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Summary of the Scientific Symposium: From Arctic to Antarctic 24–25 February 2022

“The polar regions give us our last chance for a sustainable future; if we fail there, we will fail elsewhere.” Similar quotes during the Scientific Symposium: From Arctic to Antarctic denote the significance of the frozen world for the global climate and human socioeconomic development. All people on Earth depend directly or indirectly on the Ocean and cryosphere. Environmental changes in the Arctic and the Antarctic are accelerating, affecting local species and ecosystems, and impacting the broader climate and ecological systems far beyond the polar regions.

In line with these realities, the symposium convened, contributing to the UN Decade of Ocean Science for Sustainable Development “by bringing the poles and, thus, the world together.”

The symposium was structured around four main themes:

- understanding changes in the poles, including changes in the Arctic and Southern Oceans chemistry, as well as in ice regimes, permafrost, glaciers, and biodiversity;
- the contribution of polar changes to the global climate, focusing on how changes in the poles are amplifying global climate changes, including ice melting driving sea level rise, and links between polar changes and extreme weather events around the planet;
- effects of polar changes on global human societies and economies, including assessing and mitigating risks for dependent communities; and
- management responses in the face of uncertainties.

The symposium resulted in numerous significant messages regarding the polar regions, related to:

- the fact that polar changes have a significant global impact, leaving no region unaffected, accompanied by the reality that polar regions are part of human history and culture, containing many secrets still to be discovered.
- the need for additional international collaboration, including joint scientific missions in the polar regions, to provide the necessary scientific data for policy decisions and for monitoring transformations;
- the need for collaboration in the science-industry-society nexus, including contributions from Indigenous Peoples;
- the imperative to focus on science communication, informing the public and enabling decision making based on the best available science;



HSH Prince Albert II of Monaco | Photo Credit: Michel Dagnino, Musée Océanographique

- challenges generated by scientific uncertainty, including the need to potentially take decisions with incomplete information;
- risks associated with polar changes linked to social and economic developments in the polar regions and beyond;
- the key role of polar and marine protected areas (MPAs) regarding reducing pressures on polar life from economic exploitation, pollution, noise, and other stressors; and

In This Issue

Scientific Symposium: From Arctic to Antarctic Report	. 2
Introductory High-level Session 2
Understanding Polar Changes 3
Contributions of Polar Changes to Global Climate	... 4
Effects of Polar Changes upon Global Human Societies and Economies 5
Management Responses in the Face of Uncertainties	.. 6
Closing Session 7
Upcoming Meetings 8
Glossary 8

- the optimistic message that the point of no return can still be averted, by urgently deviating from business as usual and jointly addressing the environmental existential crisis.

The meeting included:

- a keynote address by HSH Prince Albert II of Monaco, who cautioned against “selfish interests and short-sighted economic calculations,” and reaffirmed his foundation’s continuous efforts to support scientific endeavors in the ocean and the poles, and his personal commitment to carry the voice of scientific knowledge to policy leaders;
- an interview with Frederik Paulsen, Owner and Chairman, Ferring Pharmaceuticals, who shared insights and stories from his successful environmental initiatives and travelling adventures,
- four in-depth panel discussions on the meeting’s main themes, accompanied by contributions by early career researchers; and
- the official signing of the Polar’s Initiative Memorandum of Understanding by partners.

The symposium is part of the Polar Initiative, a four-year programme that builds on previous work on polar regions by the Prince Albert II of Monaco Foundation and its partners. The Polar Initiative aims to: produce science-based evidence and knowledge; drive campaigns to weigh in on impactful policy changes; build capacities through fellowships via the Scientific Committee on Antarctic Research (SCAR) and the International Arctic Science Committee (IASC); and deliver conservation actions through the Prince Albert II of Monaco Foundation’s calls for projects.

The meeting took place from 24-25 February 2022 at the Oceanographic Museum in Monaco, under the theme “The Cold Is Getting Hot,” attracting 35 speakers and 150 participants, including leading and early career scientists, and key partners. It was convened by the Prince Albert II of Monaco Foundation, SCAR, and IASC, in collaboration with the Oceanographic Institute, Prince Albert I of Monaco Foundation, the International Cryosphere Climate Initiative (ICCI), and the UN Decade for Ocean Science for Sustainable Development.

