Scientists moor ship in Arctic ice for a year to better understand climate change

September 27 2019, by Marta Moreno Ibáñez and Rene Laprise

Credit: AI-generated image (disclaimer)

Long polar nights, polar bears, freezing temperatures plunging to -45C. This is what the 600 experts taking part in the MOSAic expedition—the largest ever carried out in the heart of the Arctic Ocean—are facing.

From September of this year to September 2020, the group of scientists

will live on an icebreaker that will drift, following the movement of the ice for a whole year.

MOSAiC, which stands for Multidisciplinary drifting Observatory for the Study of Arctic Climate, is the result of an effort by an international consortium of polar research institutions. It has a budget of more than 120 million euros ($175 million dollars).

The main objective of this scientific odyssey is to study the Arctic climate system— the entire atmosphere, ocean, sea ice and biosphere, as well as their interactions.

The Arctic climate system is particularly sensitive to climate change. The way it responds is complex and has a significant impact on the rest of the globe.

The Arctic is warming faster

The Fifth Assessment Report of the Intergovernmental Panel on Climate Change(IPCC) provides a detailed and reliable account of the state of the climate. The report concluded that the Arctic has warmed substantially since the middle of the 20th century, and that humans have contributed to the warming. Between 1972 and 2012, the average annual Arctic sea ice extent decreased at a rate of between 3.5 and 4.1 percent per decade. The mass of the Greenland ice cap has also decreased in recent decades.

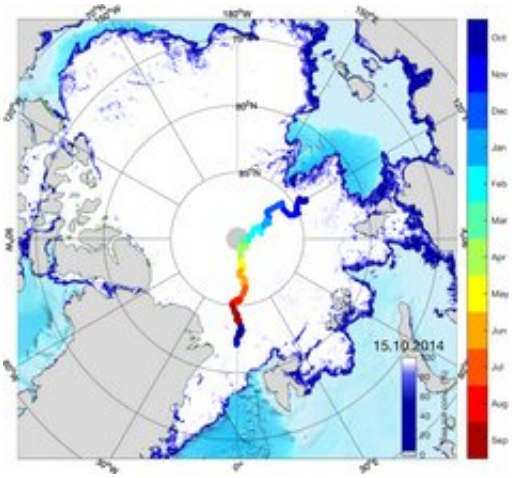
On Sept. 20, 2019, the German research icebreaker Polarstern left Tromsø, Norway and, once at its destination, will spend the following year drifting across the Arctic Ocean, trapped in ice. Credit: The Alfred Wegener Institute, CC BY

More recently, the NOAA Annual Report on the Arctic found that by 2018 the rate of increase in near-surface temperature in the Arctic was still twice as high as the global rate. In this context of global warming, extreme weather events, such as the record one-day ice melting in Greenland's ice cap, are expected to become more frequent.

The fact that warming in the Arctic is more intense than global warming is known as "Arctic amplification." This phenomenon is the result of many interdependent physical processes that take place in the Arctic.

One of these processes is albedo feedback. Albedo refers to the ability of a surface to reflect the energy of the sun. As an example from daily life, we know from experience that asphalt becomes particularly hot in the summer. This is due to the fact that it reflects little of the sun's energy. To combat the phenomenon of urban heat islands in some cities, reflective roofs are being built.

In the Arctic, if the near-surface temperature increases, snow and ice will melt more quickly and, because the underlying ground and ocean reflect much less solar energy, the temperature will increase. And so on and so forth.



Potential drift path of the Polarstern for the chosen starting position at 120° E and 84° N. The colours represent the month of drift that begins in October 2019 and ends in October 2020. The small coloured bar shows the concentration of sea ice. Credit: Alfred-Wegener-Institute

