A Wenner-Gren Symposium
&
Satellite Activity to the UN Decade of Ocean Science for Sustainable Development Laboratory
"An Accessible Ocean"

The mediated ocean: a cross-disciplinary workshop on marine data and policy

KTH Royal Institute of Technology, Stockholm, Sweden
10-11 May 2022

Over the past half century, the ocean has become subject to an accelerated pace of mediation and datafication, as ocean knowledge is increasingly technologically informed and processed. This ongoing transition has become so comprehensive that the understanding, management and governance of the marine environment is dependent on enormous flows of data from a 'vast machine' of measuring tools. These processes combined have formed a 'mediated ocean' that now – at the start of both the United Nations Decade of Ocean Science for Sustainable Development and the 'Decade of Action' for the Sustainable Development Goals – is both the object and outcome of human decision-making. Mediation and its data formats and technologies are profoundly reshaping perceptions of the marine environment and of the ways it can and should be approached and managed, which should ideally be democratic and guided by the SDGs.

The impacts of processes of mediation on ocean science and governance are manifold, from practices around data collection and processing to the role of environmental data in formulating, monitoring and supporting ocean sustainability outcomes, such as SDG 14 and the objectives of the Ocean Decade. This workshop aims to explore and critically assess these impacts. Questions we plan to address include:

- How do goals like SDG 14 and the Ocean Decade objectives influence the generation and aggregation of ocean data? And, vice versa; how does the nature and availability of ocean data shape the formulation and priorities of ocean governance aims and intentions?
- Public institutions increasingly rely on corporate processing of environmental data. What are the implications of this for, for example, independent scientific inquiry and democratic decision-making for the ocean?
- Autonomous technologies and the data they generate have revolutionised everyday practices for ocean scientists, with potentially profound consequences for the accessibility and affordability of marine scientific research. What are the implications of this extensive datafication? What are some specific challenges and opportunities, for example with regards to making ocean science and policy-making more accessible and inclusive?
- Ongoing and planned exploitation of marine resources, including in areas beyond national jurisdiction, so far seem bent on increasing rather than ameliorating existing inequalities between rich and poor nation states. In what ways are ocean data implicated in the current state-of-affairs, or, vice versa, how can data be used as an equalising force?
- What is the role of the global environmental commons (GSDR 2019), an expanded concept increasingly used in policy, for a mediated and datafied ocean? How are increasing amounts of ocean data with improved resolution tied to global power relations? How does more data and modeling relate to regulation, protection and conservation?

Some of these questions and challenges are addressed with increasing urgency within disciplinary boundaries. However, in their nature, the questions span disciplinary divides, and hence this workshop aims to create an opportunity to explore answers that draw on interaction and insights from across the natural and social sciences and the humanities. The workshop is structured around three thematic perspectives: data, history, and governance, all of which can productively be investigated from an integrative transdisciplinary approach combining insights from environmental history, oceanography, law, policy and media theory.

The workshop includes both an in-person and an online component. The in-person event is a one-day workshop comprised of three sessions with 3-4 presenters, each with a commentator and a chair, taking place at KTH Royal Institute of Technology in Stockholm, Sweden. The second day is shorter but more intense, with a set of panel discussions where the participants will gather around pre-circulated questions about challenges and opportunities tied to ocean data and mediation that speak to multiple disciplinary perspectives. This set of panel discussion will take place online as we will apply for them to form a Satellite Activity to the Ocean Decade Laboratory on "A Transparent and Accessible Ocean," taking place 10-12 May 2022. We will invite additional participants to the online event, expanding the group from the previous day. If our application is successful, the panel discussions will be broadcast live on the Ocean Decade's website as one of several official Satellite Activities.

The organisers plan for the workshop to eventually result in an edited volume provisionally also titled "The Mediated Ocean." All workshop participants will be invited to contribute to this outcome, but participation in the workshop does not require a commitment to also be part of the written publication.

The workshop is funded by The Wenner-Gren Foundations. It is organised as part of the research project *The Mediated Planet*, funded by the Swedish Research Council for Sustainable Development (Formas) and based at the Division of History of Science, Technology and Environment at KTH Royal Institute of Technology in Stockholm. Contact persons are Susanna Lidström (susanna.lidstrom@abe.kth.se) and Adam Wickberg (adam.wickberg@abe.kth.se).

