

Informed Decisionmaking for Sustainability

Paul Arthur Berkman
Alexander N. Vylegzhanin
Oran R. Young · David Balton
Ole Øvretveit *Editors*



Building Common Interests in the Arctic Ocean with Global Inclusion

Volume 2



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Informed Decisionmaking for Sustainability

Series Editors

Paul Arthur Berkman

Science Diplomacy Center, EvREsearch LTD, Falmouth, MA, USA

Science Diplomacy Center, MGIMO University, Moscow, Russian Federation

United Nations Institute for Training and Research (UNITAR), Geneva, Switzerland
and

Program on Negotiation, Harvard Law School, Cambridge, MA, USA

Alexander N. Vylegzhanin

International Law School, MGIMO University, Moscow, Russian Federation

Oran R. Young

Bren School of Environmental Science and Management, University of California,
Santa Barbara, CA, USA

This Springer book series – Informed Decisionmaking for Sustainability – offers a roadmap for humankind to address issues, impacts and resources within, across and beyond the boundaries of nations. Informed decisions operate across a ‘continuum of urgencies,’ extending from security time scales (mitigating risks of political, economic or cultural instabilities that are immediate) to sustainability time scales (balancing economic prosperity, societal well-being and environmental protection across generations) for nations, peoples and our world. Moreover, informed decisions involve governance mechanisms (laws, agreements and policies as well as regulatory strategies, including insurance, at diverse jurisdictional levels) and built infrastructure (fixed, mobile and other assets, including communication, research, observing, information and other systems that entail technology plus investment), which further require close coupling to achieve progress with sustainability. International, interdisciplinary and inclusive (holistic) engagement in this book series involves decisionmakers and thought leaders from government, business, academia and society at large to reveal lessons about common-interest building that promote cooperation and prevent conflict. The three initial volumes utilize the high north as a case study, recognizing that we are entering a globally significant period of trillion-dollar investment in the new Arctic Ocean. Additional case studies are welcome and will be included in the book series subsequently. Throughout, to be holistic, science is characterized as ‘the study of change’ to include natural sciences, social sciences and Indigenous knowledge, all of which reveal trends, patterns and processes (albeit with different methods) that become the bases for decisions. The goal of this book series is to apply, train and refine science diplomacy as an holistic process, involving informed decisionmaking to balance national interests and common interests for the benefit of all on Earth across generations.

More information about this series at <https://link.springer.com/bookseries/16420>

Paul Arthur Berkman
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Paul Arthur Berkman
Science Diplomacy Center
EvREsearch LTD
Falmouth, MA, USA

Science Diplomacy Center
MGIMO University
Moscow, Russian Federation

United Nations Institute for Training
and Research (UNITAR)
Geneva, Switzerland

Program on Negotiation
Harvard Law School
Cambridge, MA, USA

Oran R. Young
Bren School of Environmental Science
& Management
University of California Santa Barbara
Santa Barbara, CA, USA

Alexander N. Vylegzhanin
International Law School
MGIMO University
Moscow, Russian Federation

David A. Balton
Polar Institute
Wilson Center and U.S. Arctic Steering
Committee
Washington, DC, USA

Ole Rasmus Øvretveit
Initiative West Bergen
Bergen, Norway

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Cover illustration: Holistic (international, interdisciplinary and inclusive) integration is represented in this figure with the eight Arctic states and six Indigenous Peoples' Organizations in the Arctic Council; biogeophysical features of the Arctic Ocean represented by the 2012 sea-ice minimum; and boundary of the Central Arctic Ocean High Seas established under the international framework of the law of the sea to which all Arctic states and Indigenous Peoples' Organizations "remain committed." Details of this cover illustration are elaborated in the first figure in Chapter 1.

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Preface

This preface complements Chapter 1 (“Introduction: Building Common Interests with Informed Decisionmaking for Sustainability”) for this book, *BUILDING COMMON INTERESTS IN THE ARCTIC OCEAN WITH GLOBAL INCLUSION*. The purpose of the preface is to provide background on the process to assemble as well as navigate this second edited volume in the Informed Decisionmaking for Sustainability book series published by Springer. Assembly of this volume also reinforces the international, interdisciplinary and inclusive (holistic) spirit envisioned in the book title, highlighting next-generation capacities with both early career and seasoned practitioners from diverse backgrounds to achieve progress with sustainable development (Figure).

The first three volumes in the book series represent a trilogy with the Arctic Ocean as a common feature, framed by the *Arctic Options* and *Pan-Arctic Options* projects to address “*Holistic Integration for Arctic-Coastal Marine Sustainability*” (Berkman et al. 2020):

VOLUME 1 – *GOVERNING ARCTIC SEAS: REGIONAL LESSONS FROM THE BERING STRAIT AND BARENTS SEA*

VOLUME 2 – *BUILDING COMMON INTERESTS IN THE ARCTIC OCEAN WITH GLOBAL INCLUSION*

VOLUME 3 – *PAN-ARCTIC IMPLEMENTATION OF COUPLED GOVERNANCE AND INFRASTRUCTURE*

The *Arctic Options* and *Pan-Arctic Options* projects also supported production of the *BASELINE OF RUSSIAN ARCTIC LAWS* (Berkman et al. 2019), as a complementary contribution to the book series, recognizing Russia’s governance history in the Arctic since the early nineteenth century with sovereignty across much of the Arctic today.

The first volume in this book series and the *BASELINE OF RUSSIAN ARCTIC LAWS* were coordinated through the Science Diplomacy Center (with P.A. Berkman as Founding Director) in the Fletcher School of Law and Diplomacy at Tufts University. In 2018, on behalf of the book series editors (Paul Arthur Berkman, Alexander N. Vylegzhanin and Oran R. Young), the Science Diplomacy Center also signed a Memorandum of Understanding (MoU) with Arctic Frontiers (with Ole Øvretveit as Director) to co-produce the second and third volumes in the book series (Arctic Frontiers 2020a). The Science Diplomacy Center is now part of EvREsearch LTD,

which is coordinating production of this second volume with continued funding through the National Science Foundation for the *Pan-Arctic Options* project. The editorial team of this second volume includes these four individuals with the important addition of Ambassador David A. Balton, who had been a key contributor to the binding Arctic agreements that have emerged since 2009.

