

INES 2024

FROM ARCTIC TO ONE OCEAN

Why is the Arctic so important for our planet?

23-27 September 2024

23 September 2024.

DAY I MARINE BIODIVERSITY

9:00 – 10:00 Lecture by Jan Marcin Węslawski: Arctic biodiversity paradox.

Lecture description.

Arctic is regarded as one of the youngest large ecosystems on Earth, with its floating ice cover not older than 0.7 million years. The shelf waters were released from the Last Glacial Ice Sheet about 11 thousand years ago, and only then shallow fauna was able to colonize the new seabed. Contrary to many other regions of the world, where biodiversity is drastically shrinking, in the Arctic it is rising, being supplied from the southern regions. This process has numerous implications for the carbon flow, structure of wildlife and commercial use of the marine resources.

10:00-10:15 Break.

10:15 – 11:15 Lecture by Sergey Olenin: Human-mediated introductions of aquatic species into the Arctic: diversity, pathways and consequences.

Lecture description.

The coastal zone of High Arctic Svalbard is widely regarded as a pristine environment in comparison to many other regions on our planet. However, over the past few decades, the effects of climate change have become increasingly evident, resulting in the rapid depletion of sea ice, alterations in sea temperature and salinity, and significant shifts in coastal geomorphology, for instance, the formation of periglacial lagoons due to the retreat of glaciers. With the shifts in the natural world and the surge in human activity, new opportunities have arisen for species to migrate from boreal regions. The lecture provides an overview of recent arrivals of new species, the pathways of their introductions, and the resulting impacts, both real and perceived.

11:15 – 11:30 Break.

11:30 – 12:30 Lecture by Simone Montano: Coral reefs of tomorrow: impacts and solutions.

Lecture description.

Coral reefs are a vital part of the marine ecosystem, and their potential disappearance can have unequivocal consequences on our environment. They are under increasing threats from multiple stressors, including the spread of diseases and the increase of sea surface temperatures. In this regard, reef restoration has gained much momentum in terms of scientific advancements, as well as through its increasing diffusion and upscaled practical applications. So far very few mitigation strategies have been proposed and developed to control those threats and in boosting the performances of the most commonly coral reef restoration techniques used. A strategy to slow down the decline of coral reefs could be using new, innovative, and ad-hoc technologies to increase the rates of survivorship of those coral colonies still alive and enhance coral reef restoration and rehabilitation performances.

12:30 – 13:15 Lunch.

13:15 – 15:30 Practical classes.

18:00 - ICE BREAKER.

24 September 2024.

DAY II Oceania cruise and practical classes.

Group A – Oceania cruise.

MEETING POINT: IOPAN at 8:00.

9:00 cruise starts.

20:00 the latest when cruise ends.

Group B – Lectures and classes.

10:00 – 14:00 Interactive workshop including beach activities.

14:00 – 15:00 Lunch.

15:00 – 16:00 Lecture by Ilaria Tani: The Arctic Ocean and the law of the seas.

Lecture description.

The lecture will focus on the maritime boundaries (already settled and to be settled) in the Arctic Ocean, including the difficult delimitation question of the Beaufort Sea; the extended continental shelves claimed by the Arctic States and the most recent recommendations of the Commission on the Limits of the Continental Shelf under the United Nations Convention on the Law of the Sea (Montego bay, 1982); the legal regime of the Arctic Straits, including a legal analysis of the regime of navigation through the “Northwest Passage” (through the Canadian Arctic Archipelago) and the “Northern Sea Route” (along the Russian coast); future shipping routes and Arctic coastal States’ navigational policies; submarine voyages; and marine environmental protection, with a focus on the impacts of climate change.

16:00 – 16:15 Break.

16:15 – 17:15 Lecture by Tymon Zielinski: Sustainability in light of global changes. Environmental and social aspects.

Lecture description.

Our planet is facing multiple environmental stressors (climate change, ocean acidification and pollution) engendered by these human activities and resulting in the degradation of world environments. Over the coming decades, a changing climate, growing global population, and increased environmental stressors will have significant yet highly uncertain impacts on food security and human welfare. Therefore, adaptation strategies and science-informed policy responses to global change are urgently needed. During the lecture we will discuss issues related to the need for generation of scientific knowledge and underpinning infrastructures and partnerships needed to support all sustainable development goals of 2030 Agenda. We will show how important it is to involve scientists, policy makers, managers, and service users to work together to ensure that modern science delivers greater benefits for both the planetary ecosystems and for society. We will stress out how important are global communication and mutual learning across research and stakeholder communities in the sustainability process.