Program

Day 1, 10 May

Location: Room D36, Lindstedtsvägen 5, floor 3, KTH Main Campus

10.00-10.30 Welcome and introduction

The mediated ocean
Susanna Lidström and Adam Wickberg, Division of History of Science, Technology and Environment, KTH Royal Institute of Technology

10.30-12.30 Session 1: Data

Multisolving ocean data challenges: Exploring the role fisheries surveys play in supporting ocean observing needs under the UN Decade of Ocean Science for Sustainable Development
Natalya Gallo, Department of Biological Sciences, University of Bergen

Biodiversity data at the deep-sea industrial frontier
Thomas Dahlgren, Department of Marine Sciences, University of Gothenburg and NORCE Norwegian Research Centre

How may data quality and availability affect policy-making for deep-seabed mining?
Tanja Stratmann, Department of Ocean Systems, NIOZ - Royal Netherlands Institute for Sea Research

Commentator: Nina Wormbs, Division of History of Science, Technology and Environment, KTH
Chair: Johan Gärdebo, Division of History of Science, Technology and Environment, KTH

12.30-13.30 Lunch

13.30-15.30 Session 2: History

The Elephant in the Room. Mediations of a Heating Ocean in Times of Global Climate Change
Sabine Höhler, Division of History of Science, Technology and Environment, KTH

A nuclear sea: synopticity and nuclearity in the International Geophysical Year (1957-1958)
Jessica Lehman, Department of Geography, Durham University

Elisabeth Mann Borgese and the Law of the Sea – histories and futures of ocean governance
Tirza Meyer, Division of History of Science, Technology and Environment, KTH and Oslo School of Environmental Humanities, University of Oslo

Commentator: Erik Isberg, Division of History of Science, Technology and Environment, KTH and Centre for History and Economics, University of Cambridge
Chair: Erik Ljungberg, Division of History of Science, Technology and Environment, KTH

15.30-16.00 Coffee break

16.00-18.00 Session 3: Governance

Terra/aqueous: vexing vents and amphibious legalities in the Anthropocene
Surabhi Ranganathan, Faculty of Law and the Lauterpacht Centre for International Law, University of Cambridge

The common heritage of humankind, deep seabed minerals and the governance of data: Current practices at the International Seabed Authority and way forward
Pradeep A. Singh, Research Center for European Environmental Law, University of Bremen

The Politics of Ocean Science Data
Sam Robinson, Southampton Marine and Maritime Institute, University of Southampton

Commentator: Jesse Peterson, Department of Ecology, SLU Swedish University of Agricultural Sciences
Chair: Anna Åberg, Department of Technology Management and Economics, Chalmers University of Technology

18.00-18.15 Concluding remarks

Environing the ocean
Sverker Sörlin, Division of History of Science, Technology and Environment, KTH

20.30 Dinner: Coco & Carmen (Banérgatan 7, Stockholm)

Abstracts (in order of appearance)

Multisolving ocean data challenges: Exploring the role fisheries surveys play in supporting ocean observing needs under the UN Decade of Ocean Science for Sustainable Development
Natalya Gallo

Multisolving refers to using one policy or investment to address multiple problems, and is connected to the system dynamics school of thought. The multisolving approach has much to offer the ocean science community in developing an effective and equitable strategy to achieve the goals of the UN Ocean Decade and the targets of Sustainable Development Goal 14. The need for a multisolving approach becomes especially apparent when considering that the goals are substantial, the time is short, funding is limited, and the ocean is vast. However, multisolving requires thinking beyond disciplinary boundaries. Ocean data collection, similar to ocean, climate, and biodiversity policy, has found itself operating in historic silos. In this talk, I focus on the fisheries science and ocean observing communities. These communities share certain goals, such as tracking oceanic change and related impacts on marine resources, but do not typically coordinate data collection. Despite the wealth of ocean observations collected by fisheries surveys, they are not always integrated in the ocean observing framework. In this talk, I will share recently published results from a U.S. West Coast case study of how fisheries surveys contribute to the collection of Essential Ocean (EOV), Essential Climate (ECV), and Essential Biodiversity Variables (EBV) prioritised by the ocean observing community, and discuss opportunities to leverage these existing surveys. However, even if all partners are theoretically supportive, there are non-minor challenges that need to be addressed for multisolving to work. These include: data access and hosting infrastructure (i.e. are data publicly accessible and who is responsible for upkeep), identifying appropriate funding mechanisms and personnel time for additional sampling that is beyond the primary focus of a sampling program, agreeing on best practices for the measurement and reporting of certain ocean variables, and addressing the legacy of "parachute science" and other jurisdictional challenges in data collection and publication. The talk aims to leave the audience considering the following questions: How can a multisolving approach contribute to building a more sustainable ocean observing strategy under the UN Ocean Decade and what are the appropriate forums for developing a multisolving approach to ocean data collection.