The MoU enabled the first volume in the book series (Young et al. 2020) to be launched at Arctic Frontiers in Tromsø in January 2020 and simultaneously to initiate this second volume, synchronizing potential chapter contributions just before global lockdowns due to the COVID-19 pandemic. The theme of that annual meeting was Knowledge to Action (Arctic Frontier 2020b), complementing the integration of research and action to produce informed decisions, which are the focus of this book series (please see Chap. 1).

Moreover, research and action underlie the general format of Arctic Frontiers 2020, which paralleled the “science” and “plenary” sessions, respectively:

- **Research:** Science sessions with open abstract submissions that are reviewed by committees who determine their acceptability for oral or poster presentations.
- **Action:** Plenary sessions with invited experts and high-level decisionmakers from governments as well as industry with international and interdisciplinary inclusion.

As identified in the Table of Contents, this book includes “research” (6000 to 10,000 words with figures, tables and references) and “action” (750 to 1200 words without figures, tables and references from written interventions or presentation transcripts) contributions from the Arctic Frontiers 2020 sessions. These written contributions also reflect general characteristics of presentations with the research and action communities, underlying different skills and methods involved to be helpful with their target audiences.

With Arctic Frontiers 2020, the option was introduced for submitted science session abstracts to be considered for inclusion in this second volume, which involved an additional review process with the editorial team. If the abstracts were acceptable by both the Arctic Frontiers and editorial teams, the authors from the science sessions were invited to submit draft chapters for further consideration. Among the 60 abstracts that were received for consideration as part of this book, just over 30 were invited as possible chapters, including contributions across the professional spectrum from graduate students to renown experts.

However, to ensure rigor and quality control, contributions from the early-career scientists involved additional interactions with the editorial team. Each young scientist iterated their contributions with a designated member of the editorial team, who was responsible to ensure possible chapter contributions were review-ready before soliciting input from anonymous reviewers. Each research chapter in this book was anonymously reviewed by at least two experts and revised accordingly before acceptance by the full editorial team.

Action chapters were invited from all of the plenary speakers to capture decisionmaking snapshots and emphases at the moment of the Arctic Frontiers 2020 conference. Recognizing that plenary speakers commonly read their statements, often

carefully vetted by their institutions, the written interventions or transcripts from the plenary presentations are included in this book by self-selection of the authors without review or revision. The action chapters are grouped with reference to their respective sessions.

The research and action chapters in this volume together represent an holistic approach, as reflected by the interdisciplinary contributions from nearly 20 nations, ranging from a high-school student to foreign ministers along with graduate students, postdoctoral scholars, professors, organizational leaders, Indigenous peoples, subnational-national-international officials and community representatives. During the course of this book’s production, there were two virtual author-editor meetings to further integrate the research chapters in view of informed decisionmaking (Berkman et al. 2017; Berkman et al. 2020; Berkman 2020a,b). The editorial team also had bi-monthly meetings to produce a book that has touch points for diverse readers who are interested to contribute with informed decisions that operate short-to-long term. The goal of this second volume in the INFORMED DECISIONMAKING FOR SUSTAINABILITY book series is to be helpful with Arctic sustainability in a local-global context with common-interest building as an inclusive process that is responsive to ever-changing circumstances with hope and inspiration across generations.



FIGURE: UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS (United Nations 2015) with international, interdisciplinary and inclusive relevance at local-global levels, balancing environmental protection, economic prosperity and societal well-being for the benefit of all on Earth across generations.

Falmouth, MA, USA
 Santa Barbara, CA, USA
 Moscow, Russian Federation
 Washington, DC, USA
 Tromsø, Norway

Paul Arthur Berkman
 Oran R. Young
 Alexander N. Vylegzhanin
 David A. Balton
 Ole Rasmus Øvretveit

Editors' Addendum We are living through an important moment in human history, which relates to the aspirations of this book. The COVID-19 pandemic erupted just after work began on this book at the Arctic Frontiers 2020 Conference, with devastating consequences worldwide. Now, just as this book is being published after being completed, events in Ukraine have created new peril that has the potential to cascade into world war, something we all have responsibilities to prevent forever after the twentieth century. Circumstances in Ukraine have already created significant instability in international relations, including for the Arctic region, jeopardizing dialogue, cooperation and progress among the eight Arctic states, six Indigenous Peoples' Organizations and international community of observers participating in the Arctic Council. This book and its journey to production reveal common interest building as a necessary complement to conflict resolution, utilizing science diplomacy as a "language of hope" to operate across a "continuum of urgencies" short to long term with direct application to current circumstances. It is our hope that the theory, methods and skills of informed decision-making – reflected with lessons throughout this book – will help to balance national interests and common interests for the benefit of all on Earth across generations.

References

- Arctic Frontiers. (2020a). *Arctic frontiers 2020. Annual report: The power of knowledge*. Tromsø, Norway. <https://www.arcticfrontiers.com/conference/2020-the-power-of-knowledge/>
- Arctic Frontiers. (2020b). *Arctic frontiers 2020. Conference summary. The power of knowledge*. Tromsø, Norway. <https://www.arcticfrontiers.com/wp-content/uploads/2020/10/plenaryreport2020.pdf>
- Berkman, P. A. (2020a). Science diplomacy and its engine of informed decisionmaking: Operating through our global pandemic with humanity. *The Hague Journal of Diplomacy*, 15, 435–450. https://brill.com/view/journals/hjd/15/3/article-p435_13.xml
- Berkman, P. A. (2020b). 'The pandemic lens': Focusing across time scales for local-global sustainability. *Patterns*, 1(8), 13 November 2020. 4p. <https://pubmed.ncbi.nlm.nih.gov/33294877/>
- Berkman, P. A., Kullerud, L., Pope, A., Vylegzhanin, A. N., & Young, O. R. (2017). The Arctic science agreement propels science diplomacy. *Science*, 358, 596–598. <https://science.sciencemag.org/content/358/6363/596>
- Berkman, P. A., Vylegzhanin, A. N., & Young, O. R. (2019). *BASELINE OF RUSSIAN ARCTIC LAWS*. Springer. <https://www.springer.com/gp/book/9783030062613>
- Berkman, P. A., Young, O. R., & Vylegzhanin, A. N. (2020). Preface for the book series on informed decisionmaking for sustainability. In: Young, O. R., Berkman, P. A., & Vylegzhanin

(Eds.) VOLUME 1: GOVERNING ARCTIC SEAS: REGIONAL LESSONS FROM THE BERING STRAIT AND BARENTS SEA. Springer. <https://link.springer.com/content/pdf/bfm%3A978-3-030-25674-6%2F1.pdf>

United Nations. (2015). *Transforming Our World: The 2030 Agenda for Sustainable Development*. Res. A/RES/70/1 (25 September 2015). United Nations General Assembly, New York. <https://sustainabledevelopment.un.org/post2015/transformingourworld/publication>

Young, O. R., Berkman, P. A., & Vylegzhanin, A. N. (Eds.). (2020). INFORMED DECISIONMAKING FOR SUSTAINABILITY. VOLUME 1. GOVERNING ARCTIC SEAS: REGIONAL LESSONS FROM THE BERING STRAIT AND BARENTS SEA. Springer. <https://link.springer.com/book/10.1007/978-3-030-25674-6>

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This is the second volume in a trilogy with the Arctic as a global case study to balance national interests and common interests for the benefit of all on Earth across generations. On this journey, we are grateful to the residents of the Arctic, especially the Indigenous peoples, who have demonstrated resilience over millennia with lessons for humanity into the twenty-second century and beyond in the face of accelerating global changes.

