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UNDERSTAND, *INNOVATE* AND TAKE ACTION

During the last austral summer, I had the opportunity to support and take part in a major international expedition around Antarctica. The 10-week mission involved surveying the grounding line, where ice surges away from land. Four aircraft equipped with radar, lidar and atmospheric sensors set out to accurately assess the ice mass balance of this vast continent and finally establish whether it has been gaining or losing ice over the years.

These field missions are expensive and public funding is diminishing. That is why I believe civil society and the private sector should step up in supporting researchers, funding innovation and voicing the concerns of scientists to those with the power to set policy.

The cryosphere – the collective term for all the polar ice caps, sea ice, snow, glaciers and permafrost on Earth – is deteriorating. Not a day goes by without media warnings of dwindling freshwater reserves, rising sea levels, biodiversity loss and intensifying extreme weather events. In response to this crisis, the United Nations has declared 2025 to 2034 the Decade of Action for Cryospheric Sciences. Ten years in which to understand, innovate and take action. Taking action means supporting scientific research and finding practical, sustainable solutions to slow down or even – more optimistically – to reverse climate change. There is a huge task ahead, but giving up is not an option.

Frederik Paulsen,
President of the Fondation Albédo pour la Cryosphère

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CONTENTS

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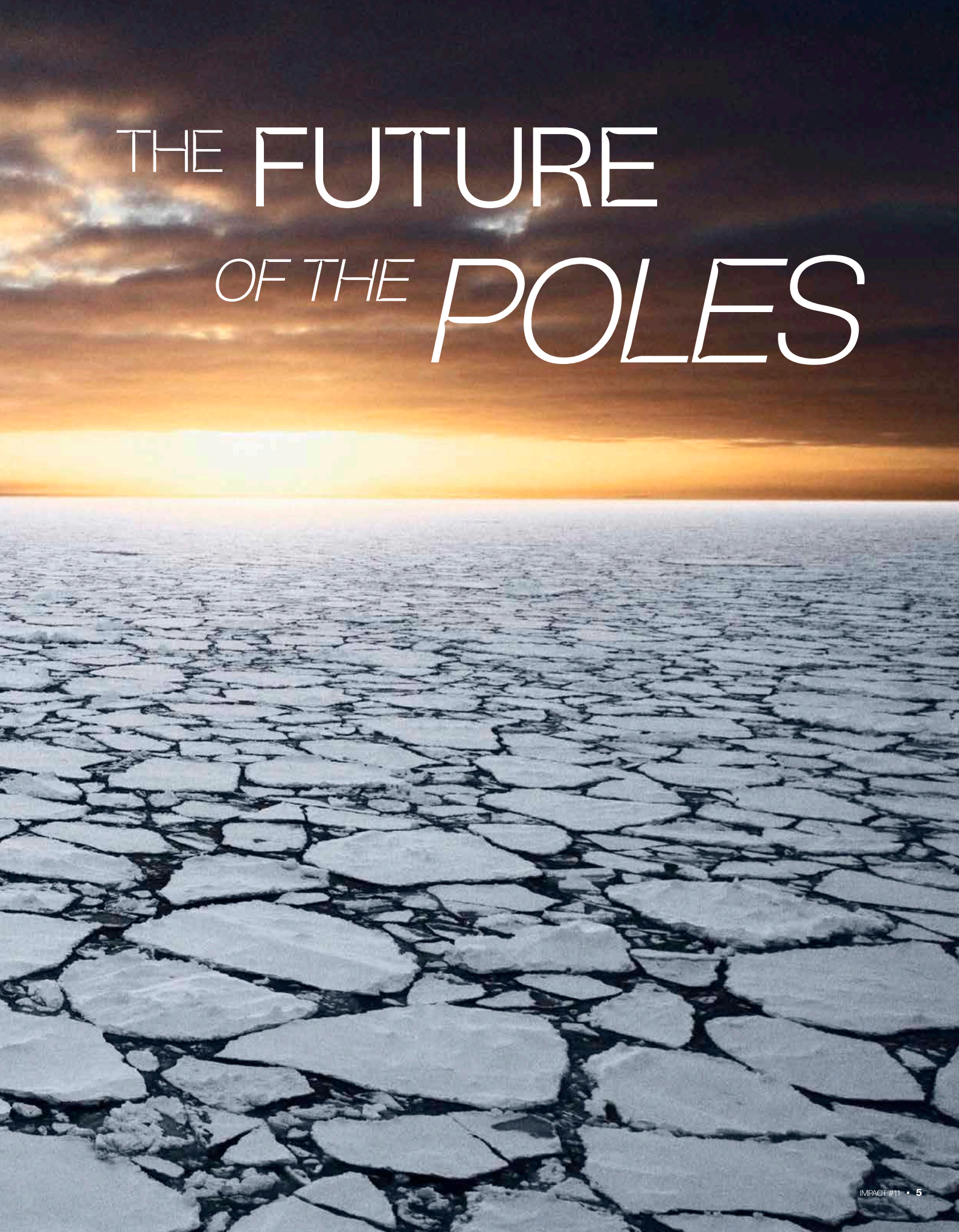
THE FUTURE OF THE POLES



Twin regions, 20,000 kilometres apart, moderate the Earth's climate. To the south, a white continent in the centre of an ocean. To the north, an ice-covered ocean surrounded by land. Powerful ocean currents rise and fall around the poles, stirring up centuries-old waters, capturing carbon and releasing nutrient-rich particles. The Arctic, which has been inhabited for thousands of years, is now a target for ambitious economic plans. The Antarctic, a vast frozen desert, has become a shared heritage in the name of science and peace.
Yet, despite their remoteness, these last frontiers are the regions most affected by the climate crisis. They are warming and deteriorating at a rapid pace, as evidenced by melting ice, disruption to ocean currents and species collapse. The ecological balance in the polar regions seems bound for irreversible breakdown – with consequences for the whole world, as IPCC (Intergovernmental Panel on Climate Change) Chair Hoesung Lee already highlighted in 2019.

As we enter the second year of the United Nations Decade of Action for Cryospheric Sciences (2025–2034), these regions could prove key in rising to the challenge of our collective survival. For 20 years, the Prince Albert II of Monaco Foundation has been campaigning for their protection, for greater international collaboration in science and for informed, coordinated action.

Under the Polar Initiative, which the Foundation launched in 2022, its symposiums gather together key stakeholders from the polar regions to build a shared vision and strengthen commitments to protecting these regions.

1 VIEWS FROM THE *POLES*

These regions are opposites in more than one way: beyond 60 degrees south is a continent surrounded by a vast ocean; beyond 60 degrees north is an ocean encircled by continents. The Antarctic and the Arctic, polar regions with inverse geography, have long remained beyond the reach of globalisation. These white deserts polarised the obsessions of explorers from the second half of the 19th century until the early 1920s, as philosopher Olivier Remaud points out.[1] Their ships crossed latitudes, venturing through the ice of the Arctic Ocean as it shifted forms and sometimes closed in on them as they passed. Here, they explored the Barents Sea, Kara Sea, Beaufort Sea, Thule Sea and Baffin Bay. Meanwhile, whalers and other explorers navigated the treacherous southern seas until they first caught sight of the frozen continent in 1840. Here, they found Adélie Land, the Weddell Sea in the shelter of the Antarctic Peninsula, and the Ross Sea.

At that time, the far north was inhabited by Indigenous communities, including Siberian, Inuit and Samoyedic peoples, whose lives revolved around a science based on their wisdom and understanding of ice and polar darkness. The far south was still largely *terra incognita*, patrolled by katabatic winds and the most powerful currents on the planet.

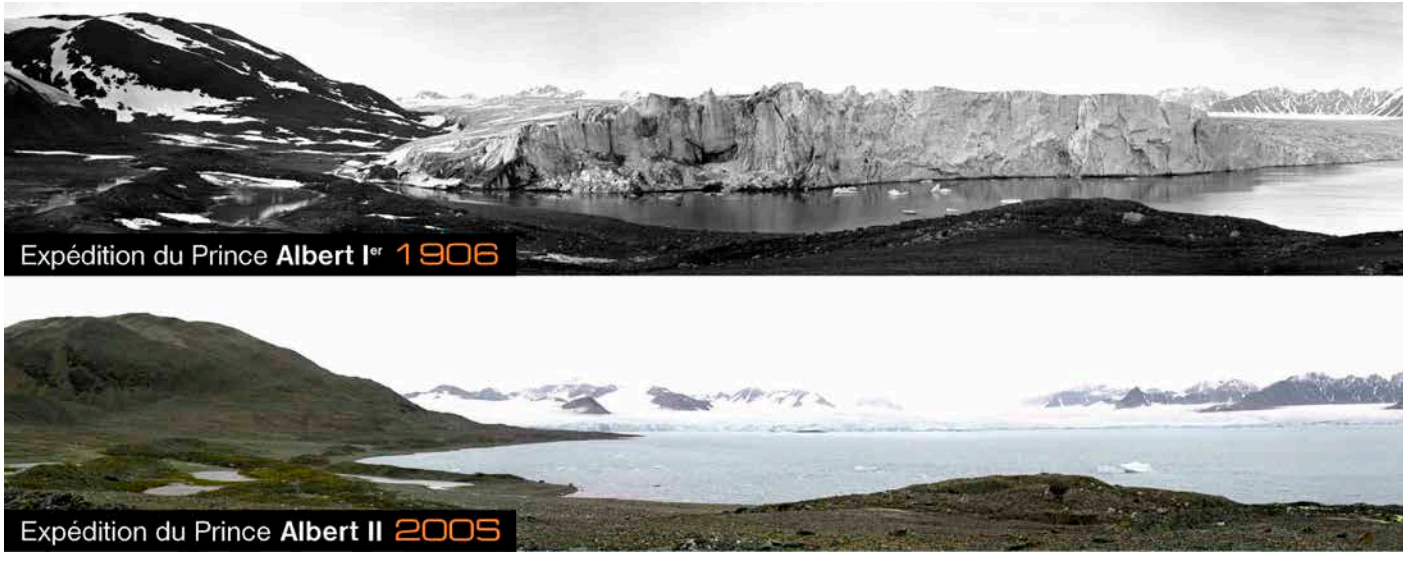
The Arctic ice cap then covered more than 13 million square kilometres of ocean, and the thick ice sheets blanketing the Antarctic continent had not yet started to melt. Hundreds of thousands of blue whales swam through the polar waters, while large populations of toothfish could be found in the southern seas. The subglacial volcanoes in Antarctica were yet to be discovered, and the importance of sea ice for marine productivity – the fact that zooplankton is dependent on it – was not yet understood. No one realised that the frozen soil surrounding the Arctic Ocean stored vast quantities of carbon dioxide and methane, or that the permafrost would thaw over the coming decades.[2] Nor that the Antarctic ice holds the secrets of climate change; the latest ice core samples from the Beyond EPICA project released air bubbles trapped nearly three kilometres deep, remnants of the Earth's atmosphere from 1.2 million years ago. Plastic pollution did not exist; now there are 12,000 microparticles per litre of Arctic ice. And no one had heard of the hole in the ozone layer over the Antarctic, which reached a record size of 26 million square kilometres in 2023.[3] Back in those early days of polar exploration, a finely tuned system of currents redistributed waters still free of persistent pollutants throughout the world's oceans, maintaining the stability of the Earth's climate.

A century later, the Arctic and Antarctic are feeling the full force of the Anthropocene. The annual decline in the cryosphere illustrates how the global economy is impacting the polar regions.

[1] Olivier Remaud, *Thinking Like an Iceberg*, Polity Press, 2022.

[2] Permafrost covers approximately 25% of land in the northern hemisphere. According to the IPCC, even if global warming is limited to well below 2°C, approximately 25% of near-surface permafrost (3 to 4 metres deep) will thaw by 2100. If greenhouse gas emissions continue to climb rapidly, around 70% of it will thaw. See also Hui-Jun Jin et al, *Changes in permafrost and snow cover in the Boreal and Arctic zones (BAZs) and their impacts*, Advances in Climate Change Research, Vol 14, Issue 2, 2023, pages 157-163.

[3] Camille Escudé and Lydie Lescarmontier, *Les pôles: Au centre des nouveaux enjeux géopolitiques et climatiques*, Tallandier, 2025.




© Nicolas Sausser/Palais princier

HSH Prince Albert II of Monaco is the only head of state to have visited both poles, following in the footsteps of his great-great-grandfather's expeditions. He is committed to ensuring that these regions are better protected.

[4] IPCC, 'Special Report on the Ocean and Cryosphere in a Changing Climate', 2019.
[5] Gilles Lapouge, 'Fascination pour les pôles', Monde Diplomatique, décembre 2010.

The geography of their landscapes is changing and they are warming two to four times faster than the rest of the globe.[4]
The extraction of ice cores from Antarctica and Greenland in the early 2000s enabled the first large-scale scientific analyses to model climate change. Here again, there are marked differences between the twin regions. The post-war period had a unique destiny in store for Antarctica. In 1959, following the third International Polar Year and in the midst of the Cold War, 12 countries signed the Antarctic Treaty, ending territorial claims on the continent. Forty years later, the Madrid Protocol confirmed its status as a "natural reserve, devoted to peace and science", supporting international scientific cooperation on climate issues.
In the far north, where eight neighbouring states established the Arctic Council in 1991, the geopolitical landscape is very different. There are conflicting views on whether to protect or exploit the region's resources. Currently, the prospect of ice-free Arctic summers by 2050 is stoking tensions between the polar countries as they race to access energy and fishing resources and emerging shipping routes.
The contours of the new world map are becoming blurred due to the speed of change, which highlights the need for increased scrutiny of these regions. In Svalbard, one of the areas most affected by warming (where it is happening seven times faster than the global average), glaciers are retreating by several hundred metres a year. The Antarctic Peninsula is also showing worrying signs, and sea ice here has reached historically low levels in recent years (the British Antarctic Survey recorded a loss of more than 2 million square kilometres of ice in 2023). The polar regions offer a glimpse of a world in upheaval, challenging our established benchmarks and testing our ways of understanding.

As we look ahead to the fifth International Polar Year (2032–2033), the poles are no longer shrouded in mystery. The serious threats they face, the scientific information they hold and their fragile, majestic beauty are forcing nations and citizens around the world to sit up and pay attention. These white wildernesses are endangered, which in turn endangers us: the changes they undergo affect the stability of the planet, particularly the climate. As French writer Gilles Lapouge has observed, we are also at risk of "*losing a whole realm of imagination and emotion*".[5] These landscapes act as mirrors, reflecting the fates of others around the globe. This shared trajectory has never been so apparent. It inevitably changes how we view the poles, which provide us with our very conditions for existence.

New voices for the Arctic

A MESSAGE FROM THE YUP'IK TERRITORY

"We carry the knowledge of our ancestors and a deep commitment to ensuring our homelands survive for future generations."

Charitie Ropati, from the Native Village of Kongiganak in south-west Alaska, is a rising star among young climate justice activists. A graduate of Columbia University's School of Engineering, the young scientist uses her expertise as a water engineer to serve the Yup'ik territory, which is increasingly impacted by climate change. Believing passionately in the importance of education and training, she founded lilnativegirlinSTEM in 2022, which provides educational programmes informed by Alaska Native culture to encourage young Indigenous women to pursue careers in science and engineering. Her commitment has earned her the title of Champion for Change (2019), bestowed by the Center for Native American Youth, followed by the WWF Conservation Leadership Award (2023).

"I always think of the vast tundra, the smell of the ocean and the tall grass moving in the coastal wind. Kongiganak is a small but mighty Yup'ik community in south-west Alaska. It sits near the mouth of the Kuskokwim River and close to Bethel, the regional hub for many villages.

Home means being deeply rooted in place and people, where our language, values and relationships with land and water guide daily life. But the land is changing quickly. Permafrost is thawing at an alarming rate, altering the ground beneath us and reshaping how our community moves, hunts and lives.

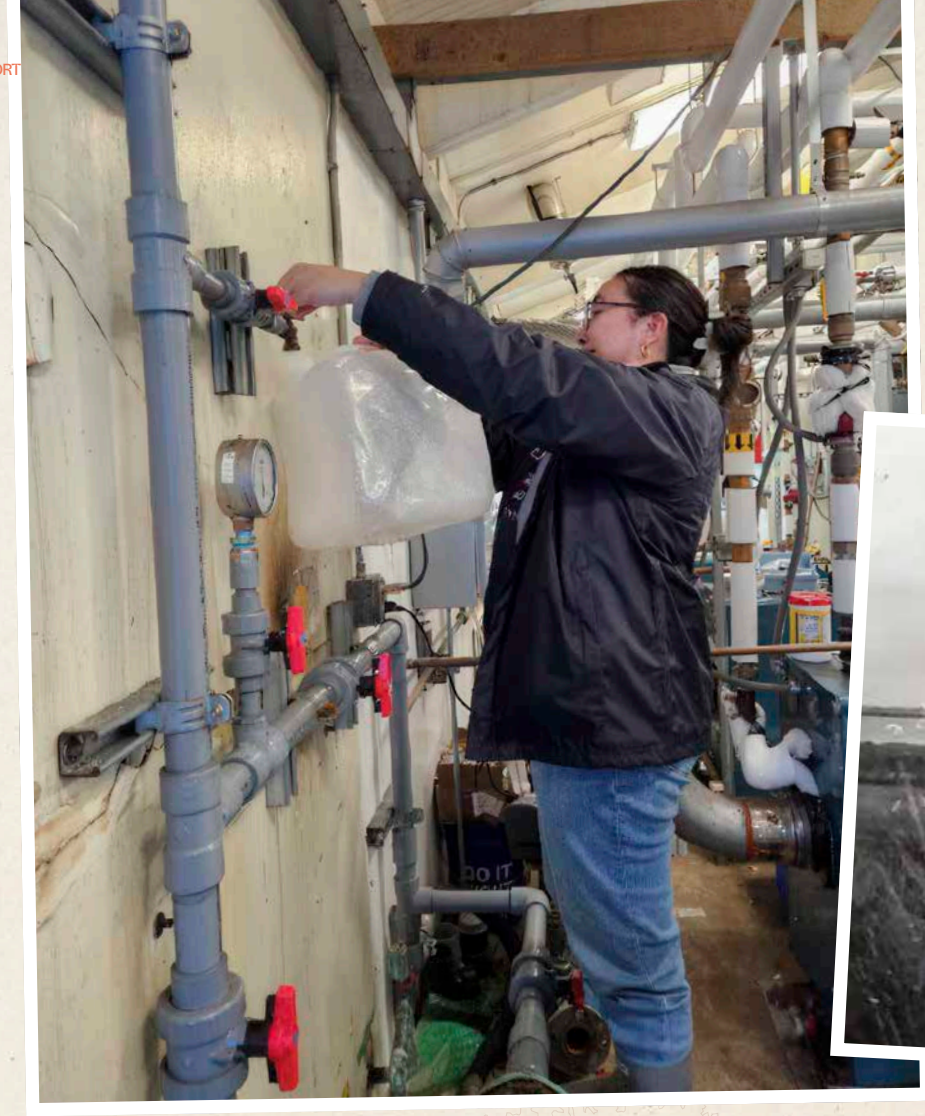
Recently, Typhoon Halong tore through our region, devastating communities in Western Alaska. Homes drifted into the ocean and over 2,000 people were evacuated. Our people became climate refugees in lands we have called home for thousands of years. Storms are growing stronger every year in our region and the impacts are impossible to ignore.

In 1967, my great-grandfather and other men tied ropes around our homes and pulled them 11 miles across frozen tundra, using ski-doos and dog sleds, to escape the rising waters. They did this without government aid. That act of courage, of moving a village by hand, is how my community came to be, and how I came to be.

Our Yup'ik teachings remind us that all living things – the land, waters and animals – are our relatives, bound together by Ellam Yua, the spirit that connects all things. When that sacred balance is broken by those who exploit and disrespect the land, particularly the fossil fuel industry, our spirit is harmed as well. Yet despite contributing almost nothing to this climate crisis, our communities bear its greatest consequences.

Traditional knowledge is essential for adaptation, not as something nostalgic, but as a living, evolving framework for life. It helps communities make decisions when modern data is limited or slow to respond to daily realities.

In rural Alaska for example, access to safe water and sanitation is a long-standing issue. Many communities still rely on hauling water and using honey buckets for waste removal. My work has focused on designing and supporting water and pipe infrastructure in places where permafrost, geography and extreme conditions make engineering uniquely challenging.



My engineering training complements the Indigenous knowledge I grew up with. Science gives me tools for modelling, design and problem-solving. Indigenous knowledge tells me how the land behaves, how water moves and what truly matters to the community. Together, they create resilient solutions.

Alaska is at the forefront of the climate crisis, experiencing some of the fastest warming on the planet. Because of that, our land also has the potential to lead, through Indigenous stewardship, community-driven innovation, and adaptation strategies rooted in reciprocity rather than extraction. What is happening in our region is not isolated. It is a warning, a mirror and a call. Protecting the Arctic is a responsibility that belongs to all of us, because the Arctic shapes the world's climate systems. What happens to our ice, coastlines and communities will ripple far beyond our homelands. What happens in the Arctic does not stay in the Arctic. Our region is not a remote, distant place, it is a global climate indicator. The changes we witness now are previews of what the world will face.

We are living in a time when the storms we face, literal and spiritual, are accelerating. Addressing this crisis can no longer be the burden of Indigenous Peoples alone. For too long, our communities have been expected to adapt, to be resilient, to carry the weight of a crisis we did not create.

We need collective courage equal to the courage my ancestors showed when they pulled our village across frozen tundra. We need governments to act with urgency, industries to be held accountable and people everywhere to understand that their choices, from energy systems to political will, directly affect whether places like mine will survive.

What gives me hope are Indigenous youth. We carry the knowledge of our ancestors and a deep commitment to ensuring our homelands survive for future generations. Across the Arctic, youth are advocating, organising, studying and returning home to serve their communities. Their leadership shows a pathway forward centred on justice, care and the co-production of knowledge.

We have lived in relationship with this environment for thousands of years. Protecting the Arctic is about protecting cultures, communities and knowledge systems that hold solutions for a just climate future.

The Arctic is worth fighting for. Our homelands matter. And our stories are not just about loss; they are about resilience, love and our unwavering responsibility to future generations."

Charitie Ropati

Living in the ice

AN ACCOUNT OF ARCTIC DRIFT

© Mélina Bardy - Fondation Tara Ocean

© Nicolas Floc'h

From the French coastline to the shores of Japan, via the Gulf of Mexico, photographic artist **Nicolas Floc'h** puts the ocean under the microscope. His black-and-white photographs challenge our perceptions of ocean spaces. His series 'La Couleur de l'eau' (The Colour of Water) investigates the blue planet, expressing the biogeochemical cycles of water as a colour spectrum.