Biodiversity data at the deep-sea industrial frontier
Thomas Dahlgren

The deep sea defined as what is outside of the continents with their submerged shelfs, is a bit more than half or the planet. Deep-sea ecosystems are significantly different from shelfs and to large parts still unexplored. With the growing interest to exploit deep-sea resources there is also a need to learn to know its inhabitants and to better understand these ecosystems. The society has decided that biodiversity must be protected and that ecosystems should not be exposed to "serious harm". To find out what species inhabit the deep-sea and what their distributions are, is an important starting point to further understand what the impact may be. Any emerging industry may also want to draw this baseline in some detail (and in appropriate reference areas) to avoid being blamed for changes in the ecosystem that is not caused by them (but eg climate change). Authorities need to be able to monitor biodiversity change to properly manage activities. Most species inhabiting the deep-sea are not known to science but progress is being made. Examples will be presented from the Clarion Clipperton Fracture Zone in the Pacific Ocean, an area eyed by the mining industry for its resources of metals in demand for electric vehicle batteries.

How may data quality and availability affect policy-making for deep-seabed mining?
Tanja Stratmann

The International Seabed Authority (ISA) has the mandate to oversee current exploration and future deep-seabed mining activities in areas beyond national jurisdiction. In this function, the ISA requires regular environmental baseline studies of the contractors as part of their exploratory surveys and the submission of the geological and environmental data to the ISA. This should lead to an extensive dataset that scientists could use to study the

functioning and resilience of the abyssal ecosystem of the Clarion-Clipperton Fracture Zone (CCZ) in the central Pacific. However, most of these data are not publicly accessible via e.g. the "DeepData" database of the ISA because they are considered confidential. Therefore, the scientific community is (often) unable to study ecological, biogeochemical, geological, and physical-oceanographical differences along the CCZ.
Using own studies, I will show how differences in data quality and availability changes our knowledge about the potential recovery from deep-seabed mining and about carbon cycling in the CCZ which is required for policy making and developing the mining code.

The Elephant in the Room. Mediations of a Heating Ocean in Times of Global Climate Change
Sabine Höhler

Humans are a terrestrial species. Human understanding of the ocean is shallow; the bulk of the ocean remains opaque. The sea can be experienced in some direct ways, for example through fishing, sailing, or sampling, but already the attempt to dive more than a few meters below the waves requires elaborate technology. Our ocean knowledge is mostly mediated. Narratives and literature made the ocean meaningful and communicable in different cultures. The sciences compiled the ocean through arrays of instruments operated from a distance, from sounding devices attached to ships to remote sensing satellites. Technologies of surveying the ocean in breadth and depth created a sense of the ocean as a 'legible' volume. Modern "ocean literacy" was made possible through an ocean of data.

What are the strengths, what are the challenges of our mediated understandings of the ocean? This question needs to be posed since the ocean moved center-stage not only for its wealth of nutrient, mineral, and energy resources and for its increasing exploitation as the planet's largest dumping site. Today, the ocean is increasingly recognized for its climate and ecosystem functions. The ocean has become an object and an agent of global climate change. Considering that we know about ocean environments primarily through collected information, datafied and storified, we need to ask what a mediated ocean makes us see and what it obscures. The paper will pursue this question with the example of the oceanic heat patch which appeared in the Pacific Ocean during the early 2010s. The mysterious pool of warm water developed off the coast of Alaska and triggered algae blooms which became toxic to marine life and humans alike. The so-called Pacific Blob was a novel environmental phenomenon that defied any quick explanation. The blob borrowed from science fiction narratives of an uncanny and unquantifiable mass from the sea threatening to consume marine and human habitats. Science fact created amorphous collections of oceanographic data and temperature readings by satellite to detect and trace the blob as a "Sea Surface Temperature Anomaly" which spread to 100 meters deep and 1,500 kilometres wide. In their own ways, both accounts normalized an alien and inexplicable nature. Together, the accounts made sense of a changing local environment without accounting for its relations to a changing global climate. Any project to apply data to formulate, monitor and support ocean sustainability outcomes, so the paper argues, will have to see over how established formats of mediation distribute forces and effects in the slow disaster of global climate change.