This volume was initiated as part of the *Arctic Options* and *Pan-Arctic Options* projects (2013–2021), both addressing “*Holistic Integration for Arctic Coastal-Marine Sustainability*” with funding from the United States National Science Foundation (NSF-OPP 1263819 NSF-ICER 1660449 NSF-OPP 1719540 and NSF-ICER 2103490). The holistic (international, interdisciplinary and inclusive) characteristics of these intertwined projects were represented from the start with co-funding from the Centre national de la recherche scientifique (CNRS) and collaboration with the Université Pierre-et-Marie-Curie in France, considering options (without advocacy) with colleagues from the University of California Santa Barbara (UCSB) and the University of Alaska Fairbanks (UAF) in the United States.

Elements of the *Arctic Options/Pan-Arctic Options* projects are elaborated in the book series preface for INFORMED DECISIONMAKING FOR SUSTAINABILITY published in *VOLUME I. GOVERNING ARCTIC SEAS: REGIONAL LESSONS FROM THE BERING STRAIT AND BARENTS SEA* (2020). The options for Arctic sustainability further included colleagues from the Russian Federation, acknowledging MGIMO University, which enabled the first formal dialogue between the North Atlantic Treaty Organization (NATO) and Russia as part of a NATO Advanced Research Workshop project through the University of Cambridge in 2010, memorialized in the Springer book on

ENVIRONMENTAL SECURITY IN THE ARCTIC OCEAN (2012). We thank Springer for their continuing support of science diplomacy, as reflected also by the *BASELINE OF RUSSIAN ARCTIC LAWS* (2019), which accompanies this book series.

Accelerating from the 2009 *Antarctic Treaty Summit*,¹ science diplomacy has been the framework to address options with *Arctic Options/Pan-Arctic Options* projects, expanding with inclusion through the Belmont Forum. We thank the Agence Nationale de la Recherche (ANR) for additional funding in France along with new collaborations involving national funding agencies in Canada, China, Norway and Russia. In particular, we acknowledge the strong and ongoing financial support from the Research Council of Norway (RCN), representing durable and longstanding alignment with the NSF funding. We also acknowledge coordination with the Social Sciences and Humanities Research Council of Canada (SSHRC), National Science Foundation of China (NSFC) and the Russian Foundation for Basic Research (RFBR).

Moving from UCSB, the *Arctic Options/Pan-Arctic Options* projects were coordinated from 2015 to 2020 through the Fletcher School of Law and Diplomacy at Tufts University with additional research collaboration through the University of Colorado, Norwegian Polar Institute, Ocean University of China and Carleton University. We thank these institutions for enabling research and education to be triangulated with leadership, which evolved into ambassadorial panels in 2015 and 2016 – “*Arctic High Seas: Building Common Interests in the Arctic Ocean*” – at Reykjavik University in collaboration with the Arctic Circle, conceived and co-hosted by the *Arctic Options/Pan-Arctic Options* projects. These two ambassadorial panels along with earlier collaborations among the book series editors (P.A. Berkman, A.N. Vylegzhanin and O.R. Young) are the origin of this volume *BUILDING COMMON INTERESTS IN THE ARCTIC OCEAN WITH GLOBAL INCLUSION*.

We thank Ari Kristinn Jónsson, Rector of Reykjavik University, for enabling the 2015 and 2016 panel dialogues with ambassadors to Iceland from China, France, Germany, Norway, Russia, Sweden, the United Kingdom and the United States, along with other diplomats from Canada, Finland, Greenland, and Iceland, and thank especially the Foreign Minister of Iceland for her written remarks.² It is special honour to thank former President of Iceland, Ólafur Ragnar Grímsson, for his leadership and keynote presentations with both of these dialogues to build common interests in the Arctic Ocean, notably in the Central Arctic Ocean High Seas as an area beyond national jurisdiction where global lessons are emerging to promote cooperation and prevent conflict with a precautionary approach short-to-long term.

¹Berkman, P.A., Lang, M.A., Walton, D.W.H. and Young, O.R. (eds.). *SCIENCE DIPLOMACY: ANTARCTICA, SCIENCE AND THE GOVERNANCE OF INTERNATIONAL SPACES*. Smithsonian Institution Scholarly Press, Washington, DC. (<https://repository.si.edu/handle/10088/16154>).

²H.E. Lilja Alfreðsdóttir (Minister for Foreign Affairs of Iceland). *Opening Address. Second Annual Ambassadorial Panel on the Arctic High Seas. Pan Arctic Options and the Reykjavik University*. 6 October 2016 (<https://www.stjornarradid.is/library/04-Raduneytin/Utanrikisraduneytid/PDF-skjol/Arctic-pre-event%2D%2D-raeda-ra%CC%81dherra.pdf>).

From the *Arctic Options/Pan-Arctic Options* project, the Science Diplomacy Center was founded in 2017 to coordinate rapidly progressing co-production of knowledge, including development of this INFORMED DECISIONMAKING FOR SUSTAINABILITY book series. We thank the collaborating scholars, decisionmakers, patrons, next-generation leaders and friends who have shared insights, observations and ideas to transform research into action across the data-evidence interface with informed decisionmaking as the engine of science diplomacy.