In June 2025, his ocean explorations took Floc'h to the Arctic for the first test drift of the Tara Ocean Foundation's floating laboratory, the Tara Polar Station. He boarded the station in Svalbard and spent four weeks drifting beyond 82 degrees north, encircled by ice, diving and photographing the polar waters. On his return, he shared his observations.

"We were plunged into the sea ice as far as the eye could see. Sometimes it was covered by thick fog. The rainbows were white. We could see water in all its forms."

"I'd been hoping to reach the ice for a long time. After sailing along the Svalbard coast from Longyearbyen, at the start of the sea ice we started to follow in the wake of the *Polarstern*.[6] As the blocks of ice broken up by the ship ahead appeared in our path, surrounding and colliding with our vessel, I soon realised it was going to be a unique experience. Then, embedded in the sea ice, we watched the trail of the icebreaker disappear. We began to drift as one with the sea ice, which is what the Tara Polar Station is designed to do. We were moving at the pace of the ice and water, at an average speed of 10 to 20 kilometres a day. Joined to the ice, you don't really notice the movement, even though the ice field is always changing. You know you're moving because of the onboard charts and instruments, but you don't feel it.

We steadily tested how the vessel worked in this lunar environment of shifting ice. Every day, from any deck, the panoramic views plunged us into the sea ice as far as the eye could see. Sometimes it was covered by thick fog. The rainbows were white. We could see water in all its forms: liquid, frozen, thawing and refreezing, and as vapour. I realised we were travelling through an incredibly dynamic environment, where different states of water coexisted and interacted. I was lucky to be experiencing it during the Arctic summer, in constant daylight and relatively mild temperatures.

Under the water, it was a different matter entirely. I worked through the moon pool, the access shaft to the water via the wet laboratory. Every day, I lowered a camera to a depth of 100 metres for my series on the colour of water. I could tell how fast we were drifting by the angle of the cable. I took a photograph about every five metres while bringing the camera back up.

The colour grid I captured from the Arctic waters is truly magical. Approaching 83 degrees north, the waters were very blue and clear. Now and then there was a light plankton bloom, a hint of green created by photosynthesis. Then the sea ice carried us southwards. As the ice opened up and light got through, I recorded very pronounced blooms, including a peak of green lasting nearly four days. Using this method, I could observe ocean dynamics that are very difficult to see from above.

[6] *Research vessel of the Alfred Wegener Institute.*

The Colour of Water – Arctic, Water Column, colour photograph, *2025, Tara Polar Station.*
The most common ocean landscape in the photic zone forms a colourful expanse stretching as far as the eye can see. Each photograph was taken in natural light with a wide-angle lens, at a different depth in the water column. The complete work, consisting of 276 photographs shot at depths of 5 to 100 metres and arranged in a grid (23 columns organised geographically), records the Tara Polar Station's first drift over 300 kilometres, from 82° 37' North southwards to where the ice meets the ocean.

With the help of the team, I was also able to dive under the sea ice. You can't see the bottom, only the shadows of the depths – there are 3,000 to 4,000 metres of water beneath the boat. Blue or green as far as the eye can see. Near the surface, there is a very white, opalescent ceiling, with light variations depending on the relief of the ice. Further down, there is a risk of losing the access hole due to the current, so we were attached to the boat by a safety line. And then there were the polar bears. The team above water kept a close watch, as the bears are very proficient at swimming and diving. As we approached the warmer waters of the Gulf Stream, the ice was melting and pools were forming. The sea ice spat us out in the end. It's a vast ice-making machine: the ice forms off North America and east of Russia and is carried by the Transpolar Drift westward through the Fram Strait alongside Greenland.

I hadn't realised how much the ice moves. We know that the sea ice is a frozen expanse, but we are often unaware of the dynamics at work. Spending a month living in the frozen ocean brought me into contact with an ecosystem that embodies both extreme elemental forces and great fragility. It's very strange to see the ice cover shrinking. Many people are thinking about the opportunities opening up for shipping routes, without considering the consequences. New routes, but at what price? At an enormous cost to the planet. When you're there, you realise that. This experience has confirmed my instincts and refined my understanding of the interaction between global ecosystems and the essential role of ice. The more it recedes, the less the sea ice can reflect the sun, the more the ocean absorbs the heat and the more the planet warms, continental ice melts and sea levels rise. My first encounters with the world of the cryosphere were intense and unique. I need to process all these impressions. It will take years to develop my understanding."

Nicolas Floc'h

Open letter from the Ross Sea

A VOICE FOR ANTARCTICA

Since undertaking eight expeditions to Antarctica to study the Antarctic ecosystem, including toothfish, **Cassandra Brooks** feels responsible for telling the story of urgency in a rapidly changing world.[7] The marine biologist and associate professor at Colorado University embodies a new generation of scientist activists shaping polar diplomacy. She worked alongside a global coalition and the 25 nations of the CCAMLR[8] to help create the world's largest marine protected area: 2 million square kilometres in the Ross Sea, south of Antarctica, which was adopted in 2016. She now heads a Ross Sea Research Coordination Network set up to support the MPA's first 10-year review in 2027. The recipient of the Ronne Award for Antarctic Exploration (2022) and an honoree of The Explorer's Club 50, Cassandra Brooks leads the Scientific Committee on Antarctic Research's (SCAR) Standing Committee on the Antarctic Treaty System.

"After four expeditions to the Antarctic Peninsula, I finally reached the Ross Sea in 2013. When our vessel pushed through the ice and entered the polynya – the vast pool of open water surrounded by ice – I understood why this place would capture my life. In the Ross Sea, winds blowing off the ice shelf push the sea ice away, creating this opening. Those same winds help generate upwellings and when sunlight hits the water, massive phytoplankton blooms explode into life.

[7] The top fish predator inhabiting the icy waters of the Southern Ocean and possessing natural antifreeze proteins in its blood that allow it to survive.

[8] Convention for the Conservation of Antarctic Marine Living Resources.

You emerge from expansive ice into this explosion of productivity. The smell hits you first – you can literally smell how alive this environment is. Orcas and minke whales surface everywhere. A quarter of the world's emperor penguins and 35% of Adélie penguins thrive in this small corner of Antarctica. It's not just abundant, it's intact; one of Earth's last truly healthy ecosystems. As a biologist, I am constantly in awe of the life that thrives in this freezing environment, with animals so superbly adapted, with fish that have antifreeze in their blood to survive. I fell in love with the place.

What strikes you immediately is the curiosity of animals who've never learned to fear humans. Emperor penguins approached our bright orange vessel in lines, waddling across the ice just to look at us. Humpback whales would spy-hop beside our ship, rising with their eyes above water to examine these strange visitors. In places so rarely visited, we become the curiosity.

My work centres on Antarctic toothfish – the "sharks" of Antarctica – top predators that can live over 35 years and grow to over 2 metres and 150 kilogrammes. Analysing their ear bones, we read rings like tree trunks, counting their years. Through chemical analysis of these otoliths, we're uncovering remarkable life stories.[9]

A toothfish born in the Ross Sea starts as a buoyant egg drifting with ice, potentially circling toward the Amundsen Sea before settling on the shallower Ross shelf to feed and grow. At maturity, it returns to deep pelagic waters to spawn. But we predict that not all individuals follow this script – some might get carried by currents to East Antarctica, the Bellinghausen Sea, even the Peninsula. Toothfish are neutrally buoyant – a 150-kilogramme giant weighs nothing in water, allowing currents to carry them vast distances.

Right now, we're in that electric moment of discovery, analysing data that rewrites what we thought we knew. This matters because, due to climate change, everything's changing faster than our models predicted. The Peninsula – where fishing, tourism and research converge – is warming as fast as parts of the Arctic. Krill populations are contracting southward with the ice. Penguin colonies are collapsing in some areas, while growing in others.

[9] Otoliths are small calcium carbonate structures in a fish's inner ear that help it maintain balance and detect sound.

That's why we fought so hard to protect the Ross Sea and why four other marine protected areas remain under negotiation. These refugia won't stop climate change, but by reducing other stressors – fishing pressure, human disturbance – we give these ecosystems their best chance at resilience. The Ross Sea and Weddell Sea are predicted to stay colder longer, providing sanctuary as we race to reduce emissions.

With my husband, John Weller, who started The Last Ocean project, we brought this invisible world to people who'll never experience it. Through photography and film, we conveyed how this incredibly productive, intact ecosystem needs global protection.

It's unique to work somewhere with no permanent human inhabitants, where stars burn brightly in winter darkness and summer brings 24-hour daylight. The extremity defines you. Hurricane-force katabatic winds once ripped welded metal equipment off our ship. Ten-metre swells are routine. You feel intensely alive – excited, scared, privileged. With privilege comes responsibility. We scientists become Antarctica's voice, showing the world why this matters.

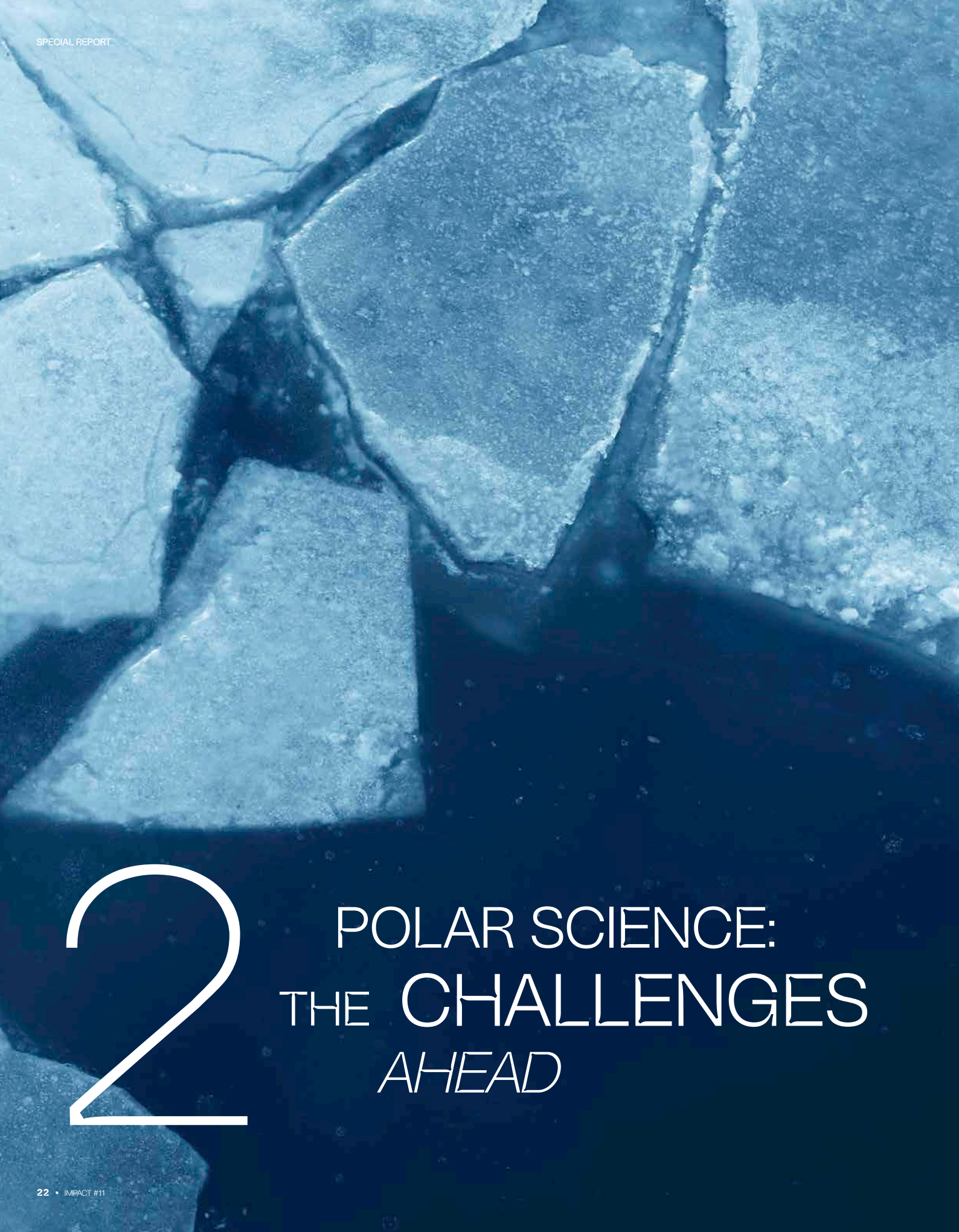
Every time I return, I understand this isn't about data or publications. When you've watched emperor penguins parade towards your ship out of curiosity, when you've breathed air thick with plankton blooms, when you've witnessed life thriving at the world's frozen edge – you're documenting something irreplaceable.

The chemistry we've collected in recent months reveals toothfish travelling between Antarctic regions in ways we never imagined. As I analyse this data with my students, I think about those fish – born in deep waters, drifting with ice, surviving decades in darkness. Their resilience gives me hope, but time is running out. The ice is retreating, the waters are warming and we're learning their secrets just as their world transforms.

This is why I keep returning, why I push for protection, why I share these stories. Antarctica doesn't belong to any nation, yet it belongs to all of us. And those of us lucky enough to work there – to smell its productivity, witness its abundance, feel its winds – we carry the obligation to ensure it endures."

Cassandra Brooks

"We scientists become Antarctica's voice, showing the world why this matters."



2 POLAR SCIENCE: THE CHALLENGES *AHEAD*

White is not just a colour; it is evidence of a world surviving. Yet, as satellite images and long-term measurements confirm, the ice is melting ever faster. The phenomenon became noticeable in the 1990s, but now it is accelerating due to rising temperatures. Since 2009, the Antarctic ice sheet has been losing more than 250 billion tonnes of ice annually. Meanwhile, the Greenland ice sheet, which is thinner, covers a smaller area and therefore has less resistance, is losing mass twice as fast.[10] These losses are irreversible: continental ice cannot reform with global average temperatures currently 1.5°C warmer than in pre-industrial times. Greenland's vast expanse of glacial ice seems doomed to disappear if temperatures reach +2°C.[11] Meanwhile, some West Antarctic ice shelves have reached critical levels, having lost 18% of their volume.[12]

Sea ice, which is even more vulnerable, has been disappearing at a fluctuating rate since 1970. (The British Antarctic Survey recorded an unexplained pause in the loss of Antarctic ice in 2020 and 2021.) The melting is accelerating warming in these regions by reducing how much solar radiation is reflected (the albedo effect). Normally, 80% is reflected by ice, compared to 30% by soil and just 7% by water, which is significantly darker. The Arctic ice cap is an expanse of sea covered by a layer of ice one to three metres thick. Its decline (the surface area has been shrinking for over 40 years) is an ominous sign.[13] Some see this as an opportunity for new shipping routes. However, these channels raise major geopolitical challenges and impact Indigenous Peoples who are dependent on the sea ice.

According to recent studies published in *Nature*, summer sea ice could disappear by 2035.[14] How this affects the rest of the planet is a key research area in polar science – a field that extends beyond the high latitudes to investigate global interactions between the cryosphere, biosphere and society. Several models suggest that sea levels could rise by over a metre by 2100. Not to mention the impacts on freshwater reserves and on stocks of krill, small crustaceans that feed on algae growing on ice and are central to the marine food chain.

There is concern that critical thresholds will be crossed, leading to irreversible climate change, particularly if we exceed 2°C of warming. The warming of Arctic waters, combined with decreasing salinity, could destabilise the Atlantic Meridional Overturning Circulation (AMOC) and disrupt the Gulf Stream, the marine current that moderates Europe's climate. Similarly, disruption of the Antarctic Circumpolar Current would have serious consequences for the climate.[15] This current, which has 500 times the flow of the Amazon River, mixes and redistributes water around the world. The Southern Ocean currently absorbs 70% of the heat and 40% of anthropogenic carbon in the oceans. The frozen regions act as global barometers, highlighting the significance of every climate variable; the slightest disruption destabilises the Earth's entire system. Polar scientists are carrying out extensive research to understand these regions. Their work includes studying ice sheets, tracking changes in the polar seas, monitoring the thawing permafrost and accelerating sea ice melt, studying the behaviour of major ocean currents and changes in polar climates, and analysing the impacts of pollution and invasive species.

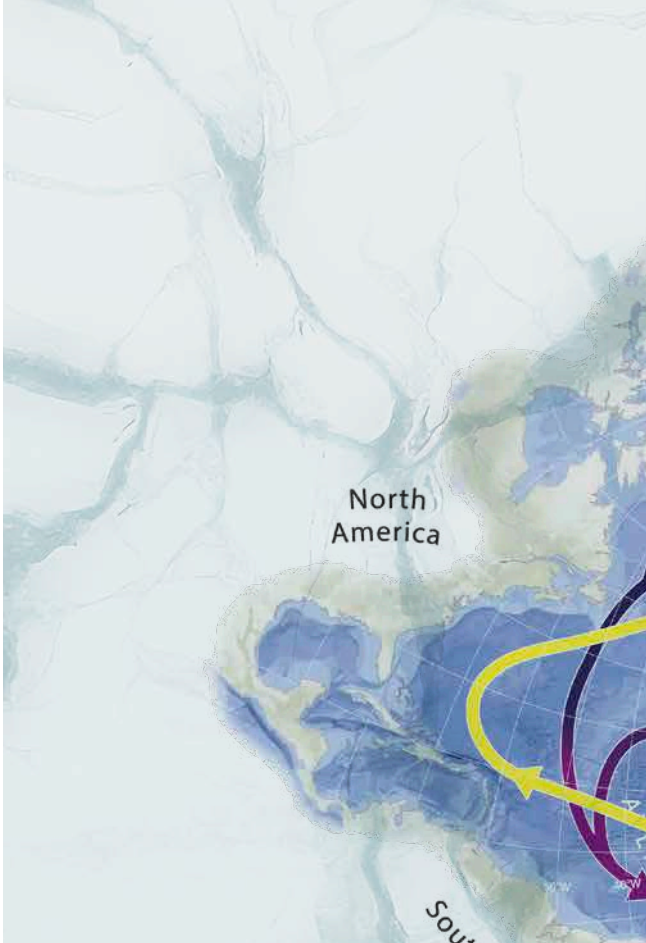
These "barometer regions" offer some of the best opportunities for understanding our planet. Since the late 19th century, science has been the guiding force in their governance. However, polar exploration requires "*international coordination involving every possible effort and expertise*".[16] Several decades after the first foray into the continent of Antarctica, the first International Polar Year (IPY), which took place from 1882 to 1883, brought 12 countries together for joint research missions. The third IPY (1957–1958) established an entirely new era of global cooperation on Antarctica. The following year, the Antarctic Treaty elevated the region to the status of common heritage. The fourth IPY (2007–2008) placed climate change at the centre of the research objectives. But the 2019 IPCC 'Special Report on the Ocean and Cryosphere in a Changing Climate' warned of significant gaps in our understanding of cryospheric systems (particularly in terms of long-term sampling and winter data), which limits the accuracy of future climate projections.

[10] The Greenland ice sheet, which is on average 2 kilometres thick and covers an area of approximately 1.7 million square kilometres, is 10 times smaller than the Antarctic ice sheet in the southern hemisphere.
[11] Camille Escudé and Lydie Lescarmontier, *Les pôles: Au centre des nouveaux enjeux géopolitiques et climatiques*, Tallandier, 2025.
[12] ibid.
[13] Its surface area has decreased by 70,000 square kilometres since 1979, and it continues to shrink.
[14] Céline Heuzé and Alexandra Jahn, 'The first ice-free day in the Arctic Ocean could occur before 2030', nature.com, 3 December 2024.
[15] Timothy M Lenton et al, 'The Global Tipping Points Report 2023', Global Systems Institute, University of Exeter, 2023.
[16] Marie-Béatrice Forel and Pierre Sans-Jofre, *Grands froids: Mémoires des pôles*, Muséum national d'histoire naturelle, 2025.

The fifth IPY (IPY-5) has been brought forward by 25 years due to the urgency of the situation. It will provide an opportunity to intensify research into the polar regions, improve our understanding of the changes occurring there and forge stronger links between science, society and politics. IPY-5 will take a collaborative approach, looking at climate change alongside ecological and social issues, and integrating Indigenous knowledge.[17] IPY-5 will be held in 2032 to 2033, but preparations are already underway through the Decade of Action for Cryospheric Sciences, which aims to improve polar monitoring, develop adaptation solutions and raise awareness of the risks associated with the collapse of the cryosphere.

Against this backdrop, international forums such as the third Polar Symposium (25 to 27 February 2026), organised by the Prince Albert II of Monaco Foundation, Scientific Committee on Antarctic Research (SCAR), International Arctic Science Committee (IASC) and Oceanographic Institute of Monaco, aim to facilitate the application of scientific solutions and informed governance for the sustainable future of the polar regions. Scientists, Indigenous representatives, policymakers, civil society and philanthropists will collaborate on cross-cutting issues relating to the two poles, including recommendations on long-term observation systems, data sharing, polar governance and integrating Indigenous knowledge. Informed decisions about the changes that are already happening will only be made possible through a coordinated approach combining science, innovation and scientific diplomacy.

