

Summary of Meeting of AMAP Climate Expert Group
February 15-16, 2006
Oslo, Norway

AMAP Climate Expert Group

Purpose of Group: Provide expert advice to the AMAP Working Group as it plans its future activities related to climate in the Arctic. The first priority is to help shape the AMAP scientific response to the ACIA report. Future activities could include planning and conduct of assessment activities, and other activities to be determined. A second responsibility may be to provide advice to a larger set of Arctic Council activities, but this is still to be determined.

Meeting Goals

1. Review results from AMAP Climate Workshop of June 2005, which included a review of recommendations from the ACIA
2. Brainstorm possible AMAP actions in response to ACIA and workshop report
3. **Identify a number of feasible, high payoff activities that can be accomplished in the near term**
4. **Identify a number of more complex yet highly important activities that need further development and possibly partners**
5. Review the current AMAP climate monitoring plan and decide on a means for updating it post-meeting (Need to make it compatible with GCOS Implementation Plan for example)
6. Review EU “indicator-based assessment” document

AMAP Climate Expert Group (CEG)
First Meeting
February 15-16, 2006
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Agenda

1. Introduction of Attendees and Purpose of Meeting – John Calder
2. Statement from CEG co-Chair – John Walsh
3. Review of AMAP ACIA workshop of June 2005 – John Calder
4. Discussion of AMAP ACIA workshop outcome – John Walsh
5. Brainstorm session – John Walsh (could be preceded by a quiet reading time if needed)
 - a. Establish sub-groups if desired
 - b. Opportunity for individual presentations
 - c. Discussion of high priority activities based on feasibility, scientific payoff, etc (example Carbon Cycle Workshop)
 - d. Strategy for taking action on priority activities (interaction with other groups and plans, proposed IPY activities, etc)
 - e. Suggest possible lead countries for priority activities
 - f. Identify key contacts in other groups
6. Establish process for updating AMAP Climate Monitoring Plan – John Walsh
7. Discussion of other ways in which CEG can contribute – John Calder
 - a. Advisory to Arctic Council “Focal Point”
 - b. Planning for AMAP-CAFF joint monitoring
 - c. Support the IPY Secretariat
8. Relation of AMAP CEG to adaptation, vulnerability, etc. issues – John Walsh (defer to next meeting, develop actions to follow the synthesis of IPCC report)
9. Summary of action items and plans for the future

Summary of action items and plans for the future

1. AMAP to circulate materials developed at CEG meeting to AMAP HODs and all members of CEG, asking for comment and changes (response to entire CEG and to AMAP Secretariat by March 20, 2006; documents revised by Editor to AMAP Secretariat by April 1, 2006. CEG co-Chairs can polish the entire set of documents as soon as possible thereafter.)
2. CEG members to review existing AMAP Climate Monitoring Plan and recommend changes (response to AMAP Secretariat by April 1, 2006) (Capture USGS and Zackenburg experience with existing AMAP plan)
3. AMAP WG in late June will consider the CEG recommendations for ACIA follow-on actions and changes to the AMAP Monitoring Plan and adopt those that it can support. Identification of “lead countries” for various tasks will be done. The AMAP WG will submit a report and proposed actions to SAO/Ministers in August for approval at Ministerial meeting in October.
4. CEG will be asked to review during April, the “State of the Arctic Report” (20 pages) being prepared in the US. Comments due in about 1 month.
5. Andreas and Mikkel will plan to attend the Focal Point meeting on Feb. 24 in CPH.
6. AMAP WG meeting in late June in Groningen – co-Chairs of CEG should plan to attend.

Possible ACIA Follow-On Tasks Proposed by the CEG
(Name of Principal Editor)

1. **State of the Arctic Report (Jim Overland)**
2. Arctic Carbon Cycle workshop/assessment (Terry Callaghan)
3. **Establishment of climate “observatories” (terrestrial, marine, atmospheric) and coordination of existing observation activities (Terry Callaghan)**
4. Model/Data Harmonization in Support of Reanalysis of Environmental Data (Oleg Anisimov)
5. Downscaling Climate Models (Inger Hansen-Bauer)
6. Review/synthesis IPCC-4 models and information (Vladimir Kattsov)
7. **Encourage better use of paleo-data and older instrumental/human observations to extend Arctic climate history (Tom Armstrong)**
8. **Greenland ice sheet/Arctic glaciers observations/mass balance (Andreas Ahlstrom)**
9. Assess IPY projects and, eventually their results to define legacy observation programs (Included in No. 3)
10. Review existing climate-related observations plans to define most basic set of observation requirements – (Included in No. 3)
11. Coupled UV/Biological Monitoring (Georg Hansen)
12. Consideration of impacts, adaptation issues – defer
13. Contaminant pathways as altered by climate change – seek a champion to work via email – may be a research topic at this time
14. Climate Change and Human Health Issues (Jon Odland)