We thank many foreign ministries (including from Algeria, Armenia, Canada, Colombia, Costa Rica, Ethiopia, Hungary, India, Indonesia, Japan, Norway, Russian Federation and United States) and the United Nations Institute for Training and Research (UNITAR) for enabling science diplomacy to be shared in a scalable manner that builds on lessons from the *Arctic Options/Pan-Arctic Options* projects. Since 2020, with continued NSF funding from the *Arctic Options/Pan-Arctic Options* projects, the Science Diplomacy Center has been operating through EvREsearch LTD, coordinating production of this book to address issues, impacts and resources across all kinds of boundaries (ecopolitical, geographic, generational, population, cultural, legal, historic and other dimensions) inclusively in view of Arctic and Earth systems.

On behalf of the book series editors (Berkman, Young and Vylegzhanin), in 2018, the Science Diplomacy Center (Berkman) signed a Memorandum of Understanding (MOU) with Arctic Frontiers (Øvretveit), which had assembled “*the first global scientific conference on economic, societal and environmental sustainable growth in the north*” in 2006, becoming an annual international forum in Tromsø, Norway. Production of this book has been enriched by the additional member of the editorial team (Balton), bridging research and action with contributions of a key diplomat behind the binding Arctic agreements that emerged over the past decade.

We specially thank Akvaplan-Niva for enabling knowledge co-production with this book, which emanated from Arctic Frontiers 2020, and Alexey Pavlov for his key assistance to engage a self-selected team of contributors inclusively with the research chapters (from the science sessions) and action chapters (from the plenary sessions) herein. We further thank Anu Fredrikson and her leadership with co-production of *VOLUME 3. PAN-ARCTIC IMPLEMENTATION OF COUPLED GOVERNANCE AND INFRASTRUCTURE*, which will arise from Arctic Frontiers 2022 with the Woodrow Wilson Center and Mike Sfraga also as co-editors.

Most importantly, we thank the chapter contributors to this book, who have enabled us to compile an unique collection of observations about the Arctic from diverse vantages, ranging from a high-school student to foreign ministers along with graduate students, postdoctoral scholars, professors, organizational leaders, Indigenous peoples, subnational-national-international officials and community representatives across a dozen nations. We appreciate their interdisciplinary breath across the natural sciences, social sciences and Indigenous knowledge – inclusively as the “study of change” – in view of patterns, trends and processes (albeit with different methodologies) that become the bases for decisions. We further appreciate their transdisciplinary efforts to address questions of common concern, integrating data

into evidence in view of the decisionmaking institutions that produce governance mechanisms and built infrastructure as well as their coupling with sustainable development. In these efforts, we thank the research-chapter authors especially for the passion and creative contributions delivered with enthusiasm in the two editor-author team teleconferences during our global pandemic.

The rigor, quality and legacy of this book is influenced further by the community of experts who have shared their time and candid comments with the chapter authors, as part of a process with two anonymous reviews and subsequent revisions, leading to consensus decisions by the co-editors. We are grateful to these reviewers for their essential input, recognizing their voluntary contributions, and thank: Steinar Andresen; Raymond V. Arnaudo; Betsy B. Baker; Michael S. Bank; Mia M. Bennett; Lawson W. Brigham; Robert W. Correll; William Eichbaum; Gail Fondahl; Jeffrey T. Fong; Jon L. Fuglestad; Jacqueline M. Grebmeier; Peter Harrison; Alf Håkon Hoel; Gunhild Gjørsv Hoogensen; Noor Johnson; Randy “Church” Key; Timo Koivurova; Yekaterina Y. Kontar; Valeriy A. Kryukov; James H. Lever; Molly McCammon; Erik J. Molenaar; Frode Nilssen; Andreas Østhagen; Andrey N. Petrov; Svein Vigeland Rottem; Jon-Arve Røyset; Scott Stephenson; D.R. Fraser Taylor; and David L. VanderZwaag.

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As an editorial team, it has been an honour as well as pleasure working together with all involved to produce this book, especially during the COVID-19 pandemic when there once again is a common interest in survival of humankind at local to global levels, unlike any period since the Second World War.

BUILDING COMMON INTERESTS IN THE ARCTIC OCEAN WITH GLOBAL INCLUSION is an ongoing journey, involving a “continuum of urgencies” to address across generations with informed decisions. We are grateful to all contributors in this international, interdisciplinary and inclusive process with hope for humanity.

Science Diplomacy Center,
EvREsearch LTD, Falmouth, MA, USA

Paul Arthur Berkman

Science Diplomacy Center,
MGIMO University,
Moscow, Russian Federation

United Nations Institute for Training and
Research (UNITAR), Geneva,
Switzerland

Program on Negotiation, Harvard Law
School, Cambridge, MA, USA

Bren School of Environmental Science
& Management, University of California
Santa Barbara, Santa Barbara, CA, USA

Oran R. Young

International Law School,
MGIMO University, Moscow,
Russian Federation

Alexander N. Vylegzhanin

Polar Institute, Wilson Center and U.S.
Arctic Steering Committee,
Washington, DC, USA

David A. Balton

Initiative West Bergen, Bergen, Norway

Ole Rasmus Øvretveit

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³“Research” and “Action” chapters are described in the Preface (see also Figure 1.6)

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About the Contributors

Dina Abdel-Fattah is an Associate Professor in the Department of Technology and Safety at UiT – The Arctic University of Norway and a Senior Lecturer in the Department of Computer and Systems Science at Stockholm University. She has an interdisciplinary background in natural and social science as well as decision and risk analysis. Her research is primarily focused on cryospheric and natural hazards and their impacts on local communities in the Arctic and sub-Arctic.

Mathias Albert is Professor of Sociology at Bielefeld University. His research covers the history and sociology of world politics, youth studies, and, more recently, polar politics. His latest book publications in English include: *A Theory of World Politics* (Cambridge: Cambridge University Press 2016); *The Politics of International Political Theory* (ed. with A.F. Lang. London: Palgrave 2019); *What in the World? Understanding Global Social Change* (ed. with T. Werron. Bristol: Bristol University Press 2021).

Ekaterina S. Anyanova completed her LLM and Dr.iur studies at Hamburg University and 3 years later received her Candidate of legal science degree from Institute of State and Law in Moscow. During her studies she conducted legal research and analysis in the law of the sea area. At present she is working on her Doctor of Legal Science thesis on the maritime security issue. She also works as a Legal adviser.

Eda Ayaydin is a lecturer at Sciences Po Bordeaux and PhD candidate at the University of Paris-Saclay in Paris, France. Her research interests include history of Arctic exploration, Arctic geopolitics, science diplomacy and governance.