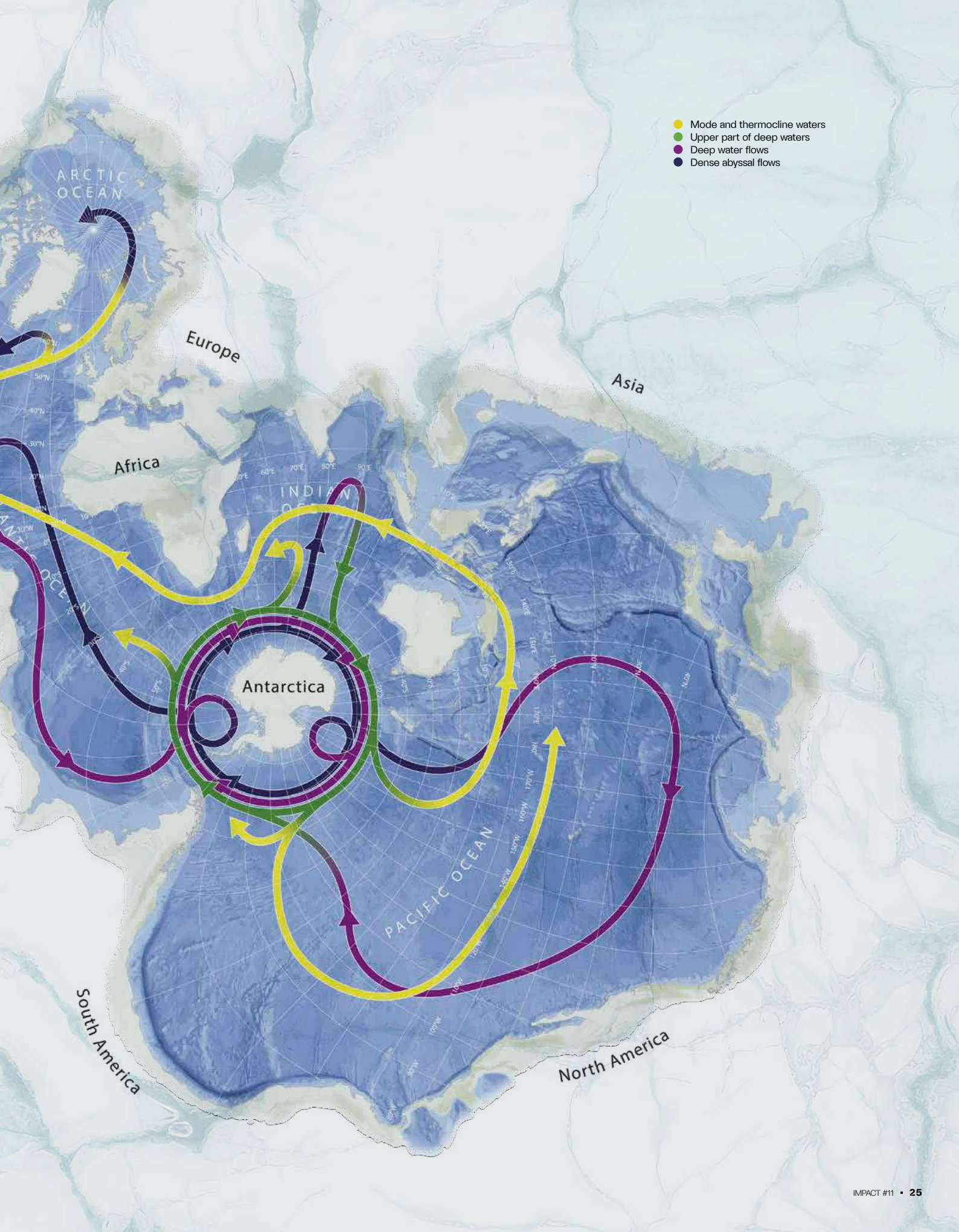
[17] CNRS Climate, Biodiversity and Sustainable Societies Research Programming Agency, 'French Polar Research Strategic Plan 2025–2035: Delivering a French Polar Research Program for the Next Decade (Summary)', June 2025 (lists the 15 scientific challenges for IPY-5).



The Southern Ocean around Antarctica is central in the global ocean circulation.[18] It enables connectivity across the whole planet by linking the Atlantic, Pacific and Indian Ocean basins and is the key site where waters are returned to the surface from depth, creating new water masses that then sink to the depths for hundreds, or even thousands, of years.[19]

[18] Michael P. Meredith, 'The global importance of the Southern Ocean, and the key role of its freshwater cycle', *Ocean Challenge*, Vol 23, No 2, 2019.

[19] Katsumi Matsumoto, 'Radiocarbon-based circulation age of the world oceans', *Journal of Geophysical Research*, Vol 112, Issue C9, 2007.


Mode and thermocline waters
Upper part of deep waters
Deep water flows
Dense abyssal flows
ARCTIC OCEAN
Europe
Asia
Africa
INDIAN OCEAN
Antarctica
PACIFIC OCEAN
South America
North America

THE SOUTHERN OCEAN, INTEGRAL TO THE CLIMATE SYSTEM

Deciphered by Michael P. Meredith, senior ocean scientist at the British Antarctic Survey, professorial fellow at Murray Edwards College, University of Cambridge, and lead editor of *Antarctica and the Earth System*

What if our view of the world was wrong? Michael P. Meredith has mapped Earth's ocean currents using the Spilhaus projection. This map of the world puts Antarctica at the centre and reveals what conventional maps hide: Earth is first and foremost an ocean planet, and the Southern Ocean is its beating heart. Thanks to its unique circulation, which connects surface waters and deep waters, this ocean has absorbed 67% of global excess heat since 1871 and 40% to 45% of oceanic anthropogenic CO2.[20] The Antarctic Circumpolar Current – the world's most powerful ocean current system – links the Atlantic, Pacific and Indian Oceans in an uninterrupted loop, and has been warming by 0.2°C per decade for 50 years. Meet the scientist who is redefining our understanding of Antarctica and its role in Earth's climate system.


© Dasha Tereshina

What does the Spilhaus projection fundamentally change in our understanding of Earth's climate system?[21]

We land dwellers conceive the world in terms of our lives ashore. But Earth is an ocean planet, with 70% of its surface covered by water. Yet ocean measurements and understanding lag behind what we know about the atmosphere and land.

The Spilhaus projection does an extraordinary visual service in depicting the planet as we should think about it, with one single ocean whose circulation connects all elements of Planet Earth. Unlike conventional maps, on which Antarctica is often smeared across the bottom edge, or missing entirely, the Spilhaus projection shows it squarely at the centre. This is appropriate, given the importance the frozen continent has on global climate and sea level rise – reminding us that Antarctica needs to be factored into all our thinking of how we protect the planet and ourselves.

[20] Michael P. Meredith *et al., Antarctica and the Earth System*, Earthscan, April 2025.
[21] The Spilhaus projection, designed in 1942 by Athelstan Spilhaus (one of the pioneers of the bathythermograph, an early instrument for collecting ocean data), represents the globe as an ocean surrounded by continents rather than continents surrounded by ocean. This representation highlights the interconnected nature of the global ocean and places the Southern Ocean at the centre as the junction point of all global ocean circulation. Michael P. Meredith, 'The global importance of the Southern Ocean', 2019.
[22] The gap that separates it from South America.

What data and technologies did you rely on to create the map?

Mapping ocean circulation has been an ongoing global initiative since the early days of ocean science and exploration. Scientists have made many millions of ocean measurements, originally from ships, and more recently using autonomous vehicles that collect data without humans on board. Satellite-borne sensors now scan the ocean surface continuously. Folding all this information together has led to our understanding of ocean circulation as a dynamic and globally connected phenomenon.
Graphical sketches provide simplified perspectives but can have great impact. I worked with Jamie Oliver from the British Antarctic Survey to create a suitable version of the Spilhaus projection and to trial various configurations for portraying the circulation on top.

What is the role of the Antarctic Circumpolar Current?

The Antarctic Circumpolar Current began to form around 30 to 35 million years ago, after continents had detached from Antarctica and Drake Passage had opened.[22] Now it links the Atlantic, Pacific and Indian Oceans – the true ocean connection point for our planet.
It moves huge quantities of heat, carbon, nutrients and other important substances in a continuous clockwise flow around the continent. Loops split off this flow into the other ocean basins, distributing the heat, carbon and nutrients around the world. This determines our climate and supports ocean productivity.
This circulation is not just horizontal: there is an important vertical aspect also. In the Southern Ocean, waters that were last in contact with the atmosphere hundreds of years ago, and thousands of kilometres away in the North Atlantic, rise to the surface and interact with the atmosphere and the ice. This allows exchange of carbon between the ocean and the air: pre-industrial carbon released from the depths, modern-era carbon absorbed. The deep ocean is filling up with carbon as more is absorbed from the atmosphere, but some old waters still have very low levels of anthropogenic carbon. This will change in coming decades.

Is the Southern Ocean's absorption capacity slowing down or threatened today?

Because of its unique vertical circulation, and the connection between the atmosphere and ocean depths, the Southern Ocean is the key site globally for absorbing excess heat. This circulation is sensitive to changes in sea ice and meltwater from Antarctica. We're seeing signs of this circulation slowing down, which could threaten the ocean's ability to store heat and carbon at the same rates in future. This could lead to a vicious circle that feeds back into more climate change.

"Understanding the future of ocean circulation is a central challenge in managing our planet."

How do ocean current changes influence the fate of Antarctic ice, which in turn affects currents?

Antarctica is vulnerable to ocean heat. As Southern Ocean waters heat up and contact Antarctic ice, they can cause ice shelf collapse and increased glacier melting. This has a big impact on sea levels worldwide. The heating ocean can also affect floating sea ice, which recently retreated at a rate greater than anything seen in the Arctic. The meltwater from Antarctica can slow the vertical circulation in the Southern Ocean, with impacts on climate and feedbacks on the cryosphere.

How can a better representation of ocean currents transform our relationship with the ocean?

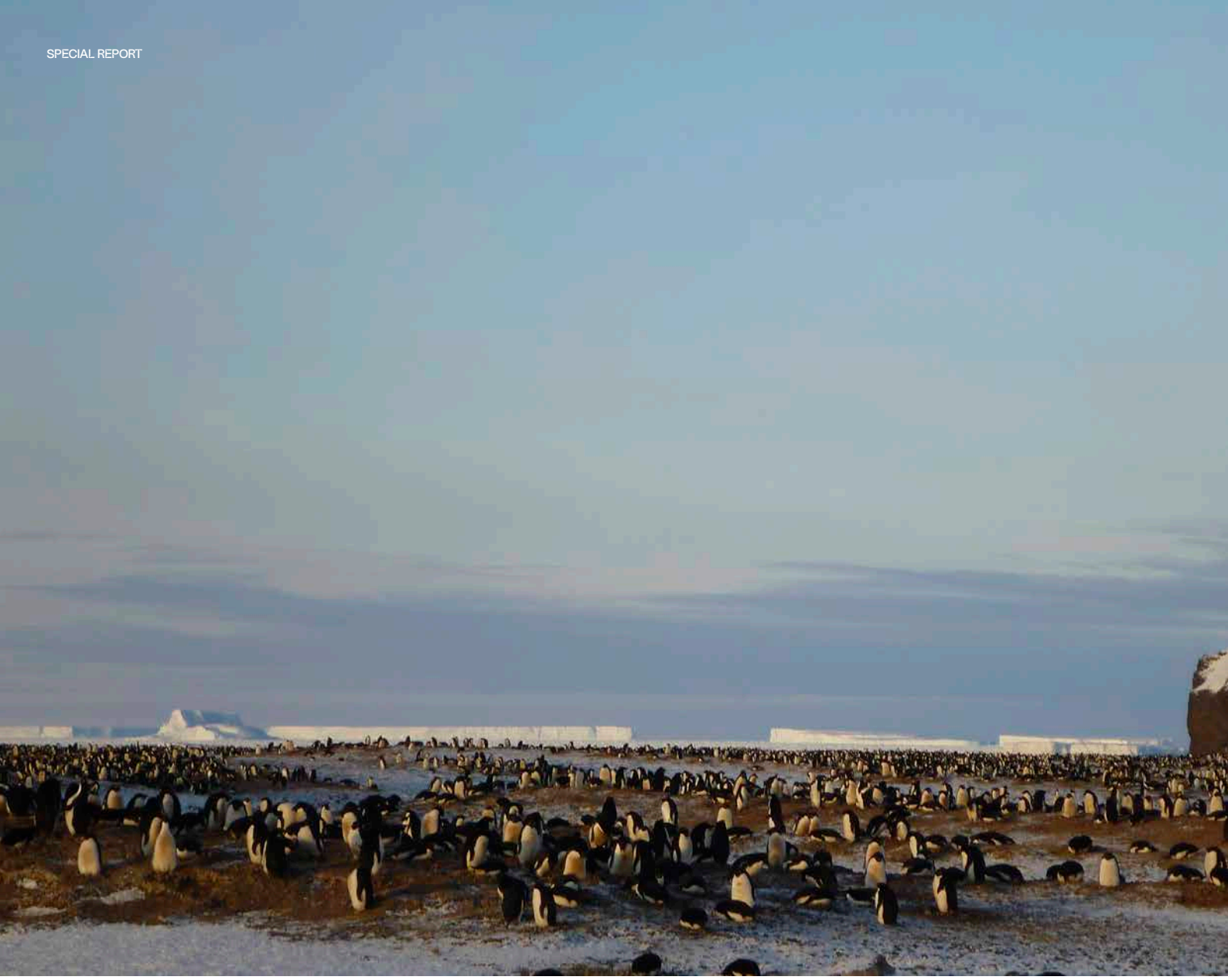
Understanding the future of ocean circulation is a central challenge in managing our planet. We need strong and immediate action to protect the poles, to save as much of the cryosphere as we can and preserve the health of our planet. We need better scientific information on ocean currents, and to portray that information so it resonates best with decision-makers and the public worldwide. Humans are visual animals – we care most about things we can see and interact with – and we need to bring the ocean alive for them in the most accessible way.

Michael P. Meredith drills through Antarctic sea ice to collect samples (March 2016). Beneath this floating surface lie several kilometres of Southern Ocean.

POLAR SCIENCE AT A CROSSROADS

A two-pole perspective by Gary Wilson, President of the Scientific Committee on Antarctic Research (SCAR) and Henry Burgess, President of the International Arctic Science Committee (IASC)

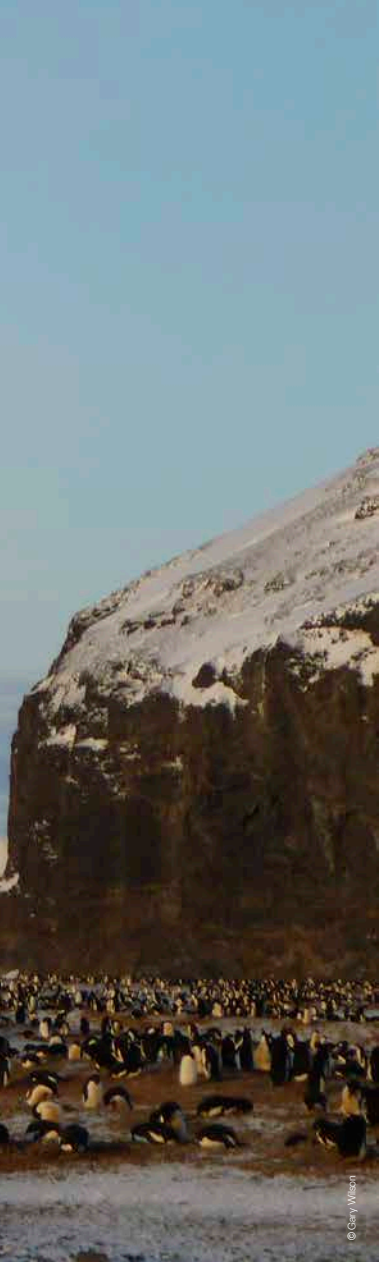
While the polar regions are changing faster than the rest of the planet, two international organisations, both members of the International Science Council (ISC), are at the forefront of strengthening the scientific community and translating science into action.
Gary Wilson, President of SCAR (46 member countries) and Deputy Vice-Chancellor Research (specialising in Earth's climate system and carbon cycle) at New Zealand's University of Waikato, is a leading science voice in the Antarctic Treaty System.
Henry Burgess, President of IASC (25 member countries) and Head of the UK's Arctic Office, persuades decision-makers that Arctic science is of practical value to societies worldwide, from weather predictions to climate adaptation strategies. Ahead of International Polar Year 5 (IPY5) in 2032–33, both are facing a critical challenge: closing the gap between what science knows and what governments do.



Why should the polar regions be at the heart of global priorities?

Gary Wilson: The polar challenge is global: climate change, biodiversity loss and human impacts. We conduct our research in that global context more and more. Since the International Geophysical Year in 1957, we've discovered that Antarctica and the Arctic are increasingly important in what we see globally and are more vulnerable to the global-scale changes we see. We talk about two degrees of warming but that equals seven or more degrees in vast regions of the Antarctic and the Arctic. The poles share that vulnerability and sensitivity to the global system.

Henry Burgess: The pace of change in polar regions is outstripping the change in other parts of the world. It's the canary in the coal mine: these changes are a precursor of what the rest of the world will face – this dramatic change that outstrips the ecosystem's ability to respond positively to it. These systems and creatures, flora and fauna have adapted over thousands of years to live in a specific tolerance framework, and we're throwing that out of the window in decades. It's an important place to study this change.



View from Cape Adare, looking north towards the Southern Ocean.

How can we have a long-term vision, given the pace of change?

Gary Wilson: It's vital. But hard. Short-term political expediency takes the focus away from making long-term measurements. Yet long-term structural change has wider impact around the planet, whether biological structural change or physical systems. As an organisation, SCAR's goal is to bring ongoing measurements from different scientists and countries together into a collective international database. We also have cross-disciplinary programmes, such as Antarctic Terrestrial Observing Systems, that are starting to install longer term monitoring points.

Henry Burgess: The Arctic Ocean is one of the few oceans without a proper global observation system. But without proper long-term observations and monitoring – including real-time data – we are missing a vital part of the picture, including the important connections with Atlantic currents. Autonomous vehicles and gliders, such as Argo floats, will go into the Arctic, but what we need is a proper global observation system that every country can find its place in and contribute to. But monitoring long-term observations is not glamorous and the investors won't have an immediate result necessarily.
We hope International Polar Year will help remind people how important these long-term measurements are and how we can do much more with smaller, autonomous systems, connecting on-the-ground observations to remote sensing, bringing in Indigenous knowledge in co-production. IPY5 will be a good opportunity to re-energise these monitoring systems.

International Polar Year 5 (IPY5) is happening sooner than usual – only 25 years after the last one, instead of 50 – in response to the current state of emergency. How does it create opportunities for translating science into action? What do you expect?

Henry Burgess: The challenge is stark, but the opportunities are there as well. Technology advances faster now. We need this data for the IPCC to incentivise political action – to demonstrate the changes as a result of what's happening in the north and south. IPY is not just about countries that already do Arctic or Antarctic research. It's genuinely international: new countries that haven't been involved in past IPYs can find their niche. There's interest from Gulf States such as United Arab Emirates, which has had unprecedented floods and wants to understand weather patterns. Singapore focuses on shipping routes but also faces vulnerability as a low-lying city affected by ice melt.

Gary Wilson: We hope IPY will allow us to go to important places we haven't accessed – like the grounding line of ice sheets and ice shelves where ice and ocean connect. We've made more measurements on the moon than that! Given the rapid change, we need this knowledge base to increase quickly so we can get action before structural changes become irrecoverable.

Your organisations operate in very different geopolitical frameworks. What are the specific mechanisms you use to translate science into action and influence decision-makers?

Gary Wilson: SCAR is unique when it comes to the Antarctic Treaty System, providing objective and independent scientific advice. At every treaty meeting, SCAR brings the science voice to deliberations. Information from SCAR papers often represents the final word in agreements and negotiations.
And we have a number of avenues, like the Antarctic Environments Portal, which is about science-to-policy readiness of information, so members can quickly assimilate, understand and utilise information for policy. We produce annual reports and updates – for example, 'Antarctic Climate Change and the Environment', a report shared with the UNFCCC[23] and IPCC. Nations place importance on the treaty, so we show up with a strong delegation and present the latest

[23] United Nations Framework Convention on Climate Change.

information. We need to see the treaty strengthened; nationalistic pressures reduce attention compared to global collaboration. We believe that the more scientific knowledge we bring to the table, and the more we translate into policy-ready understanding, the more we help.

Henry Burgess: On the Arctic side, we don't have the same relationship to a treaty organisation, but there is the Arctic Council. We work closely with Arctic Council and IASC working groups, providing advice and expertise on pollution, sustainability and similar issues. IASC has convening power similar to SCAR. It starts initiatives funded by national governments or international processes. An example is the MOSAiC expedition (2019–2020), 100 million euros: German icebreaker *Polarstern* drifted across the Arctic during polar night, frozen into the ice, conducting unique science. We also produce a 'State of Arctic Science Report' every year about gaps in the science system, directing countries and international organisations to priorities for the future.

What role can the Monaco Polar Symposium play?

Henry Burgess: There are many Arctic conferences. But Monaco is different: it brings organisations we don't often connect to, particularly philanthropic organisations and conservation NGOs. If we're going to make IPY successful, we'll need all those voices, that support and that connection. That makes Monaco stand out.

Gary Wilson: Indeed, the Monaco symposium reaches a wider audience. Someone needs to help us maintain the global view and take responsibility for the global commons as many nations retreat to nationalistic perspectives. The gap between science and action requires solutions, not just problem reports. It's not too late to act for the global commons. Billions of people living close enough to the ocean to be affected by sea level and cyclones need us to work on solutions. Maybe shifting from the sole focus on emissions to nature-based solutions – restoring the planet's self-regulation – offers opportunities Monaco can champion.

Can you share concrete examples of how polar research has led to real-world policy changes or protection measures?

Henry Burgess: In the Arctic, persistent organic pollutants (POPs) and forever chemicals accumulate in higher mammals and enter the food chain for 400,000 people living in the Arctic. Through the Stockholm Convention, these are now listed as chemicals of concern, creating the opportunity to track and regulate their production and use.

Gary Wilson: The Antarctic Treaty Consultative Meeting (ATCM) has a multi-year strategic work plan using scientific data. SCAR feeds into it every year, so science drives policy response and action. The Ross Sea Marine Protected Area (2016) is a major example of science-policy collaboration involving huge, long-term effort. The other example: we talk globally about two degrees of warming. Understanding we might lose the West Antarctic Ice Sheet is a major visual understanding that informed the critical two-degree threshold. Once you start losing major ice sheets, it's really difficult to recover.

There's increasing talk of geoengineering solutions. What are your thoughts on the subject?

Gary Wilson: The Southern Ocean is one of the major carbon drawdown points for the planet, but human actions limit it. There's much potential in restoring natural systems that already draw down way more CO2 than any engineered response. Geoengineering was considered at the most recent ATCM meeting – it is an invasive and risky activity, which at best can provide a short-term sticking plaster: incredibly expensive and a distraction from the real issue. We need to think about restoration of natural planetary systems. Yes, emissions are a problem, but so is preventing natural sequestration.

Collecting surface meltwater samples in the Fram Strait (Central Arctic Ocean), during research vessel Polarstern's *MOSAiC expedition on 27 July 2020.*

"We believe that the more scientific knowledge and understanding we can bring to the table, and the more we can translate that into policy-ready understanding, the more we can help."

Gary Wilson

An Antarctic field camp in front of the Commonwealth Glacier in the McMurdo Dry Valleys.

What is an example of an effective nature-based solution?

Henry Burgess: A good example in the Arctic is Norway's seagrass and kelp restoration. It's often eaten by urchins. Controlling these invasive species restores habitat – a triple benefit for climate, biodiversity and pollution.

What's your message to potential contributors about opportunities to engage with IPY5?

Henry Burgess: Although we've done planning, IPY isn't locked down regarding science priorities. I don't want people to think there's no place for them. A lot depends on people's creativity, enthusiasm and ability to secure funding. We can do the architecture at the top, but it'll still need people's creativity. We're starting earlier than ever to give people space to develop and fund ideas. There's a role for everyone.

Gary Wilson: There's also an opportunity to point out that we don't have to choose between economic development and nature. Most of our economies are nature-based. So it might be worth focusing on restoring nature to better serve our economies.