A nuclear sea: synopticity and nuclearity in the International Geophysical Year (1957-1958)
Jessica Lehman

This paper follows the entanglements with nuclearism in the International Geophysical Year (IGY, 1957-1958) to understand how the pursuit of scientific knowledge has colluded in the creation of the ocean as a nuclear environment. The IGY was arguably the biggest scientific project of the 20th century and has significant lasting legacies in a number of geosciences, as well as broader influences on global-scale integrative modeling. The IGY oceanography program was a key development in contemporary understandings of the ocean as a planetary-scale entity, through its central role in the development of synoptic knowledge of the ocean. The IGY's entanglements with nuclearism were central to both its global-scale objectives and synoptic methods. In this paper, I examine two dimensions of IGY's nuclearism: its goal to evaluate the storage of nuclear waste in the sea, and its use of longwave recorders developed in US nuclear tests to develop synoptic understandings of the sea. I argue that both these elements were key to the configuration of the sea as a nuclear environment, albeit one overwritten by scientific knowledge of planetary nature – with implications for contemporary marine environmental politics.

Elisabeth Mann Borgese and the Law of the Sea – histories and futures of ocean governance
Tirza Meyer

In the late twentieth century, as the United Nations struggled to come up with a new legal system for the oceans, one woman saw the opportunity to promote radical new ideas of justice and internationalism. Ocean governance expert Elisabeth Mann Borgese (1918–2002) spent decades working with the United Nations Law of the Sea Convention. Throughout this sprawling series of global conferences, she navigated allegiances and enmities, intrigues and setbacks, fighting determinedly to develop a just ocean order. This talk introduces the book *Elisabeth Mann Borgese and the Law of the Sea* that explores timeless questions of justice and international collaboration and asks whether the extraordinary drive and vision of a single person can influence the course of international law.

The book gives us an opportunity to ponder recent challenges of governing the world's oceans by casting a light on the original ideas that were discussed during UNCLOS III. The delegates at UNCLOS III were not blind to the uncertainty of future developments. The International Seabed Authority was set up in a flexible way with a Preparation Committee as an insurance against an uncertain future. Elisabeth Mann Borgese's initial visions for ocean governance were much more 'holistic' and internationalist than those that later went into the Law of the Sea Treaty. In her first draft of an 'Ocean Regime' she intentionally left a loophole, designing the ocean regime in such a way that it could transform into a world regime. She was convinced that everything in the ocean and also in the world at large was interconnected – and that only a governance system that encompassed the entire planet could meet the challenges the world faced both in her own time and in the future. Based on this idea of a more holistic ocean governance, this talk will also attempt to look at those initial ideas to see whether history can help solve present and future problems with the current fragmented ocean governance system that was inspired by resource distribution and promises of deep sea mining.

Terra/aqueous: vexing vents and amphibious legalities in the Anthropocene
Surabhi Ranganathan

This talk uses the 'vexing' liminality of ocean vents to think about how the law of the sea, and ongoing law-making processes, imagine and configure ocean space and ecologies. It begins with an account of the surprising discovery of vents in the late 1970s, at a time when negotiations over the 1982 UN Convention on the Law of the Sea (UNCLOS) were heading to a close. Vents, being both mineral-rich formations of manganese, copper, iron, nickel, cobalt, gold and silver, and densely inhabited by unique ecosystems (now much sought by biotech and pharmaceutical industries), were a potential gamechanger for these negotiations. They called into question the abstractions and classifications between land and water, life and matter, and mobility and immobility upon which the new law of the sea was being founded. But the discovery came a shade too late, and vents are, if at all, only obliquely comprehended in the UNCLOS text. Their growing importance, not least to different types of extractive interests, has spurred fresh efforts to better describe, classify and regulate the deep ocean. The ongoing processes vis-à-vis Biodiversity Beyond National Jurisdiction at the UN and seabed mining at the International Seabed Authority seek to absorb vents within suitably tailored regimes that can make sense of the particular ways in which new scientific knowledge confronts the existing law of the sea. However, as I will argue, both processes amount to legal 'fixes' that discount the potential that vents offer to open up how we approach the ocean, its history and political economy.

The common heritage of humankind, deep seabed minerals and the governance of data: Current practices at the International Seabed Authority and way forward
Pradeep Singh

Beyond the limits of seabed areas that fall within national jurisdiction lies the international seabed, which comprises more than half of the global seabed area. Since 1970, the international seabed has been "off limits" to claims of sovereignty or any exercise of sovereign rights over its resources. The mineral resources of the international seabed in particular are the common heritage of humankind, whereby all of humanity collectively

own these resources. In practice, decisions relating to the administration of these resources are taken through an international organization with near universal participation (i.e. 167 Member States and the European Union), known as the International Seabed Authority (ISA), which is empowered to act on behalf of humankind. The ISA is responsible to ensure that the exploration and exploitation of these minerals are carried out for the benefit of humankind as a whole, while taking necessary measures to safeguard the marine environment from the harmful effects of mining, and providing for the equitable sharing of financial and other economic benefits derived from such activities. In over 25 years of existence, the ISA has developed regulations for mineral prospecting and exploration, with the latter conferring long-term exclusive rights to explore. Over thirty exploration contractors for polymetallic nodules, polymetallic sulphides, and cobalt-rich ferromanganese crusts are currently in existence covering the international seabed across the Pacific, Indian and Atlantic Ocean. In recent years, the ISA has accelerated its efforts to develop regulations that would soon allow for these activities to transition from the exploration phase to commercial exploitation.