David A. Balton is a Senior Fellow with the Woodrow Wilson Center's Polar Institute. He previously served as the U.S. Ambassador for Oceans and Fisheries, with a portfolio that included managing U.S. foreign policy issues relating to the Arctic and Antarctica. During the U.S. Chairmanship of the Arctic Council (2015–2017), he served as Chair of the Senior Arctic Officials. He also led

negotiations that produced the 2011 *Agreement on Cooperation on Aeronautical and Maritime Search and Rescue in the Arctic*, the 2013 *Agreement on Cooperation on Marine Oil Pollution Preparedness and Response in the Arctic*, and the 2018 *Agreement to Prevent Unregulated High Seas Fisheries in the Central Arctic Ocean*. Ambassador Balton now serves as Executive Director of the U.S. Arctic Executive Steering Committee.

Manuel Barange is Professor and Director of the Fisheries and Aquaculture Policy and Resources Division at the FAO. Previously he was Deputy Chief Executive and Director of Science at the Plymouth Marine Laboratory, UK, and Chair of the Science Committee of the International Council for the Exploration of the Sea (ICES). He is a global expert on the impacts of Climate Change on marine ecosystems, fisheries and aquaculture, and on the interactions between natural and socio-economic drivers of change. He is a Review Editor of the forthcoming IPCC Special Report on Oceans and the Cryosphere in a Changing Climate (SROCC). In 2010 he was awarded the UNESCO-IOC Roger Revelle Medal for his contribution to ocean science.

Marnix van den Berg completed a MSc in Offshore and Dredging Engineering at Delft University of Technology in 2014 and received a PhD degree from Norwegian University of Science and Technology (NTNU) in 2019. His research focusses on numerical modelling of ice-structure and ice-ship interaction processes with a specific interest in the influence of discrete interactions of ice floes within a broken ice field on the ice loads experienced by structures and ships.

Paul Arthur Berkman is the Fulbright Arctic Chair 2021–2022. Professor Berkman is Director of the Science Diplomacy Center at EvREsearch LTD in the United States and at MGIMO University in Moscow, Russian Federation. He is an Affiliated Fellow of the United Nations Institute for Training and Research (UNITAR) and a Faculty Associate of the Program on Negotiation at Harvard Law School. Paul wintered in Antarctica in 1981 on a SCUBA research expedition when he was 22 and began teaching science diplomacy the following year as a Visiting Professor, leading to his doctorate in oceanography and lifetime journey to help balance national interests and common interests for the benefit of all on Earth across generations.

Jon Bjørnø received in 2016 his MSc in marine cybernetics at the department of Marine Technology, Norwegian University of Science and Technology (NTNU), Trondheim, Norway. Today, he is working towards a PhD degree within the same field at the Marine Technology department, NTNU. His research interests include motion control for single or multiple vessels, guidance and control, and Arctic ice management operations. The PhD work is a part of the Center for Research-Driven Innovation, Sustainable Arctic Marine and Coastal Technology (SAMCoT).

Aileen Campbell Cabinet Secretary for Communities and Local Government, Scottish government, was first elected to the Scottish Parliament in 2007 as a list member for the South of Scotland. She was re-elected as the Member of the Scottish Parliament for Clydesdale in 2011 and appointed as Minister for Children and Young People. She was appointed Minister for Public Health and Sport in 2016. Ms. Campbell started a career in publishing as an editor for the construction magazine *Keystone* in 2003 and has been an editorial assistant on the newspaper, the *Scottish Standard*. Before her election to parliament, Aileen also worked as a Parliamentary Assistant. Aileen Campbell has an MA joint honours degree in Politics with Economic and Social History at the University of Glasgow.

Colleen J. Charles is a Woodland Cree First Nation from the Lac La Ronge Indian Band in northern Saskatchewan, Canada. She is a single mother of three children and has a granddaughter. She is a certified Antiracism Education Facilitator. Colleen has her Master of Education (MEd) from the University of Saskatchewan. Her research interest includes, Indigenous land-based education, Indigenous water rights, critical anti-racist learning and practice.

Joel Clement is an Arctic Initiative Senior Fellow at the Harvard Kennedy School's Belfer Center for Science and International Affairs with a background in climate and energy issues, resilience and climate change adaptation, landscape-scale conservation and management, and Arctic social-ecological systems. Mr Clement has priorly served as an executive at the U.S. Department of the Interior. In 2017, he was awarded The Joe A. Callaway Award for Civic Courage and has received multiple awards for ethics, courage, and his dedication to the role of science in public policy. In addition to his role at the Harvard Kennedy School, he is an Associate with the Stockholm Environmental Institute and a Senior Fellow with the Union of Concerned Scientists.

Ranjan Datta Canada Research Chair in Community Disaster Research at Indigenous Studies, Department of Humanities, Mount Royal University, Calgary, Alberta, Canada. Ranjan's research interests include advocating for Indigenous environmental sustainability, Indigenous food sovereignty, Indigenous energy management, decolonization, Indigenous reconciliation, community-based research, and cross-cultural community empowerment.

Yulia Ermilova is a leading GIS Specialist in the Lomonosov Moscow State University Marine Research Center. Yulia's main activities are selection, editing and systematizing of spatial data and GIS-support of engineering and environmental surveys. She takes part in the creation of ecological atlases for Russian energy companies (Gazprom, Rosneft) and develops map designs for scientific publications.

Nadezhda Filimonova is a PhD Candidate at the University of Massachusetts Boston. Her research addresses the topics of Arctic governance, Russian Arctic

policy and Arctic urban climate governance. She holds two master's degrees: one in Political Science and International Studies from Uppsala University, and a second in International Relations from St. Petersburg State University. She held visiting fellowships at several foreign universities including Aalborg University, University of Granada, Ludwig-Maximilians-Universität München and the University of Missouri.

Greg Fiske is a geographer whose background includes extensive use of geographic techniques including Geographic Information Systems (GIS), Cartography, Remote Sensing and relational database management to conduct and communicate environmental science. He has broad expertise in cloud-based spatial data analysis and data management and administers technical aspects of Woodwell Climate Research Center's geospatial activities. He has designed and developed complex spatial analysis workflows and has taught scientists, students and researchers on the use of both open-source and proprietary geospatial software. Prior to joining Woodwell, he worked at the Lawrence Livermore National Laboratory in California. Mr Fiske earned his BS from Plymouth State University in New Hampshire and his MS from Oregon State University.

Anna Gebruk is a PhD candidate in the School of GeoSciences at the University of Edinburgh. Anna is a Head of international collaboration of the Lomonosov Moscow State University Marine Research Center and a President of the UK Polar Network 2020–2021. Anna's main interests are in functioning of benthic ecosystems and the challenges they are facing including invasive species and pollutants, as well as international scientific collaboration in Arctic observing networks.