Learn more about IPY5

www.ipy5.info

"There are many Arctic conferences. But Monaco is different: it brings organisations we don't often connect to."

Henry Burgess

3 PURSUING ADAPTATION AND RESILIENCE IN THE POLAR REGIONS

The northern boundaries of the Arctic are shifting and moving northwards due to warming, adding to the instability of a region that is governed by eight sovereign states and home to four million inhabitants, including an Indigenous population of half a million.

"*The palsas have started to thaw*", laments a Sámi reindeer herder from north-eastern Sweden, as his animals' hooves sink into the sub-arctic Vissátvuopmi peatland.[24] The soil that has been frozen for thousands of years is warming and becoming dangerously soft. Grazing and cloudberry picking areas in northern Norway and throughout the Arctic are suffering the same fate. "*People have already been forced to change their patterns of movement on palsa mires in Finnmark, Norway*", the Saami Council noted in their 2023 climate change report.[25] In 2022, the Intergovernmental Panel on Climate Change (IPCC) concluded that "*Climate change has impacted Indigenous subsistence resources across the Arctic*".[26] The degradation of high-latitude habitats is putting future food systems and ecological connections at risk both in those regions and more globally.

In the IPCC's 'Synthesis Report' (the final part of their Sixth Assessment Report), adopted in March 2023 by the panel's 195 member governments, the scientists state: "The impacts on some ecosystems are approaching irreversibility, such as [...] the changes in [...] Arctic ecosystems driven by permafrost thaw".[27] Arctic and Antarctic sea ice loss is also among the irreversible damage being caused by current climate conditions. The IPCC experts also conclude, that in these regions experiencing very specific climate conditions, as well as in some warm-water coral reefs, coastal wetlands and rainforests, "ecosystems will have reached or surpassed hard adaptation limits".[28]

Four years earlier, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) observed that "*Goals for 2030 and beyond may only be achieved through transformative changes across economic, social, political and technological factors*".[29] These changes require coordinated efforts, inclusive and flexible governance approaches and measures, multi-sector planning and transformative policies in the public and private sectors.

The IPCC scientists stress the importance of including Indigenous Peoples in "*the evaluation, implementation and monitoring of policy instruments for land-based climate change adaptation and mitigation*" to enhance the effectiveness of decision-making and governance.[30] Successful adaptation efforts have been undertaken, for example, by an Indigenous Sámi community in the Njávdámjohka (Näätämö in Finnish) river watershed in Finland, which is severely affected by climate change. An essential waterway for the Skolt Sámi people, the Njávdámjohka is also an important spawning area for Atlantic salmon. For the past 15 years, it has been managed collaboratively through a project hailed as an example of best practice in Arctic environmental governance. It involves actions such as the ecological restoration of habitat and spawning areas to ensure salmon survival, establishing a local database and reviving traditional Indigenous practices.[31]

There are no Indigenous communities to represent the voice of Antarctica, but an international community of 56 countries has signed the Antarctic Treaty. For nearly 70 years the continent of Antarctica has been protected by this miracle of diplomacy and international law, which will remain unchanged until 2048 and even beyond. This framework unlike any other in the world dedicates Antarctica to science and ensures its voice is heard in international negotiations. Various bold solutions have been established within the framework of the treaty, including the world's largest high seas marine protected area in the Ross Sea. Created 10 years ago, this nature-based solution is strengthening the region's resilience to environmental threats.

Despite experiencing sweeping structural upheaval, along with the growth of tourism, international trade and fishing as a result of new shipping routes being opened up by the melting ice, the polar regions are pioneers when it comes to adaptation and conservation. Indigenous populations are increasingly making their voices heard and are now publishing their own scientific literature. Science is playing

[24] *Palsa* is a term from the Sámi language, meaning a mound of frozen peat and soil, formed by the expansion of its ice core, found in peat mires in the polar and sub-polar zone of discontinuous permafrost.
[25] Saami Council, 'Climate Change in Sápmi – an overview and a Path Forward', 2023.
[26] IPCC, 'Climate Change 2022: Impacts, Adaptation and Vulnerability', part of the Sixth Assessment Report (AR6), February 2022.
[27] IPCC, 'Climate Change 2023: Synthesis Report', final part of the Sixth Assessment Report (AR6), 2023, Geneva, Switzerland.
[28] ibid.
[29] IPBES, 'The Global Assessment Report on Biodiversity and Ecosystem Services: Summary for Policymakers', IPBES secretariat, Bonn, Germany, 2019.
[30] IPCC, 'Climate Change and Land: An IPCC Special Report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems (Summary for Policymakers)', 2019.
[31] Camilla Brattland, 'How Traditional Knowledge Comes to Matter in Atlantic Salmon Governance in Norway and Finland', *Arctic*, Vol 71, No 4, December 2018.

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Project led by UArctic to support reindeer herders in Indigenous communities facing climate change, supported by the Prince Albert II of Monaco Foundation between 2011 and 2013.

a more crucial role than ever in a turbulent geopolitical landscape, caught between protecting the polar regions on the one hand and using and appropriating polar resources on the other. Yet, as CNRS researcher and Arctic expert Éric Canobbio sums up, we are witnessing "*the emergence of circumpolar awareness arising from the research being carried out into the boreal [Arctic] environment and the health of its inhabitants*".[32] Will we succeed in shifting the focus of our largely anthropocentric awareness? Will we be able to "*think like the poles*", to paraphrase one of the forerunners of ecological thinking, US forester Aldo Leopold? As early as the 19th century, Leopold pioneered a philosophy respecting the intrinsic value of all elements within an ecosystem. When will there be widespread "*transpolar awareness*" arising from the research being carried out into the Arctic and Antarctic environments and the health of the human populations and other animals?

[32] *Pôles*, Reliefs, Vol 3, 2016; see also Éric Canobbio, *Atlas des pôles. Régions polaires : questions sur un avenir incertain*, Autrement, 2007.

SHIPPING IN THE ARCTIC:
TACKLING BLACK CARBON

INTERVIEW WITH SIAN PRIOR

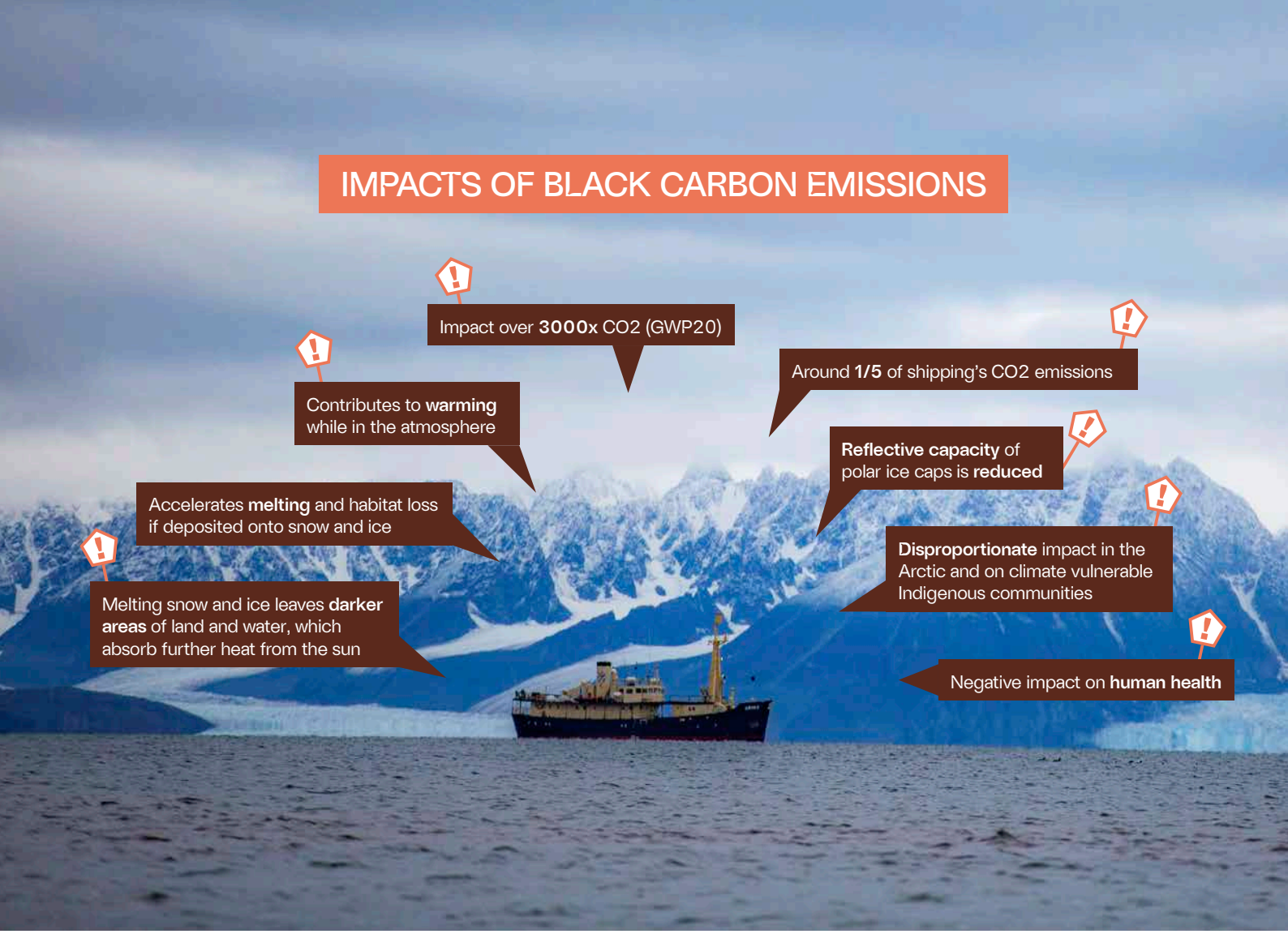
Lead Advisor to the Clean Arctic Alliance

The Clean Arctic Alliance is a coalition of 24 environmental organisations (including Greenpeace, WWF, Ocean Conservancy and Pacific Environment) campaigning for cleaner fuels and putting pressure on governments and international institutions to protect the Arctic from black carbon shipping emissions, which have doubled since 2015.
After contributing to the adoption of the 2021 International Maritime Organization (IMO) heavy fuel oil ban in the Arctic, it is waging a new battle against black carbon, the super-pollutant that darkens sea ice and accelerates melting.[33] Drawing on Pacific Environment's report 'On Thin Ice' (July 2025), which calls for binding measures, the Clean Arctic Alliance is now mobilising Arctic States against black carbon pollution and promoting "polar fuels" – marine fuels with low emissions.

What is driving this black carbon campaign?

Black carbon is a super-pollutant with a global warming potential 1600x greater than CO2 on a 20-year basis. Its impact is nearly five times greater in the Arctic because, when it settles out of the atmosphere onto snow and ice, it speeds up the melting and reduces the albedo.[34]
On the positive side: black carbon is short-lived – it only remains in the atmosphere for a matter of days – so action will see benefits very quickly. While the Arctic Council has very nearly reached its 25 to 33% reduction target since 2017, Arctic shipping emissions have remained totally unregulated and have more than doubled. The IMO must act now.

[33] The Prince Albert II of Monaco Foundation has signed the Arctic Commitment, joining more than 165 companies, explorers, politicians and NGOs.
[34] Surface reflectivity.



How could the mandatory adoption of "polar fuels" – which received growing support at the IMO meeting in January 2025 – transform Arctic shipping?

These are existing maritime fuels that result in lower emissions of black carbon and therefore are more suitable for use in the Arctic. Currently many ships operating in the Arctic use heavy residual fuels (the leftover waste from the crude oil distillation process) that produce high levels of particulate matter, which includes black carbon or soot.
Distillate and alternative new fuels would reduce emissions by between 50 and 80%, or more. Mandatory global regulation requiring Arctic shipping to only use these fuels would ensure a level playing field for the shipping sector.

What impact does the US obstruction in October 2025 have on your campaign and on the adoption of binding measures?

The delay to the adoption of the IMO's Net Zero Framework to address climate emissions as a result of the US blockage and bullying has no direct result on our black carbon campaign, but it creates uncertainty. At this stage it is impossible to know if these tactics will be brought to other negotiations. The EU, whose ships dominate emissions in the Arctic, could play a key role. We must push ahead, especially as black carbon also poses serious health risks.

How does the Clean Arctic Alliance's experience with the 2021 heavy fuel oil ban inform your current strategy?

During our HFO ban campaign, we started generating a groundswell of support and highlighted the benefits of a ban on the carriage and use of heavy fuels in the Arctic – which had already been recognised in the Antarctic a decade earlier. We also clarified to delegations the downsides of including exemptions from the ban.
We were successful in securing the ban, though the exemptions and waivers limit the ability of the ban to be truly effective until the end of the decade. This experience taught us the importance of preparation, of understanding the full impact of the problem and of offering solutions that are simple and easy to deliver while being aware of potential unintended consequences. Today, awareness is growing: the Arctic Council has changed our understanding of these issues and created a framework for collaboration among countries. And companies such as Royal Arctic Line are making bold decisions to voluntarily eliminate HFO. Which comes back to the value of regulation – of putting in place the rules that everyone needs to work to.

The Clean Arctic Alliance recommended that Arctic States submit proposals regarding "polar fuels" in December 2025. Were they onboard?

The IMO has spent over a decade considering how to tackle the impact of black carbon emissions on the Arctic from shipping, but this pollution remains completely unregulated. We spent months last year talking to Member States, the Arctic Council, the EU and, importantly, the shipping and fuel industry. We helped to identify common ground and were hopeful that a "concrete proposal" for regulation of black carbon emissions would emerge. What happens at the IMO's Pollution Prevention and Response meeting in February 2026 will be entirely dependent on the proposals and papers submitted at the end of 2025, but black carbon is on the agenda, and we will ensure that as a minimum there is further consideration of action, but also hopefully ensure that decisions can be made.[35]

Black carbon also directly affects the health of Indigenous and coastal populations. How do you integrate this human dimension into your advocacy?

We aim to work closely with representatives of the Indigenous communities. These are the communities living on the frontline – they are the people who will be impacted by pollution in the Arctic and will likely be the first responders in the event of accidents and spills. They have vast knowledge of the Arctic environment and their voices must be recognised at the IMO. Because what happens in the Arctic doesn't stay in the Arctic: their survival conditions ours.

[35] Outcomes of the meeting (9 to 13 February 2026) unknown at the time of going to print.

"Mandatory global regulation requiring Arctic shipping to only use polar fuels would ensure a level playing field for the shipping sector."

THE ROSS SEA MPA IN ANTARCTICA:
A 10-YEAR REVIEW

INTERVIEW WITH CLAIRE CHRISTIAN

Antarctic and Southern Ocean Coalition (ASOC) Executive Director

The waters bordering the White Continent enjoy unique protection. Designated a marine protected area in October 2016 by CCAMLR's then 24 Member States and the European Union, this 2 million square-kilometre area is the largest marine sanctuary on the planet – marking a turning point in the international protection of the high seas. This deep bay is a haven for Adélie and emperor penguins, Weddell seals, Ross Sea killer whales and rare benthic species, as well as abundant krill, Antarctic toothfish and migratory species like humpback whales. The Antarctic and Southern Ocean Coalition (ASOC) was actively involved in the MPA's designation, which required several years of negotiation. Ten years after it was created, Claire Christian, ASOC Executive Director, discusses the benefits of its protection.

What led to the creation of this first large-scale MPA on the high seas? In 2012, there were other candidates. What tipped the decision towards the Ross Sea?

The Ross Sea had special characteristics that motivated people. It's pristine with much research activity – 460 scientific projects since 1967, 293 completed, with 30 states participating. But the reason for its designation, over East Antarctica, was mainly political advocacy. The United States and New Zealand invested time in diplomatic outreach to get CCAMLR members to agree. A krill fishery research zone was added to help China feel comfortable and, to convince Russia, a research zone for toothfish fishing was included. That counts when you have a high-level political mandate to negotiate. It's partly about specific issues, but also politics.

What is the outcome after 10 years of protection?

10 years sounds long, but also kind of short. Good evidence has been collected. The MPA protects early life stages of the toothfish. Researchers found information about growth and reproduction, suggesting the MPA covers the right areas. For species with long lifespans, like penguins, seals, whales, and toothfish – which don't reproduce until after more than a decade – it might be difficult to tell exactly whether the MPA has done everything it's supposed to do.
With the MPA, there's a robust scientific community coordinating: a Ross Sea Research Coordination Network started last year. These collaborations address MPA objectives for conservation and as a reference area. Climate change is affecting the continent, ecosystems and species. Even if penguin populations decline in the Ross Sea MPA, that control area is valuable for comparing with fished areas. It helps us understand what climate change is causing and what human activity is causing, and determine how to manage fishing or tourism.

"It's a great demonstration of what's possible when countries cooperate – we need that more than ever. Our environmental problems are global, not local."

Is managing this remote MPA challenging compared to more accessible seas?

CCAMLR has special rules for licensed vessels: they must transmit their position regularly, international observers must monitor activities etc. The rest of the time, there shouldn't be anybody in that zone – illegal fishing vessels tend not to go there because it's dangerous. In a way, it's easier than other areas. Moreover, with satellite monitoring and Global Fishing Watch, it's difficult to evade regulation. There is a high level of compliance, and small violations are caught by the compliance system. So we feel confident that the area is being monitored appropriately.

Is this nature-based solution a positive example of how to tackle climate change?

Absolutely. Ecosystems function better when left alone. Protecting areas preserves nature, ecosystem relationships and details about how environments work that humans don't understand.

There are great examples in the Southern Ocean: fur seals have rebounded from an incredibly small population in recent decades; great whales were almost wiped out by whaling; blue whales are recovering slowly; humpback whales are almost at 80% of their pre-whaling levels; and we're seeing huge fin whale supergroups, unseen for decades. Whale faeces contain nutrients that grow plankton, which krill eats. So more whales means more krill.

We didn't do that by managing or reducing whaling a little. We stopped whaling almost entirely. The response has been amazing. Our best hope is to set aside a portion of nature.

The Ross Sea MPA will remain in place until 2052. What are the main issues for the coming years?

There's tremendous scientific cooperation. Research is going on in the Ross Sea, with the new coordination network. But Russia and China don't support the Ross Sea Research and Monitoring Plan. We need CCAMLR members to agree. That's the main challenge, because we want the MPA renewed, and there's scepticism from those countries. We need to increase international cooperation and trust between scientists. More broadly, we need to keep making the case for MPAs as important conservation tools. They're gaining momentum with the High Seas Agreement, the Global Biodiversity Framework and the 30x30 goals. But we're not close to 30% ocean protection. Supporting growing human populations requires a healthy ocean.

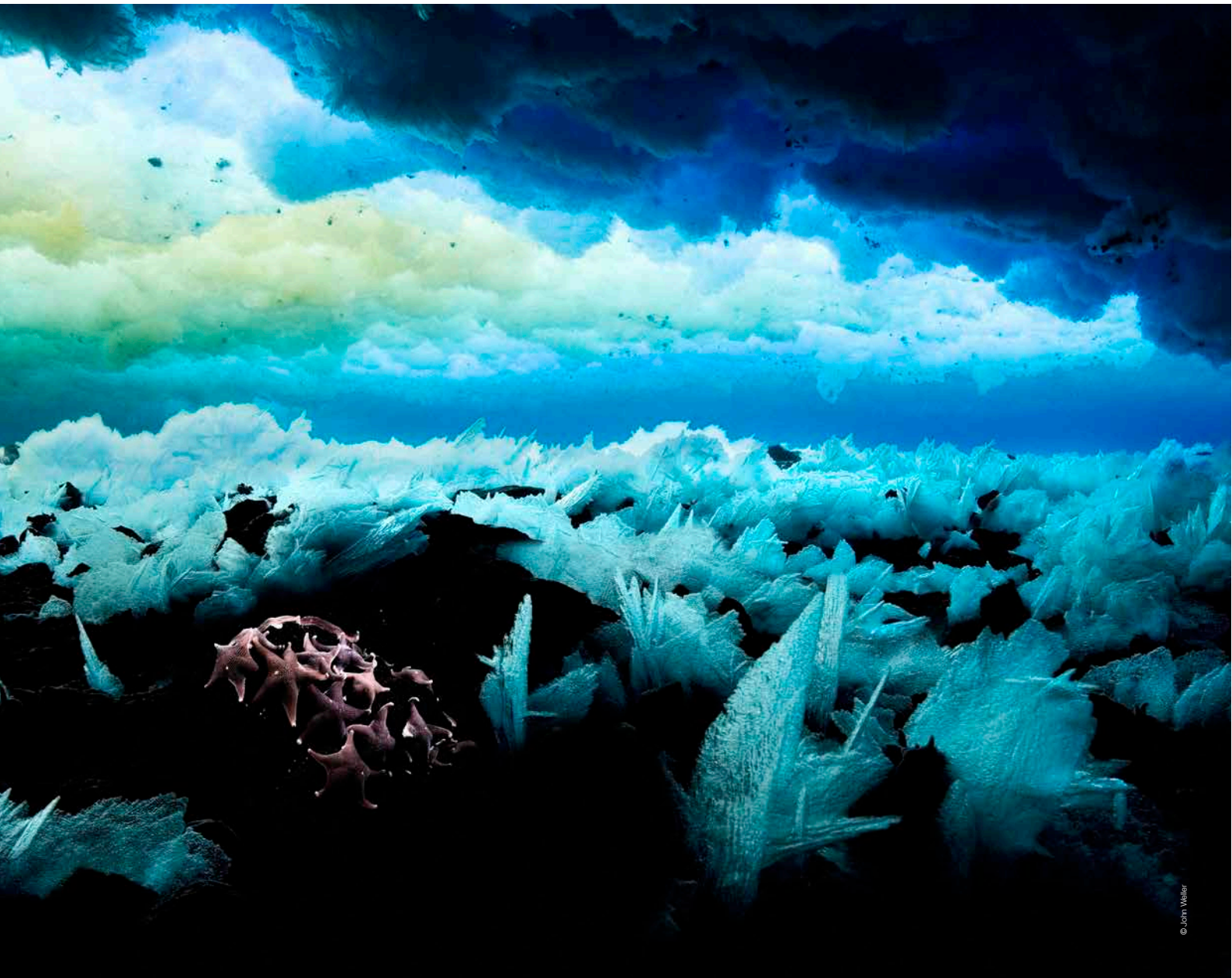
We need good data over the next few years to understand the MPA's impact and ensure it's protecting what it needs to protect. We also need to educate the public about why MPAs are important. The Ross Sea MPA demonstrates the benefits of special places where ecosystems are intact and functioning.

Is the largest marine protected area in the world, covering 2 million square kilometres, a great demonstration of what's possible when countries cooperate?