Scientific Symposium: From Arctic to Antarctic Report

Introductory High-level Session

On Thursday, the symposium opened with an audio experience of the haunting effects of collapsing ice glaciers and breaking icebergs in the South Pole, by filmmaker Luc Jacquet.

Master of ceremonies Genie Godula introduced the event’s organizers, noting the symposium is endorsed as an action of the UN Decade of Ocean Science for Sustainable Development. She stressed that during the two-day event, leading scientists will showcase how changes in polar regions affect the global climate and how quickly.

Remarks from Convening Partners: Robert Calcagno, Director General, Oceanographic Institute, Prince Albert I of Monaco Foundation, welcomed all participants, underscoring the importance of exchanging scientific data and elaborating upon rational evidence to shape relevant environmental policies. He commended cross-institutional collaboration, underscoring current and future joint projects.

Olivier Wenden, CEO and Vice President, Prince Albert II of Monaco Foundation, highlighted that the symposium is the first

scientific symposium to simultaneously address challenges in the Arctic and Antarctic, underscoring Monaco’s long-standing efforts in this regard. He emphasized that polar regions suffer from a lack of awareness, consideration, and protection, stressing the importance of interdisciplinary approaches and platforms. He provided an overview of the four axes of work of the Polar Initiative, namely: the development of science-based evidence and knowledge; campaigns for impactful policy changes; capacity building; and conservation actions.

Larry Hinzman, President, IASC, stressed the need for joint efforts among scientists, policymakers, and international foundations to address imminent challenges. He noted “while scientists have a message and common understanding, they do not necessarily have a voice,” urging both the scientific community and decision makers to overcome communication obstacles and address urgent societal needs.

Jefferson Cardia Simões, Vice-President, SCAR, noted changes in the polar regions are felt worldwide. He highlighted the unique opportunity the symposium offers to discuss and find innovative ways to work together. He emphasized that “the polar regions give us the last chance for a sustainable future; if we fail there, we will fail elsewhere.” He urged spreading related scientific knowledge to the public.

Keynote Speech: In his keynote address, HSH Prince Albert II of Monaco noted the symposium focuses on both the Arctic and Antarctic, stressing the need for a holistic analysis, addressing and understanding the challenges, and working towards identifying the best solutions. He highlighted the importance of polar regions for the planet as a whole and reflected on the policy environment, cautioning against “selfish interests and short-sighted economic calculations.” He concluded underscoring the importance of scientific expertise and data to convince decision makers to adopt the necessary policies, address the challenges in polar regions, and move towards a sustainable future.

Inspiration and Setting the Scene: This segment began with the screening of a short film on Venturi Antarctica, the first electric polar exploration vehicle. It explains that, after 12 years of work, the first zero-emission transport solution for scientific missions in Antarctica is fully operational at the Princess Elisabeth Antarctica Station.

Antje Boetius, Director, Alfred Wegener Institute, offered an overview of the Earth’s cryosphere, focusing on sea-ice extent and global warming. She underscored that the frozen



L-R: **Olivier Wenden**, CEO and Vice President, Prince Albert II of Monaco Foundation; **Larry Hinzman**, IASC; **HSH Prince Albert II of Monaco**; **Jefferson Cardia Simões**, Vice-President, SCAR; and **Robert Calcagno**, Director General, Oceanographic Institute, Prince Albert I of Monaco Foundation | Photo Credit: JC Vinaj

world is home to a vibrant, living ecosystem, threatened by global warming, especially the Arctic, which is warming two to three times faster than the rest of the world. Boetius further highlighted: coastline erosion; social considerations regarding four million people living in the Arctic; uncertainty regarding predictions and simulations; and the importance of international collaboration, including the [Terrestrial Multidisciplinary distributed Observatories for the Study of Arctic Connections \(T-MOSAIC\)](#) under IASC.

Jane Francis, Director, British Antarctic Survey, focused on the Antarctic, noting the situation is quite different compared to the Arctic, though moving along similar patterns. She warned that “if all the ice on the Antarctic melted, global sea levels would rise by 50 meters.” Specifying that satellite data shows ice is thinning fastest around the West Antarctic Ice Sheet, she emphasized the [International Thwaites Glacier Collaboration](#) is critical for polar science. Francis provided examples of projects, including drilling for ice sheet history and enabling the understanding of historical patterns and how ice and climate interact. She further highlighted the importance of the Southern Ocean, drawing attention to stressors, including ocean acidification, which threaten unique and largely unknown ecosystems.

