiction
- Role and importance of multilateral arrangements, including the Law of the Seas, regional and bilateral fisheries agreements and the Arctic Council
- Meeting the many dimensions of sustainability: environmental/ecological, economic, social/cultural, and corresponding institutional aspects
- Lessons learned from governance and management of other ecosystems, including the Antarctic
- Preparing and reforming our governance systems to make them appropriate for the Arctic of tomorrow

We are especially interested in crosscutting papers, across academic disciplines and related to the science-policy interface. We recognize the challenge of integrating diverse knowledge sources, and we welcome proposals for papers based on local and indigenous knowledge.

We encourage all potential speakers to prepare specific and practical recommendations on possible ways forward, in particular for improved governance and for understanding and evaluating vulnerabilities. The science committee intends to prepare an outcome document (synthesis) from the session, based on the presented material and on a process for co-production of results. Keynote speakers will be identified on key themes, and information will come on the conference web site.

There is a general agreement that the integrity of Arctic ecosystems must be maintained and protected in order to secure resilience, functions and continued provision of valuable ecosystem services. At the same time, we need to understand what Arctic ecosystem vulnerabilities that need particular attention, and how these vulnerabilities can affect policy makers, Arctic communities and human welfare in general.

The Arctic region is undergoing dramatic changes, in particular due to climatic changes and subsequent responses in the ecosystems. Rapid change requires adaptive management and governance with explicit consideration of ecological, social, cultural, economic and institutional aspects. Are the governance structures apt to deal with large ecosystems as a whole, in particular when they extend to the jurisdiction of other states, extend to areas beyond national jurisdiction or exceed the competence of a management organization for fisheries or other resources? Are the governance systems sufficiently flexible over time, so that new measures could be implemented fast if necessary – and are there mechanisms in place to ensure that the governing bodies have the necessary information and science advice at the right time? Is science and monitoring in place to sufficiently provide the governing bodies with the knowledge and insights needed for sound governance and decision-making? In short: How secure is the future for our Arctic ecosystems?

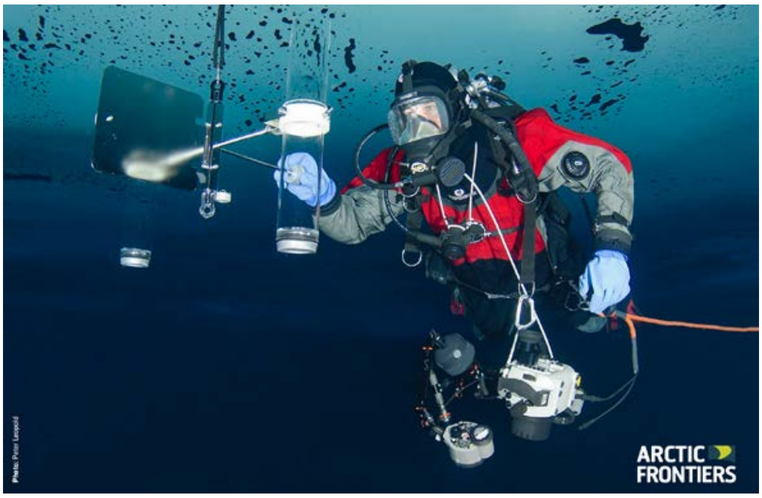
Recent key studies, assessments and management plans have been provided by nations with Arctic regions, as well as Arctic Council strategies, studies and assessments that draw the bigger picture. This includes the Arctic Marine Strategic Plan (AMSP) 2015-2025, the Arctic Biodiversity Assessment (ABA) and the assessments on Adaptation Actions for a Changing Arctic (AACA) and Snow, Water, Ice and Permafrost in the Arctic (SWIPA). It is important to build on what is already present and how this can be relevant for the future research and governance. Arctic Frontier 2019 will combine overarching and general Arctic regions issues and challenges with existing management and governance structures and discuss how these work, while also draw on ecosystem research and assessments along with examples of how the concept of ecosystem services is being applied.