Definitely, and we need that more than ever. Our environmental problems are global, they're not local – they can't be solved by one country. This MPA is a project that the whole world needs to participate in. Showing that it can be done between countries that have very different political systems, different beliefs, is a really important act of leadership.

Can it serve as a model for other Antarctic MPAs?

Definitely. CCAMLR's focus is the Antarctic Peninsula MPA. Proposals for the Weddell Sea in East Antarctica are still active. But the Antarctic Peninsula is one of the fastest warming areas with a growing krill fishery. One of the ways to protect the ecosystem is to designate an MPA there.



PURSUING INCLUSIVE CLIMATE CHANGE ADAPTATION FOR SÁMI COMMUNITIES

INTERVIEW WITH EIRIK LARSEN (LÁSSE IVVÁR ERKE)

Sámi lawyer and head of the Human Rights Unit at the Saami Council

The Sámi have travelled across the frozen Arctic lands for thousands of years. They are a people without a state, but they inhabit a vast region. Sápmi spans northern Sweden, Norway, Finland and Russia's Kola Peninsula, and has an estimated population of 100,000 Sámi. Reindeer herding, fishing, hunting and small-scale farming are central to Sámi culture. These lands are now experiencing unprecedented climate disruption, including temperatures rising three times faster than the global average, thawing permafrost and unpredictability. Added to this is the political challenge of energy transition. It is a bitter paradox for the last Indigenous People of Europe, who have been recognised for their essential role in conserving these territories in IPCC and IPBES reports.

How are Sámi communities experiencing climate change in the Arctic?

In former generations, changes happened more slowly. But now we can see rapid climate change: snow and ice conditions are changing and new species are arriving towards the north. This disrupts our way of life and livelihoods. It challenges our knowledge developed over generations through close observation. Usually when there is snow on ice, it's safe to cross. But now, that is no longer the case. Where I live, in Guovdageaidnu, we had only a week of cold temperatures before the snow came. In November, 40 reindeer drowned while crossing the river covered in ice and snow. Older people have also drowned crossing rivers, because specific areas where they used to cross during that month aren't safe anymore. We see tragedies every year.

What is the “double punishment” for Sámi communities?

As Indigenous Peoples, we are among those who have contributed the least to global warming, but we are among the most affected. And we are being asked to give up our remaining land to save the world from a crisis that others are responsible for.

We see this as a double punishment. We are experiencing increased interest in our land because it’s “undeveloped” and “unused”. Europe is looking north, and Nordic governments see this as an opportunity to deliver renewable energy to Europe. We call this “green colonisation” because it’s the same method in a new context. The majority measures our interests against theirs, this time “for the greater good”. But we will always lose because we are a minority.

Without our land, our culture will not survive because we are deeply connected to specific land. Our land already contributes more than we use, thanks to hydropower dams and wind power facilities. We deliver critical materials to the world – many more than we will ever use ourselves.

What are Sámi priorities today?

We need time for climate adaptation – to learn how to act with the new climate conditions. But rights holders are taking time to defend their remaining land, replying to authorities and businesses.

We are struggling with mental health issues because it’s hard to witness rapid climate change and outside interest in our lands. We struggle with suicides, especially among young men in traditional livelihoods.

How can Indigenous knowledge guide adaptation?

Our ancestral knowledge contains useful strategies because our way of life is slower and we have always closely observed the land and weather. We have been mobile, meaning we can go elsewhere if conditions in one area are not suitable. But with less land, it’s hard to maintain our mobility strategies.

Our knowledge and our people on the land observing everything could be valuable for others as well. However, traditional reindeer herders and fishers have provided observations that have been used against them.

What tools is the Saami Council developing to strengthen community decision-making capacity?

In the Nordics, we have high trust in governments. But we see that governments are now taking shortcuts in the name of the green transition.

We’ve learned that we need to follow other tracks, such as improving our communication skills with businesses and investors, who might be more interested in finding solutions with us. We are developing a handbook on how to communicate and develop capacity for paperwork. This is one of our latest projects to mitigate the difficult situation with both climate change and outside stakeholders’ interest in our land.

With support from the Prince Albert II of Monaco Foundation, we will organise courses and workshops, providing tools for rights holders to enhance their consulting skills.

| *Sámi duodji (handicraft) items sewn using reindeer hide. Duodji is a living Sámi tradition, rooted in respect for nature and using all available resources.*

“Our ancestral knowledge is being challenged by climate change.”

Industrial wind power development on Fosen in Norway, encroaching on, and fragmenting, traditional grazing lands, undermining the foundation of Sámi reindeer herding and culture.

In the Saami Council, you're developing a Free, Prior and Informed Consent (FPIC) protocol. Why is this crucial?

The UN Expert Mechanism on the Rights of Indigenous Peoples visited Norway in 2024 at our request. The context was the green transition and increased interest in our land for development projects, mining and renewable energies. One recommendation was to develop a Free, Prior and Informed Consent (FPIC) protocol, so that's what we're doing.

In the current situation, if you engage in dialogue, you lose when you're dealing with people who are invested financially and politically. After a while, the project starts running anyway. With the FPIC protocol, we can express our own terms to be accepted prior to dialogue. This will give us the opportunity to consent to a project or to stop a project if it doesn't meet the criteria or the expectations of rights holders.

The Swedish Supreme Court's 2020 Girjas Sámi Village ruling recognised that community's exclusive hunting and fishing rights. What impact is that victory having?

It was historic. Following that case, we were hoping for legal reforms and political solutions for all Sámi reindeer herding communities in Sweden, but it doesn't seem to be happening. We expect other Sámi communities will do the same as Girjas. But it will demand resources and time. The case started in 2014 and took many years to reach the Supreme Court. That's why a political solution would be more effective in respecting our rights.

What concepts from your ancestral knowledge could inform our relationship with nature from a sustainability perspective?

One important concept is *Birgejupmi*, which is used by IPBES. It is a North Sámi word that's difficult to explain, but it means "you shouldn't take more than you need from nature". It's not about growth, but a model of living, for yourself and your family.

There's also *Meahcci*. Norwegians translate it as "wilderness", which is wrong because our land is not wilderness – we are using it. *Meahcci* is a concept in which humans are part of nature. We can use the word as a verb, meaning "doing nature".

In our storytelling, we haven't made treaties with the states, but we have made a treaty with the reindeer, who have agreed to give up their life if we treat them well during their lifetime and promise to respect all their resources and utilise every part of the animal.

We also ask for permission. Let me share a personal story. When I was young, I noticed that a close relative, when cutting trees, didn't cut every tree. He made sure there were old trees and new trees with room to grow up. But I noticed he would tap on the tree with the saw or axe. I didn't know why. Later, knowledge holders explained that he was asking for permission from the tree. He never told me that, and I'm not sure if he knew why he was doing it. But it makes a connection between humans and trees.

ESTHER HORVATH *ARCTIC EYE*

PORTRAITS OF WOMEN SCIENTISTS IN THE POLAR NIGHT

Experience the complete darkness of the Arctic night alongside photographer Esther Horvath as she captures the adventure of polar science from a woman's perspective.

Back from the icy lands of Svalbard, she describes a disrupted, meticulously studied world, from snow crystals to the arrival of new species.

Four months in darkness, camera in hand, surrounded by ice. In September 2019, Esther Horvath embarked on her 13th Arctic voyage on board *Polarstern*, a German research icebreaker drifting in the central Arctic Ocean, trapped in ice, for MOSAiC, the largest polar expedition ever run. In temperatures of -42°C, the Hungarian photographer captured the daily lives of scientists in a region that is warming four times faster than the rest of the world. One question guided her lens: how are these remote Arctic areas being impacted by global climate change?

One year later, different latitude, same urgency. In February 2021, during the pandemic, she undertook her 14th expedition with the Alfred Wegener Institute. Destination: Ny-Ålesund, Svalbard, an international research station and the northernmost town on Earth, where warming has reached seven times the world average. At the French-German Arctic Research Base, women climatologists, biologists and glaciologists are documenting the accelerating changes in the Arctic – the bellwether of climate change. Here, Horvath created a series of 45 portraits entitled 'Women of Arctic Science', photographed in the darkness of the polar night. For her, having never seen a woman's face on polar expeditions when she was growing up behind the Iron Curtain, these women scientists working in extreme conditions are extraordinary role models.

On the eve of her departure for Antarctica, where she will document the largest colony of Adélie penguins, Esther Horvath reflects on the highlights of her Arctic quest.

INTERVIEW WITH ESTHER HORVATH

Hungarian photographer Esther Horvath trained at the International Center of Photography in New York and works with National Geographic and the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research. Since 2015, she has focused on documenting climate research and scientific expeditions in the polar regions. A multi-award winner (World Press Photo Award 2020 for MOSAiC, Infinity Award 2022, Wayfinder Award 2024), she is a Fellow at the International League of Conservation Photographers, a Nikon Ambassador and has served on the jury of the Prince Albert II of Monaco Foundation's Environmental Photography Award in 2023 and 2024.

How did your 2021 expedition to Svalbard to photograph women scientists at work come about?

I was so inspired by the four months I spent in total darkness during the MOSAiC expedition in the middle of the Arctic Ocean. I found the polar night intensely beautiful and I wanted to keep working in that darkness. I was already in love with the Arctic, with the ice and the cold, but the idea came to me to document the women dedicated to science in that part of the world.
The Alfred Wegener Institute, which I work for as a photographer, has a station in Ny-Ålesund, Svalbard. It's possible to travel there in winter. My very first trip to Svalbard was in 2019, and in 2021 – just one year after MOSAiC – I started working on this project. It was very difficult to get there, because all travel was virtually impossible due to the pandemic.

What was it like, living in the darkness of the polar night for the first time?

Being in the polar darkness is like living inside a glass bubble, with snow inside. Everything happening in the world fades away, the darkness covers you like a warm blanket. Everything slows down. And you're constantly in a Christmas lights atmosphere.
Ny-Ålesund is a very small town. In winter, only 40 people live there. They all work in climate and environmental research. You just need to go a short distance from the centre to see a sky seen nowhere else. When you go out at 11 am, all you see are the Northern Lights and the stars.

It was in those moments that I understood why, for thousands of years, ancient cultures were all connected to the stars, to the universe.
I'm fascinated by the people who stay in Ny-Ålesund, far from their families and friends for a year and a half, sometimes for 10 years! The place is so magical that you only need to come once to want to return. There's something very special about it. I think it's due to the way we can connect to nature, to the stars – something we've forgotten, I think, with light pollution, big cities and living in concrete houses.

How do you deal with the presence of polar bears in the region?

As soon as you set foot in Ny-Ålesund, you must complete annual polar bear safety training. It's very important: when you go out in the field and leave town, someone must carry a rifle and a signal pistol. I passed the permit for that. If you have a job to do, you have to go out with a guard who stays vigilant in case of a polar bear encounter.
I've never encountered dangerous situations. I work very slowly, very carefully, like everyone else. That's what we learn during safety training. I think the key is to be slow and really pay attention.
For me, one of the most dangerous things is falling on the ice in town! That happened to me several times, when I forgot to put my crampons under my shoes. I fell really hard. Fortunately, I didn't get hurt.

What technical difficulties did you encounter, photographing during the polar night?

Photographic technique in that environment is a real challenge. Hands freeze. It's very difficult to handle the camera, to change batteries – which run out very quickly – and memory cards. Especially if there are very strong winds. Using my light becomes almost impossible: if I put it down somewhere, it blows away. I could do with an assistant, but in these locations, I always travel alone because places are very limited. So I have to be very creative in the way I work.

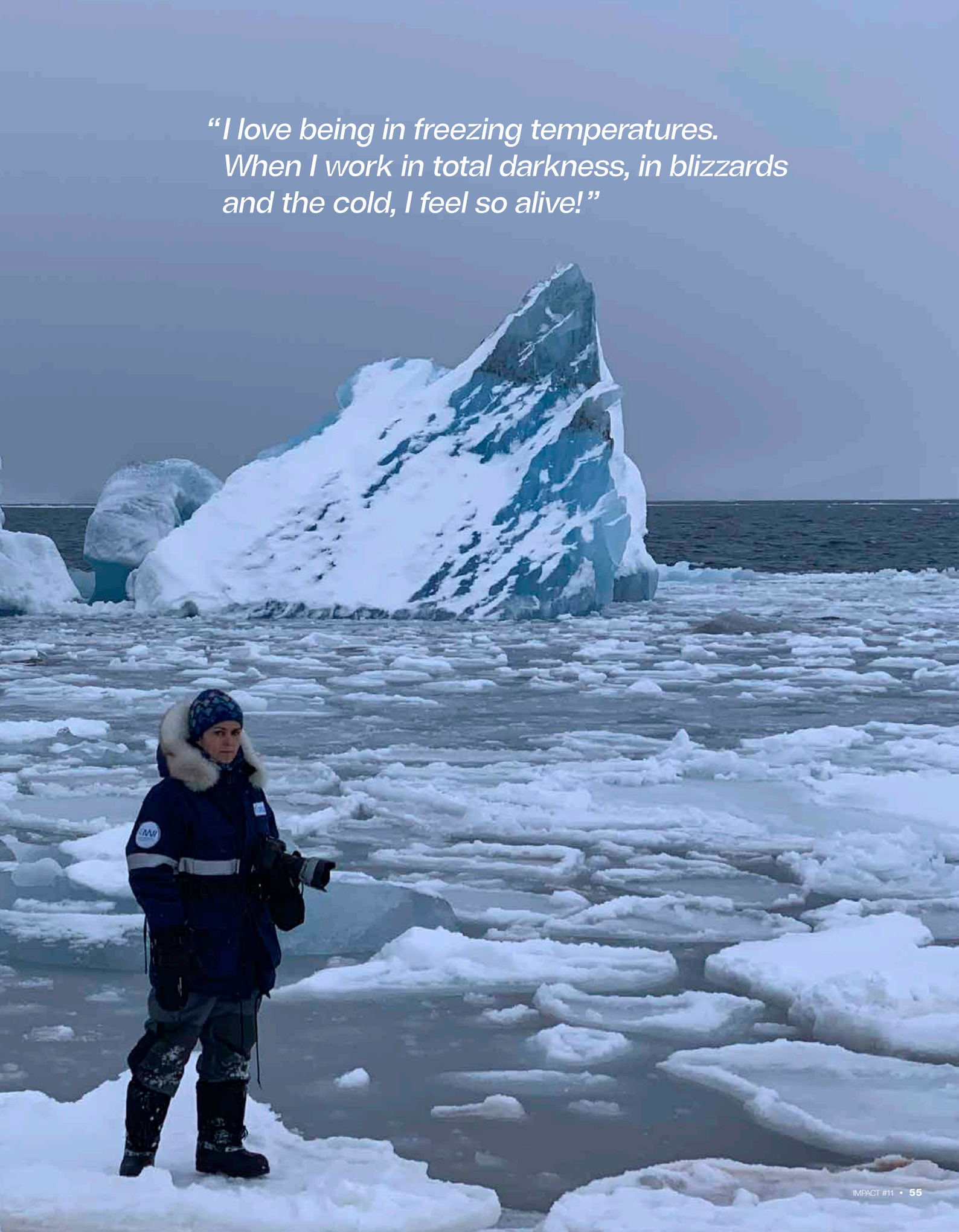
Does living at those latitudes change your relationship with time?

Life in the Arctic has really taught me to slow down, internally and physically. In urban daily life, we rush so much. When I'm there, I recharge! In the Arctic, I inhabit the present moment more, and it's a very healthy space to be in mentally.

How different is daily life in that extreme isolation?

Everything is slower and you have to be present in everything you do. When you're in that small community of 40 people, with no roads, no WiFi, with a plane just twice a week if the weather permits, you develop a unique form of solidarity. There's no store – just a small souvenir shop that's open twice a week for an hour. Breakfast, lunch and dinner are served in the canteen on the village square – the main meeting place, especially during the polar night. We form a very tight-knit circle then. Everyone shares a common goal – research – and that creates a sense of belonging I've never experienced elsewhere.

"I love being in freezing temperatures. When I work in total darkness, in blizzards and the cold, I feel so alive!"



"In the polar night, everything is slower and you have to be present in everything you do."

How did you approach photographing the women scientists to create the sense of intimacy you have captured in your images?

What's so important to me is the connection I feel or can build with a woman. Many of the women in this portrait series have become friends over time. By the time I asked if I could photograph them, we had talked a lot, and we came together around the same passion for the Arctic.

Before the photo session, we decide on the location of the portrait together. Each person chose to pose with an accessory expressing something important to her, about her life, her work, her passion. It's funny because most of the photos were taken in freezing temperatures. But I often ask the subject to take off their jacket, otherwise they disappear in it! So in the series, we see many women just wearing sweaters. In reality, it was -25°C or even -30!

When I photograph, I like to do so calmly. For this series, we're immersed in the darkness of the polar night. I'm silent, I guide the person, ask her to look in a direction and I start taking photos. I take my time. Sometimes I change the light, but I keep silent. The person begins to relax, her features soften. I always want to capture the natural expression of the face, so I don't take photos when she smiles. I just want the natural gaze. Those are the photos I'm looking for. I love those very calm, gentle and slow moments spent with those women.

Very few women used to spend the whole winter in Ny-Ålesund. Today, many are carrying out vital research there. What did you want to highlight through your portrait series?

Since the 1990s, a pivotal decade, more and more women have engaged in polar research. Today, in Ny-Ålesund, the scientific base has as many women as men. It's a beautiful example of equality. It's now managed by the Norwegian Polar Institute and the Norwegian Government's company Kings Bay, whose directors are women! A century ago, that was impossible. In 1926, explorer Roald Amundsen departed from Ny-Ålesund aboard an airship to reach the North Pole. At that time, women being on a polar expedition was unthinkable.

In Ny-Ålesund, there's wonderful international collaboration, which is so important for understanding Arctic changes, and there are no differences between female and male roles. With 'Women of Arctic Science', I chose to highlight the women at the base first for a personal reason: I was attracted to the Arctic very early on, I watched documentaries as a child, and for a very long time I never saw women in polar science or exploration. Moreover, my goal is to inspire young girls and young women! If their dream is to work in a polar region, there's a place for them. Besides the photographic portraits, with an artist I also made a series of eight illustrated postcards and a small booklet for young people about these women of science.

'Women of Arctic Science' is part of a larger project, 'Stars of Polar Night', which concerns all the inhabitants of Ny-Ålesund. What I want is to highlight Arctic research and communicate about the changes affecting this region.

The Telegrafen building was the only point of communication with the outside world until 1964.

Svalbard is warming seven times faster than the rest of the planet. How does it make you feel, creating such strikingly beautiful images against the backdrop of that climate emergency?

It would be wonderful if the changes I've chosen to document were something positive. But the fact is they're negative, and that's true in every scientific field I explore.
One of the most shocking examples to me would be the glacier very close to Ny-Ålesund. You can see it from town. And every year, you can measure its retreat at a glance. I've been travelling to Ny-Ålesund since 2019 and witnessing that retreat. It's so sad. According to the Norwegian Polar Institute, the glacier retreated 750 metres in 2025. Soon, the glacier front may retreat onto land. Another change that affects me: I travel there during winter and now, increasingly, it rains instead of snowing. In the middle of winter, it suddenly reaches 0°C and it rains. All the snow melts. Then it refreezes, and the landscape is nothing but frozen ice. I find that very shocking and sad. There's also the thawing of permafrost and the arrival of invasive species like the helmet jellyfish...

You point out that the women you photograph have in common care, concern and love for the most fragile environment on our planet. How does the female approach of caring bring something different to climate research?

Generally speaking about Ny-Ålesund, I'd say that everyone at the base cares for and loves that polar environment. But more generally, in society, women are more often the ones who carry motherly care, maternal love. I always find that in a healthy society, it's so beautiful if men and women are equal because we all bring something different. I feel that both forces and qualities are necessary. And we feel them particularly in that place.

SIX WOMEN IN *NY-ÅLESUND*

For *Impact* magazine, Esther Horvath has put together six portraits from her 'Women of Arctic Science' series – six windows into the world of research and survival at the edge of the Arctic night. Each image reveals a moment of science, courage and connection to the frozen frontier.

| *Susana Garcia Espada, station manager at the Kartverket/Norwegian Mapping Authority's Geodetic Earth Observatory, in Ny-Ålesund, Svalbard.*

Susana is standing in the geodetic observatory building with the observatory's 20-metre diameter radio telescope in the background. This instrument looks into the most distant galaxies up to 13 billion light years away to measure and monitor regional and global changes in the Earth's crust, the rotation of our planet, and its exact position in space. The Kartverket/Norwegian Mapping Authority's Geodetic Earth Observatory in Svalbard is the northernmost facility of its kind, and it is part of a global network for observation and research, contributing to the global geodetic reference frame. The observatory's antennas record signals from distant celestial objects known as quasars, up to 13 billion light years away.

"I feel grateful every day for this challenge and opportunity to work in the Geodetic Observatory in Ny-Ålesund. I love the Arctic landscapes. Every day I am impressed by its light and changes. I am grateful to be surrounded by Arctic nature, it makes me feel more connected to the environment and myself."

| *Bettina Haupt, station leader at the French-German Arctic Research Base AWIPEV (2020–2021) at Ny-Ålesund, Svalbard.*

Bettina is holding a weather balloon. For the past 30 years, scientists at the AWIPEV Atmospheric Observatory have launched a weather balloon every single day at 11.00 UTC. The data collected indicates that Svalbard is the key region of global warming, with average winter temperatures having increased by 6 to 8°C since measurements began. This rise is happening much faster than anywhere else on the planet.

"I want to do as many projects as possible to understand the rapidly changing, unique ecosystems of the Arctic and Antarctic before they probably disappear. The smallest steps towards this goal count. The changing of the climate concerns us all and will impact us all. It knows no borders and does not pause, but the Arctic is impacted by it the most. So studying the Arctic gives us a small glimpse of a potential future on Earth. The more knowledge we get now about our Earth's cooling system, the better our chances to survive as a species might be in the long run."

Katie is dressed as her favourite character, Elsa, from the Disney movie *Frozen*. It was her dream to wear this costume in the Norwegian Arctic winter in Svalbard as the story is set in Norway and highlights that "strong females can achieve many things", as she explains in her own words. For her, this character is an inspiration for her scientific work, as she seeks to forge her own path, much like Elsa in the film.