While the deep ocean remains poorly understood and many knowledge gaps still exist, recent scientific findings confirm that the potential environmental harm of seabed mining will be large, and in the case of some impacts, would remain for decades or centuries. The protection of the marine environment from the harmful effects of seabed mining activities is a critical aspect of the ISA regime, and consequently, is the theme that has probably received the most attention so far from Member States, observers, stakeholders, scientific groups, the media and the public. Another crucial aspect that has received less attention, however, pertains to seabed-related data and its governance at the ISA. It is important to note that the availability of reliable and high quality data is essential for a regulator to develop appropriate regulations and standards, particularly those relating to environmental protection. It is also an essential requirement to ensure that contractors are meeting their obligations, particularly with respect to their environmental responsibilities.

Having an accessible ocean includes allowing access to data. The current practice of the ISA on data, which now seems to be deeply entrenched within the regime, makes a distinction between geological (or resource-related) data and environmental data. Geological data collected by prospectors or ISA contractors are considered proprietary – despite the fact that humankind owns the mineral resources but are kept in the dark with respect to its abundance and value – while contracts are required to provide the ISA with environmental data. In effect, the ISA's current practice on this front has allowed for a situation whereby data concerning humankind's commonly owned resources is kept within the hands of a few and treated as a commodity that can be sold or exchanged. This has also left the ISA to be fully reliant on prospectors and contractors with respect to knowledge acquisition, although independent science is now starting to play a role. More importantly, such practices at the ISA have ultimately led to mining activities being pursued with a view to profit and in competition with each other, as opposed to with a view to benefit and in partnership with each other. Instead of ameliorating inequities, this creates more imbalance and appears to contravene the original intentions from over half a century ago that eventually led to the establishment of the ISA. Coming back to present day, it is noted that the ISA's approach to data governance will soon involve another layer, bearing in mind the ongoing negotiations on the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction (BBNJ), which will undoubtedly overlap with ISA interests.

This presentation begins with an overview on deep seabed minerals and the ISA. Following this, the presentation will introduce provisions relating to data (and data confidentiality) under the UN Convention on the Law of the Sea, as well as under related ISA regulations and its strategic plan. Recent initiatives by the ISA, such as the establishment of 'DeepData', the ISA's database will also be covered here. Thereafter, the presentation will turn to address a number of specific themes. First, a distinction between independent marine scientific research, prospecting and exploration activities will be drawn and its important implications explained. Second, the relevance of data insofar as it concerns equity, two aspects – the Enterprise (the entrepreneurial arm of the ISA envisaged to conduct mining activities as independent contractor) and the concept of reserved areas (sites that have been prospected and known to have economic potential that are set aside for the Enterprise and developing countries) – will be explained. Third, issues relating to data governance, in particular, the relevant institutional arrangements and roles and functions of the relevant ISA organs (including who decides on data confidentiality and who will synthesize data provided by contractors into useable knowledge to support and inform decision-making), as well as expertise and transparency concerns, will be discussed. Fourth, the extent to which data have been used in the decision-making processes of the ISA, for instance, with respect to the development of regional

environmental management plans, will be investigated. The presentation will question if recent ISA decisions and measures are informed by data. The theme of baseline data will also be considered, including issues of quality and adequacy, with some perspectives on how such data is currently shared and made publically available, e.g. for scientific purposes or for public stakeholder review. Fifth, the theme of environmental impact assessments, including procedural- and process-related issues, and data generated therefrom will also be discussed. Closely related to this, the aspect of monitoring, including the need to compare data collected subsequently once activities commence against baseline data, will be highlighted. Additionally, a recent proposal by Germany on compulsory test mining, which could prove to be essential in the quest for collecting necessary data to support informed decision-making, will also be examined. Finally, the presentation will end with some concrete recommendations with respect to improving data governance at the ISA, including promoting greater transparency and the establishment of a Data Committee at the Council.