Blaine Mirasty, early career scientist, University of Saskatchewan and the Arctic University of Norway, Nehiyaw (Cree) tribe, via video address, focused on activities by Arctic communities at the local level and during different seasons. He addressed recent changes in climate and extreme weather events, affecting human communities like his, animal behavior, and migration cycles. Mirasty called for ecosystem-based management and policies, incorporating Indigenous worldviews and promoting sustainable innovations.

Olivier Poivre d'Arvor, French Ambassador for the Poles and Maritime Issues, reflected on the outcomes of the One Ocean Summit that recently concluded in Brest, France. He underscored the need for international commitments and global cooperation, highlighting the current turbulent political environment. He congratulated the Polar Initiative, noting “it reminds us of the strong messages the poles send, while voiceless.” He drew attention to environmental and geopolitical challenges in the Arctic, and increasing competition in the Antarctic, calling for joint efforts to create MPAs and fight against global warming in both poles.

A live connection with the [Tara Ocean Foundation](#) scientific schooner, on its way back from an expedition in Antarctica, informed participants on its research on surrounding ecosystems, offering insights on the key role of nutrients and addressing international collaboration with other missions.

Partners of the Polar Initiative officially signed a Memorandum of Understanding (MoU) in the presence of HSH Prince Albert II of Monaco. The MoU provides a framework of cooperation among partnering organizations of the Polar Initiative across the project's four axes of work and defines corresponding terms and conditions.

Understanding Polar Changes

On Thursday, this panel discussion focused on the rapid and unprecedented altering of geophysical and living features of the polar regions. Speakers addressed changes in: Arctic and Southern Oceans' chemistry, temperature, and carbon pump function; ice regimes, permafrost, and glaciers; and terrestrial and

ocean species, food webs, and ecosystems in the polar regions. Panelists further discussed the resulting social impacts.

The session was moderated by Antje Boetius, Director, Alfred Wegener Institute. In his introductory remarks, Jan-Gunnar Winther, Director, Norwegian Centre for the Ocean and the Arctic, and the Arctic University of Norway, provided an overview of the overarching scientific and policy trends, underscoring that “polar regions are the world's thermometer.” He highlighted that the Intergovernmental Panel on Climate Change (IPCC) Working Group I report, which assesses the physical science of climate change, is “a code red for humanity.” He stressed changes in the polar regions further affect issues of jurisdiction, shipping, security, tourism, mineral extraction, energy, and fisheries. He urged avoiding past mistakes and holistically addressing climate change, the biodiversity crisis, and the equality crisis.

Julie Brigham-Grette, Glaciologist and Professor of Geosciences, University of Massachusetts-Amherst, US, focused on ice sheet records, highlighting evidence of warm periods where the ice sheet could not have survived. She urged drawing lessons from the past on ice sheet vulnerability, stressing that “every tenth of degree of temperature increase matters” in an interconnected planetary system.

Gabriela Schaeppman-Strub, Associate Professor of Earth System Sciences, University of Zurich, Switzerland, focused on energy cycles and permafrost, noting that warming can cause permafrost to thaw more extensively and faster. She said decomposed organic matter in thawed permafrost releases carbon dioxide (CO₂) and methane in a vicious cycle that needs to be urgently addressed.

Bruce Forbes, Research Professor in Global Change at the Arctic Centre, University of Lapland, Finland, focused on adaptive capacity, stressing it facilitates resilience in the face of multiple challenges. He discussed the slow evolution of the institutional framework in Alaska to incorporate local communities' views on adaptive pathways. He called for meaningful dialogue, and inclusive and respectful participatory processes. He warned that if the focus is “on economic



Panel on understanding polar changes (L-R): **Jan-Gunnar Winther**, Arctic University, Norway; **Antje Boetius**, Director, Alfred Wegener Institute; **Julie Brigham-Grette**, University of Massachusetts-Amherst, US; **Gabriela Schaeppman-Strub**, University of Zurich, Switzerland; **Bruce Forbes**, University of Lapland, Finland; and **Rob de Conto**, University of Massachusetts-Amherst, US | Photo Credit: JC Vinaj



Participants during the first day of the Scientific Symposium
Photo Credit: JC Vinaj

productivity rather than environmental sustainability, humanity will fail to adapt.”