Jacqueline M. Grebmeier is a Professor at the University of Maryland Center for Environmental Sciences, Chesapeake Biological Laboratory in the United States. She holds a BA in Zoology (1977), MS in Biology (1979), MS in Marine Affairs (1983) and a PhD in Biological Oceanography (1987). She completed a postdoctoral position at the University of Southern California (1988) and was a research faculty member at the University of Tennessee before joining the Chesapeake Bay Laboratory in 2008. Her oceanographic research interests include pelagic-benthic coupling, benthic carbon cycling and benthic faunal population structure in relation to ecosystem structure in polar marine systems, primarily in the Arctic.

Markus Haraldsvik Leader, Student Council, Bardufoss upper secondary school. Markus (16) was born in Namsos in Trøndelag County, Norway and spent his first years in Trælnes, Brønnøysund Municipality. He graduated from Brøstadbotn secondary school and is now a pupil at the Bardufoss upper secondary school in Tromsø, specializing in sports. Markus has held various leading positions in youth councils at local and regional levels in Tromsø, including deputy head of Tromsø County Youth Council.

Sian F. Henley is an interdisciplinary marine scientist based at the University of Edinburgh (UK), focusing primarily on the Polar Oceans and their importance in the Earth System. She specializes in marine biogeochemistry and ecosystem functioning in the Arctic and Antarctica, and the way these are changing in response to climate and environmental change and in turn influencing these changes. In addition to primary research, Sian is actively involved in science-policy interactions, public engagement and science education.

Lea-Anne Henry is a marine ecologist and Chancellor's Fellow in the School of GeoSciences at the University of Edinburgh in Scotland, United Kingdom. Her research seeks to understand the spatial and temporal drivers of marine biodiversity and biogeographical patterns over ecological and geological timescales, including effects of man-made activities and climate change. Much of her research is in collaboration with the international offshore industry community, governments and non-governmental organizations.

Alf Håkon Hoel is professor of Ocean Law and Policy at UiT – the Arctic University of Norway in Tromsø. His research addresses the governance of oceans and the management of natural resources. He is also affiliated with the Norwegian Institute of Marine Research and the Polar Institute of the Wilson Center in Washington DC.

Jens Frølich Holte State Secretary in the Norwegian Ministry of Foreign Affairs has been State Secretary to the Minister for EEA and EU Affairs, acting State Secretary to the Minister of Transport and Communications, and political adviser in the Ministry of Climate and Environment. Prior to his current position he was State Secretary for International Development in the Ministry of Foreign Affairs. Frølich Holte has a master's degree in economics and business administration from the Norwegian School of Economics and Business Administration and a master's degree in economic history from the London School of Economics. He became politically active in the Young Conservatives at the age of seventeen.

Aili Keskitalo is the President of the Sámi Parliament in Norway. She is the first female President of any Sámi Parliaments. She served as President of the Sámi Parliament in Norway in 2005 for the first time. Keskitalo has a master's degree in Public Administration from Copenhagen Business School, focusing on higher education in Norway and Greenland. Keskitalo is married and has three daughters. She lives in Guovdageaidnu / Kautokeino, Norway.

Nathan Kettle is a Research Assistant Professor in the International Arctic Research Center at the University of Alaska Fairbanks and Co-Investigator for the Alaska Center for Climate Assessment and Policy. His research in the Arctic centres on knowledge co-production to inform decisionmaking, climate adaptation, decision support tools and evaluation. He received his PhD in Geography from the University of South Carolina in 2012.

Elena V. Kienko Candidate of Science (International Law), has LLM in International Economic Law from MGIMO University, Russia. She is currently working at the Primakov National Research Institute of World Economy and International Relations, Russian Academy of Sciences. She specializes in legal aspects of cooperation between Russia and Non-Arctic States in the Arctic Region (primarily between Russia and Japan, between Russia and the People's Republic of China and between Russia and the Republic of Korea). She has published a wide range of articles on International Law, International Maritime Law and Arctic Law (mainly in Russian).

Yunjin Kim is a former researcher at the Korea Legislation Research Institute. She participated in Arctic Frontiers as a student forum participant, young ambassador and research presenter for 3 years (2018–20). She did her internship at the International Tribunal for the Law of the Sea and has been involved in research related to marine protected areas and high seas. She expects to see younger generations gain hope to lead the efforts in making the Arctic sustainable.

Sebastian Knecht is a postdoctoral researcher at the Faculty of Sociology at Bielefeld University. He was a fellow at the Berlin Graduate School for Transnational Studies (BTS) at Freie Universität Berlin from which he received his PhD in 2019. His research is primarily concerned with international cooperation in the polar regions, the design and stratification of membership systems in international organizations, and science-policy interactions. He is co-author of the German-language textbook *Internationale Politik und Governance in der Arktis: Eine Einführung* (Springer 2018) and co-editor of *Governing Arctic Change: Global Perspectives* (Palgrave Macmillan 2017).

Sveinung Løset is professor of Arctic Marine Technology at the Norwegian University of Science and Technology (NTNU) since 1995. He is Adjunct Professor at the University Centre in Svalbard (UNIS), and in 2005, he was appointed honorary doctor of St. Petersburg State Polytechnical University, St. Petersburg, Russia. Currently Dr Løset is dean of research and innovation at the Faculty of Engineering, NTNU. Professor Løset has been a pioneer within Arctic Marine Engineering. He established this research field in Norway.

Wenjun Lu received a joint MSc degree in Coastal and Marine Engineering from NTNU (Norway), TU Delft (the Netherlands) and University of Southampton (UK) in 2010; and then in 2014 the PhD degree in Arctic Technology from NTNU. His thesis was awarded the “Chorafas foundation prize” for the best doctoral thesis of NTNU for that year. Since 2015, he has been engaged in the development of SAMS, especially the analytical ice fracture module.

Raed Lubbad is Associate Professor at NTNU. He holds an MSc Degree in Coastal Engineering and PhD degree in Arctic Marine Civil Engineering from NTNU. He has a broad knowledge and a wide range of experience related to engineering

challenges in the Arctic. Dr Lubbad has extensive experience with leading research projects and he has good experience with tech start-ups (he is a co-founder and the managing director of the NTNU spin-off company: ArcISO).