The Politics of Ocean Science Data
Sam Robinson

Data has always been fundamental to knowledge of the ocean. Whilst most publications on the history of ocean data sharing emphasise the element of technical coordination, they often overlook the negotiation (science diplomacy) processes enabling data-sharing. They also tend to emphasise openness in data distribution without considering in sufficient depth obstacles preventing it. The history of marine data is particularly important in this context as it is often portrayed as one of 'collaboration' in data collection and management between Intergovernmental Organisations (IGOs) such as the Intergovernmental Oceanographic Committee (IOC) and non-governmental organisations (NGOs) such as the ICSU Scientific Committee on Oceanographic Research (SCOR), whereas in fact recent literature reveals competing ambitions and tensions (Hamblin, 2005). These tensions shape data sharing regimes, and influence the data that is collected, by whom, and how. What is known about the ocean and by whom is shaped by asymmetries of ocean scientific power.

The data itself is significant here. The literature on the IOC data network - the International Ocean Data Exchange - recalls its significance for elaborating bathymetric charts and improving the understanding of the oceans (Holland, 2006). But this institutional recollection overlooks conflicts on data-collection and networking exercises that paved the way to the contentious debates of the UN Law of the Sea conventions. In that context data was a particularly contentious issue, given that less developed countries viewed greater access to data as enabling "ocean (neo)colonialism" (de Vos, 2020). Their criticism drew on the realisation that in research areas such as ocean oil pollution and marine biodiversity, wider access to oceanographic data would be useful to Global South countries only if coupled with scientific capacity building. Thus, only the provision of scientific instruments to equip local laboratories would shape a need for new data, rather than the supply of already acquired data and, in turn, be of assistance in individual countries' development projects.

Thus, the established rhetoric of ocean data sharing as open and accessible hides the various ocean injustices. For example, sharing data revealing the presence of hydrocarbons within a developing states territorial water without also enabling the marine technology transfer essential to the creation of a local industry for resource exploitation, which has essentially maintained the power of multinational corporations to monopolise ocean industrial development. The historical legacies of ocean science continue to shape and provide challenges to decision making in the contemporary ocean.

Participants

Anna Åberg works as an Associate Professor at the Department of Technology Management and Economics at Chalmers University of Technology. She is a historian of technology, focusing on energy and resource history and she obtained her Ph.D. in 2013 from the KTH- Royal Institute of Technology in Stockholm. She has a strong interest in academic outreach and has organized an academic film festival and several public seminar series, as well as consulted on museum exhibits. Her current research topics includes Swedish oil history, Science diplomacy in fusion research, and gender and energy use.

Thomas Dahlgren splits his time between the research institute NORCE in Bergen, Norway and the University of Gothenburg, Sweden. He is a marine benthic ecologist and invertebrate taxonomist with extensive experience from Nordic seas, polar oceans and the Pacific Ocean. He is currently involved in research projects to better understand how we should monitor environmental change from anthropogenic stressors in the ocean including mineral extraction, offshore wind energy conversion and aquaculture.

Dr. Natalya Gallo is a postdoctoral researcher in the Department of Biological Sciences at the University of Bergen and is an affiliate of the Bjerknes Centre for Climate Research. Her overarching interest is in how climate change impacts deep sea communities and fisheries species and how scientific research can support sustainable ocean management and development. She is a member of the Early Career Ocean Professionals group of the UN Decade of Ocean Science for Sustainable Development and is teaching the University of Bergen course on Sustainable Development Goal 14 during spring of 2022. University website: https://www.uib.no/en/persons/Natalya.Dmitrievna.Gallo

Johan Gärdebo is a historian of science, technology and environment at Uppsala University. He has researched climate transition policies, environmental diplomacy, and technoscientific aid. His monograph dissertation Environing Technology (2019) analysed the role Swedish satellite remote sensing expert's played in articulating political imperatives to monitor and manage a global environment during the late twentieth century. As part of the Mediated Planet project, Gärdebo studies the history of standardising, automating, and digitising environmental data.

Sabine Höhler is an Associate Professor of Science and Technology Studies at KTH Royal Institute of Technology in Stockholm. Her research addresses the intersections of technoscience and environmental history, focusing on the earth sciences in the nineteenth and twentieth centuries in a global historical perspective. Her recent work addresses the history of global environmental governance with case studies on ecological and economic accounting systems, biodiversity management, stress ecology, resilience, remote sensing, and terraforming. Publications include the monograph *Spaceship Earth in the Environmental Age, 1960-1990* (Pickering & Chatto 2015/Routledge 2016) about the spaceship as a key metaphor in the late twentieth-century debate over the world's resources and the future of humankind, and the co-edited theme issue "Writing History in the Anthropocene", with Andrea Westermann, published in 2020 in *Geschichte und Gesellschaft. Zeitschrift für Historische Sozialwissenschaft/Journal for Historical Social Sciences*.

