

Arctic Frontiers 2011

Introduction

Arctic Frontiers holds its 5th annual conference in Tromsø, Norway, entitled *Arctic Tipping Points*, which is composed of a policy conference and a scientific conference. This call for papers addresses the Scientific Conference.

The scientific conference of Arctic Frontiers 2011, taking place from 26-28 January in Tromsø, is given the title of

The Arctic in the Earth System perspective: the role of tipping points

The scientific conference is divided into 3 parts: 1. A joint and multi disciplinary first day with 10 invited speakers ending with a panel and plenum debate; 2. Four parallel sessions (included a poster session) on the second and third day; 3. a summary session ending with a plenum debate

The parallel sessions address 4 connected, interwoven and interdisciplinary themes:

- Ice-ocean-atmosphere interactions in the Arctic
- Marine ecosystems and fisheries
- Socioeconomic and institutional perspectives
- People of the North

Background

The Arctic is an important part of the Earth System that can be defined as the conglomerate formed by human civilization and its planetary matrix (i.e. all parts of the Earth that interact with the members and manifestations of humans). Based upon an Earth System perspective the science part of the 2011 Arctic Frontiers conference wishes to focus upon the role of thresholds, tipping elements and tipping points in the Arctic, in particular the Arctic Ocean. We do so, convinced that it is timely to focus upon the non-linearity of processes. Unforeseen, rapid changes, i.e. tipping points, can be observed everywhere, but do hardly become a part of management strategies. In order to be prepared and to look for bellwethers of close to be reached tipping points, it is thus of general importance that science, society and management look for tipping elements, include the concept of tipping points. Tipping points experienced during the recent bank crisis or the decline of the cod fisheries in eastern Canada decades ago are significant elements of what we could call the extended Earth System and are examples of the far reaching significance that non-detected tipping points have on the livelihood of humans. To highlight tipping elements and tipping points and to increase the awareness for rapid and at time irreversible changes in the domain of the Arctic is the main goal of the conference.

The science conference is organized by a cooperation between the ARCTOS network (<http://www.arctosresearch.net>) and the FP7 EU project Arctic Tipping Points (ATP) (<http://www.eu-atp.org>). The science conference starts after the political section of the conference has come to an end (24-25/1 2011). The program for this part of the conference is not ready as yet, but a visit at <http://www.arctic-frontiers.com> provides an impression from the four years that Arctic Frontiers has been scheduled. To participate during the

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entire conference is highly recommended and the political part is a fine introitus to the highly interdisciplinary nature of *The Arctic in the Earth System perspective: the role of tipping points*. The background of the main organizer ARCTOS is, for the most, natural science. However, ATP is an interdisciplinary project and the conference reflects the dedicated desire of Arctic Frontiers to be highly interdisciplinary.

There is mounting evidence that institutional, economical, political and climate systems as well as ecosystem response to pressures often involves abrupt, non-linear responses leading to regime shifts. Such non-linear responses often derive from qualitative changes in the structure or function of system, such that the response of impacted ecosystems to pressures is no longer the same as that of the original ecosystem. Regime shifts arise, for instance, from introduction of alien species or the loss of key species in the ecosystems, which may alter the structure and flow of matter through the food web or the patterns of space occupation; and changes in the fundamental processes that regulate organismal functions. Climate drives many key organismal functions and it, thus, hardly surprising that marine ecosystems often display climate-related regime shifts, leading to major shifts in community structure.

Arctic ecosystems are particularly likely to show regime shifts in response to climate change because (1) loss of ice represents a loss of critical habitat that may induce major qualitative changes in the species composition, through the loss of ice-related species, in the ecosystems and causes major changes in the underwater light and turbulence environment affecting ecosystem function (2) warming of polar ecosystems allows their invasion by species opportunistically extending their latitudinal range toward polar latitudes and because of the major effect of temperature on the physiological and life-history traits of the organisms present. Because the Arctic is warming about three fold faster than the global rate, Arctic ecosystems are likely to encounter climate-driven thresholds and tipping points leading to abrupt changes much sooner than other ecosystems will, as the spectacular recent acceleration of Arctic ice loss suggests. Indeed, the Arctic ice sheath has been identified as one of the key tipping elements in the world climate system, and the Arctic climate is particularly vulnerable to abrupt climate change. Establishing where these ecological thresholds and tipping points are for regime shifts of Arctic ecosystems forced by climate warming is, therefore, a matter of urgency.

