NORWEGIAN POLAR INSTITUTE

The Norwegian Arctic

A Rapidly Changing Climate

Arctic and **Antarctic Knowledge**

The Norwegian Polar Institute provides knowledge on the Arctic and the Antarctic, based on scientific research and environmental monitoring, to the international community

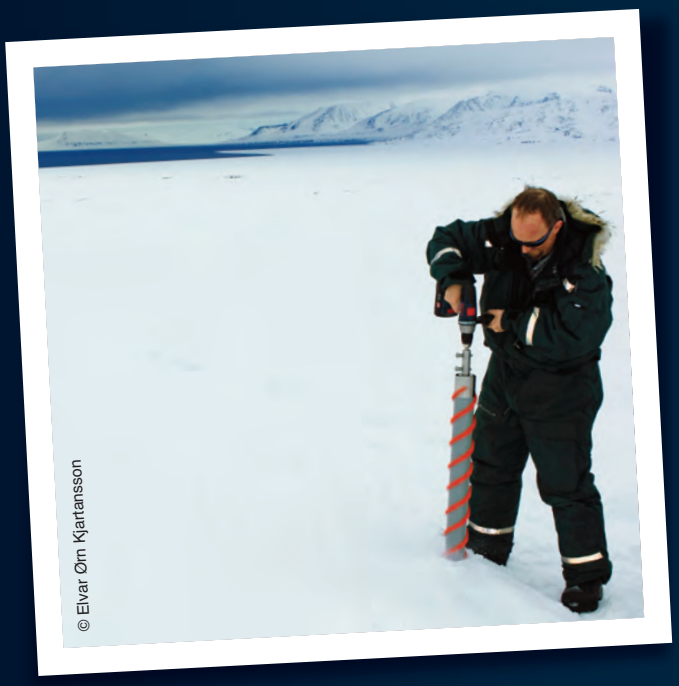
A government agency under the auspices of the Ministry of Climate and Environment, the Norwegian Polar Institute (NPI) is Norway's main institution for research, environmental monitoring and topographic and geological mapping in Norwegian polar regions. The Institute also advises Norwegian authorities on matters concerning polar environmental management and runs research stations in the Arctic and Antarctica. It is the competent authority responsible for implementing and overseeing Norwegian Antarctic environmental legislation. NPI experts take part in work regarding environmental management and represent Norway in international processes, and are involved in the work of the Intergovernmental Panel on Climate Change (IPCC).