"My personal motivation to study the Arctic is to investigate some of the most incredible environments on Earth and the organisms that rely on those environments. These studies will allow humans to better understand the magnitude and incredible diversity of life on our own planet and therefore will help prime us to understand other planets! I feel a sense of personal connection to the Arctic because this pure and endangered ecosystem is on the cusp of being lost forever. The purity of the Arctic amplifies the desire to preserve and study all of its hidden secrets that might change our world forever."

| *Katie Sipes, former PhD student at the University of Tennessee, Knoxville, USA, now a postdoctoral researcher at Aarhus University in Risø, Denmark.*

| *Fieke Rader, observatory engineer at the French-German Arctic Research Base AWIPEV (2020–2021) and station leader (2022–2023).*

The green light instrument is the VISSS, which stands for Video In-Situ Snowfall Sensor. It consists of two cameras positioned perpendicular to each other, each with a green light in front of it. When snowflakes fall in front of the lights, the cameras take photos. These pictures produced from different angles provide new insights into snow and ice properties. The image of the snowflake (or of its shadow) helps to identify the processes active in clouds during snowflake formation. This also contributes to improving and better interpreting remote sensing observations.

"It is easy to forget life 'in the South' while overwintering in Ny-Ålesund. The small, faraway community is absorbing and tempting. Full of hard work, social events and vast nature. Yet at the same time, the place and its climate are changing and as the ice is melting, the world's eyes are focusing more on the Arctic. In Ny-Ålesund, you are far away in your little cold, but cosy, bubble, but also in the middle of climate change and world politics. It can be quite contrasting and confusing."

Charlotte Havermans, researcher at the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, with a plankton net for biological research in Kongsfjorden.

A professor in marine zoology, and a researcher in the polar region for the last 15 years, Charlotte leads the Arctic Jellies research group, studying the diversity, ecology and adaptation of polar jellyfish. Changes in the Arctic also affect the water column and all the organisms inhabiting it. Charlotte first observed the helmet jellyfish during the polar night in January 2022 – a new species in Arctic waters. Seen for the first time some years earlier in the fjord, it could pose a threat to biodiversity. The proliferation of jellyfish due to poleward shifts of Atlantic species may be a result of climate change and could affect local fish populations. Jellyfish migrating from warmer waters can compete with native Arctic fish species for the same food source in the food web, affecting and changing the ecosystem.

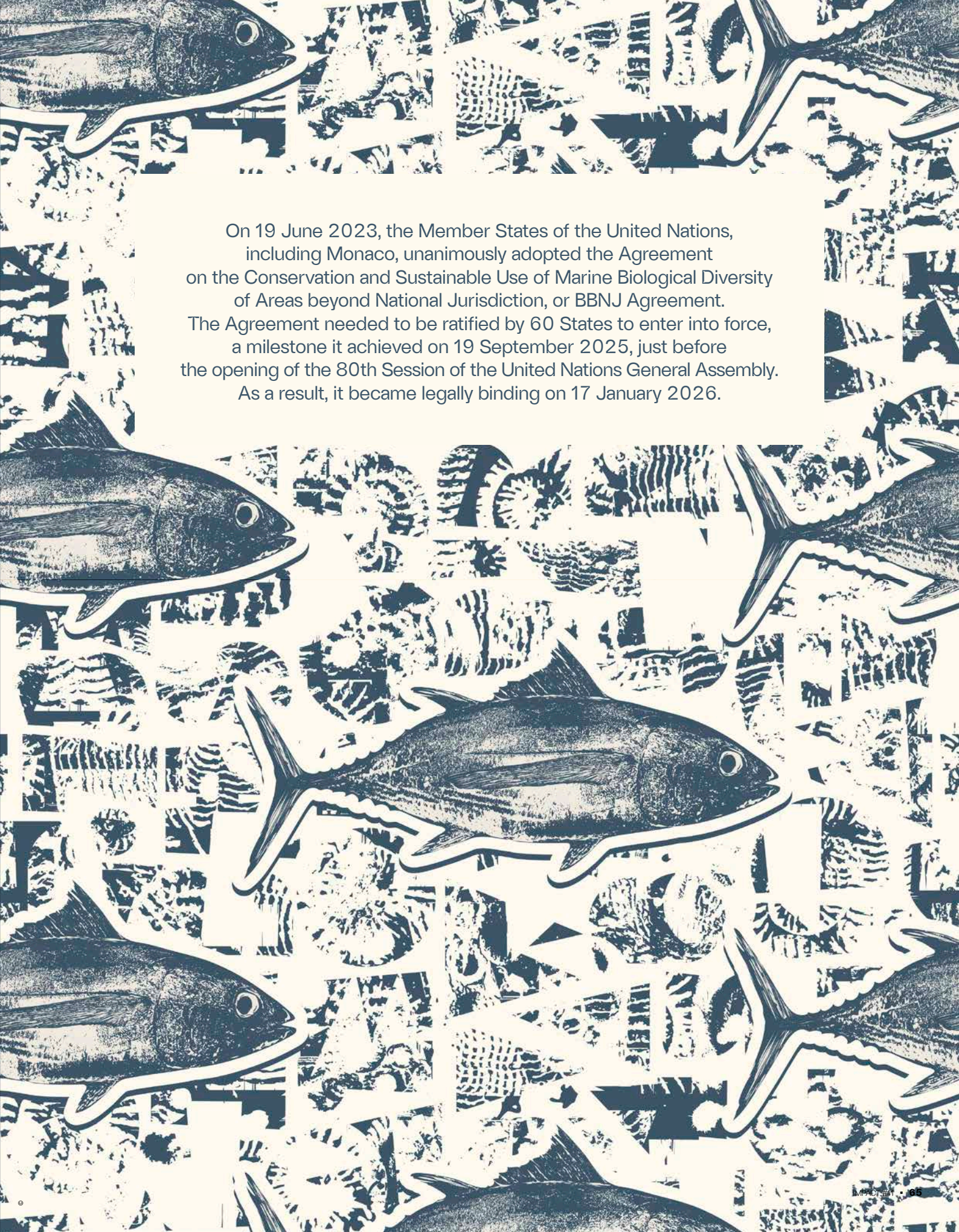
"So much of what we research is new to science; if we look for something specific, we find another aspect of marine life and its interactions that weren't known until then. And then there is the honour of being there and witnessing their characteristics across places and seasons, for example, when navigating through waters covered by ice surrounded by fog, or under the moonlight that brightens up the landscape in the darkness of the polar night. And seeing the animals, big and small, inhabiting these environments, adapted to their unique cycles. And then most importantly, this sense of urgency. To realise we know so little, but that we need to know so much more, to be able to protect these treasures from the future change that is coming faster than we imagined."

Alex is standing with her diving equipment in the harbour of Ny-Ålesund, where the Alfred Wegener Institute has operated an underwater observatory since 2012. She is responsible for planning and overseeing diving activities around the island. She is also heavily involved in technical work, such as setting up, dismantling and maintaining sensors. As a diver, she also collects samples, including algae, animals and sediment cores.

"The Arctic has fascinated me for a long time. I first went on a diving expedition to Ny-Ålesund in 2019 and was – and still am – blown away by the scenery above and below the water. I find it so exciting and important to research these regions in order to better understand the changes and their effects on the ecosystem and the world climate. Through my job, I am very fortunate to explore the underwater world in one of the most remote places in the world."

| *Laura Alexandra ("Alex") Eickelmann, diver at the Alfred Wegener Institute and station leader at the French-German Arctic Research Base AWIPEV (2024–2025).*

HIGH SEAS *BIODIVERSITY* AGREEMENT: *CHALLENGES* AND OPPORTUNITIES



On 19 June 2023, the Member States of the United Nations, including Monaco, unanimously adopted the Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction, or BBNJ Agreement. The Agreement needed to be ratified by 60 States to enter into force, a milestone it achieved on 19 September 2025, just before the opening of the 80th Session of the United Nations General Assembly. As a result, it became legally binding on 17 January 2026.

HSH Prince Albert II of Monaco signed the BBNJ Agreement on 20 September 2023, the day it was opened for signature during the 78th UN General Assembly. On 9 May 2024, the Principality of Monaco became the first European and Mediterranean State to ratify this landmark agreement to protect the oceans. The negotiation process lasted almost 20 years and Monaco played an active role at every stage, from being part of an informal working group (2004–2015) to contributing proposals during the Preparatory Committee sessions (2016–2017) and the Intergovernmental Conference responsible for drafting the text of the Agreement (2018–2023). In 2020, HSH Prince Albert II of Monaco and former US Secretary of State John Kerry jointly opened the High Seas Treaty Dialogue, organised by the Norwegian Nobel Institute and the Prince Albert II of Monaco Foundation. The event brought heads of government together in Monaco to discuss ocean protection and the importance of safeguarding international waters. The BBNJ Agreement has now entered into force and work is underway to ensure it achieves its ambitions.

INTERVIEW WITH ATT. DR VIRGINIE TASSIN CAMPANELLA

An Avocat à la Cour (Paris Bar), EU/EFTA Attorney-at-law (Zürich Bar) and double Doctor in Law (Melbourne and Sorbonne), Dr Tassin Campanella is the Founder of VTA Tassin, a public international law firm dedicated solely to the oceans and seas, President of INDEMER Scientific Council and Member of ABLOS representing the International Hydrographic Organization. She is also Editor-in-Chief of the INDEMER *Annuaire du droit de la mer (Law of the Sea Yearbook)* and the editor and author of the *Routledge Handbook on Seabed Mining and the Law of the Sea.*

© Manuel Braun

To begin with, let's explore the terminology. We hear the terms "High Seas Treaty" and "BBNJ Agreement". Which is correct?

There is in fact, already a High Seas Treaty, which dates back to 1958.[1] The new BBNJ Agreement is linked to the United Nations Convention on the Law of the Sea (UNCLOS), which was adopted in 1982. A mechanism was introduced to update UNCLOS by allowing the adoption of more specific "implementing agreements". The BBNJ Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas beyond National Jurisdiction (i.e. the High Seas) is the third implementing agreement to UNCLOS. The two previous agreements were on deep sea mining,[2] and on straddling and highly migratory fish stocks.[3] What's interesting about these agreements is that they are complementary: they apply in conjunction with the Convention, but also in conjunction with each other.

[1] The 1958 Convention on the High Seas is an international treaty that codifies the rules of international law relating to the High Seas (international waters).
[2] The 1994 Agreement on seabeds under UNCLOS.
[3] The 1995 UN Fish Stocks Agreement under UNCLOS, which aims to improve management of these marine resources within and beyond exclusive economic zones.

In what way is the BBNJ Agreement historic?

The BBNJ Agreement has been 20 years in the making: 14 years of preparation, by various working groups, and nearly 5 years of intergovernmental negotiations – with a 2-year break due to Covid. States had already done a huge amount of work on UNCLOS, as never before had there been such detailed provisions on the protection and preservation of the marine environment in international law.
The BBNJ Agreement goes even further on several points, such as the conservation and sustainable use of biological resources, and obligations to monitor and assess the impact of activities on the High Seas. It's also innovative in regulating access, collection and benefit sharing in relation to genetic resources in the High Seas. Lastly, this agreement reaffirms the requirement for cooperation – between States and also national, regional and sub-regional institutions – to ensure consistency in these protection measures. It also reiterates the responsibility for knowledge sharing and technology transfer, which was included in the 1982 Convention, but has been further developed in the BBNJ Agreement.

What are the next steps in implementing the Agreement?

The BBNJ Agreement was adopted in June 2023 and its implementation was triggered once it had been ratified by the first 60 States. It officially took effect on 17 January 2026. The next step will be to organise the first Conference of the Parties (COP) during 2026. This is not a meeting as such, but a governing body that will have specific powers and be able to adopt implementation codes, regulations, procedures, etc. The States didn't wait until the Agreement had entered into effect to start planning this first COP. Two preparatory sessions were held in April and August 2025, and a final session will be held from 23 March to 2 April 2026. The focus is currently on refining the institutional framework of the COP (rules of procedure, finance, secretariat, observer participation, etc.) and teasing out the procedural, technical and organisational aspects in connection with the key pillars of the Agreement. These include issues relating to cooperation with the various legal frameworks and institutions, operating procedures for the scientific and technical body that will play a crucial role in establishing marine protected areas (MPAs), the creation and remit of a committee on benefit sharing of genetic resources, and the functioning and governance of a Clearing-House Mechanism that will provide open access to data on genetic resources, MPAs, environmental impact assessments and more. The aim is not for this first Conference to list everything that needs to be done, but for it to be able to start functioning. As there are many strands to the BBNJ Agreement, there's plenty of work to do!

[4] On 19 September 2025, the BBNJ Agreement exceeded the threshold of 60 State ratifications required to trigger its entry into force.

How will the Agreement be financed?

Significant funding will be required to establish the BBNJ Agreement, as it will need staffing, time and an entire infrastructure – a supreme body (the COP), an executive body, a scientific and technical body, a compliance body and a financial body. This institutional structure will be financed through contributions by the signatory States. Three mechanisms have been established to support implementation of the Agreement. Firstly, a voluntary trust fund will help developing countries participate in the meetings and institutions. Secondly, a special fund will be financed through profits from patents involving marine genetic resources taken from the High Seas and voluntary contributions from other States and the private sector. Lastly, the Global Environment Facility trust fund can be used to support capacity building programmes or conservation programmes by Indigenous Peoples and local communities.

States will be able to provide further voluntary support for the Agreement through direct or indirect contributions, for example by providing staff for the COP institutions. There may also be external funding available. The European Union has already pledged 40 million euros under the Global Ocean Programme, to support African, Caribbean and Pacific countries in preparing to ratify and implement the Agreement.[5] The BBNJ Agreement will also help to mobilise private funding to support initiatives for the conservation and sustainable use of biodiversity in the High Seas.

Realistically, the Agreement can only be made truly effective through diversified funding sources and support from developed countries. This will also maintain the momentum and encourage States that have not yet ratified to feel confident enough to do so. If there is insufficient support, this could make them hold back – because when you sign an agreement, you need to be able to honour it.

[5] According to the European Commission's website.

Although the total amount of initial funding needed hasn't yet been estimated, the pledges of support appear to be growing. Isn't this encouraging?

For the moment, there are mostly only political statements and announcements. The exact figure for the contributions required by the States has not yet been established – this will be decided by the COP. However, EU calls for proposals to support developing countries – in Africa, the Caribbean and the Pacific – are already live. In addition to this funding for the institutional structure and for signatory States, support and funding will be needed for marine scientific research and to develop technologies for the effective protection and conservation of biodiversity. This will not necessarily involve direct aid to States; it could take the form of support for programmes and projects – whether public, semi-public or run by private operators who then decide to publicly share the knowledge acquired. For example, let's consider biodiversity data. Much of it can't be observed by satellite alone; it has to be observed *in situ*. However, most of the data is in the hands of private stakeholders working in the blue economy. Therefore, partnerships need to be established, because the more we know about biodiversity through scientific and technical data, the better equipped States will be to see how to manage their activities effectively. For example, they need to know where to establish MPAs, how to adjust their geographical areas, and potentially how to relocate them in response to the movements of certain species, climate change, etc.
So there's a great deal that can be done, in various ways, to help support this Agreement, and I find hope in that. There's also still a lot of work ahead...

How can such vast areas be monitored and controlled? This is already proving difficult with marine protected areas, but here we're talking about the High Seas.

There is a mechanism in place but, as always, it depends on the willingness of States. With vast areas, there are generally several States involved – they monitor the areas as well as each other. They all have equal legitimacy. Of course, it also depends on the resources they have available, but they are all equal in terms of their rights and their responsibilities to monitor the impact of their activities. Every State that conducts maritime activities – whether or not it is coastal, and whether it uses ships (in which case we refer to it as a flag State), drones, aircraft or satellites – has a responsibility to ensure that the activities under its control and jurisdiction comply with international law. However, there are still many cases where States are not playing by the rules and are not necessarily monitoring all their activities. If States could start, for example, by better regulating activities under their flag, that would resolve many of the problems on the High Seas.

Where States do not comply, what is the procedure?

Before a flag State that fails to regulate its fleet is brought before the International Tribunal for the Law of the Sea or an arbitral tribunal, the complaining State must first seek to resolve the matter through diplomatic means. This is the invisible side of international law: the negotiations and diplomatic pressure that can be used to ensure compliance. Then there's the case of damage caused by private operators, who are liable and responsible under domestic law. The main concern is that, in most cases and in their various capacities (coastal State, port State or flag State), States have ineffective prosecution procedures that don't act as a deterrent. When penalties are imposed, they carry little weight, particularly in terms of criminal law. As a result, some operators continue to do whatever they want.

Could the BBNJ Agreement make a difference in the case of deep sea mining?

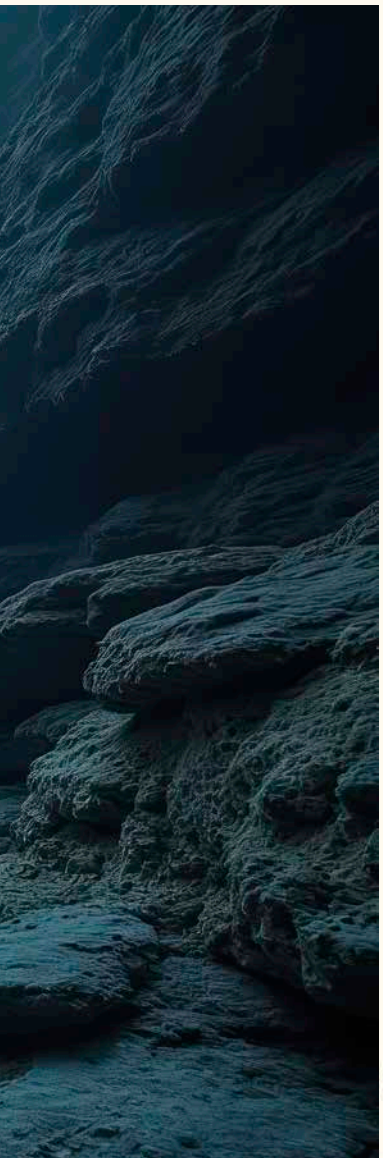
The BBNJ Agreement is definitely making an impact here. First of all, we must bear in mind that seabeds are used for more than just mineral mining; other activities carried out there include scientific research, installation of cables and pipelines, and harvesting of biological resources through fishing or bioprospecting. All these practices need to run in parallel, and the BBNJ Agreement provides a consistent, unified framework that applies to any activity that could have negative impacts on biodiversity.

Deep sea mining activities are already overseen by the International Seabed Authority (ISA), which applies existing regulations including those designed to protect the marine environment, favouring the precautionary approach. States that have ratified the BBNJ Agreement who are also members of ISA will now need to observe both sets of rules on these activities. They are also expected to "promote" the objectives of the BBNJ Agreement within ISA. This clearly illustrates the overlap between legal frameworks and roles as mentioned earlier. In fact, we can see that States were already playing along before the BBNJ came into effect. The ISA Mining Code currently under negotiation is heavily influenced by the BBNJ Agreement, particularly in terms of the knowledge and factors to be taken into account in environmental impact assessments.

In practice, the BBNJ Agreement may affect mining activities in several ways. For example, if areas harbouring high-value genetic resources (such as hydrothermal vents) are targeted for mining activities, ISA could provide even stronger protection for these resources, by giving research or conservation activities priority over exploration or mining. The BBNJ Agreement also has an indirect influence on mining activities. By building capacity and environmental knowledge, it will enable us to better understand how ecosystems work, identify risks, and strengthen precautionary measures to avoid negative impacts on biodiversity.

What provisions are included in the BBNJ Agreement in relation to the management of genetic resources?

The Secretariat for the BBNJ COP will manage a platform for exchanging information on all activities related to the collection and use of genetic resources from the High Seas. Each request to access these resources will be assigned a reference number, making it possible to track how the information is used and the various ways in which it is subsequently shared, whether in the context of marine scientific research (publications, access to samples or digital sequences) or in the private sector, for patents (pharmaceuticals, cosmetics, industrial innovation). Use of these resources will be subject to benefit sharing between the Parties to the BBNJ Agreement, using a mechanism and procedures that are yet to be defined. So it will be interesting to see how this will be set up to satisfy private operators. Bioprospecting, research and development are very expensive activities. How can this public interest in benefit sharing be aligned with the commercial interests of business?



The same issues apply to deep sea mining, should it ever be carried out on the High Seas: the benefits from mining will have to be shared with all Parties to UNCLOS. How can we ensure benefits are shared in a way that recognises the operators' initial investments, the risks they've taken and the marketable benefits from these resources? This is not yet known; it's one of the big issues to be addressed.

The BBNJ Agreement offers some very promising avenues. In what ways does it give you hope? What progress can we expect as a result?

We've entered a new era in the Law of the Sea, with many more stakeholders feeling affected by it. We're also witnessing a real generational shift, because 40 years ago not many people in NGOs, foundations or civil society were showing an interest in these issues. At the same time, the law is being implemented more fluidly. We no longer just think in terms of individual agreements or individual sectors; we've moved towards a more holistic approach. As we've seen, the BBNJ Agreement must be applied in conjunction with UNCLOS overall, as well as the two other UNCLOS agreements. The Law of the Sea must also be applied in conjunction with international trade law, investment law, human rights law and climate law. We're in a phase where we can broaden the scope for implementation and interpretation. And that gives me a lot of hope. It enables us to dust off international law and make it more dynamic and practical. However, the law is still highly complex, as is the BBNJ Agreement. We need to be very careful how we communicate about this Agreement, to avoid jeopardising cooperation and creating conflict between States that ratify it and those that don't (but that may have ratified other agreements). The purpose of the Law of the Sea is to encourage cooperation between all States, regardless of government policy – which can sometimes change very fast. To support ambitions such as those in the BBNJ Agreement, we must keep referring to the roots of law and take one step at a time.

BUILDING COASTAL RESILIENCE *IN PAKISTAN*

In 2023, the Pakistan office of the IUCN (International Union for Conservation of Nature) launched a programme to preserve the coastal ecosystems of the Indus Delta and the Balochistan coast. With support from the Prince Albert II of Monaco Foundation, it is helping to transform Pakistan's coastline by engaging with local communities and offering them new opportunities.

© Danish Rasool

Pakistan's coastline is over 1,000 kilometres long, two thirds of which is in the province of Balochistan, with the remaining third in Sindh. It has abundant mangrove forests and is home to many marine species – from fish, crabs and shrimps to sea turtles, dolphins and porpoises. The area also harbours small pockets of coral reef. However, the natural resources in these coastal ecosystems are under threat. Urban development is encroaching on the mangrove habitats, where trees are also being felled for firewood. The coastline is heavily industrialised, with around 70% of the country's industrial activity concentrated in the metropolis of Karachi. This is a major source of pollution and it is having an impact on small-scale coastal fishing – a crucial economic activity for the local population. In 2023, with support from the Prince Albert II of Monaco Foundation, IUCN Pakistan launched a programme to build coastal resilience in the country by stepping up coastal ecosystem conservation and diversifying the livelihoods of communities who are dependent on coastal resources. The programme has introduced a range of measures which are already delivering results on the ground: development of marine protected areas (MPAs), mangrove restoration, awareness campaigns and support for local action and community initiatives.