State of the Arctic Report (Editor – Jim Overland)

The purpose of this product is to provide annual updates on changes occurring in the Arctic based on multiple indicators derived from recent atmospheric, oceanographic, sea ice, land and ecosystem data relative to longer time records. This provides a follow on to the basic environmental information in the ACIA Report, some of which is 5 years old. In particular some of the conditions in the Arctic have changed since then, including regions of major anomalous warm temperatures and associated impacts. Such information provides the ability to track the regions with abrupt change and shifts in the structure of the Arctic climate/ecosystem as a whole.

Under USA sponsorship a State of the Arctic Report is being prepared by an international group of scientists, with a primary focus on the physical system. The Report will be completed by April 2006. It is proposed that this Report be vetted by the AMAP Climate Expert Group (CEG) and be made available as an AMAP product by early summer. This would also provide the CEG a common basis of information for providing advice.

Future activities would include a scientific conference session on Arctic change in October 2006, soliciting broad participation and submissions. In 2007 the data from the first report would be updated and information of the state of **marine and terrestrial ecosystems** would be added. The Report in 2008 would include a summary statement about the future of the Arctic based on a review **and synthesis of material from the IPCC** fourth climate assessment for the Arctic; the source of this information will be from other activities of the CEG.

Assessment of Arctic Carbon Cycle (Editor – Terry Callaghan)

AMAP should focus on two strategies initially:-

1. Holding the proposed workshop on the assessment of the Arctic carbon cycle
1. Reviewing current monitoring, process studies, and models addressing the carbon cycle

1. Holding the proposed workshop on the assessment of the Arctic carbon cycle

Ensure that the assessment is multi and interdisciplinary. It should include terrestrial (tundra, boreal forest), marine, cryosphere (terrestrial permafrost and shelf hydrates), atmosphere.

Focus on carbon stocks and fluxes and particularly on transport of carbon between permafrost, terrestrial, freshwater, marine, as well as between the Arctic and the globe.

Ensure inclusion of extreme events such as forest fire, insect pest outbreaks, thermokarst as well as carbon sequestering processes (sedimentation) as well as release to the atmosphere.

Ensure that the assessment compares carbon dynamics in terms of fluxes and radiative forcing of CH₄ and CO₂.

Ensure that recommendations for mitigation of climate change through carbon sequestration (point D) address the opposing effects of reduced albedo and other environmental impacts..

Recommend that a group with wide expertise starts planning as soon as possible, but that the workshop/assessment is held in 2007/2008 when new data is available and a significant advance from recent assessments can be made. (Iceland carbon meeting, ACIA report)

2. Reviewing current monitoring, process studies, and models addressing the carbon cycle

Establish year-round and long term flux measurement activities at existing environmental observatories and seek alternative methods to ensure wider geographical coverage (e.g. temporary, mobile chambers and flux towers, and remote sensing techniques).

Identify needs for greater process understanding, facilitate modelling of current and future carbon dynamics and assess (for example through the planned workshop), the current state of the Arctic's carbon balance across all domains (marine, terrestrial cryosphere etc)

Review IPY projects and ensure coordination of new studies and monitoring of carbon dynamics, and particularly legacy in terms of securing data and continued measurements. This relates to the recommendations from the "Observatories" group

Establishment of "Climate Observatories"

Editor – Terry Callaghan

Subgroups and tasks:

3 - Climate "Observatories" (terrestrial, Marine, atmospheric) and coordination of existing obs activities.

9 - Assess IPY projects and eventually results to define legacy observation programs

10 - Review existing climate-related observations plans to define most basic set of observation requirements

Participants in subgroup:

Hans Tømmervik, Jon Børre Ørbæk, Bogi Hansen, Oleg Anisimov, Alexander Klebikov, Einar Sveinbjørnsson, Aapo Tanskanen, Terry Callaghan, Mikkel Tamstorf

Resumé:

Observatories have been defined in the AMAP report from June 2005 on page 26A (Box1). This definition could include satellite platforms.

