Polar Record 52 (267): 621–623 (2016). *doi:10.1017/S0032247416000103*

Introduction

Arctic in the Anthropocene: sustainability in a new polar age

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Received February 2016

Foreword

The Arctic provides one of the most striking signatures of climate change impacts. Accelerated loss of sea ice extent and thickness, loss in biodiversity, changing atmospheric circulation patterns, and melting permafrost portray only a few aspects of a rapidly changing Arctic. In recognition of the inter-, multi-, and trans-disciplinary (Keil 2015) discussions, tools, mechanisms, and implementation strategies necessary to address these challenging and pervasive issues of this century, the first Potsdam Summer School, entitled 'Arctic in the Anthropocene', took place in June–July, 2014. The summer school was coordinated by the Institute for Advanced Sustainability Studies (IASS), the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research (AWI), the GFZ German Research Centre for Geosciences, the Potsdam Institute for Climate Impact Research (PIK), and the University of Potsdam, in conjunction with the city of Potsdam. The principal vision of the summer school was to eliminate disciplinary language barriers, and to foster communication amongst individuals trained in law and international relations, public health, and science, with the goal of extending an integrated science-policy dialogue for the benefit of humanity, the planet that we inhabit, and for which we share a collective responsibility.

Central to the Potsdam Summer School (PSS) theme was the narrative of a shared responsibility to recognise the Arctic and its inhabitants as being integral to the development of a comprehensive scientific, social, and legal framework for climate change adaptation and mitigation at the international, national, and local level of governance and implementation. Reflecting the spirit of Potsdam itself, thriving within a vibrant cultural, scientific, and intellectual mandate and vision, the school advocates elimination of barriers between disciplines to address the challenges of a rapidly changing Arctic through dialogue, development, and implementation of a collective vision for climate change solutions. One element of such a vision is to interpret and communicate the scientific evidence of climate change in the Arctic to date to global citizens and institutions such as has been done through the Arctic Climate Impact Assessment (ACIA) and International Panel on Climate Change (IPCC) reports. A second element is to synthesise existing policies and legislation within an international framework pertaining to industrialdevelopment in the Arctic, and identify priorities requiring immediate attention. A third and key element is to develop and present recommendations together with stake- and rights-holders attached to which, in contrast to an era of reports and recycled recommendations, is an implementation programme and timeframe.

Subsequent elements of such a vision must re-examine our role in defining our self-inflicted era, the Anthropocene, an age as the 'geology of mankind' (Crutzen 2002; Steffen and others 2007). Of particular importance is the recognition of the narrative founded on our collective responsibility as global citizens to mitigate our impacts and create new adaptive capabilities within Anthropocene age that we have created, and to act on that recognition. Decades of reports, warnings, meetings and discovery underlining and providing evidence for the impacts of climate change have shown that discussion on its own, although necessary to integrate and cultivate ideas, is insufficient for action on climate change. Additional research, although necessary to understand physical mechanisms responsible for observed phenomena, is insufficient on its own to address climate change. Recommendations and international legislation are also insufficient in the absence of an implementation strategy and monitoring programme to address the challenges incurred by climate change.

The summer school began with a discussion of the term 'Anthropocene' which is increasingly being

recognised as a new geological time period wherein human activities have a substantial impact on the Earth system. During the first week of the programme, several experts shared their knowledge about the fundamentals of Earth system dynamics, in order to help participants understand the complexity of the system and related processes from natural and social science, specifically from governance standpoints. Topics that were covered during the first week included sea-ice developments, land-atmosphere interactions, climate system dynamics, ecological and environmental risks, marine Arctic governance, the political Arctic, and the role of resources in the Arctic. The second week of the programme launched discussions on science-policy aspects of the changing Arctic, science communication, and sustainable development. Participants were challenged to apply their newly acquired knowledge by engaging in a role-playing exercise around planning for sustainable future in the Arctic. The school concluded with the recognition of the idea of 'shared responsibility' between Arctic inhabitants and visiting scientists, among researchers, between agencies, among nations, and across disciplines.

Following the conclusion of the summer school, several participants were engaged in continued discussions about the Arctic. This special issue and the articles described below are a result of those sustained interactions among participants.

In the review article 'Ethical communication to guide climate policy decisions in the Arctic', Mona Behl highlights challenges and measures that are essential for responsible communication for effective decision-making on climate-related issues pertaining to the Arctic. This article defines ethical communication as 'articulation of climate change information and uncertainty, in addition to implications of responses to climate change', and underlines the importance of training to bridge the gap in terminology and language between the disciplines of science, law, and journalism. The article further advocates a 'participatory model for decision-making', integral to effecting change through a sense of collective responsibility and addressing climate change challenges.