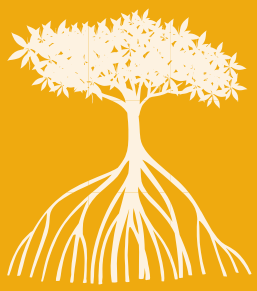
photos © IUCN Pakistan

9,000

people have attended events raising awareness of environmental issues.

7,400

Nearly 7,400 students and teachers have taken part in environmental education programmes.



6,712

hectares of degraded mangrove ecosystems along the coast of Pakistan are undergoing restoration and 5 community nurseries have been established.

IUCN (International Union for Conservation of Nature) Pakistan country office has been operating since 1985, as part of the organisation's global network established in 1948. IUCN Pakistan works at the intersection of science, policy and community engagement, bringing together government, civil society, academia and private sector stakeholders to advance nature conservation and sustainable development. Its mission aligns with IUCN's Nature 2030 Strategy, focusing on conserving biodiversity, restoring ecosystems and promoting climate resilience. Key priorities include coastal and marine conservation, mangrove restoration, establishing marine protected areas (MPAs), sustainable fisheries and livelihood diversification for vulnerable communities. Through policy advocacy, capacity building and nature-based solutions, IUCN Pakistan strives to ensure that people and nature thrive together, safeguarding ecosystems while empowering local communities for a resilient future.

INTERVIEW WITH NAVEED ALI SOOMRO

Manager, Sindh Programme, IUCN Pakistan

Why is coastal resilience a major issue in Pakistan?

Coastal resilience is a critical issue in Pakistan because its 1,050-kilometre coastline and vast Indus Delta are highly vulnerable to climate change and human pressures. Rising sea levels, coastal erosion and reduced freshwater inflows have led to the salinisation and desertification of deltaic wetlands, threatening biodiversity and livelihoods. Overexploitation of fisheries, mangrove deforestation and pollution further degrade ecosystems that buffer storms and support food security. With millions of people dependent on small-scale fisheries and mangrove resources, these stresses amplify poverty and disaster risk. Strengthening resilience means restoring ecosystems, diversifying livelihoods and establishing MPAs to safeguard biodiversity and reduce vulnerability to cyclones, flooding, and sea intrusion.
We do this by following a method called Integrated Coastal Zone Management (ICZM) that ensures that coastal ecosystems remain productive and communities thrive, while meeting national and global biodiversity and climate targets.

One of the programme's key initiatives concerns MPAs. What progress has been made in that area?

IUCN Pakistan, with support from the National Coordinating Body (NCB), has significantly advanced Pakistan's MPA agenda, filling a critical gap in national conservation strategy and aligning with the Kunming–Montreal Global Biodiversity Framework's 30x30 target. A major milestone was the approval of the Astola Island MPA Management Plan in April 2025, establishing a national model for future MPA planning and co-management. With the project created momentum on the conservation regime of the MPAs, Churna Island was designated as Pakistan's second MPA in 2024 and Miani Hor in September 2025, while six other potential sites have been prioritised for feasibility studies with Patiani and Dabbo Creeks's feasibility study completed and supporting the deliberations for its designation as MPA. To strengthen governance, the programme has launched capacity-building initiatives, including an exchange visit to Koh Mai Nai MPA in Thailand, enhancing knowledge among senior officials and accelerating progress toward a resilient MPA network.

What are the next steps to strengthen coastal governance and MPA monitoring?

Strengthening coastal governance requires inclusive, multi-level coordination and robust institutional frameworks. The National Coordinating Body (NCB) has proven effective in aligning government agencies, civil society and private sector stakeholders, but future steps must deepen co-management by empowering local communities and integrating Other Effective Area-Based Conservation Measures (OECMs). Long-term monitoring of MPAs will hinge on formalised management plans, capacity building and technology-driven solutions such as GIS mapping, ecological baselines and periodic audits. Establishing a national MPA monitoring protocol, supported by trained personnel and sustainable financing, is essential. Planned actions include developing governance standards that are aligned with the IUCN Green List of Protected and Conserved Areas, expanding partnerships and leveraging lessons from international exchanges like the visit to Koh Mai Nai MPA in Thailand to ensure adaptive management and resilience.

Regarding the restoration of mangroves, another of the programme's central actions, what practices have been put in place?

Mangrove restoration under the programme is rooted in community-led strategies and scientific planning. Sites were identified through consultations and endorsed by provincial departments, ensuring institutional support. Baseline conditions were documented and communities implemented measures such as regulated grazing plans, watch-and-ward routines and banning destructive practices like dragging seine nets on mudflats to protect natural regeneration. Assisted restoration included seed collection and dispersal in degraded areas, earthworks to improve tidal hydrology for better inundation and transplantation of nursery-raised saplings where direct sowing was ineffective.

How do you manage to involve the different stakeholders in these projects?

Stakeholder engagement is central to our approach. At government level, collaboration is ensured through the NCB, which brings together federal and provincial agencies to endorse restoration sites, approve MPA plans and align actions with national policies. For local communities, especially women, the approach focuses on participation and ownership. They are trained in mangrove nursery raising, transplantation and eco-tourism skills, with incentives such as water tanks and livelihood support to sustain engagement. Women are actively involved through income-generating training, such as seafood cooking for tourists and souvenir-making, and participating in income-saving committees, ensuring gender inclusion. This multi-tiered approach combines policy advocacy with community empowerment, creating shared responsibility for coastal conservation.

How can we ensure that community engagement continues beyond project-specific support?

Sustaining community engagement beyond project timelines requires institutionalising participatory mechanisms. For example, we support microcredit Small Grants Funding projects selected through a rigorous, transparent process under the NCB. These projects mobilise communities, create livelihoods and foster stewardship of coastal resources. They strengthen local governance, empower women and fisherfolk, and often build links to other donors, enabling the continuity and scaling of successful initiatives. This grassroots approach ensures ecological impact and long-term social resilience.

The Small Grants Funding model can evolve into a long-term community resilience fund under NCB oversight. Embedding co-management and Community-Based Ecological Mangrove

"We combine policy advocacy with community empowerment, creating shared responsibility for coastal conservation."

"Continuous environmental education and media outreach are effective ways of nurturing a conservation ethic in younger generations."

Restoration (CBEMR) practices into provincial coastal policies can ensure legal continuity. Building leadership and entrepreneurship skills, especially for women and youth, alongside eco-tourism, blue economy ventures and eco-labelling can create lasting economic incentives. Continuous environmental education and media outreach are effective ways of nurturing a conservation ethic in younger generations. These measures transition communities from project beneficiaries to institutionally recognised stewards of coastal ecosystems.

What are the main difficulties encountered?

At governance level, the main difficulties stem from fragmented coordination among agencies and limited technical capacity for MPA management, which slow progress. Ecologically, severe degradation of mangroves, reduced freshwater inflows and tidal restrictions require costly interventions. Social challenges include poverty, dependence on unsustainable fishing and resistance to changing traditional practices, such as banning destructive nets. Engaging communities, especially women, demands continuous trust-building, incentives and training. Additionally, climate-induced risks like cyclones and sea-level rise amplify restoration costs and uncertainty. Despite these hurdles, strong partnerships, capacity building and community-led approaches are helping overcome barriers and sustain momentum.

How do you envision the evolution of the Pakistan's coastal ecosystem in 10 years?

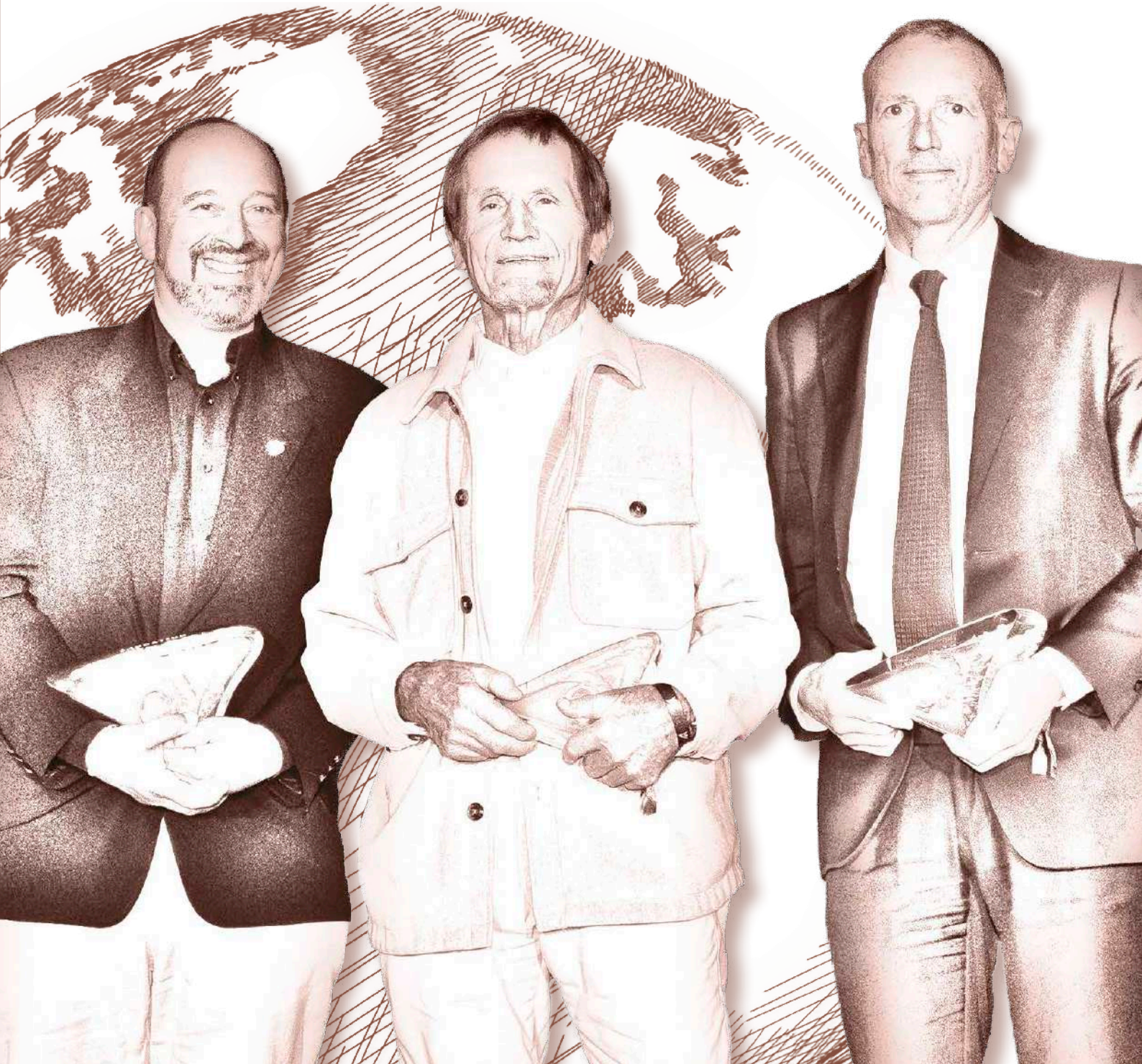
I envision a resilient, nature-positive coastline, where restored mangrove belts and a connected MPA network safeguard biodiversity, weaken cyclones, reduce sea intrusion and underpin diverse, dignified livelihoods for fisher households, especially women and youth. I aspire that by 2035 to 2045, Pakistan meets and sustains 30x30 through well-managed MPAs and OECMs that are embedded in law, co-managed with communities and aligned with IUCN's Nature 2030 agenda of recognise–retain–restore–resource–reconnect. We will scale CBEMR to the whole Indus Delta and all lagoons along the entire coast, restore hydrology and regenerate blue-carbon ecosystems that buffer rising seas and support eco-tourism and sustainable fisheries. I long for a long-term national monitoring system, standardised protocols, GIS/RS, community rangers and periodic audits, to track ecological and social outcomes and guide adaptive management in line with IPCC risk guidance for low-lying coasts. This is a future where people and nature thrive together.

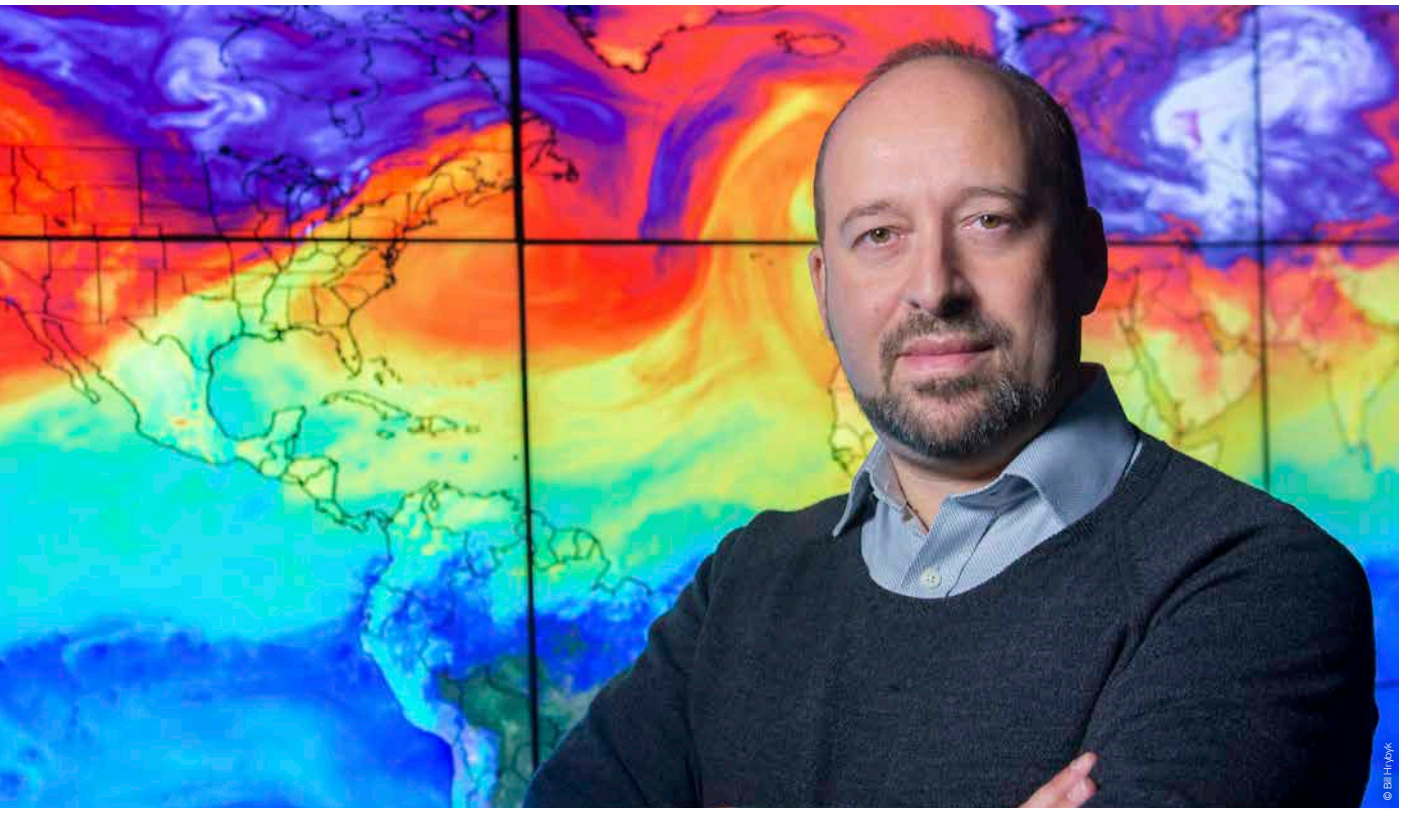
"These measures transition communities from project beneficiaries to institutionally recognised stewards of coastal ecosystems."

THREE VISIONARIES IN THE SPOTLIGHT

GAVIN SCHMIDT - ERNST GÖTSCH - EMMANUEL FABER

Since 2008, the Prince Albert II of Monaco Foundation Planetary Health Awards have celebrated leading individuals and organisations for their outstanding commitment to preserving our planet, in three key areas: awareness, science and innovation. The three 2025 winners were honoured at the 18th Award Ceremony in London on 17 October.





INTERVIEW WITH DR GAVIN SCHMIDT

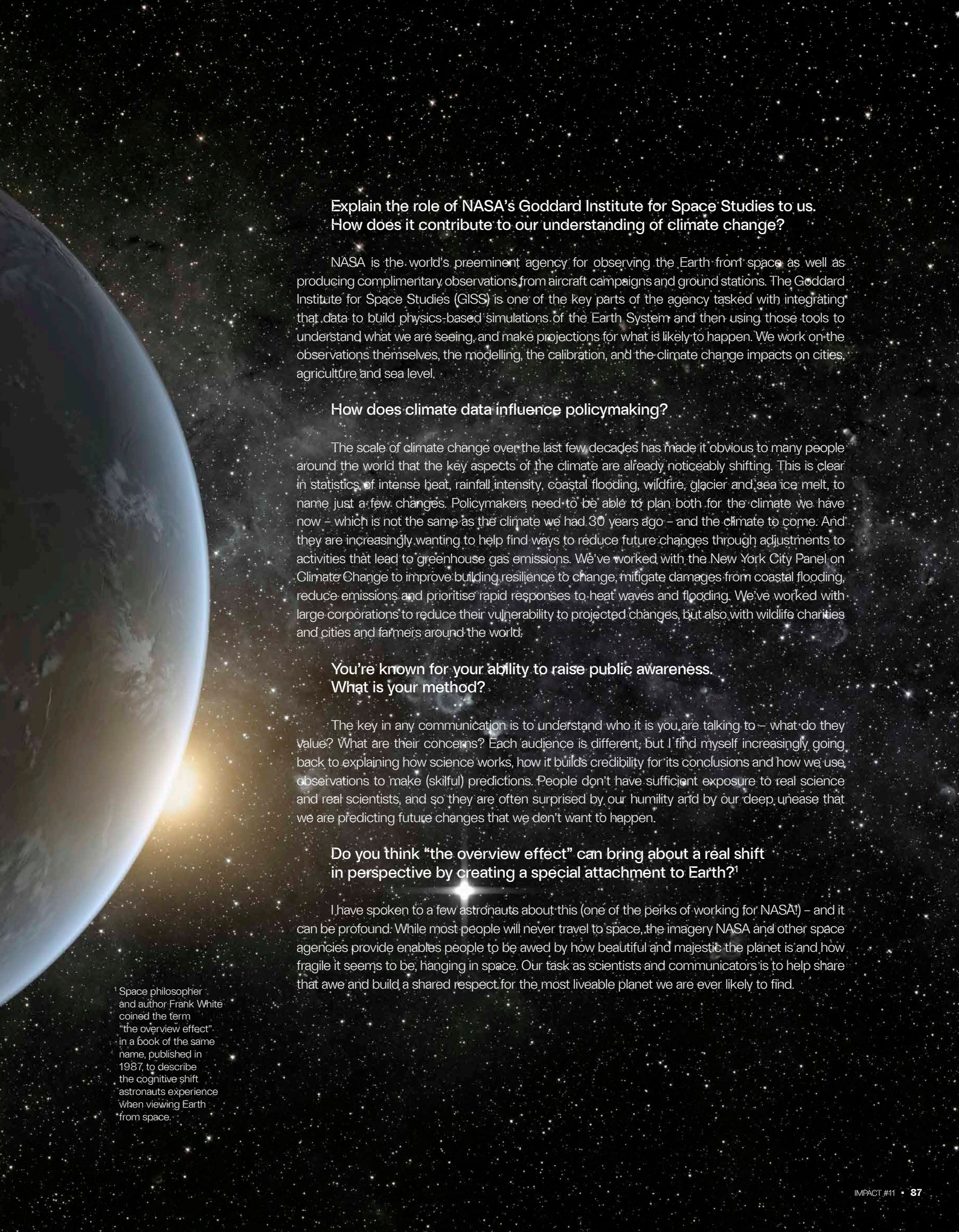
Dr Gavin Schmidt is a British climatologist and Director of NASA's Goddard Institute for Space Studies (GISS) in New York. He received the 2025 Planetary Health Award in the Science category for his pioneering work in climate modelling and his commitment to making science accessible.

Dr Schmidt trained as a mathematician, has authored over 170 scientific articles and has developed tools that have become essential in understanding Earth's climate trajectory. He is committed to helping younger generations through his role as a mentor to climatology students at Columbia University. He co-founded the RealClimate blog and has written widely published papers that have made climate science accessible to policymakers and the general public worldwide.

"Moving from climate knowledge to climate action has to be on the basis of shared values."

© NASA Earth Observatory/ Lauren Dauphin

"Our task is to help share that awe and build a shared respect for the planet."



Explain the role of NASA's Goddard Institute for Space Studies to us. How does it contribute to our understanding of climate change?

NASA is the world's preeminent agency for observing the Earth from space as well as producing complimentary observations from aircraft campaigns and ground stations. The Goddard Institute for Space Studies (GISS) is one of the key parts of the agency tasked with integrating that data to build physics-based simulations of the Earth System and then using those tools to understand what we are seeing, and make projections for what is likely to happen. We work on the observations themselves, the modelling, the calibration, and the climate change impacts on cities, agriculture and sea level.

How does climate data influence policymaking?

The scale of climate change over the last few decades has made it obvious to many people around the world that the key aspects of the climate are already noticeably shifting. This is clear in statistics of intense heat, rainfall intensity, coastal flooding, wildfire, glacier and sea ice melt, to name just a few changes. Policymakers need to be able to plan both for the climate we have now – which is not the same as the climate we had 30 years ago – and the climate to come. And they are increasingly wanting to help find ways to reduce future changes through adjustments to activities that lead to greenhouse gas emissions. We've worked with the New York City Panel on Climate Change to improve building resilience to change, mitigate damages from coastal flooding, reduce emissions and prioritise rapid responses to heat waves and flooding. We've worked with large corporations to reduce their vulnerability to projected changes, but also with wildlife charities and cities and farmers around the world.

You're known for your ability to raise public awareness. What is your method?

The key in any communication is to understand who it is you are talking to – what do they value? What are their concerns? Each audience is different, but I find myself increasingly going back to explaining how science works, how it builds credibility for its conclusions and how we use observations to make (skilful) predictions. People don't have sufficient exposure to real science and real scientists, and so they are often surprised by our humility and by our deep unease that we are predicting future changes that we don't want to happen.

Do you think "the overview effect" can bring about a real shift in perspective by creating a special attachment to Earth?[1]

I have spoken to a few astronauts about this (one of the perks of working for NASA!) – and it can be profound. While most people will never travel to space, the imagery NASA and other space agencies provide enables people to be awed by how beautiful and majestic the planet is and how fragile it seems to be, hanging in space. Our task as scientists and communicators is to help share that awe and build a shared respect for the most liveable planet we are ever likely to find.