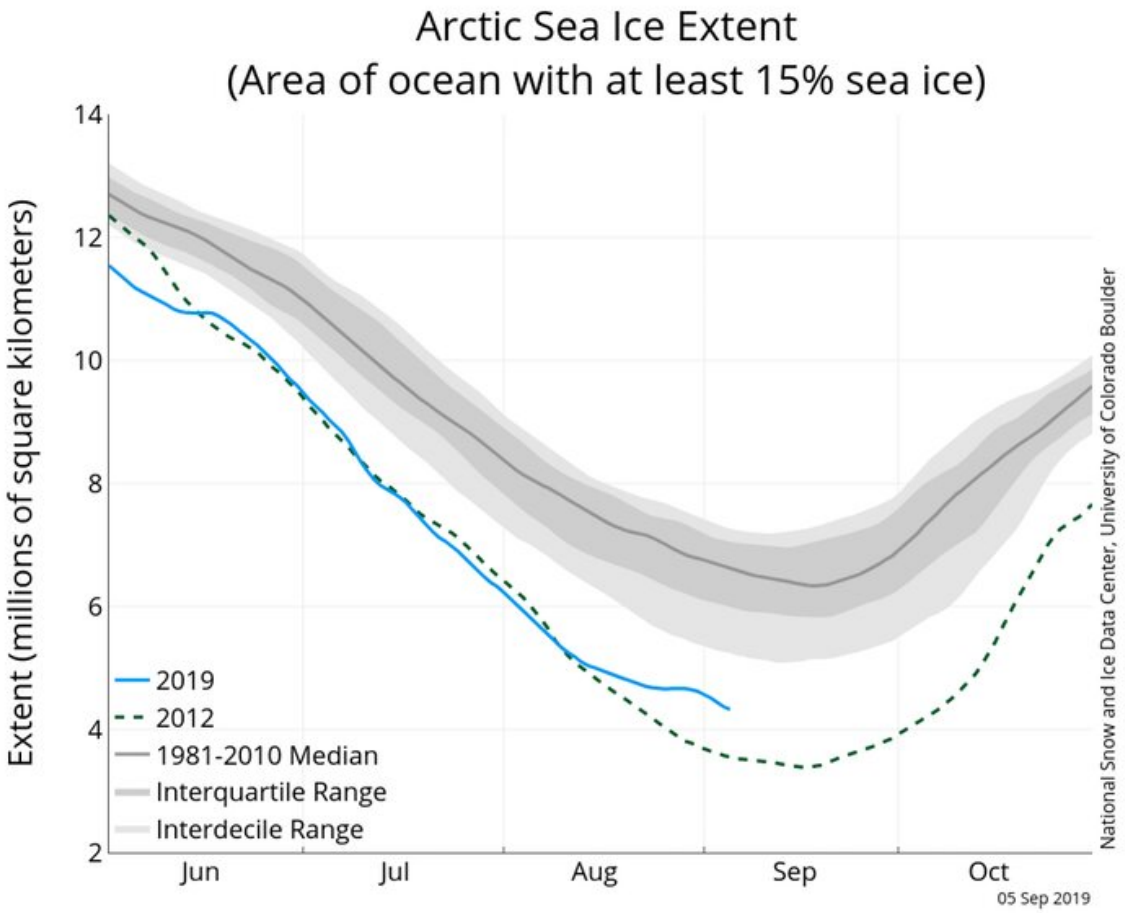
Refine climate models

To study the evolution of climate over time, the scientific community

has developed climate models. These models are composed of a set of modules, each representing a component of the climate system (atmosphere, ocean, etc.).

Let's take the atmosphere as an example. To develop a model of the atmosphere, it is first necessary to know the physical laws that govern its evolution. These laws are represented by a set of equations. If the atmosphere is divided into a large number of small cubes, these equations can be applied in each cube to obtain changes in temperature, wind and other atmospheric variables. This will provide a 3-D image of the atmosphere at different times.

One of the main challenges for the development of climate models is that some model parameters need to be adjusted to properly represent physical processes, such as cloud formation. This adjustment requires the availability of observations that allow us to better understand these processes.



Extent of Arctic ice pack (ocean surface with at least 15 per cent sea ice). Credit: National Snow & Ice Data Center

The importance of observational data

Polar satellites, which circle the Earth along a north-south trajectory, can provide observations of the Arctic region with good horizontal resolution—a lot of detail horizontally. However, the time elapsed between observations from the same location is too long.

"Conventional" observations, which are mainly provided by surface weather stations, ships and aircraft, are therefore essential to better understand processes such as cloud formation in the Arctic. Unfortunately, since the Arctic is isolated, there are few such observations available in this region.

This is where MOSAiC comes in. This expedition will provide observational data on physical quantities such as temperature and humidity. This data will contribute to improving the performance of climate models, resulting in more realistic projections of climate change. In addition, the success of this expedition could lay the foundation for even more ambitious measurement campaigns in the Arctic.

But MOSAiC is more than just a matter for scientists. All over the world, professors and students are invited not only to ask their questions to scientists on the edge of MOSAiC, but also to suggest experiments. It is a way of making it clear to as many people as possible that the Arctic is everyone's business.

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