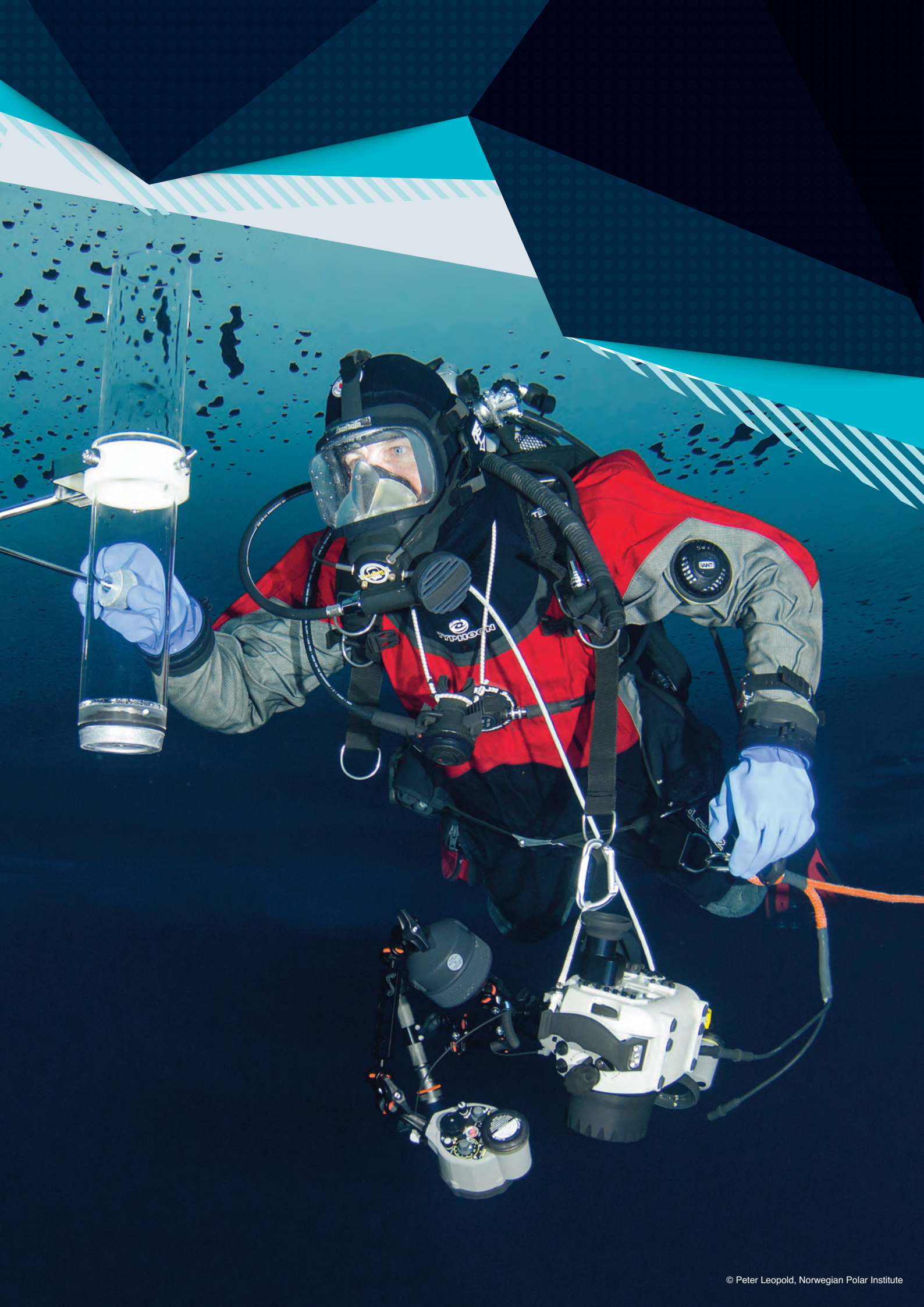
NPI researchers spend much time in the field. In January 2015, the research vessel Lance was frozen into the ice during the Arctic darkness, at 83° N, drifting with currents and ice for almost six months. The data collected during the Norwegian Young Sea Ice Cruise 2015 will improve current climate models, thus providing better knowledge about future climate change.

The Arctic is warming more rapidly than any other region on the planet. NPI's Oceans & Cryosphere and Geology & Geophysics Programmes contribute to a greater understanding of climate change by considering climate variability and feedbacks in the sea ice–land–ocean–atmosphere system, assessing the system's sensitivity to disturbances and analysing the consequences of a changing climate from a physical perspective. NPI polar climate monitoring programmes collect data in collaboration with international institutions. The Institute's climate research contributes to regional climate models.

NPI's Biodiversity Programme is designed to provide sound scientific advice to Norwegian and international agencies responsible for resource management and conservation practices. The scientists contribute to the global knowledge base regarding polar ecosystems and their functioning. The Ecotoxicology Programme gathers knowledge to improve our understanding of the sources and biological effects of contaminants in the European Arctic.

The NPI publishes reports and handbooks. Its international peer-reviewed open access journal, Polar Research, presents articles concerning diverse fields of research in the polar regions. The library has a substantial collection of polar literature, and newer publications from the Institute are published open access online. The photo library contains well over 100 000 contemporary and historical photographs, of which 50 000 are publicly accessible via an online database; see **www.npolar.no**



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Look
to the Arctic

The Arctic is a hotspot – literally, as it is more affected by global warming than the rest of the world, but also in the sense that several nations are directing their political interest towards the far north – or the High North, as Norwegians call it

For the past decade, several countries have looked to the Arctic and strengthened their interests in this part of the world. Institutions from 10 countries are present in Ny-Ålesund, a research village in the Svalbard Archipelago at 79 N, which best can be described as a natural laboratory. The NPI has been a cornerstone of the settlement since 1968, whereas institutions from counties like China, India and South Korea started their long-term research commitments in the 2000s.

