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Sea-ice loss to disrupt almost all Arctic chemistry and ecosystems

New research by an Institute for Marine and Antarctic Studies (IMAS)-led team of international sea-ice experts has detailed the likely outcomes of shrinking Arctic sea-ice and highlighted the urgent need for further research to inform future decision-making and climate modelling.

Led by IMAS Associate Professor Delphine Lannuzel and published in the journal *Nature Climate Change*, the study explores how the loss of Arctic sea-ice due to climate change will disrupt the region's biogeochemistry and ecosystems.

Associate Professor Lannuzel said improving understanding of the likely implications is important for both the accuracy of global climate models and issues such as Arctic resource management and marine governance.

"The rapid transformation of the sea-ice scape will result in disruption across almost all aspects of Arctic chemistry and life," Associate Professor Lannuzel said.

"Sea ice in the Arctic is expected to continue to become thinner, younger and less long-lasting, and we are only just beginning to understand how profound, complex and diverse the consequences will be.

"We anticipate impacts across the whole food web, from microorganisms to top predators such as whales.

"At the base of the food chain, a warmer and more sunlit Arctic will allow ice algal blooms and phytoplankton to be more productive, but less diverse. A big unknown is how much nutrients will be available to sustain this growth.

"The most likely result includes an increase in the recycling of carbon produced in surface waters and a reduction in the amount of carbon exported to the seafloor.

"Overall, species endemic to the Arctic, such as beluga whales, polar bears and polar cod, will decline as their habitat dwindles and will be replaced by sub-polar species better adapted to the new conditions," she said.

Associate Professor Lannuzel said other changes would include:

- a reduction in atmospheric halogens and therefore a decrease in ozone depletion events (ODEs);

- an increase in the greenhouse gas methane emission from the ocean to the atmosphere; and

- an increase in the emission of dimethylsulfide, a gas that helps to produce clouds.

"The net impact on CO_2 capture in the Arctic is highly uncertain," Associate Professor Lannuzel said.

"Depending on the processes at play, the Arctic Ocean may either capture or emit more CO_2; it is difficult to say.

"Better understanding these complex interactions will allow more accurate representations of the influence of the Arctic changes in global climate models and improve our predictive capabilities

"A reduced sea-ice extent also has consequences for resource conservation and management as it will lead to increased human pressure on wildlife in the Arctic through shipping, oil and gas exploration, fisheries and tourism.

"Studies such as ours are therefore fundamental to the development of effective marine governance schemes for the future.

"For all these reasons, intensified long-term observations and modelling efforts are vital to support further research that can improve our understanding of this complex system, Associate Professor Lannuzel said.

"Closer to home, we are now in the process of making similar prognosis for Antarctica."

The research included more than 30 researchers from Finland, The Netherlands, Norway, Germany, Belgium, Canada, the USA, the UK, Japan, France and South Africa.

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