Scientific committee members:

- Lars-Otto Reiersen, Akvaplan-niva AS & UiT The Arctic University of Norway, Norway (lead)
- Alf Håkon Hoel, Counselor Fisheries and Oceans, Norwegian Embassy to the USA, Washington DC[1]
- Claire Armstrong, Norwegian College of Fisheries Science, UiT The Arctic University of Norway, Norway
- Finn Katerås, Norwegian Environment Agency, Norway
- Gro I. van der Meeren, Institute of Marine Research, Norway
- Robert Stephenson, St. Andrews Biological Station, Canada

[1] from 01 August 2018, UiT The Arctic University of Norway, Norway

STATE OF THE ARCTIC



While the planet has warmed by 1°C since the late 19th century, the warming in the Arctic has been 2–3°C. This session addresses the current observational basis and causal understanding of the observed change manifested to date in Arctic Atmosphere-Ocean-Cryosphere interactions, and impacts on ecosystems – marine and terrestrial. We foresee a session benefitting from recent and ongoing efforts in documenting and understanding the state of and change in the Arctic such as the 2017 SWIPA report and the IPCC's Special Report on Global Warming of 1.5°C (SR1.5) and Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC).

We welcome abstracts addressing one or more of the topics further specified below, including state estimates and quantifications of causal links and processes. Both observation-and model-based studies are welcome; we particularly appreciate studies integrating both approaches.

Cryosphere interactions

One of the largest manifestations of Arctic change is the rapid shrinking and thinning of the Arctic sea ice cover and the consequences thereof. Feedbacks from sea ice loss has played a significant role in Arctic warming, but other factors such as increased down-welling longwave radiation from increased cloud cover, atmospheric moisture from local and remote sources and greenhouse gases, as well as changes in oceanic and atmospheric circulation are also important. Atmospheric responses to sea ice loss depend in part on the state of the background atmospheric circulation pattern with some sea ice reduction years having a smaller influence on tropospheric warming than others.

Also, mass loss of the Greenland Ice Sheet and of glaciers surrounding the Arctic has likely become the dominant source of sea-level rise in recent years. The importance of ice-ocean interaction for this mass loss, both at the interface of marine-terminating glaciers, but also through increased runoff from land-terminated glaciers, illustrates the importance of understanding the coupling of Arctic climate dynamics for the entire planet.

Permafrost is the third mayor component of the Arctic cryosphere. Extensive warming or thaw of permafrost has persisted for decades and is expected to accelerate. This in turn affects greenhouse gas dynamics, as previously frozen organic matter in soils and sediments is exposed to decomposition. Permafrost thaw causes a feedback to global warming that is comparable to climate forcing from all human land-use. These processes occur over vast areas, but are characterized by a high degree of spatial and temporal variability, which makes accurate scaling or projections challenging.

Oceans

The oceans of the Arctic are changing more rapidly than the global ocean as a whole with pronounced changes on a decadal timescale in temperatures, stratification, freshwater content, ice cover and pH. With the retreating sea ice, Atlantic and Pacific water masses reach further poleward; there is increasing evidence that the oceanic influx is causal in the former, particularly for wintertime sea ice change. Adding to this is the prominent interannual to multidecadal variability in hydrography, suggesting that the ocean is key to disentangling natural and forced change in Arctic climate, including maritime continental climate and near-term predictability. In the Arctic shelf-seas, there is evidence that sub-sea permafrost is rapidly thawing, which in turn may affect greenhouse-gas release.

The Arctic Oceans are also very important carbon sinks since despite constituting only ~4% of the total ocean surface area they account for ~12% of the ocean's total annual CO_2 uptake. Further, since the cold waters of the Arctic have weak buffer capacity this means that ocean acidification is more severe than elsewhere.