Rob DeConto, Climate Scientist and Glaciologist, University of Massachusetts-Amherst, US, highlighted the importance of geological records, offering a long-term observational period to analyze ecosystem changes. He emphasized that loss of ice is the dominant driver of increased CO₂ and we should expect sea levels to rise by approximately 30-35 cm by 2050. He added that increasing uncertainty surrounds predictions beyond 2050. He called for increased mitigation efforts, cautioning that “when the process starts, the ice sheet will not recover and humanity may have to wait for the next ice age for the ice to come back.”

Early career scientists Gwenaëlle Gremion, Université du Québec à Rimouski, and Association of Polar Early Career Scientists (APECS), and Cristina Genovese, Université Libre de Bruxelles, presented their story of how they got engaged in polar research, offered their insights on science communication and the role of early career researchers, and engaged in an interactive discussion with panelists. The discussion focused on: obstacles for communicating scientific findings to non-scientific audiences; opportunities and challenges regarding the training of young professionals; the level of ambition required to successfully address polar changes; and dealing with anxiety feelings among the research community, due to awareness regarding imminent threats.

Contributions of Polar Changes to Global Climate

On Thursday, this session opened with a short video, by OceanX and BBC Earth, on deep-sea research and the formidable living deep-sea ecosystems in the Antarctic.

The session focused on how changes in the poles are amplifying global climate changes, and how global warming has led to shrinking of the cryosphere, creating multiple challenges and straining ecosystem and societal resilience. Participants deliberated on how: polar ice melt drives global sea level rise; polar changes are linked to extreme weather events worldwide; and interconnectivity in the Ocean brings about altered oceanic circulation of temperature, carbon, and nutrients.

Session moderator Pam Pearson, Director, ICCI, underscored ICCI’s role in bringing science to policymakers, including on impacts from changes in the polar regions on the whole planet.

Eric Rignot, Chancellor Professor of Earth System Science, University of California, Irvine, and Senior Research Scientist,

NASA Radar Science and Engineering Section, provided introductory remarks, stressing that the Arctic is warming at three times the global average. He noted ice loss in the Arctic is unprecedented over the last 1,500 years, cautioning that sea levels could rise exponentially with time. He further emphasized ice sheet collapse in the Antarctic, underscoring that some sectors present the fastest ice retreat in the planet, reaching 1-3 kilometers per year. He concluded with the optimistic message that tackling the challenges is possible with current technology, requiring, however, international cooperation and allocation of the necessary resources.

Markus Rex, MOSAiC Expedition Leader and Senior Researcher, Alfred Wegener Institute, focused on the Arctic, describing dramatic changes over the past few decades. He underscored that reducing carbon emissions can save the Arctic as “we have not crossed the tipping point yet,” calling for international, multidisciplinary research activities.

Julienne Stroeve, Professor of Polar Observation and Modelling, University College London, focused on remote sensing of snow and ice, and implications of a seasonally ice-free Arctic Ocean on the global climate. She underscored the role of CO₂ emissions on the loss of Arctic sea ice and analyzed how much CO₂ can still be added before ice-free summers emerge in the region. She concluded, drawing attention to ocean circulation patterns, noting that “everything is interconnected; what happens in the Arctic is not going to stay there.”

Michael Meredith, Oceanographer and Science Leader, British Antarctic Survey, stressed three key messages referring to the IPCC Special Report on the Ocean and Cryosphere in a Changing Climate: the polar regions are changing rapidly and we still do not know what all the changes mean; the changes in polar regions affect the whole planet; and in the imminent future, the polar regions will look different. He emphasized the degree of change in the polar regions depends on human activities, underscoring the responsibility that accompanies that causal relationship. He concluded presenting a world map the way fish would have drawn it, highlighting the ocean basins’ interconnectivity, creating one planetary Ocean. The map further visualized ocean currents circling around the Antarctic continent like a roundabout.