Andrew Mahoney is a Research Associate Professor of Geophysics at the Geophysical Institute at the University of Alaska Fairbanks. His research focuses on the physics of sea ice and its relationship to the climate, ecology and human systems of the Polar Regions.

Alexandra Middleton is a researcher with a PhD in Economics and Business Administration from the University of Oulu, Finland. Her research has focused on sustainability, corporate social responsibility reporting and Arctic business development. Alexandra has published scientific articles on climate change accountability in the Arctic, Arctic sustainable business development, demographics, human capital, innovations and connectivity solutions in the Arctic. As part of her Arctic work, Alexandra has been a Fellow in Science In/for Diplomacy EU funded programme. She is actively engaged in science diplomacy to raise awareness of the Arctic economic, social and environmental challenges.

Bjørn Inge Mo is chair of the Troms and Finnmark County Government in Norway, representing the Labour Party. Mr Mo was deputy mayor for 4 years before serving as mayor for 12 years in the Municipality of Kåfjord. In 2017 he was elected to the Sami Parliament and in 2019 to the Troms and Finnmark County Parliament. In addition, Mo has been leader of the Troms Labour Party, member of the Labour Party's national board as well as member of the party's executive board for 4 years. Mr Mo has served as a board member of the Council of the Torne Valley for 17 years and chairing the Council for 2 years.

Vadim Mokievsky (PhD, D.Sci) is a Chief scientist, head of the Laboratory of Coastal benthic ecology in P.P. Shirshov Institute of Oceanology, Moscow, Russia. Zoologist and ecologist. Expert in taxonomy of marine nematodes. Primary interests in ecology dealing with dynamics of natural communities and ecosystems with special reference to benthic communities of Arctic seas. Leader or participant of a number of expeditions and research cruises in coastal zone and high seas, mainly of the Northern hemisphere.

Annika E. Nilsson is researcher at KTH Royal Institute of Technology, Sweden (Division of History of Science, Technology and Environment) and professor-II at the Nordland Research Institute, Norway. Her research focuses on the politics of Arctic change, environmental governance and communication at the science-policy interface. She is currently engaged in the Nordic Centre of Excellence 'Resource Extraction and Sustainable Arctic Communities' where she looks at participatory scenario methods and indicators for sustainable development as potential tools for improving assessments of the long-term impacts of mining.

Annika Olsen has been the Mayor of Tórshavn Faroe Islands since 2017. She was elected in the City Council in Tórshavn for the People's Party at the age of 28. Since first elected she has been Minister of the Interior and Minister of Social Affairs in the Faroe Islands. Annika Olsen was a Member of Parliament before becoming Mayor of Tórshavn. Between 2011 and 2015 she was the Deputy Prime Minister of the Faroe Islands. Annika Olsen holds a master's degree in Danish and Religion from the University of Southern Denmark. She has also been a university teacher as well as teaching at upper secondary schools.

Alexander Osadchiev is a senior researcher in Shirshov Institute of Oceanology, Moscow, Russia. His research focuses on coastal oceanography with the special emphasis on river plumes and estuarine processes. His main results describe, first, structure of large-scale river plumes formed by the Great Siberian Rivers in the Arctic Ocean and, second, structure, dynamics and variability of small river plumes in many World's coastal areas.

Anders Oskal Executive Director International Centre for Reindeer Husbandry (ICR) is the Secretary General of the Association of World Reindeer Herders (WRH) and the Executive Director of the International Centre for Reindeer Husbandry. Oskal is a reindeer herding Sámi from northern Norway, with a master's degree in Business. Throughout his career, Oskal has worked with reindeer herding, Indigenous issues, policy, innovation and business development. Oskal represents WRH in the Arctic Council, is a Member of the Arctic Economic Council and was a co-author of the 5th IPCC report. He is currently leading the Arctic Council EALLU project, focusing on traditional Indigenous food knowledge as a source of innovation, value added and, in a wider sense, adaptation to Arctic change.

Ole Rasmus Øvretveit is the director of Initiative West, a think tank focusing on the sustainable ocean economy, societal growth and the green transition operating from the west coast of Norway. Prior to his current position Øvretveit was Director of Science to Policy for SDGs at the university of Bergen and was the director of Arctic Frontiers for 8 years. Mr Øvretveit has an MA in Comparative Politics from the University of Bergen. He has served on several boards and committees. Mr Øvretveit has broad insight in ocean issues and the connection between science, business and politics.

Jay-Kwon James Park is a former graduate researcher and a teaching assistant at the University of Washington, who served as an Arctic Research Fellow at the International Policy Institute. He participated in Korea Arctic Academy (2016–17), Arctic Council's Ministerial Meeting (2017), and Korea Arctic Partnership Week (2017) as a participant and a presenter.

Anita L. Parlow Principal A.L. Parlow & Associates, LLC, Anita Parlow, Esq., MSt. Oxford University is a recent Fulbright Scholar to Iceland, was advisor to the

Harvard-MIT Arctic Fisheries Project and Founding Team Lead for the D.C.-based Woodrow Wilson International Center for Scholars' Program on the Polar Code. Parlow, who has spoken in symposia in the United States, Canada, Europe and China on Arctic issues, has authored numerous articles on Arctic shipping, energy and infrastructure and subsistence topics. She is currently consultant to the Port of Nome, Alaska.

Alexander Pilyasov Doctor of Economic Geography (1995), Professor in Regional Economics (1998), Professor at Lomonosov Moscow State University, General Director of the Autonomous Non-commercial Organization "Institute of Regional Consulting". Major research themes: 1) Economic development of the Russian and Circumpolar North and Arctic; 2) Regional science as the interdisciplinary field (European experience of regional economic development); 3) Innovative and small business development in the Russian regions. Author of more than 175 scientific published papers, including 41 monographs.

Mikhail Pogodaev was born on 7 June 1978 in Topolinoe, Sakha Republic (Yakutia). In 2001, he graduated from Saint-Petersburg State University of Economics and Finance with a Master's degree in Economics. In 2007, at the same university, he defended his PhD dissertation in Economics. He was the Senior Advisor for Economic and International Relations at the Permanent Representation of Sakha Republic under the President of the Russian Federation from 2005 to 2014. He served as Chair of the World Reindeer Herders Association from 2009 to 2019 and Executive Director of the Northern Forum from 2015 to 2019. Since 2019, Dr. Pogodaev is the Vice-minister for Arctic Development and Indigenous Peoples Affairs of the Sakha Republic.