An important reason for this interest is global warming. The regime of the High North's ecosystem is changing. Warmer waters from the south alter the balance in the sea. Sea ice is diminishing in extent and thickness, causing trouble for seals and polar bears, and allowing for more heat from the sun to be absorbed by the ocean. In winter, spells of milder temperatures melt snow on the ground, which freezes during cold snaps, preventing reindeer from reaching their food. Melting glaciers cause sea levels to rise. As glaciers shrink, marine mammals and seabirds lose the upwelling of rich nutrients that occurs when glacier fronts drop chunks of ice into the sea. Rising waters, less sea ice and thawing permafrost cause coastal erosion, which threatens to eradicate villages and settlements. As onshore and undersea permafrost thaws, the potent greenhouse gas methane is released to the atmosphere. In addition, there is evidence that Arctic climate change affects weather and climate elsewhere through atmospheric and oceanic connections.

The economic opportunities in a less icy Arctic are numerous. New shipping lanes, commercial fishing, bioprospecting and marine ingredients for bioproduction (including species well down the food chain) are among the main gains from the situation. Oil, gas and minerals are other resources that may be possible to exploit increasingly further north in the near future. Norway manages a fair part of the High North, and taking care of the natural environment is of importance to Norway. However, today's rapidly changing climate and the major ecosystem changes that go with it impose a fundamental challenge for management: the system is highly dynamic.

We must avoid making decisions and investments for the future based on yesterday's situation. This calls for a continuously updated knowledge base and sophisticated earth system models to project future changes.

Norway is building a state-of-the art polar research vessel to be launched in 2018. So are Germany, the UK, and China. New technologies for research in remote and hostile conditions will make a huge difference: unoccupied underwater robots and unmanned aerial vehicles will provide far more data than ever before.

Further collaboration between nations with an interest in climate change and the Arctic is expected to give enhanced results with global benefits.

A unique **sea ice story**

From January to June 2015, the Norwegian Polar Institute had its research vessel Lance freeze into the ice north of the Svalbard Archipelago, at 83°N, 756 km from the North Pole and 364 km from land, drifting along as the ice conditions changed. This allowed scientists from 11 countries to study ice conditions at close range, during constant winter darkness and 24-hour summer light

The Arctic Ocean is shifting to a new regime: the thick Arctic sea ice layer is disappearing Younger and thinner ice has replaced the thick multi-year ice. Winters are still cold enough for new sea ice to form, but it melts away again in summer. This means that thick ice is getting scarcer in a part of the world that has always been ice covered. The vast ice cover around the North Pole has also shrunk in extent.

Much of our current knowledge of Arctic sea ice stems from the former old-ice regime. We need new knowledge to understand the system in its current state and to improve our capacity to predict its future. Understanding the dynamics of the ice pack is one of the key challenges for climate models.