Several initiatives and products should be used for the definition of the future role of the observatories – AON, COMAAR, CEON, IPY monitoring/IPY data management subcommittee groups, AMAP workshop report June 2005 and others. The expert group should review these and then follow up on this process.

Support from AMAP as recommendations for observations is important to facilitate funding for observatories and platforms.

Observatory cooperation:

A lot of data is currently being collected at each existing observatory but cooperation between these are lacking. There is a long chain of activities from establishing an observatory and monitoring program, gather data, validate these and put them in databases.

AMAP should have a coordinating role for acquiring and standardising data suitable for priority assessment. Initially this would focus on enhancing long-term datasets on existing observatories (f.ex. for a study on biological effects by UV the actual dose is needed to be able to compare to other studies).

There should be a focus on integrated observations at each site (f.ex. to attribute causes of changes in one variable – UV-B radiation and impacts, another is temperature and radiation). Another example is to relate climate to biodiversity and then to ecosystem function

AMAP should facilitate sign-up to the AMAP process by the existing observatories – commitment. It should help to prevent observatories from disappearing because focus is needed to ensure geographical coverage. Further, AMAP should ensure that observatories are contributing to the global process.

AMAP should promote the use of remote sensing as a monitoring platform and should coordinate observatories to validate images and models. This uses Arctic observatories to fill a gap.

IPY:

AMAP should contribute to identify IPY projects that focus on integrated observations for a process of continuation to facilitate a handover from research to monitoring

AMAP could/should design a sampling strategy over time – be able to monitor on a longer time scale at low frequency (50 years or similar) identify IPY campaigns that could form the basis of long term monitoring.

AMAP should refine its list of monitoring variables and review IPY and other climate related projects that could contribute to that list. Multi variable observations assist with attribution effort.

Initial steps – review funded IPY projects to begin the process of coordination. Focus on more intensive observing sites and evaluate benefits of augmentation of existing sites to achieve goal of integrated observations.

Review existing networks and evaluate their spatial coverage, observation types, etc.

Advocacy, coordination, data access – what is the role of AMAP?

Model/Data Harmonization in Support of Environmental Data Reanalysis. Editor – Oleg Anisimov

Task A: The proposed long-term activities focuses on development of analytical tools to improve the compatibility of environmental (i.e. climatic, vegetation, soil, permafrost, hydrological, etc.) observations and modeled data in the Arctic. There has been little effort to develop an explicit hierarchy of environmental models, to evaluate their performance using standardized validation tools and data sets, to rank the performance of various models in different applications and to explicitly link modeling results with observations in the Arctic. Data for most environmental variables are typically available only at isolated locations and times, making them insufficient to evaluate the conditions over large regions. Although this situation is changing dramatically with the increasing availability of remote sensing data and automated ground-based systems, most of the new data are only indirectly related to the state of the environmental parameters. This necessitates development of methods for processing and interpreting data obtained from different sources over a range of geographical scale, and combining them with mathematical modeling to make the best use of limited empirical information.

The specific objectives of the ongoing activities are the following.

1. Provide a comprehensive evaluation and intercomparison of the approaches to environmental modeling in the Arctic, synthesize knowledge related to the current status of such models, identify critical scientific uncertainties and data needs.
2. Use results from environmental modeling to discern weaknesses in existing observation networks, and make recommendations about the optimization of the network structure, measuring parameters and protocols.
3. Provide a detailed small-scale (i.e. applicable to large geographical regions) model-based characterizations of various environmental parameters, including their dynamic, consistent with observed spatial and temporal patterns and supplementing them. This will increase the scientific credibility of model-based predictions.

4. Generate a comprehensive set of products, including the environmental data and process-oriented models for the circumpolar Arctic useful to a broad group of scientists and stakeholders. Example of such a product is the atmospheric reanalysis data sets generated by climate models that fully consistent with the available observations.

Possibly organize a workshop to consider these tasks and determine the way to proceed on meeting these objectives.