Erik Isberg is a PhD Student at the Division of History of Science, Technology and Environment at KTH Royal Institute of Technology in Stockholm, Sweden. He is currently working on a thesis on the postwar history of paleoclimatology and the temporalities of environmental knowledge, which draws together theory of history, environmental history and history of science. As a part of the ERC project *SPHERE (Study of the Planetary Human-Environment Relationship),* he is also interested in broader questions concerning the scientific and political history of the global environment.

Jessica Lehman is an Assistant Professor of Geography (Human-Environment) at Durham University. Her research interests include international environmental politics, marine geographies, resource politics, and environmental knowledge production.

Susanna Lidström is a researcher in environmental humanities at the Division of History of Science, Technology and Environment at KTH Royal Institute of Technology in Stockholm, Sweden. With a background in literary studies, her research focuses on environmental narratives and their form, function and development over time. She is currently working in the project *The Mediated Planet: Claiming Data for the Environmental SDGs*. Since 2015 she has been based in La Jolla, California as visiting researcher at Scripps Institution of Oceanography. For the academic year 2022-2023 she will be a visiting researcher at University of Oslo, in the project *Maritime Modernities: Formats of Oceanic Knowledge*.

Erik Ljungberg is a PhD candidate at the Division of History of Science, Technology and Environment at KTH. His research grapples with how to render graspable the novel modes of relation between human-beings, the environment, and digital technologies that emerge in the practice of environmental scientists and planners that make use of artificial intelligence. Drawing upon work within the fields of STS, media theory and history of knowledge, he focuses particularly on the application of machine learning within the domains of Earth Observation and remote sensing.

Tirza Meyer is a postdoctoral researcher at the division of history at KTH Royal Institute of Technology in Stockholm. She is a contemporary historian and writer currently working on environmental history, media and the history of underwater technology and she is affiliated with the project *The Mediated Planet: Claiming Data for Environmental SDG's*. She holds a PhD from the Norwegian University of Science and Technology (NTNU) in Trondheim where she has conducted research on the history of the Law of the Sea and transnational governance concepts like the common heritage of humankind applied to the area outside national jurisdiction in the deep ocean. She is currently a visiting scholar at the Oslo School of Environmental Humanities (OSEH) in Oslo and a participant in the international Collaboratory *Medias Seas of the High North Atlantic*.
https://www.kth.se/profile/tirza

Jesse D. Peterson (he/him) is an American from the traditional homelands of the Shoshone, Paiute, Goshute, and Ute tribes near Salt Lake City, UT, and now works as a postdoctoral researcher at the Swedish University of Agricultural Sciences in Uppsala, Sweden. He researches societal relationships to ecological challenges using transdisciplinary methods, having focused on issues related to oceans and biodiversity. His research addresses topics such as the production of biodiversity knowledge and data, ocean health and pollution, citizen science, more-than-human relationships, socio-ecological death, and innovation in research methods, with publications in peer-reviewed journals, edited collections, literary magazines, and museum exhibits, such as *The Digital Environmental Humanities Handbook, Green Letters*, *The Discourses of Environmental Collapse*, *Geohumanities*, *saltfront* and more. Orcid ID: https://orcid.org/0000-0002-0634-8839

Surabhi Ranganathan is Associate Professor, Faculty of Law, University of Cambridge and Deputy Director of the Lauterpacht Centre for International Law. Her writings on the oceans, the history and politics of international law, treaties, and global governance have been published in, among others, the European Journal of International Law, the British Yearbook of International Law, the American Journal of International Law, the Cambridge Law Journal, and the Journal of the History of International Law. Ranganathan is also the author of *Strategically Created Treaty Conflicts and the Politics of International Law* (Cambridge University Press), a study of international legal thought and practice, exploring treaty conflicts in nuclear governance, the law of the sea, and international criminal justice. Her current work seeks to unsettle what we take as the givens in relation to the spatial zones, resource allocations and functional jurisdictions effected by the law of the sea; and extend the history and critique of international law into new areas: ocean depths and bottoms, global commons, marine infrastructures, and techno-utopian imaginaries.

Dr Sam Robinson, Southampton Marine and Maritime Institute (University of Southampton), is a post-doctoral research fellow at the Southampton Marine and Maritime Institute at the University of Southampton. Trained as an historian his research focuses on the oceans, science policy, and the Cold War in British and Globe contexts. He has previously worked at the University of Cambridge, Kent, Aberystwyth, York, and Manchester. He completed a PhD as part of the ERC funded project, The Earth Under Surveillance, focusing on the relationship between ocean science and surveillance in Cold War Britain; see *Ocean Science and the British Cold War State*, Palgrave, 2018. Between 2022-2026 he will be undertaking research as part of the ERC Advance Grant project NEWORLD@A: Negotiating World Research Data: A science diplomacy study. Producing a history of data diplomacy at Intergovernmental Oceanographic Commission.