25 September 2024.

DAY III Oceania cruise and practical classes.

Group B – Oceania cruise.

MEETING POINT: IOPAN at 8:00.

9:00 cruise starts.

20:00 the latest when cruise ends.

Group A – Lectures and classes.

- 10:00 – 14:00 Interactive workshop including beach activities.
14:00 – 15:00 Lunch.
15:00 – 16:00 **Lecture by Ilaria Tani: The Arctic Ocean and the law of the seas.**
16:00 – 16:15 Break.
16:15 – 17:15 **Lecture by Tymon Zielinski: Sustainability in light of global changes. Environmental and social aspects.**

26 September 2024.

DAY IV IMPACT OF ATMOSPHERIC AEROSOLS

- 9:00 – 10:00 Lecture by Luca Ferrero: Atmospheric Aerosol and Climate: known unknowns and unknown unknowns.**

Lecture description.

Atmospheric aerosols affect climate via direct, indirect and semi-direct effects. Despite the general knowledge concerning these phenomena a huge gap exists between the qualitative description of these and the quantitative assessment of their role. This is particularly evident in the Arctic area subjected to the Arctic Amplification. The Arctic Amplification is one of the most important climatic issues of the Arctic environment. It is due to several factors and brings to climatic feedbacks that enhance it and reflects on other areas of the globe. The lecture will focus on the atmospheric processes related to the Arctic Amplification and the climatic effect in the Arctic itself and regions far from the Arctic to open a discussion about future studies required to improve the actual knowledge.

10:00 - 10:15 Break

- 10:15 – 11:15 Lecture by Christoph Ritter: Introduction to remote sensing of aerosol and clouds.**

Lecture description.

Aerosol and clouds play a crucial role in the Arctic climate system. Due to low solar radiation and partially high surface albedo, clouds and aerosol may contribute to warming from autumn to spring. Further the formation of ice clouds under pristine conditions and the longevity of mixed phase clouds are not fully understood. In this talk some remote sensing techniques like lidar are introduced and their application to retrieve properties of clouds and aerosol will be discussed. By polarization, Doppler shift or scattering efficiencies some basic properties of atmospheric particles like their size, shape or terminal velocity can be estimated. Advantages and disadvantages of these remote sensing techniques compared to in-situ measurements will be discussed.

11:15 – 11:30 Break.

- 11:30 – 12:30 Lecture by Vera Bernardoni: Arctic Aerosol Odyssey: From Cruise Sampling to Source Characterization.**

Lecture description.

One of the main issues of the aerosol in the Arctic area is the need for an identification of its origin in term of sources. Several sources can impact the atmosphere in this polar region either natural or anthropogenic. These include: sea spray, high latitude dust, fossil fuel combustion, biomass burning, secondary aerosol, industrial activity, ship emissions, etc. The talk describes the state of the art of the source apportionment to unravel the contribution of different sources on the aerosol in the Arctic to link this knowledge with its climatic impact.

12:30 – 13:15 Lunch.

13:15 – 15:30 Practical classes.

15:45 – 16:45 Lecture by Niccolò Losi: Anthropogenic impact of human settlements on the Arctic aerosol: a window on a close future.

Lecture description.

Light-absorbing aerosols (LAA) impact the atmosphere by heating it. Their effect in the Arctic was investigated measuring the LAA heating rate (HR) and the aerosol chemical composition. Substantial differences between the Arctic Ocean background and the human settlements, among which the most impacting appeared to be Tromsø and Isfjorden, were found highlighting that, the anthropogenic activity in the Arctic can lead to an atmospheric warming one order of magnitude higher than in the pristine background conditions. Therefore, the direct climate impact of local LAA sources on the Arctic atmosphere is not negligible and may rise in the future due to ice retreat and enhanced marine traffic.

27 September 2024.

DAY V OCEAN AND CLIMATE – ONE SYSTEM.