Ecosystems

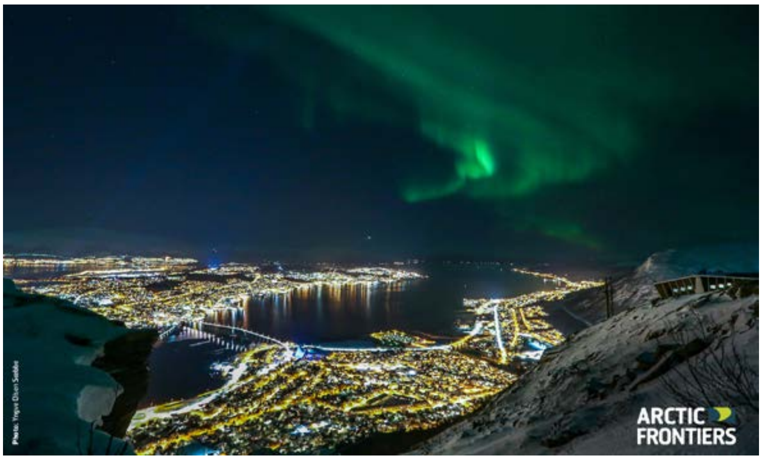
Changes in the physical conditions of the Arctic seas are affecting marine and terrestrial species and ecosystems, from primary production to top level predators. The impacts are geographically diverse, but with some general patterns. The ongoing temperature rise and reduced ice cover are already altering ecosystem function and geographical distribution of important species. In the sea this is e.g. pronounced in the north - and eastwards habitat expansion of key boreal fish stocks in the Barents Sea and Atlantic mackerel now being present off Greenland. The retreat of sea ice has also led to an increase in primary production and increased incidence of fall blooms. Eventual loss of the summer ice cover will have profound consequences for life in the Arctic seas. Furthermore, plankton species that form calcium carbonate shells or exoskeletons are highly vulnerable to ocean acidification and associated changes in mineral saturation states. Very often such species form the bottom of the food web, and the overall effects of ocean acidification on ocean ecosystems is still largely unknown.

On land, climate and environmental changes are profoundly affecting Arctic ecosystems. While some species may persist through adapting their geographical ranges, other species are less resilient. In many areas forests are migrating poleward and there is evidence of extensive shrub-expansion in tundra ecosystems. Permafrost thaw is also causing rapid changes to landforms and landscapes, altering important habitats and nesting grounds.

Scientific committee members:

- Ben Marzeion, University of Bremen, Germany (co-lead)
- Geir Ottersen, Institute of Marine Research, Norway (co-lead)
- Julienne Stroeve, University College London, NSIDC, United Kingdom (co-lead)
- Gustaf Hugelius, Stockholm University, Sweden
- Siv Lauvset, Uni Research Climate, Bjerknes Centre for Climate Research, Norway
- Tor Eldevik, University of Bergen & Bjerknes Centre for Climate Research, Norway

A SMART ARCTIC FUTURE



Between 4 and 6 million people live in the Arctic. Northern communities are diverse societies and face an array of possibilities and challenges. As with other parts of the world, there is great interest in planning for greater sustainability, accessibility, affordability and healthier cities, towns and villages. Arctic communities face particular challenges when it comes to relative isolation, infrastructural expense, harsh operating environments and environmental amplification and perturbation. Developments in automation, internet connectivity and terrestrial and marine electrification offer the promise of enhancing resilience in Arctic communities.

Terms such as 'smart city' have been used to direct policy and public attention towards habitable futures. Arctic Frontiers addresses the smart city concept and explores how, where and why it is applicable in the Arctic. Does it make sense for Arctic communities to adapt something that was developed and applied to 'southern' cities such as London, New York, Stockholm and Genoa? Is there something distinct about Arctic latitudes, ecosystems and communities that demands a different sort of 'smartness'?