[1] Space philosopher and author Frank White coined the term "the overview effect" in a book of the same name, published in 1987, to describe the cognitive shift astronauts experience when viewing Earth from space.

INTERVIEW WITH ERNST GÖTSCH

Swiss agronomist Ernst Götsch received the 2025 Planetary Health Award in the Innovation & Solutions category for his groundbreaking vision of nature-friendly, sustainable agriculture.

Götsch developed the concept of "syntropic agriculture", a regenerative approach based on natural forest processes. After moving to Brazil in the 1980s, he successfully transformed degraded land into thriving ecosystems, proving that farming could restore biodiversity, regenerate soils and produce abundant harvests without the use of chemicals. Many farmers around the world are now drawing inspiration from his approach, from cocoa plantations in Bahia to projects developed in Latin America, Africa and Europe.

Why did you choose to leave conventional agriculture?

In the early 1970s I worked in plant improvement, engineering and selecting for genotypes that were tolerant or resistant to certain so-called "pests" and diseases. But I took the decision to leave conventional agriculture because I began doubting the meaning of my work.

I loved my profession and was fascinated by what we were able to attain. But there was one important detail: once our wonderful achievements left our laboratories and were exposed to the real world, they began to fade. We believed we had managed to outsmart nature, but very quickly, nature taught us a lesson by sending new, often more powerful, agents.

So I asked myself, if we focused instead on improving the growing conditions we give our plants, could we create a more productive alternative?

Through numerous trials and systematic experiments, involving reviving and replicating some of the interesting strategies developed and used by many of our earlier farmers, as well as discovering and understanding nature's own approach, which I applied to my daily agricultural practice, I developed a form of farming based on natural processes. In this approach, the most significant external input we need to achieve vigorous, healthy and high-yielding cultivated species is knowledge: an understanding of the eco-physiological functions of all the organisms involved, including ourselves.

When we successfully follow nature's patterns in our agricultural practice, the soils become more mineral-rich, water retention improves and there is an overall improvement in energetic balance.

How can working with nature's intelligence become a catalyst for restoring ecosystems?

Nature follows patterns and employs strategies. If we were to do the same and adopt them in all our day-to-day activities, our environment would radically change.
Recognising and accepting that we are only an integral part of a macro-organism and an intelligent system, and not the "intelligent species" or the "commander-in-chief", we should try to interact in a way that makes our participation in all the different aspects of that system serve and be beneficial to all living things that are subjected to, and impacted by, our actions.
If we worked to obtain the resources from the plant, animal and mineral kingdoms that we need to meet the needs of our metabolism in the way described above, we would transform our planet into an all-embracing, abundant paradise full of flourishing life. With people as its wise mediator!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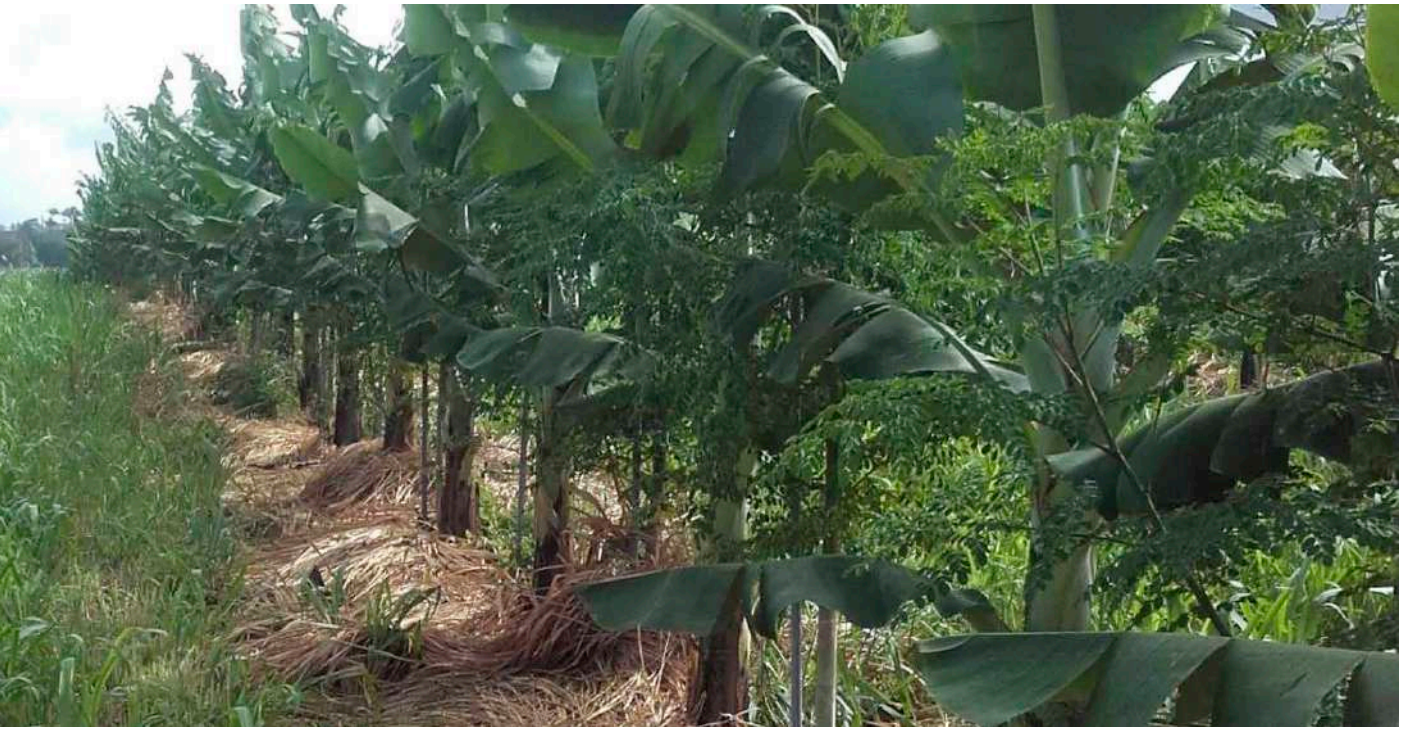
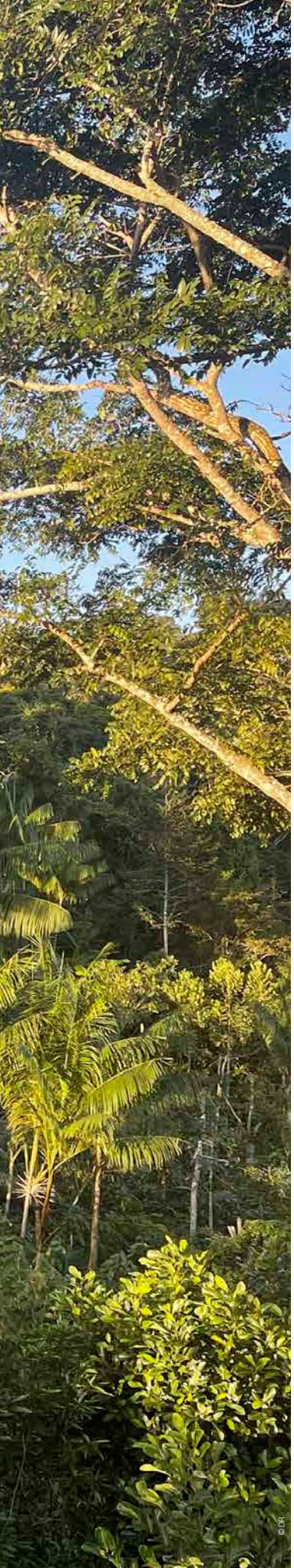
If you had to choose one example of the positive impact of your approach, what would it be?

In 1995, El Ceibo – a cooperative of around 800 smallholder farmers in La Paz Department in Bolivia – and their technical advisor, Joachim Milz, a German scientist living and working there and a member of the cooperative, invited me to assess the sustainability of their agricultural practices.
After five days visiting farms and listening to and exchanging ideas with numerous members, they asked me to lead a seminar to explain my farming approach to them. The event proved to be a historic turning point in their way of practising agriculture, and the start of a friendly and fruitful collaboration between us that continues to this day.

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In the early 2000s, Milz formally established the platform ECOTOP, which has been successfully sharing its knowledge and experiences with other farmers ever since. Working initially in Latin America, they soon began to expand their activities into numerous countries in Africa and South Asia, and since then also into Europe.

What can agriculture teach us about ourselves as human beings?

The way agriculture was practiced in each era and each different place – at local, regional, transregional, continental and global level – gives a precise picture of the cultural, spiritual, social and technological development of the human communities where it took place. Roman statesman, lawyer and philosopher Cicero (106–43 BC) famously said that a society that does not value its farmers is a society doomed to failure.
The environment impacts people and people impact the environment: it is a dialectical process. Nothing escapes. Everything has a cost and consequences. Once we understand the essence of this, it should serve as an important decision-making tool at all levels – from our small home gardens to farms, and from regional and continental to global level.

How do you see syntropic agriculture evolving in the future?

Our current global cultural, social, economic and political crisis is giving rise to movements of people trying to find strategies that might help us return to harmony with our planet and be beneficial to the living world. This could be by reviving the tasks and carrying out the functions that enabled us to become the dominant animal species 200,000 years ago. Syntropic agriculture may well become a pivotal part of those strategies, opening the door to a future for humankind.

"The way agriculture was practiced in each era and each different place gives a precise picture of the cultural, spiritual, social and technological development of the human communities where it took place."

INTERVIEW WITH EMMANUEL FABER

As Chair of the International Sustainability Standards Board (ISSB), Emmanuel Faber received the 2025 Planetary Health Award in the Awareness category for ISSB's contribution to ensuring companies globally disclose information about the sustainability risks they face.

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The ISSB, which was established by the International Financial Reporting Standards (IFRS) Foundation in 2021, has developed a global framework of sustainability-based financial reporting standards. Its two standards, IFRS S1 and IFRS S2, are reshaping sustainability disclosure practices to provide investors and regulators with transparent, comparable data on climate and other sustainability-related risks. Emmanuel Faber, a French business executive and former CEO of Danone, which became a purpose-led company under his leadership, is now bringing the same vision to the ISSB, placing sustainability at the heart of the economy.

"These relationships between nature, social, human and financial capital make up both the business models and value chains of business."

What is the mission of the ISSB?

To understand the mission of the ISSB, it helps to start with the purpose of capital markets, because the ISSB exists to serve them. Capital markets play an essential role in the world's economy: they channel resources, and help maintain the healthy functioning of the global economy. For this system to work effectively, financial markets rely on a common language: information about risk and return. The ISSB was created in response to global policymaker and investor demand to help companies meet those evolving information needs. We operate in an era marked by volatility – globally interdependent supply chains and long-term risks that extend far beyond the parameters of a company itself and into its operating environment. Investors are looking to understand whether a business can thrive in a world that may face emerging climate, nature and human-related risks and opportunities.
Our mission is to establish a decision-useful, global language for sustainability-related financial disclosures: a language that is cost effective for companies to apply and capable of providing investors with the clarity they need to price and allocate capital efficiently.

How can establishing common standards lay the foundations for global change?

With a set of common standards, investors are likely to direct capital towards companies better prepared to manage long-term risks. A redirection of just 1% of global capital – which represents approximately 500 trillion dollars in listed equities and debt – towards companies prepared to manage long-term risks could amount to approximately 5 trillion dollars annually, which aligns closely with estimates for the investment required to support the transition towards a sustainable and resilient economy that many are saying we need for capital markets to operate effectively.
The adoption of ISSB Standards is already gaining global traction. Nearly 40 jurisdictions, representing almost 60% of global GDP, are now adopting or using the ISSB Standards. Jurisdictions are recognising the benefits of connecting disclosure requirements to global capital pools.This harmonisation improves capital allocation and market confidence.

What are the main challenges?

Over the coming years, our priority is to help stakeholders use the Standards effectively, ensuring that disclosures are decision-useful and enable better capital allocation. The ISSB is working with partners around the world to support jurisdictions, investors, companies, auditors and regulators in using the Standards effectively.
At the same time, jurisdictions need to take ownership by expanding adoption, ensuring the consistency of the global baseline which will enable investors to compare company performance and prospects across borders.

Inclusion, equity and connection to nature are essential concepts for rethinking our relationship with the world and the environment today. How can we contribute to changing the narratives surrounding the story of human progress, particularly in the entrepreneurial field?

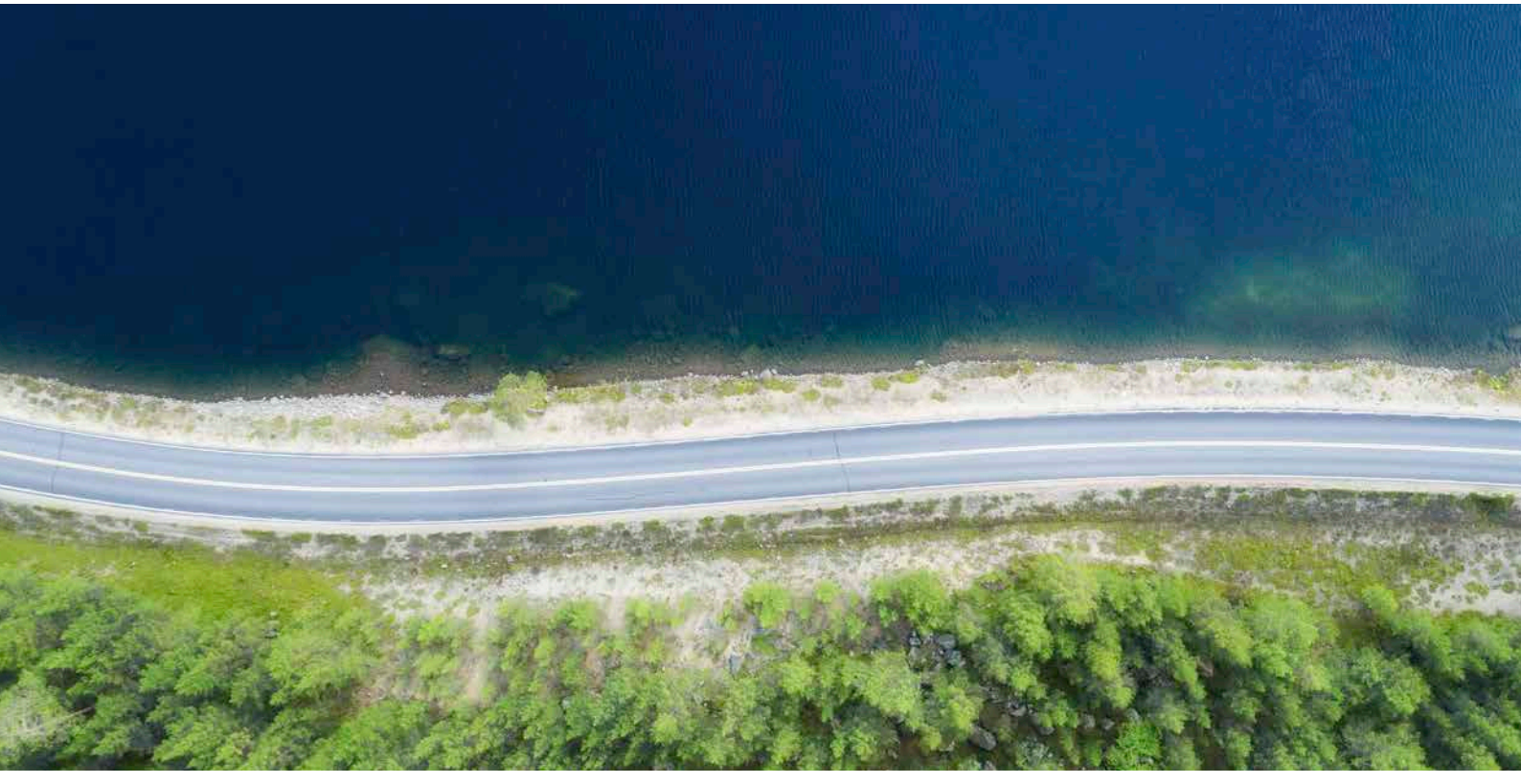
The value of a company is inextricably linked to the resources and relationships it relies on – the people its employs, the society it operates in and the natural environment it draws on to deliver its activities. These relationships between nature, social, human and financial capital make up both the business models and value chains of business.

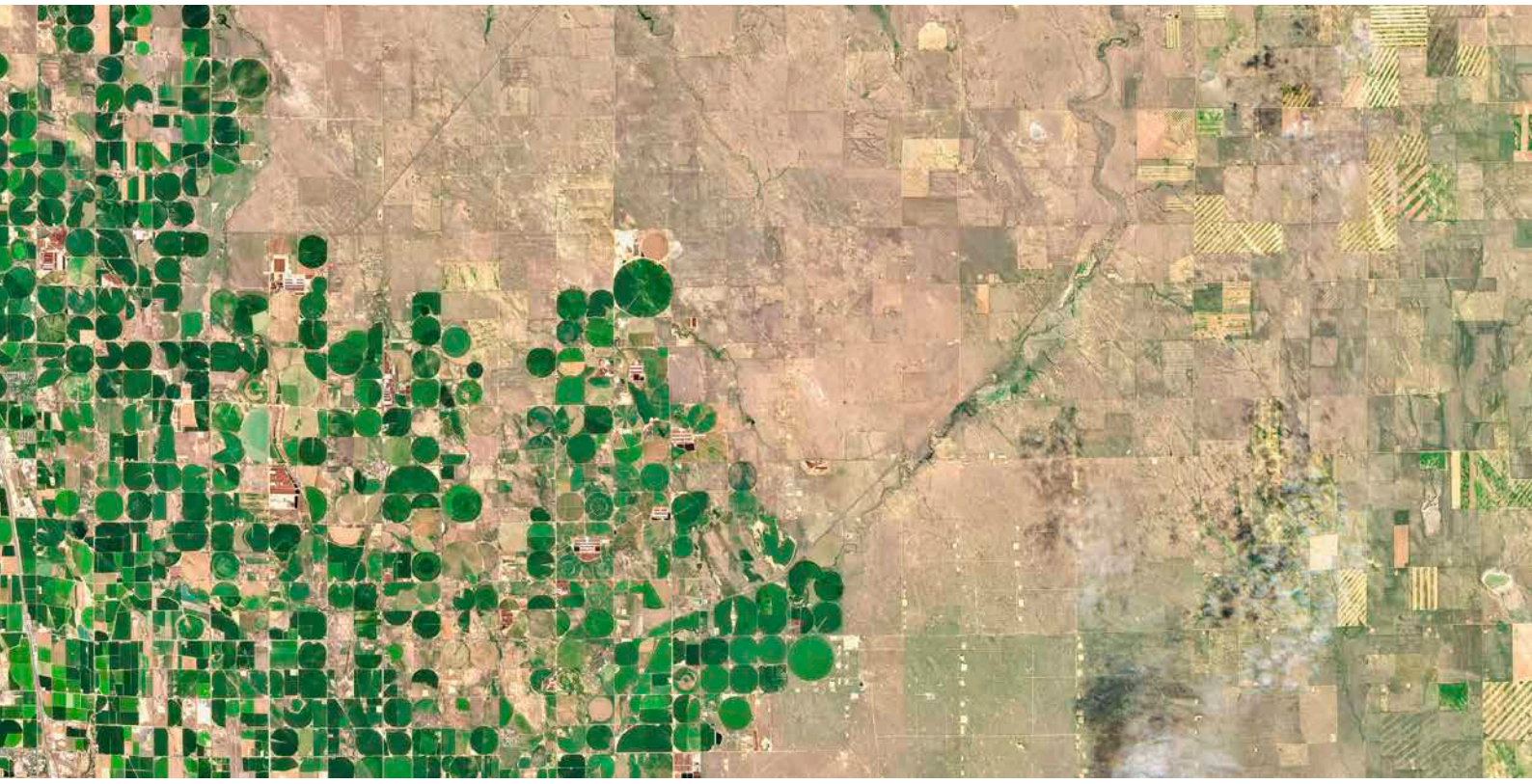
That is why ISSB Standards help companies to communicate how they create, preserve or erode the resources and relationships they depend on to achieve their goals.

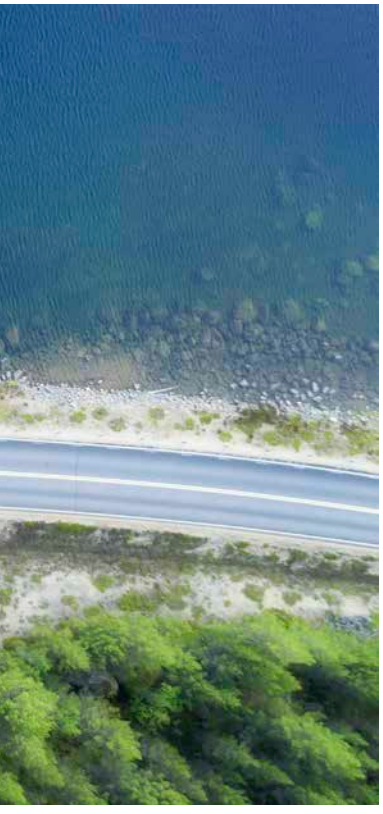
As market participants increasingly recognise these connections to financial outcomes, the narrative shifts.

We can take the example of something we never pay for, but is irreplaceable: pollination by bees. In some areas of the world, bee pollination is decreasing fast and we do not have a replacement or a solution. I saw that as a CEO of one of the largest almond crop purchasers in California. It is a risk for food companies and it is something companies need to think about, and something investors want to know a company is thinking about.

By translating all this into a common language, the ISSB Standards enable companies to communicate their strategy and their risk management, and it enables investors to allocate capital accordingly. As our access to nature changes, how companies think, plan and report will need to keep pace.







As an environmentally-committed leader, how would you describe the entrepreneur of tomorrow?

The entrepreneur of the future needs to work at the frontier rather than the centre. They must be ready to handle frictions, push themselves beyond their comfort zone and continuously learn from others, because the pace of unpredictability and change, in both space (value chains) and time horizons, has not been as fast as it is now for at least half a century.

The adoption momentum of the ISSB Standards reminds me how much can be achieved through collaboration, and by enabling flexibility to account for local realities while staying true to shared principles.

Leadership is not static; true impact comes from movement – exploring new areas, testing ideas and co-creating with diverse perspectives. At the same time, leaders must uphold their belief under pressure, making decisions without losing sight of their deep convictions.

For me, the entrepreneur of tomorrow is someone who is curious, resilient, and rooted in their principles – capable of adapting to change, seizing the opportunities of a changing world, and making a lasting effect by turning vision into sustainable action.

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