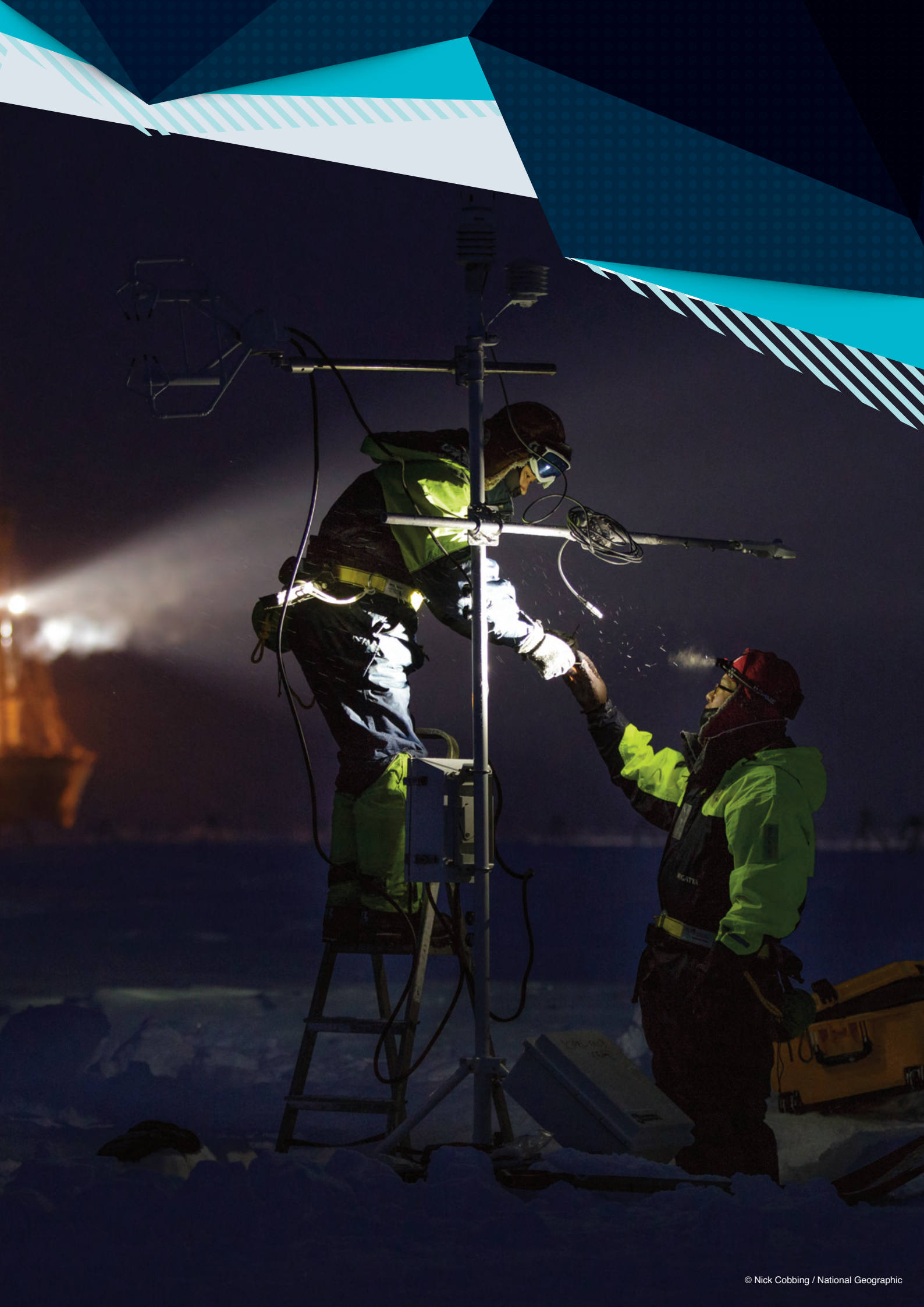
From the midst of the polar night to early summer (January to June 2015), the Norwegian Polar Institute allowed the Arctic waters to freeze around the research vessel Lance to help provide this new knowledge. The concept of the expedition N-ICE2015 followed the precedent of many previous expeditions, including the **Fram Expedition** led by Fridtjof Nansen, Russian drifting stations, the Surface Heat Budget of the Arctic Ocean campaign in 1998–1999, and the Tara drift during the International Polar Year 2007–2008. However, all of these expeditions were conducted in a thicker ice regime.

Lance, adrift in the ice, provided a base for 100 scientists and engineers who spent three to six weeks on board the vessel studying air–snow–ice–ocean interactions in a region with thinner sea ice. Ice camps were set up three times on ice floes near 83°N, then evacuated and re-established when ice broke up near the ice edge. The scientists also investigated how the marine ecosystem responds to these new conditions. Interdisciplinary work was an integral part of N-ICE2015, as physical oceanographers, sea ice physicists, atmospheric scientists, and marine biogeochemists worked successfully side by side.