Panel on polar changes’ contributions to global climate (L-R): **Eric Rignot**, University of California, Irvine, and Senior Research Scientist, NASA Radar Science and Engineering Section; **Pam Pearson**, Director, ICCI; **Markus Rex**, Alfred Wegener Institute and MOSAiC Expedition Leader; **Julienne Stroeve**, University College London, UK; **Michael Meredith**, British Antarctic Survey; and **Gustaf Hugelius**, Stockholm University, Sweden. | Photo Credit: JC Vinaj

Gustaf Hugelius, Co-director, Bolin Centre of Climate Research at Stockholm University, underscored that global warming thaws permafrost faster and more extensively. Decomposed organic matter in thawed permafrost releases CO₂ and methane, rendering the polar regions essentially a sleeping giant. He emphasized that abrupt thaw adds to projected emissions, providing examples of cumulative emissions from IPCC projections when adding the additional emissions from abrupt thaw under different global warming scenarios, which draws a very different and more dramatic picture.

Early career scientists Casimir de Lavergne, LOCEAN Laboratory, Sorbonne University, and Susana Hancock, APECS, shared their personal experiences and insights from their involvement with polar science. In an interactive discussion with panelists, they addressed, *inter alia*: whether the trends in Antarctica are understood well enough by the scientific community and how they can be communicated to the public in a comprehensible way; if and how the increased public interest influences scientific research; and whether additional focus should be given to climate forcers other than CO₂.

Moderator Pearson concluded the session, stressing that while current actions and ambition are insufficient to put emissions on a path to net zero, it is still possible, as the necessary environmental, technological, economic, social, institutional, and geophysical changes are feasible.

Effects of Polar Changes upon Global Human Societies and Economies

This session opened on Friday with a short film from the Tara Ocean Foundation on the spectacular beauty of the frozen world.

The session addressed the notion and extent of risks, and related threats and opportunities for the polar regions and the rest of the world. Panelists focused on assessing and mitigating risks, and the necessary international governance steps to take regarding fisheries, extractive resources, shipping, or tourism.

Moderator Gail Whiteman, Professor of Sustainability, University of Exeter Business School, UK, introduced the event, focusing on how socioeconomic changes in the Arctic and Antarctic affect the whole planet.

Setting the stage, Gim Huay Neo, Director, Centre for Nature and Climate, World Economic Forum (WEF), stressed that “by bringing the two poles together, the whole world comes together.” She underscored the need to think as an interconnected entity, including through the work of polar scientists and the voices of communities. She focused on the WEF’s work, particularly on: raising awareness on the interconnectedness of issues; providing safe, neutral, and trusted spaces for co-creation of solutions between science and business; and translating insights into ambition and concrete action.

Klaus Dodds, Professor of Geopolitics, Royal Holloway University of London, emphasized that, during the last 20 years, interests have been diversified in the polar regions, making them increasingly complex. He underscored the need to address the role of larger states in their polar interventions, and study the implications, especially on Indigenous Peoples in the Arctic. He



L-R: **Gim Huay Neo**, Director, Centre for Climate and Nature, World Economic Forum; **Gunn-Britt Retter**, Head of the Arctic and Environment Unit, Saami Council; **Karin Buhmann**, Head of the Centre for Law, Sustainability & Justice, University of Southern Denmark; **Yousra Makanse**, PhD Candidate, Wageningen University, Association of Polar Early Career Scientists (APECS); and **Gail Whiteman**, Professor of Sustainability, University of Exeter Business School | Photo Credit: JC Vinaj

further noted the Antarctic is a region where sovereignty is not settled, creating issues of territorial claims and sovereign rights.

Gunn-Britt Retter, Head of the Arctic and Environment Unit, Saami Council, addressed changes in the Arctic, focusing on shifting of species’ distribution in the fjords and peaks of invasive alien species. She underscored that Indigenous knowledge holds many adaptation solutions, highlighting the need to ensure communities have the necessary resilience and flexibility to adapt to changes, and cautioning against solutions to climate problems that disproportionately affect Indigenous Peoples.

Karin Buhmann, Head of the Centre for Law, Sustainability & Justice, University of Southern Denmark, and Professor in Business and Human Rights, Copenhagen Business School, focused on the Arctic Academy for Sustainability, an initiative recently launched by the University of the Arctic (UArctic) [Thematic Network on Arctic Sustainable Resources and Social Responsibility \(ASRSR\)](#), funded by the Prince Albert II of Monaco Foundation. Providing an overview of the initiative, Buhmann said the Arctic faces specific challenges due to its sparse population, fragile environmental conditions, and abundant resources. She addressed tensions between the urgent need for energy transition and harmful impacts on local communities, warning about a potential loss of legitimacy of low-carbon energy projects if the tensions are not addressed.