Historical examination of the impacts of climate change on Arctic marine ecosystems has shown that such climate-induced change, for example those reported in the waters around Greenland, have major consequences for fish catches. In a situation where the status of many living marine resources is precarious, abrupt ecosystem changes may have major socioeconomic consequences. Similar vulnerabilities affect other economic activities dependent upon marine ecosystem services, such as Arctic tourism. These activities are particularly vulnerable to abrupt, climate-driven changes to marine ecosystems, and face major challenges in adapting to the new conditions. In the high North, this applies in particular to fisheries, but also to tourism and oil and gas extraction. Management of these activities is nested into larger, global ones, affecting the ability of Arctic states to adapt to change. The institutions and policies act on varying situations from year to year, but up to now annual changes in Arctic management conditions have not been significant. Lessons

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could be drawn from other management systems that have experienced major shifts in recent history (as for example the Northwest Atlantic, Bering Sea Area). The development of a management plan for activities in the Arctic Seas that accounts for abrupt ecosystem changes represents a major institutional experiment on how to address abrupt changes in the Arctic marine ecosystem. The challenge lies in developing managerial models that can help discount anticipated risks and at the same time profit from emerging opportunities. The success of these models is dependent on two key factors, the availability of reliable scientific forecasts on the future changes of Arctic marine ecosystem in response to climate change, and the existence of viable models and conduits to efficiently and reliably transfer this knowledge into managerial and political frameworks.

When illuminating these critical processes and looking for answers to these questions, it is natural to search for the most vulnerable Earth System components, i.e. those characteristic features that will be switched on or off as the planet warms. Despite its youth, the tipping elements field is developing quickly into a broad and relevant research frontier domain. Building upon on-going large, integrated projects (THRESHOLDS and DAMOCLES FP6 IPs, and ARCTOS) the project Arctic Tipping Points (ATP) will identify the elements of the Arctic marine ecosystem likely to show abrupt changes in response to climate change, and will establish the levels of the corresponding climate drivers inducing regime shift in those tipping elements. In addition, state-of-the-art oceanographic, ecological, fisheries, and economic models will determine the effect of crossing those thresholds for the Arctic marine ecosystems, and the associated risks and opportunities for economic activities dependent on the marine ecosystem of the European Arctic.

Structure of conference

Science conference organisers: Paul Wassmann (ARCTOS, Norway), Carlos Duarte (ATP, Spain), Dorte Krause-Jensen (ATP, Denmark), Elisabeth Halvorsen (ARCTOS, Norway)

Arctic Frontiers will invite ten keynote speakers to present the basic concepts and understanding on thresholds, tipping points and regime shifts in the Earth System of the Arctic Ocean, in particular on sea ice and oceanography, marine ecosystems and fisheries, socioeconomic and institutional issues and the sustainable living conditions of the people of the North. The invited speakers will provide a comprehensive and geographically balanced perspective on the selected topics. Among the invited speakers are Timothy Lenton (UK), Oran Young (USA), Carlos Duarte (SP), Carl Folke (SE), Aqqualuc Lynge (Greenland) and Jean-Pierre Gattuso (FR).

These multidisciplinary lectures are followed by four science sessions, all focusing upon a changing Arctic and earlier or future tipping points:

Ice-ocean-atmosphere interactions in the Arctic

Convenors: Peter Wadhams, ATP/University of Cambridge/UK; Nalan Koc, ARCTOS/Norwegian Polar Institute/Norway; Cecilie Mauritzen, Meteorological Institute/Norway

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Over the past three decades a major transition has occurred in the Arctic, relating to the role, and the response, of ice, both in the sea and on land. On land the winter snowline has retreated northward, decreasing the regional average albedo and changing moisture fluxes. The greatest continental ice sheet in the north, that of Greenland, has begun to melt in summer for the first time, and now after a decade its accelerating rate of melt has made it a serious contributor to global sea level rise.

But it is in the ocean that the biggest changes have been seen, in the accelerating retreat of Arctic sea ice, particularly in summer, such that the Arctic Ocean in late summer now has a substantial ice-free area. The ability of present climate models to predict the most recent changes has been proven to be inadequate, but it is unclear whether the structure of the models is wrong or that certain physical processes involved in sea ice-ocean-atmosphere interaction in summer are simply not understood adequately. To better predict future climate we need better earth system models that describe the earth-ocean-atmosphere-ice interactions. We need to understand the individual components through process studies as well as their interactions and determine the parameters that quantify the processes described by the models. This will tell us whether the retreat of sea ice, and the melt of ice sheets and snow, are indeed "tipping elements" that are destined to be irreversible changes.