Research during N-ICE2015 was truly international and reflected the current interest in the Arctic. Scientists from institutions in more than 10 countries, including Canada, Denmark, Finland, France, Germany, Japan, Korea, Norway, Russia, the United Kingdom, and the United States, participated, and the crew came from many more nations. This unique opportunity brought together many experts in their respective fields to contribute to a better understanding of the Arctic.

The N-ICE2015 research campaign also benefited from social media and the media. Teams from the Norwegian national broadcaster **NRK**, **National Geographic** and **BBC** were invited on board the research vessel, which brought wider attention to the research and the ongoing changes in the Arctic.

Since the conclusion of this unique expedition, the data have been analysed and results are being published. New understanding of the thinner ice regime in the Arctic will help reduce the uncertainty in predictions of how the ice conditions evolve. Core data sets will be made available to the broader scientific community, which can make use of them in developing and evaluating processes and regional and global climate models.



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Arctic **Ecosystem Challenges**

Climate change is altering the planet, and nowhere is this change happening faster than in the Arctic. The northern Barents Region is an Arctic hotspot that has changed 2-4 times faster than other parts of the Arctic during the last three decades. Scientific co-operation is essential to track the changes and to mitigate against it negative effects – and to manage new possibilities for prosperity. For the species living in the Arctic, life is changing

The northern Barents Sea is experiencing the fastest temperature increase within the Arctic, along with the highest rate of sea ice loss. Grey-white sea ice reflects most of the solar energy that strikes it back to the atmosphere; more dark water is exposed as ice diminishes. Dark surfaces absorb most of the heat from the sun, and ocean temperatures increase. Also, glaciers all around the Arctic are melting as a result of higher temperatures, and fresh water is running into the salty oceans.

These physical changes are affecting a broad array of resident Arctic organisms as well as some migrants that occupy the region seasonally. In the terrestrial system, increased winter air temperatures and increases in the frequency of "rain-on-snow" events are one of the most important facets of climate change with respect to impacts on flora and fauna. Winter rain creates ice that blocks access to food for herbivores such as reindeer. In the marine ecosystem, increases in sea temperature and reductions in sea ice are influencing the entire food web.

These changes are affecting the foraging and breeding ecology of most marine birds and mammals in the Arctic, and they are associated with an increase in abundance of several temperate fish, seabird and marine mammal species.

Studies carried out by NPI scientists show that while a few species are benefiting from a warmer climate, most Arctic endemic species in the Svalbard Archipelago are experiencing negative consequences of the warming environment.

Ringed seal behaviour is changing dramatically coastally and offshore in response to changing sea ice conditions. Coastal ringed seals are very dependent on tidal glacier fronts, which are disappearing as the climate warms. Harbour seals, however, are responding positively to warming and extending their range. In combination, these seal responses are evidence that community change is already taking place.

So far, polar bears in the Norwegian High Arctic show only slightly reduced yearling production, but their body condition and the overall status are "status quo".

Around five years ago, blue whales and fin whales started coming into Isfjorden on Spitsbergen instead of staying in open waters. In 2016, these whales entered the fjord earlier, in May and June, but did not stay for the summer as they have done in previous years. Instead, in August and September, hundreds of white-beaked dolphins entered the fjord. This led to the first registration ever of the species in this area in the NPI's marine mammal database.

A softer footprint in **the Arctic snow**

Karmenu Vella, EU Commissioner for the Environment details why a stronger and more focused approach is needed to protect the Arctic

If there is one place in the world where climate change is plainly visible, it is the Arctic region. The Arctic is warming twice as fast as the rest of the world. The winter ice has lost an area of over one million square kilometres – the size of France and Germany combined.