Dmitry Yumashev, Consultant, Small World Consulting and UN Institute for Training and Research, via video, focused on the economic impacts of the changing Arctic for the rest of the world. He cautioned that climate change effects outweigh the estimated economic benefits associated with Arctic resources. He further addressed distribution of both risks and potential benefits, stressing that benefits may not be felt in the Arctic region itself.

Yousra Makanse, PhD Candidate, Wageningen University, APECS, focused on the tourism industry in the Antarctic. She underscored the increasing diversification of tourism-related

activities, including luxury camps next to the South Pole or the possibility of running a marathon. Estimating a 20% increase in visitors leading to a total annual number of 73,000 tourists, she lamented there are “98 times more visitors on tourist activities than scientific ones.” Makanse concluded discussing the impacts of tourism and the need for a concrete regulatory framework to regulate negative impacts.

Early career scientists Harmony Wayner, University Centre of the Westfjords, APECS, and Jillian Galloway, Fulbright Fellow, Iceland, shared their story of what guided them towards the polar sciences. They focused on the significance of Indigenous Peoples’ worldviews and knowledge, and sustainable aquaculture respectively. They further engaged in an interactive discussion with the panelists and audience, discussing, among others: ways to incorporate Indigenous perspectives; how to communicate science given the divide in educational curricula between sciences and humanities; economic costs related to biodiversity loss as described in assessments of the Intergovernmental Panel on Biodiversity and Ecosystem Services; quantitative risk management; and noise pollution.

Management Responses in the Face of Uncertainties

On Friday, this session began with a short film, by Conservation International, titled “Liam Neeson is Ice.”

The session focused on management responses and actions in the face of uncertainties, addressing existing ecological, financial, institutional, and governance constraints. Panelists focused on multiple stressors, including pollution, and addressed protection, restoration, and precautionary ecosystem-based management of renewable resource use to shelter the invaluable services provided by polar ecosystems.

The session was moderated by Thomas Reilly, Head of UK Public Policy, Covington, who invited panelists to discuss how to manage competing interests, coming up with solutions that address socioeconomic trade-offs.

Jane Francis, British Antarctic Survey, set the stage, discussing climate uncertainty and variability, and related tipping points. She provided an overview of polar governance, addressing: the Arctic Council, including the international moratorium on fishing

in the high seas of the Central Arctic Ocean for a minimum of 16 years to allow for scientific research; and the Antarctic Treaty System, including the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR). Francis further called for robust scientific data on the impacts of tourism on the environment; addressed the Ice Memory Foundation that aims to manage ice cores with their yielded information for decades and centuries to come; and discussed the discovery of species living beneath Antarctic ice shelves, portraying how little we know about these ecosystems.

Elizabeth McLanahan, Director, International Affairs and Senior Advisor, National Oceanic and Atmospheric Administration, US, addressed management options for the Arctic. She noted the region is very different than the Antarctic from a management perspective, drawing attention to the Arctic Council’s activities on the management of operations, environmental protection, and sustainable development. She highlighted the Arctic Council’s structure and mode of operations, stressing it only excludes military security, and discussed the production of scientific assessments and policy recommendations. McLanahan further addressed the broader international high-seas governance, highlighting the negotiations for a legally binding instrument for biodiversity in areas beyond national jurisdiction (BBNJ) and other relevant conventions.

Susie Grant, Marine Biogeographer, British Antarctic Survey and Chief Officer, SCAR Standing Committee on the Antarctic Treaty System, focused on the Southern Ocean as a critical component of the planetary system. She highlighted work by CCAMLR to manage fisheries in a sustainable way and set up MPAs, following an ecosystem approach as well as efforts to protect exposed marine areas following ice shelf retreat or collapse. She underscored the need for: precautionary responses; science communication; and flexibility in management options, considering uncertainties.