Pradeep Singh is a doctoral researcher at the University of Bremen and an independent legal consultant. He holds an LL.M degree from Harvard Law School, an LL.M. degree in Global Environment and Climate Change Law from the University of Edinburgh, and an LL.B. degree with first-class honours from the University of Malaya in his home country, Malaysia. Pradeep has published extensively on topics related to public international law; environmental, energy and climate law; the law of the sea and ocean governance. He regularly attends meetings of the International Seabed Authority as an observer delegate, and in his capacity as an independent consultant, provides legal advice to several delegates and parties to international negotiations on technical matters pertaining to deep seabed mining as well as on the conservation and sustainable use of marine biodiversity in ABNJ. Recently, Pradeep assumed the role of Deputy Chair of the Ocean Law Specialist Group at the IUCN's World Commission on Environmental Law.

Sverker Sörlin is a professor in the Division of History of Science, Technology, and Environment at the KTH Royal Institute of Technology, Stockholm, and a co-founder of the KTH Environmental Humanities Laboratory. He also serves as a policy analyst and advisor. Current research interests include the science politics of climate change, the formation of environmental expertise, and the history of global environmental governance. He is the co-author, with Libby Robin and Paul Warde, of *The Environment — a History of the Idea* (Johns Hopkins University Press, 2018), and, with Klaus Dodds, of *Ice Humanities: Living, Thinking and Working in a Melting World* (Manchester University Press, 2022).

Dr. Tanja Stratmann (Postdoctoral researcher and VENI laureate at NIOZ – Royal Netherlands Institute for Sea Research). Dr. Stratmann received a B.Sc. degree in Biology from the University of Bremen (Germany), a M.Sc. in Biology from Aarhus University (Denmark), and a M.Sc. in Statistical Data Analysis from Ghent University (Belgium). From 2014 to 2018 she did a PhD in Marine Sciences at NIOZ (Netherlands) in cooperation with Ghent University in the European multidisciplinary research program “MIDAS” (“Managing Impacts of Deep-Sea Resource Exploitation”). Dr. Stratmann defended her PhD thesis entitled “Benthic ecosystem response to polymetallic nodule extraction in the deep sea” in autumn 2018 for which she was awarded the Paul van Oye-Price of the Royal Flemish Academy of Belgium for Science and the Arts (Belgium) in 2019. Dr. Stratmann’s research focuses on deep-sea benthic ecology, ecosystem functioning, trophic ecology, and food-web modeling, both in anthropogenically undisturbed and disturbed areas. Additionally, she is interested in the role of megabenthic invertebrates, such as sponges, sea stars, brittle stars, or sea cucumbers in nitrogen and carbon cycling.

Adam Wickberg Adam Wickberg is a researcher in the history of media and environment at KTH Royal Institute of Technology, Stockholm. He received his PhD in 2016 from Stockholm University and the Research School in Cultural History. He is currently (2021-2023) a visiting researcher at the Max Planck Institute for the History of Science, dept 1, where he is also a member of the working group Anthropocene Formations. His research addresses media and environment in a broad manner, from historical contexts to current developments of new digital infrastructures and artificial intelligence in relation to sustainability. He is the co-editor of the collection *Environing Media* (Routledge, 2022), a book that probes the new theoretical concept of environing media as an analytical tool that can account for how media produce environmental epistemologies in different

historical times. His work appears in various journals including *Critical Inquiry*, *Global Environmental Politics*, *Necsus: European Journal of Media Studies*, *Resilience, History & Technology* and *Media Theory*.

Nina Wormbs is Professor in History of Technology at KTH Royal Institute of Technology. She has studied media history and digitalisation and recently studied climate change from the view-point of environmental humanities, for example the normativity of scientific assessments and the temporal dimensions of climate change models. Publications include Wormbs & Wolrath Söderberg (2021), "Knowledge, Fear, and Conscience: Reasons to Stop Flying Because of Climate Change", Urban Planning; Wormbs (2019), "Technology Dependent Commons", in Routledge Handbook of the study of the commons; Wormbs (2018), "Sublime Satellite Imagery as Environing Technology", Azimuth; and Wormbs (ed.), Competing Arctic Futures (Palgrave 2018). She communicates research through the daily press and public service radio and she collaborates with society as a member of steering committees and commissions. In 2013-14 she was the public inquirer on digitalisation of radio for the Ministry of Culture.