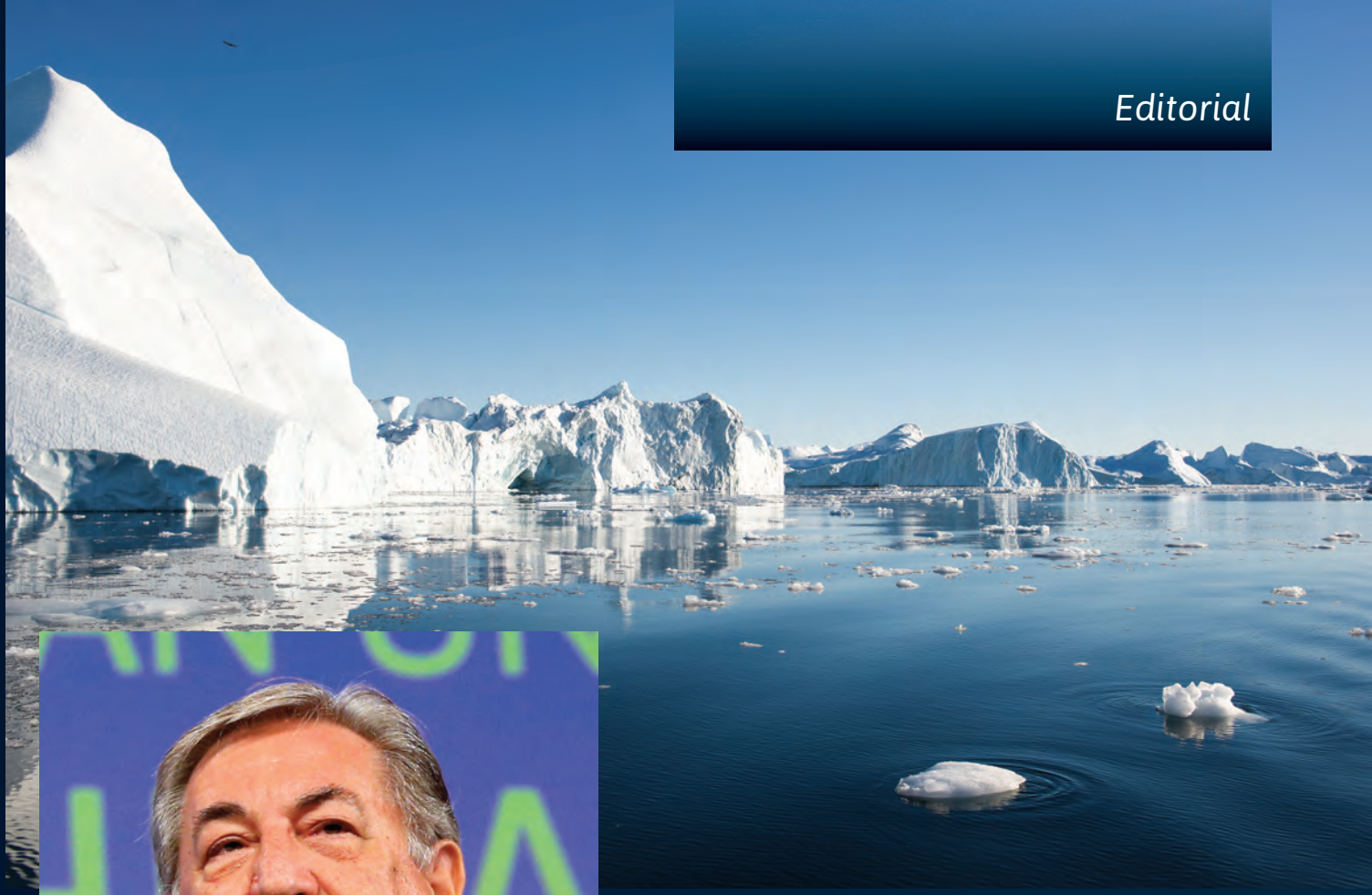
The impact is increasingly clear in Europe too: the drier summers, the shorter winters, the frequent floods and storms we have been experiencing of late – all are a product of this massive Arctic thaw, which alters ocean currents and weather patterns on a global scale.