Jerome Chappellaz, Director, L’Institut polaire français Paul-Émile-Victor (IPEV), and Chair, Ice Memory Foundation, said “the Antarctic is not the problem, but the solution.” He described ice cores from glaciers as a natural library, providing key insights for scientific advances with information for decades and centuries to come. He emphasized that science evolves, thus safeguarding this information is essential as it may bring about new ideas and solutions in the future.

Lars Kullerud, President, UArctic, provided an overview of UArctic, a cooperative network of universities, colleges, research institutes, and other organizations. He noted the Arctic is home to numerous communities that managed the region for a long time, stressing that “together” is the key word for relevant research efforts. He highlighted the need for long-term thinking, additional resources, and science diplomacy.

Thorsten Markus, Program Manager, Cryospheric Sciences Program, National Aeronautics and Space Administration (NASA), US, emphasized the need for precision in our measurements to better understand polar changes, pointing to satellite data, which is public and available. He highlighted NASA’s science portfolio, which enables future predictions, including on ice sheets. Markus further underscored science communication and environmental education to catalyze change.



Representatives of the convening partners, panel moderators, early career scientists, and the symposium organizing team | Photo Credit: JC Vinaj



Frederik Paulsen, Owner and Chairman, Ferring Pharmaceuticals
Photo Credit: JC Vinaj

Early career scientists Prem Gill, Scott Polar Research Institute, University of Cambridge, and WWF, and Helen Millman, ICCI, stressed the need to open polar research to less privileged individuals, including minorities, and discussed challenges related to communicating scientific results to decision makers. They further engaged in a dialogue with the panelists and audience, addressing, *inter alia*: science communication and relevant platforms; managing tensions among competing interests; challenges on regulating commercial fisheries in the Arctic Ocean; modalities of MPAs; and whether management responses keep up with the changes taking place in the face of uncertainty.

Closing Session

Fireside Chat: Frederik Paulsen, Ferring Pharmaceuticals, shared insights and stories from his successful environmental initiatives and travelling adventures, in an interview with Master of Ceremonies Genie Godula. He highlighted success stories, including the South Georgia Heritage Trust, which aims to protect the environment of the sub-Antarctic Island of South Georgia, and the successful eradication of invasive rats. Paulsen stressed the need to provide the necessary resources for environmental projects, noting an increasing willingness among individuals, foundations, and corporations to get involved. He further underscored the importance of a proper regulatory framework.

Feedback from Session Moderators: Antje Boetius, Alfred Wegener Institute, emphasized the urgency of understanding and addressing polar changes, noting “we may be the first generation to see an ice-free summer in the Arctic, with severe consequences.”

Gustaf Hugelius, Co-director, Bolin Centre of Climate Research at Stockholm University, on behalf of Pam Pearson, Director, ICCI, stressed that challenges are interconnected, noting that loss of sea ice makes permafrost loss much quicker, driving ocean acidification.

Gail Whiteman, Professor of Sustainability, University of Exeter Business School, UK, stressed the role of scientific and Indigenous knowledge; called for innovations regarding

information flows to better convey risks and solutions; and underscored the role of the WEF and of early career scientists.

Thomas Reilly, Covington, focused on: managing tensions for a just energy transition; addressing unknowns, including making decisions without full information; developing a proper narrative; fostering environmental campaigns; and catalyzing action. All moderators stressed the need to work collaboratively to address the environmental existential crisis and give future generations a chance.

Next Steps: Larry Hinzman, IASC, offered concluding thoughts on the way forward, stressing the need for:

- a holistic approach, taking into account socioeconomic considerations;
- data, observations, and forecasting capabilities for effective decision making;
- multidisciplinary approaches to answer complex questions;
- investing in science while still in a position to address threats; and
- urgently changing business-as-usual models, taking into account intergenerational concerns.

In the ensuing discussion, participants suggested: increasing joint monitoring and research; fostering international collaboration and cooperative field campaigns; speeding up the production of scientific knowledge; supporting bottom-up approaches with Indigenous Peoples at the forefront; co-producing knowledge, including joint development of research questions; addressing and regulating the cruise tourism sector; and fundamentally changing the funding mechanism, including providing local solutions.

Closing Remarks: Representatives of the convening partners offered closing remarks. Jefferson Cardia Simões, SCAR, noted “we need more than ever to listen to the social and human sciences,” coming up with the right set of questions and targets, and developing a robust communication framework.