Marine ecosystems and fisheries

Convenors: Susana Agusti, ATP/IMEDEA/Spain; Marit Reigstad, ARCTOS/University of Tromsø/Norway; Ken Drinkwater, Institute of Marine Research/Norway

In this session, papers on critical tipping points for marine ecosystems are sought. This covers all aspects of marine ecosystems from tipping points related to biogeochemistry such as acidification, to tipping points determining phytoplankton and zooplankton productivity. Of particular interest are examinations of tipping points for marine fish populations as well as for marine mammals and seabirds. While there is special interest on determining tipping points for major ecosystem shifts, studies of tipping points for particular trophic levels, species or between compartments such as pelagic-benthic realms, are also welcome. Presentations analyzing historical data involving major regime shift or ecosystem switch to determine possible tipping points that triggered the shifts are particularly relevant. In addition, modeling studies that seek to identify present and future tipping points in marine ecosystems are also welcome. The tipping points may be related to bottom-up or top-down forcing, be climate or fisheries induced, associated with contaminant levels in the water, invasive species, or due to species interactions within the ecosystem.

Socioeconomic and institutional perspectives

Convenors: Ann-Sophie Crépin, The Beijer Institute of Ecological Economics, Sweden; Alf Håkon Hoel, Institute of Marine Research/Norway; Christel Elvestad, Nordland Research Institute/Norway

The objective of this session is to discuss the socioeconomic and institutional implications of rapid change in the Arctic. Although different from region to region in the Arctic, climate change is likely to have wide-ranging effects on the physical systems and the Arctic marine

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environment. A variety of economic activities in the Arctic are critically dependent upon the Arctic marine environment. Fisheries, marine transportation, the utilization of petroleum resources, tourism and science all potentially see their working environment changed.

The fundamental aspect of the Arctic governance system is that of the 8 Arctic states. These are party to a large number of international agreements that apply in the Arctic. The institutional capacity of this governance system to respond to future rapid changes is a critical issue.

We invite papers that address two issues:

- socioeconomic consequences and responses to rapid changes, at all levels from community to Arctic-wide
- institutional capacity to address the emerging challenges of rapid change

People of the North

Convenors: Bob Correll, Ealat/Global Environmental & Technology Foundation/USA; Grete Broderstad, ATP/University of Tromsø; Aqqualuk Lyngø, ATP/Inuit Circumpolar Council/Greenland

The Objective of this Session: Describe and discuss roles of a changing climate and the consequences of socioeconomic changes guided by the potential for tipping points/abrupt changes affecting Arctic communities and peoples' well being across the Arctic region.

Session Format: We urge submittals that go beyond the normal scientific papers and poster sessions, with innovative formats to creatively explore the issues of potential for tipping points affecting Arctic communities and peoples' well-being across the region.

Framing the Fourth Session: Planet Earth has had a 10,000 year period of remarkably stable climate since the last glacial period, during which humankind has develop dramatically, establishing agriculture, the concepts of geopolitical systems, and moved to a stone age to the 21st century. During this period, global oceans and terrestrial surface temperatures have varied less than 1 OC (IPCC 2007), yet there were two significant warming periods (i.e., the first during Mesopotamian Era and the second during Medieval times) as well as a "little ice age," all of which occurred during this stable climatic period and affected social systems. Current projections of climate change for the Arctic region, suggests temperatures well in excess of 6 OC (IPCC 2007). Paleo-climate studies indicate the presence of climatic "tipping points" or abrupt climate change which occurs when the climate system is forced to cross some threshold, triggering a transition to a new state at a rate determined by the system itself and faster than the cause" (NRC, 2002). Many other abrupt climatic changes have been observed in paleoclimate records (Lenton 2009, <http://researchpages.net/ESMG/people/tim-lenton/tipping-points/> and Kriegler, et al 2009). The socioeconomic sciences have increasingly documented tipping points/abrupt changes in human systems (e.g., Gladwell and others have outlined tipping points in epidemics, financial systems, human behaviour, governmental processes, and responses to political interventions). It is clear that the human dimensions of abrupt changes are receiving increased attention (e.g., NSF 2009, <http://www.nsf.gov/geo/ere/ereweb/advisory.cfm>).

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Young (2009), for example,¹ suggests that there are good reasons to believe that recent development have pushed the Arctic region across a threshold triggering state change that should be taken into account in efforts to address Arctic issues effectively today and in the near future. The forces at work now involve a combination of biophysical developments and socio-economic occurrences (ibid).