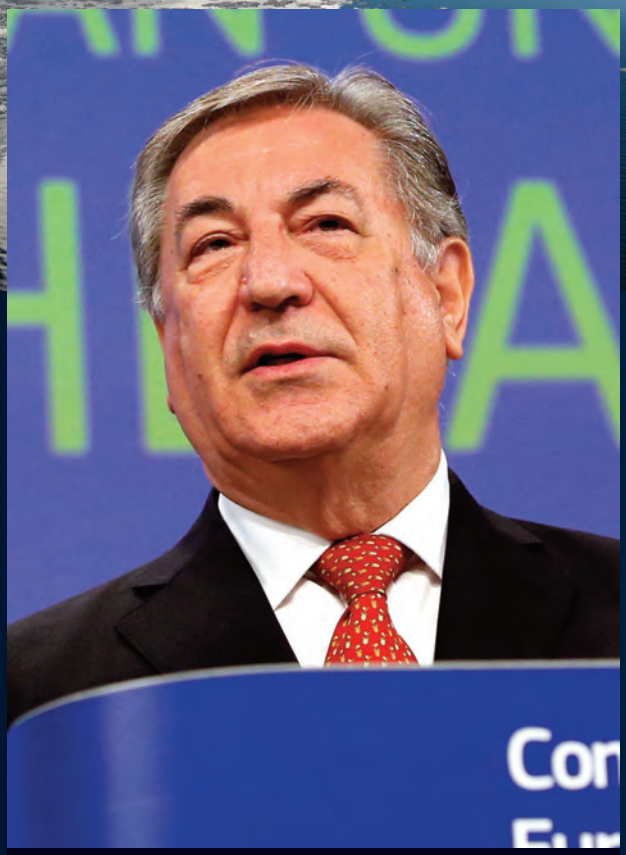
But our concern for the Arctic is not only an environmental one. The region's importance for the EU is also strategic. European companies are developing innovative cold-climate technologies, for instance new fish-farming techniques and innovative processes for clean energy like offshore wind, wave and geothermal power. The northernmost part of our Union has brought forward novel technologies, and we must make sure these are granted effective access to the Single Market. Nature tourism has taken off in Iceland and Lapland, with a positive impact on the local economy, and can be further developed.

These are some of the reasons that have pushed High Representative Mogherini and me to present in April an integrated European policy for the Arctic. For many years the EU has been invested in the region, but we believe it is time for a stronger, more focussed approach: one that champions social and economic development for the entire region above the polar circle; that promotes responsible behaviours vis-à-vis the Arctic ecosystem; and that fully recognises the Arctic's strategic value for global security, and its crucial place in our foreign policy.

We are also strongly committed to the 4 million people who live in the region, whose way of life, cultures and traditions need safeguarding must continue to thrive. Some are EU citizens, since Denmark, Sweden and Finland are EU members with Arctic territories. Their culture is part of our European culture, it is part of who we are. Together we can be a driving force towards a more circular and sustainable economy.

It is clear to me that these aims of environmental, economic and cultural sustainability can only be achieved through dialogue and cooperation – consensus being the only acceptable way to drive sustainability forward. So far the Arctic has been a primary example of constructive regional and international cooperation, but it is also true that the challenges we all face become more complex by the day: it is now even more important to engage with all relevant players, craft common positions and make collaborative solutions emerge. This is true for environmental protection and scientific research, but also for the safety and security of all maritime activities in the Arctic – areas in which we all have stakes and responsibilities.





Karmenu Vella, EU Commissioner for the Environment

Speaking of responsibilities, the EU has its own share. The people and ecosystems of the Arctic feel the influence of our emissions, our plastic bags, our industrialised fishing. We are not shying away: the European Fund for Regional Development is to invest more than €1bn in the north of Sweden and Finland by 2020. At least another €40m will go to Arctic research in 2016 and 2017 alone, while various European Structural and Investment Funds are supporting climate mitigation and adaptation strategies.

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My own vision is for the Arctic to become a global beacon for sustainable development, and that is the rationale of our new initiative. The region lies at the intersection of three continents: what happens beyond the polar circle impacts on the whole of Europe and the world. Think of this new initiative as the EU putting a softer, more positive footprint in the fragile Arctic snow, for a better future for us all.

Karmenu Vella
EU Commissioner for the Environment
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