Robert Calcagno, Prince Albert I of Monaco Foundation, reflected on moving forward with the Polar Initiative, focusing on next steps.

Larry Hinzman, IASC, highlighted the symposium’s success, noting “we are in the right place with the right people to move forward.”



Larry Hinzman, President, IASC | Photo Credit: JC Vinaj



Olivier Wenden, CEO and Vice President, Prince Albert II of Monaco Foundation | Photo Credit: JC Vinaj

Olivier Wenden, Prince Albert II of Monaco Foundation, closed the symposium, thanking all participants for their commitment and highlighting plans to further foster multidisciplinary cooperation.

Upcoming Meetings

Fourth Session of the BBNJ Intergovernmental Conference: BBNJ-4 will elaborate the text of an international legally binding instrument, under the UN Convention on the Law of Sea, on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction, with a view to developing the instrument as soon as possible. **date:** 7-18 March 2022 **location:** New York, US **www:** un.org/bbnj

Geneva Biodiversity Conference: The resumed sessions of the Convention on Biological Diversity (CBD) Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA-24), Subsidiary Body on Implementation (SBI-3) and the third meeting of the Open-ended Working Group on the post-2020 global biodiversity framework (GBF) were scheduled to reconvene face-to-face in January 2022 but have been postponed to a later date due to the emergence of the omicron variant. The meetings will address, as a core topic, outstanding issues regarding the GBF. **date:** 14-29 March 2022 **location:** Geneva, Switzerland **www:** cbd.int/conferences/geneva-2022

Ninth World Water Forum: This will be the first meeting of its kind in sub-Saharan Africa. The event will focus on the theme, “Water Security for Peace and Development,” and consider four priorities: water security and sanitation; cooperation; rural development; and means tools. **date:** 22-27 March 2022 **location:** Dakar, Senegal **www:** worldwatercouncil.org/en/dakar-2022

Arctic Science Summit Week 2022: The Arctic Science Summit Week is organized annually by IASC to provide opportunities for coordination, cooperation, and collaboration

between the various scientific organizations involved in Arctic research. **date:** 26 March – 1 April 2022 **location:** Tromsø, Norway **www:** assw.info

2022 Arctic Frontiers: Pathways: The 2022 theme of Arctic Frontiers, Pathways, reflects on the choices the Arctic is facing when addressing pressing global challenges. **date:** 8-11 May 2022 **location:** Tromsø, Norway **www:** arcticfrontiers.com/welcome-to-arctic-frontiers-2022-pathways/

44th Antarctic Treaty Consultative Meeting: Matters on the agenda include topical questions relating to Antarctica and further developments on the coldest continent on our planet. **date:** 23 May – 2 June 2022 **location:** Berlin, Germany **www:** atcm44-berlin.de/en/0_atcm-xliv-english/

UN Ocean Conference: The “2022 UN Conference to Support the Implementation of Sustainable Development Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development” will seek to propel much needed science-based innovative solutions aimed at starting a new chapter of global ocean action. **date:** 27 June – 1 July 2022 **location:** Lisbon, Portugal **www:** un.org/en/conferences/ocean2022

International Symposium on Ice, Snow, and Water in a Warming World: The Icelandic Meteorological Office together with international partners is hosting a symposium highlighting rapid changes occurring in all components of the cryosphere: glaciers, ice sheets, snow cover, sea ice, permafrost, lake ice, and river ice. **date:** 21–26 August 2022 **location:** Reykjavík, Iceland **www:** cryosphere2022.is

Year of Polar Prediction Final Summit: The Year of Polar Prediction Final Summit aims to bring the polar prediction community of operational centers, academia, environment services and polar prediction users and northern communities together, to showcase the successes of the Year of Polar Prediction and contribute to the legacy of the Polar Prediction Project. **date:** 29 August – 1 September 2022 **location:** Montreal, Canada **www:** yoppfinalsummit.com

For additional upcoming events, see sdg.iisd.org/

Glossary

APECS	Association of Polar Early Career Scientists
CCAMLR	Convention on the Conservation of Antarctic Marine Living Resources
IASC	International Arctic Science Committee
ICCI	International Cryosphere Climate Initiative
IPCC	Intergovernmental Panel on Climate Change
MPAs	Marine Protected Areas
SCAR	Scientific Committee on Antarctic Research
UArctic	University of the Arctic