The concept of 'smartness' demands further interrogation, and we invite both the natural sciences, and the social and humanistic disciplines to reflect on the scope of and for Arctic adaptation. Ongoing innovations in education, culture, economic development and modern technology can be used to connect and strengthen the resilience and viability of Arctic communities. But the roles and obligations for national governments, the international community, business, and foreign investors to support local authorities and people so that Arctic societies are sustainable and resilient are not insignificant. Ensuring that a 'smart Arctic' aligns with consent and cooperation in sustainable social, urban and landscape development is not straightforward. Greater connectivity can enhance business investment, enable public participation and community agency, and may contribute to better living standards in northern societies.

None of this should be assumed to be obvious, desirable and/or inevitable. Giving citizens and communities the right kind of 'connectivity' does not necessarily mean that they adapt and become more resilient in the face of ecological and socio-technical change. Smart city utopia rhetoric might encourage business-led technological fixes at the expense of longer-term citizen-informed planning. The technical, social, political, economic and environmental aspects of 'smartness' have to be approached in an interdisciplinary and inter-connected manner.

This session will highlight the insights gained from recent research that has:

Developed cost-effective and efficient solutions to provide anywhere anytime communication connectivity across the Arctic.

This is a challenging proposition. The extremely large coverage area with a very low density of users renders conventional terrestrial cellular wireless networks ineffective. Geosynchronous satellites can provide wide area coverage, but services to the Arctic suffer from the low elevation angles from polar locations toward the geosynchronous satellite orbit. Technological developments to address these challenges are critical due to the needs of isolated people and communities to stay connected with society, the needs to monitor and collect scientific data on changing Arctic terrestrial and marine environments, and the expressed desires by businesses and governments to exploit Arctic resources, to move through the Arctic and to manage planning and development.

Seen the emergence of Arctic Data Hubs and Data Processing Facilities.

Arctic and sub-Arctic locations are proving popular for data hub processing. Cold air and seawater reduce operating expenses for companies as costs for mechanical cooling are lowered. Data centers have opened in Sweden, Iceland and Finland and governments are attracting new businesses from high volume processors such as Facebook and Google to specific corporate operators such as BMW and Verne Global. Data hubs are also generating new investment in fiber cabling in the High North.

Deployed technology and models to obtain a broader view of the Arctic.

Robotics and mooring networks make virtually all areas of the Arctic accessible at appropriate observational scales. And complex ecosystem models are the only method to link field and laboratory studies to view systems at regional and pan-Arctic scales. Further developments in autonomous icebreakers, drones, robotics and underwater cabling are all contributing to domain awareness and data generation.

Investigated how to build and sustain resilient societies in the Arctic.

Governments, citizens and other stakeholders are generating ever more data with corresponding storage needs. Our lives are being transformed by data generation and sharing, including data driven service provision. But using and storing data also requires smart technologies to ensure their safety and security. Building a smart Arctic requires investment in cyber-resilience as well as recognizing that greater connectivity also brings with it potential and challenges in terms of social and cultural change.

Combined disciplines in unique ways to obtain a more integrated picture of Arctic ecosystems and societies.

Creative approaches are needed to secure a sustainable management and development of both ecosystems and societies. Disciplinary knowledge is being combined in innovative approaches such as ecosystem services in urbanism and place development, remote sensing technologies in mapping of ecosystems and landscape practices, critical territorial mapping, technology-based infrastructures for everyday practices in the Arctic, ethnographic methodologies and bottom-up approaches in community development.

We welcome abstracts that look at one or more of the topics named above and bring to the fore new approaches, which test current paradigms, develop new conceptual models, and enhance understandings of Arctic communities and ecosystems.

Scientific committee members:

- Chunming Rong, University of Stavanger, Norway / IEEE Cloud Computing & IEEE Blockchain (lead)
- Janike Kampevold Larsen, Oslo School of Architecture and Design, Norway
- Klaus Dodds, Royal Holloway University of London, United Kingdom
- Victor C.M. Leung, The University of British Columbia, Canada
- TBA, SINTEF Ocean, Norway