9:00 – 10:00 Lecture by Agnieszka Herman: Ocean circulation – from the global scale to North Atlantic–Arctic connections.

Lecture description.

The global ocean circulation is a multi-scale, complex, three-dimensional system of wind- and density-driven currents. Polar regions play a crucial, very special role in that circulation: with just one exception (Mediterranean Sea), all areas of deep convection, and thus deep water formation, are located at high latitudes. The production rates of those water masses depend on sea ice formation, as well as the ocean–atmosphere heat and moisture exchange, i.e., they both influence and are influenced by regional weather and climate. In the North Atlantic, those interactions are also closely linked to the transport and properties of water masses that are carried further towards the Arctic, in effect influencing stratification and mixing in the Arctic Ocean. In this lecture, we will introduce the underlying mechanisms and general characteristics of the large-scale ocean circulation; analyze in more detail circulation, water masses and ocean–atmosphere interactions in the northern North Atlantic, including the Atlantic–Arctic connections; and discuss how the observed changes in the Arctic, including negative trends in sea ice extent and positive trends in wind- and wave-induced mixing, are linked to changes in water stratification, with consequences for physical and other processes.

10:00-10:15 Break.

10:15 – 11:15 Lecture by Judah Cohen: Mid-latitude cold extremes during the recent period of Arctic amplification.

Lecture description.

We have extended a recently developed index of accumulated winter season severity index (AWSSI), originally based on temperature and snowfall observations from weather stations in the United States only, to the entire Northern Hemisphere using reanalysis output. The expanded index (rAWSSI) is analyzed to reveal relationships between Arctic air temperatures/geopotential heights and the probability of severe winter weather across the midlatitudes. We find a direct and linear relationship between anomalously high Arctic temperatures/geopotential heights and increased severe winter weather, especially in northern and eastern continental regions. Positive temperature trends in specific Arctic regions are associated with increasing trends in severe winter weather in particular midlatitude areas.

Though cold extremes are expected to warm comparable to Arctic warming, cold extremes across the United States east of the Rockies, Northeast Asia and Europe have remained nearly constant over recent decades, in clear contrast to a robust Arctic warming trend. Analysis of trends in the frequency and magnitude of cold extremes is mixed across the US and Asia but with a clearer decreasing trend in occurrence across Europe, especially Southern Europe. This divergence between robust Arctic warming and no detectable trends in mid-latitude cold extremes highlights the need for a better understanding of the physical links between Arctic amplification and mid-latitude cold extremes. Finally, we find that when the stratospheric polar vortex is weak (anomalously warm stratosphere), the rAWSSI tends to increase, suggesting an association between disruptions in the polar vortex and severe winter weather across certain regions of the Northern Hemisphere continents. It is likely that increased disruptions of the polar vortex are contributing to a lack of trend in mid-latitude cold extremes.

11:15 – 11:30 Break.

13:15 – 15:30 Interactive class by Daniela Basso: Ocean Alkalinity Enhancement for marine Carbon Dioxide Removal.

Class description.

Ocean acidification is one of the main problems of the current human-induced climate change. The Intergovernmental Panel for Climate Change suggested that reducing the CO₂ emissions at the present rate is not sufficient to avoid the worst consequences of climate change and that we have to implement any possible action to remove the excess CO₂ that is already in the atmosphere. Among the several possible strategies, ocean alkalinity enhancement is a possible response to help coping with this major challenge. It involves the “acceleration” of the natural weathering process, by increasing the alkalinity of the ocean. This process could theoretically, locally increase the pH and alkalinity of the water, but still many hypotheses remain untested. In particular, it is unclear which is the response of the biota to the expected change in pH of their environment, during the chemical reactions that are fostered to occur.

12:30 – 13:30 Lunch.

13:30 – 14:30 Lecture: An overview and importance of the MOSAiC expedition.

Lecture description.

From fall 2019 to fall 2020 the international MOSAiC expedition was successfully carried out, despite COVID-19 pandemic and many logistical challenges. This was the largest, most complex, and most expensive expedition into the Polar regions ever. Scientists from 20 countries performed measurements of the coupled systems between ice, ocean, and atmosphere. This talk will give an overview of the campaign, its importance and highlights some current results. Further, the international cooperation and the current state of Polar research will be briefly discussed.

14:30 School closing.