Rolf Rødven (PhD, MBA) is Executive Secretary of the Arctic Monitoring and Assessment Program (AMAP). AMAP is a working group to the Arctic Council, responsible for monitoring and assessing the state of the Arctic region with respect to pollution and climate change issues, and their impacts on ecosystems and human health. Rødven holds a PhD in the Northern Populations and Ecosystems programme at UiT – the Arctic university of Norway, focusing of ecology of reindeer, as well as an MBA in strategic leadership and finance. He is author on several scientific papers on Arctic ecology often related to impacts of climatic change.

Hide Sakaguchi is a President of the Ocean Policy Research Institute, the Sasakawa Peace Foundation (OPRI-SPF). Prior to OPRI-SPF, he served as Executive Director for Research at JAMSTEC from 2018 to 2021. He joined JAMSTEC in 2003 and his roles included Group Leader and Program Director of the Institute for Research on Earth Evolution, Director of the Department of Mathematical Science and Advanced Technology, and Assistant Executive Director. Prior to JAMSTEC, he served as Research Associate at Kobe University; Senior Research Scientist at the Division of Exploration and Mining of the Commonwealth Scientific and Industrial Research

Organisation of Australia; and Adjunct Professor at the Earthquake Research Institute of the University of Tokyo. He received a PhD from the Graduate School of Agriculture, Kyoto University in 1995.

Raquel Soto Sanchez Scholar of the National Council of Science and Technology (CONACYT) of Mexico, conducting her doctoral research on the protection and preservation of the marine environment under the visionary umbrella of the “Common Heritage of Mankind” with applications of science diplomacy. She is author of the book “The right of innocent passage in Mexico” (in the Spanish) published in 2015 by the Legal Research Institute of her Alma Mater the National Autonomous University of Mexico (UNAM). Raquel has a high sense of learnability, multidisciplinary research experience, creative problem-solving capacity with professionals of different backgrounds in multicultural international scenarios, and excellent interpersonal skills.

Geir Seljeseth is the Head of Europe Office of the Norwegian trade union “Industri Energi” and located in Brussels. Mr Seljeseth is born, raised and have lived in the Arctic for most of his life. For many years he was a journalist in Nordlys, the biggest newspaper in North-Norway. He also has spent some years as a journalist in Moscow as a correspondent for Norway’s biggest newspaper Aftenposten. Geir Seljeseth was for 8 years regional manager for Norwegian Oil & Gas in Northern Norway.

Igor Semiletov is a Research Professor, University of Alaska Fairbanks and a Head of the Laboratory of Arctic Research of the V. I. Iliychev Pacific Oceanology Institute of the Far Eastern Branch of the Russian Academy of Sciences (Russia). His main research interests are Polar regions, biogeochemistry, Arctic Ocean, carbon cycle, permafrost degradation, greenhouse gas flows, climate change. Expedition lead of many research expeditions in the Russian Arctic.

Mike Sfraga is the founding Director of the Polar Institute and serves as the Director of the Global Risk and Resilience Program at the Woodrow Wilson International Center for Scholars. His work focuses on the changing geography of the Arctic and Antarctic landscapes, Arctic policy, and the impacts and implications of a changing climate on political, social, economic, environmental, and security regimes in the Arctic. Sfraga served as distinguished co-lead scholar for the Fulbright Arctic Initiative from 2015 to 2017 and from 2017 to 2019. He serves as the co-director of the University of the Arctic’s Institute for Arctic Policy previously served in a number of academic, administrative and executive positions. Sfraga earned a PhD in geography and northern studies from the University of Alaska Fairbanks. Dr. Sfraga has been appointed by President Biden as Chair of the United States Arctic Research Commission from 2021–2024.

Nikolay Shabalin is a marine ecologist, graduated from the Lomonosov Moscow State University, department of invertebrate zoology in 2006 and specializing in the ecology of marine macrobenthos in the Arctic. Nikolay is an executive director of

the Lomonosov Moscow State University Marine Research Center from 2014. Key interests: Arctic marine ecosystems functioning and biodiversity, technologies of collecting and analysing environmental data, marine conservation. Nikolay is an author of over 40 patents and 10 publications.

Roger Skjetne has BSc and MSc degrees from University of California Santa Barbara and PhD from the Norwegian University of Science and Technology (NTNU) within control engineering, with Exxon Mobil prize for best PhD thesis in 2005. He is a certified electrician, earlier working for Aker Elektro on structures for North Sea. In 2004–2009 he worked in Marine Cybernetics on Hardware-In-the-Loop testing of marine control systems. From 2009 he has held the Kongsberg Maritime Professor chair in Marine Cybernetics at NTNU Department of Marine Technology.

Yeona Son is a researcher at the Korea Legislation Research Institute. She has a bachelor's degree in Law and a master's in Development Studies. In particular, she has keen interests in human rights issues, sustainable development, legislation and public policy. In this regard, she had internships at the Vandeventer Black LLP (Virginia, USA), the United Nations Global Compact(Korea Network) and the BKL Dongcheon Foundation. She was honoured to be part of the Arctic Frontiers 2020 to share bright thoughts and broaden the horizon of knowledge.

Ine Eriksen Søreide has been Minister of Foreign Affairs for Norway since 2017. Prior to that she was Minister of Defence since 2013. A member of the Conservative Party, she was elected in 2005 as a member of the Norwegian Parliament, *Stortinget*, for Oslo.

Vassily Spiridonov (PhD, Dr.habil) studied in Kazan and Moscow Universities, worked in All Union Research Institute of Fishery and Oceanography, Zoological Museum of Moscow University, as a visiting scientist in the Alfred Wegener Institute and Senckenberg Institute (Germany). In 1999–2004 organized Marine Programme of WWF Russia. Since 2005 working in Shirshov Institute of Oceanology with focus on Arctic and Antarctic ecology, biological invasions and crustacean research, having been consultant to United Nations Development Programme, Food and Agriculture Organization, Convention on Biological Diversity and the Marine Stewardship Council.

Sam Tan is currently Minister of State for Ministry of Foreign Affairs and Ministry of Social and Family Development of Singapore. He also serves as Chairman of Government Feedback Unit REACH since 2015. He has previously served as Minister of State for the Prime Minister's Office for Culture, Community and Youth and the Ministry of Manpower. In 2006, Mr Tan was elected Member of Parliament and subsequently appointed Parliamentary Secretary and later Senior Parliamentary Secretary for various portfolios and served as Senior Parliamentary Secretary for various ministries. He received the Public Service Medal (PBM) in