Invitations to Submit Content for the Session: This Fourth Sessions is designed to explore these issues through submitted papers, panels, roundtable discussions, poster sessions and other venues suggested by submitting author(s). We urge submittals that go beyond the normal scientific papers and poster sessions, with innovative formats to creatively explore the issues of potential for tipping points/abrupt changes affecting Arctic communities and peoples' well- being across the region.

In the session on *People of the North* we invite authors, inter alia, to address issues like:

- How do tipping points or abrupt changes affect cultures and human well-being – e.g. are tipping points in the Earth System, at global and local scales, challenging the socioeconomic foundations of indigenous cultures and northern societies?
- How do tipping point or abrupt changes in ecological and natural systems impact important natural resources, the environment and the health of Arctic peoples?
- Are there governance issues or historic rights of indigenous peoples that are impacted by tipping points or abrupt in the Earth systems, at any scale?
- What are the prospects of identifying ecological and social thresholds in Northern communities?
- What role could the integration of traditional knowledge play in order to anticipate tipping elements and tipping points or abrupt changes?

Processes to Submit Candidate Elements for the Fourth Session: Please submit your ideas, suggestions for formatting the session and for candidate papers/panels/poster session/etc proposals to the chairs of this session.

Important dates

Interested scientists are invited to submit abstracts to one of these four sessions for both oral and poster presentations. Please study the Arctic Frontiers web site <http://www.arctic-frontiers.com>

- 1/6 Abstracts submission on web open
- 25/10 Deadline for submission of abstracts
- 4/11 Letter of acceptance or rejection for abstract (oral, poster)
- 5/11 Programme compilation

¹ Young 2009: The Arctic in Play: Governance in a Time of Rapid Change. *The International Journal of Marine and Coastal Law* 24 (2009) 423-442. Other references can be supplied, but may not be essential to this announcement.

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Instructions for abstract submission

- All fields are required
- Please select a presentation type
- Complete the names of all authors, highlighting the presenting author in **bold**
- Please use superscript numbers to indicate the authors' institutes.
- Author format should follow: Surname, Initials e.g. **Berge J¹**, Schander G² & Johnsen G³
- List the institute address of the authors.
- The address format should follow: Department, Institute name, City, State/County, Postal code, Country. e.g. ¹Research Department, Akvaplan-niva, Polar Environmental Centre, 9296 Tromsø, Norway
- Include the email address for the presenting author only.
- Abstract text should not exceed 400 words.
- Please send your completed form to arntraut.gotsch@akvaplan.niva.no with the title of the email *Abstract for Arctic Frontiers 2011 and session title*

The official language will be English. Conference updates, programmes, etc. will be posted on this web site as information becomes available.

If you have any questions, please do not hesitate to contact Arntraut Götsch (arntraut.gotsch@akvaplan.niva.no).

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Conference time scheme

Wednesday, 26/1

09:00 Introduction (Conference convenors)
09:15 Invited speaker I
09:45 Invited speaker II
10:15 Invited speaker III
10:45 Break
11:00 Invited speaker IV
11:30 Invited speaker V
12:00 Lunch
13:00 Invited speaker VI
13:30 Invited speaker VII
14:00 Invited speaker VIII
14:30 Break
14:45 Invited speaker IX
15:15 Invited speaker X
15:45 Break
16:00 Panel debate
17:00 End

Thursday, 27/1 (4 parallel sessions)

09:00 Introduction (Session convenors)
09:15 Invited talk 1
09:45 Talk 1
10:05 Talk 2
10:25 Talk 3
10:45 Break
11:00 Talk 4
11:20 Talk 5
11:40 Talk 6
12:00 Lunch
13:00 Invited talk 2
13:30 Talk 7
13:50 Talk 8
14:10 Talk 9
14:30 Talk 10
14:50 Break
15:05 Talk 11
15:25 Talk 12
15:45 Talk 13
16:05 Poster session
18:00 End

Friday, 28/1 (4 parallel session)

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09:00 Invited talk 3
09:30 Talk 14
09:50 Talk 15
10:10 Talk 16
10:30 Break
10:50 Talk 17
11:20 Talk 18
11:40 Talk 19
12:10 Talk 20
12:30 Lunch
13:30 Discussion in 4 sessions
14:30 Break
14:50 Presentations of 4 sessions in plenum
14:50 Sea ice and oceanographic perspectives
15:05 Marine ecosystems and fisheries
15:20 Socioeconomic and institutional perspectives
15:35 People of the North
15:50 Break
16:00 Panel debate
17:00 Final words (conference convenors)
17:15 End