The science of climate change in the Arctic, and in particular contaminant transport due to industrial activity, is presented in 'Distribution of polycyclic aromatic hydrocarbons (PAHs) in snow particulates around Longyearbyen and Barentsburg settlements on Spitsbergen Island' by participant Anna Ambramova and her colleagues Sergei Chernyanskii, Nataly Marchenko and Elena Terskaya. In a novel investigation of pollutant sources at two locations on Spitsbergen, results showed dominant contributions from local sources due to fuel combustion and industrial activity, underscoring the importance of the recent International Energy Agency's recommendation to reduce the number of coal-fired power plants in its report outlining four measures for success at the COP21 negotiations (International Energy Agency 2015). This study of PAHs further underscores the need for long-term environmental monitoring to identify relative local and non-local contributions from harmful contaminants.

Military security within an increasingly accessible Arctic is explored in 'Defining security in a changing Arctic: the need to prevent an Arctic security dilemma' by Marzia Scopelliti and colleague Elena Conde Perez. The need for confidence and security-building measures to avert conflict and ensure stability in the Arctic is highlighted. Potential forums that would enable institutional modernisation in the context of military issues are also discussed. Recommendations include incorporation of confidence- and security-building measures (CSBMs) into the Arctic Council mandate to ensure that all aspects of security in the Arctic be addressed within existing organisational and cooperative entities to ensure regional and international stability.

The concept of critical environmental security is presented in 'Securing sustainability – the case for critical environmental security in the Arctic', by Wilfrid Greaves. This article argues that transformation of the existing social and political framework responsible both for a militarised perception of security and human-induced climate change is essential for ensuring a sustainable and secure Arctic future. Recommendations highlight the pivotal role to be played by the concept of critical environmental security in ensuring a sustainable future. This study further emphasises the need for circumpolar nations and non-Arctic states to recognise limitations inherent in a sectoral interpretation of security, and to develop policies predicated on 'imagining alternative futures' that question the applicability of current political and social structures and frameworks in a changing climate. The article further recognises the need to create policies focused on a decarbonised economy and limits to industrial expansion in the Arctic that intensifies, rather than mitigates, climate change impacts and international insecurity.

In 'Articulating the Arctic – contrasting state and Inuit maps of the Canadian North', participants Mia Bennett, Rudy Riedlsperger, Wilfrid Greaves, and Alberic Botella illustrate the role of maps in domestic interpretations of the Canadian Arctic. They focus specifically on the implications for communities located at the periphery of ill-defined and static boundaries within an internationally evolving definition for the Arctic described not only by geographic boundaries, but also by a changing social, cultural, and political landscape. A comparison of government maps predicated on politics and resource extraction with Inuit maps focusing on the Inuit homeland and connection with land, water, and sea ice, highlights an exclusion of indigenous knowledge under the former Harper government. Recommendations include a call for efforts to ensure that indigenous knowledge and perceptions of the Arctic-north as a homeland play a pivotal role in decision-making and sustainable development of an evolving social, cultural and political region defined by its inhabitants. Military security within an increasingly

accessible Arctic is explored in 'Defining security in a changing Arctic: helping to prevent an Arctic security dilemma' by Marzia Scopelliti and colleague Elena Conde Pérez. The need for confidence and security-building measures (CSBMs) to avert conflict and ensure stability in the Arctic is highlighted. Recommendations include the incorporation of CSBMs into the Arctic Council mandate to ensure that all aspects of security in the Arctic be addressed within existing organizational and cooperative entities to ensure regional and international stability.

A further article is included with a commentary entitled, 'The whys and hows of a cooperative mechanism for the Arctic marine environment' by Bill Eichbaum in collaboration with Brooks Yeager, Alexander Shestakov, and Postdam participant Marc-André Dubois. In this commentary, a framework and cooperative mechanism is proposed under the auspices of the Arctic Council that will ensure implementation of priority issues in partnership with member states and communities, in keeping with the PSS mandate and philosophy: to ensure a translation from knowledge to action to ensure a sustainable future for the Arctic and by extension, the planet.

As this introduction of the special issue evolved, so too did the COP21 negotiations in Paris in December 2015 predicated on a concerted effort by the international community to constrain global warming to less than 2 degrees Celsius and, as recently-elected Canadian Prime Minister Trudeau articulated in his address to the COP21 delegation, 'discover the opportunities in addition to the challenges associated with climate change'. This *Polar Record* special issue, as a culmination of perspectives and proposals dedicated to sustainability in the Arctic, reflects the transition from an idea conceived at the Potsdam Summer School, 'Arctic in the Anthropocene', to a collaborative endeavour to seek solutions, act on recommendations, and discover the opportunities that will ensure a sustainable future for the Arctic and international community.

This special issue is our call to action for a sustainable Arctic and global future.

Acknowledgements

The authors wish to thank the participants of the Potsdam Summer School 2014 for their initiative and enthusiasm to carry on the debate and collaboration on Arctic sustainability issues in the age of the Anthropocene. This is also to thank, on behalf of all Potsdam participants, Kathrin Keil and Angela Borowski for planning and coordinating the summer school, and lecturers who provided advice and knowledge essential to the summer school theme.

Financial support

This research received no specific grant from any funding agency, commercial or not-for-profit sectors.

Conflicts of interest

None.

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