Task B: Arctic System Reanalysis

An Arctic system reanalysis is a proposed activity for the IPY. The Arctic System Reanalysis (ASR) can be viewed as a specific part of the broader model-data harmonization activity discussed above. The proposed reanalysis will include components in addition to the atmosphere: ocean, sea ice, soil, hydrology and possibly vegetation. Outstanding issues include (1) the choice of models for the assimilation of data from the different system components, (2) the extent to which the component models will assimilate data in coupled or in stand-alone mode, and (3) the particular types of data to be assimilated. While a group of lead investigators has initiated preliminary activity on an ASR and has planned a strategy workshop in April 2006, there is a potential role for AMAP coordination to assist in (1)-(3). It is suggested that AMAP CEG members maintain communication with ASR participants and, at the April workshop, determine if AMAP coordination can contribute usefully to (1)-(3). If so, workshops and other coordination of international input to ASR can be an AMAP CEG activity. However, since the extent of the international partnering that will occur has yet to be determined, a determination of the nature of AMAP involvement should await the April workshop.

First set of activities will be on a longer time horizon and focus on mutual enhancement of models and observations. ASR could be a more immediate task. (ASR workshop in 2 months)

Downscaling Climate Models

Editor – Inger Hansen-Bauer

In connection with the first Arctic Climate Impact Assessment report, a gap was identified between the output from global and regional climate models (GCMs/RCMs) and the needs for climate scenario data in impact studies. Systematic errors in the climate models, as well as too coarse spatial (and sometimes also time-) resolution, make the raw output from GCMs and RCMs unsatisfactory for studying climate induced changes in e.g. in coastal regimes, hydrological systems and ecosystems. Methods for statistical downscaling of climate scenarios, as well as for statistical adjustment of output from regional models, have been developed during the later years. The application of such methods has, however, been restricted to a few specific studies, and the methods have not always been well documented, as the focus has been on the impact of climate change

rather than on the downscaling techniques. We believe it would be fruitful to arrange a workshop on application of statistical methods for adjusting climate scenarios to impact studies in the Arctic. The idea is to bring together scientists working with downscaling of climate scenarios and Arctic climate impact researchers in order to

- 1) summarize the present status concerning statistical downscaling and adjustment techniques,
- 2) identify the further needs for climate model data in Arctic climate impact studies,
- 3) discuss possible strategies to meet these demands.

AMAP should also undertake coordination of downscaling activities to ensure that no large parts of the Arctic are ignored. In first ACIA, sd was available only for a limited area, e.g., Norway. The intention is to complete downscaling activities for many other areas in advance of next ACIA-type report.

Consider application of paleo data to statistical downscaling efforts.

**Synthesis of Model Projections for the Arctic
and other Arctic Information from the IPCC – 4th Assessment
Editor – Vladimir Kattsov**

There is considerable interest in future states of the Arctic over the next 10-50 years. The current IPCC 4th Assessment process is underway and will provide considerable, peer-reviewed information to be published in 2007. This AMAP CEG task is to synthesize information from various chapters of the 4th Assessment, including those on model evaluation, polar processes and scenarios, along with other published studies. Climate change scenarios considered by ACIA were based on projections with the generation of climate models evaluated by IPCC 3rd Assessment (2001). The AMAP CEG report will address model improvements since ACIA, new computational strategies (particularly super-ensemble techniques), new methods of model evaluation, and will address changes in model projections relative to those used in the ACIA. Also considered will be advances in understanding of the arctic climate system and its interactions with global climate processes, the role of natural variability in predictability of the arctic climate, and improvements since ACIA in credibility of arctic climate projections. The synthesis can start in 2007 and should be published in early 2008. A small planning group will start work in fall 2006.

**Use of Geohistorical (Paleo) information and
older instrumental and human observations
to extend Arctic climate history
Editor: Tom Armstrong**

AMAP recognizes the usefulness of geohistorical information for understanding current and future climate systems and the physical and biological responses to the systems.

Geohistorical or paleo data can provide precise climate records that are correlated with ecologic and environmental changes. This allows us to greatly extend our knowledge of both climate trends and related consequences on a timescale well beyond the instrumental record. Of particular importance is regional covariability of temperature and other patterns in prehistoric and historic climate. However, some major challenges exist to paleoclimate analysis including:

- Identification of arctic paleo-records with suitable degree of detail/temporal resolution, internal consistency, and spatial representation to be applied to/compared with current climate models (especially Alaska, Eastern Siberia, and various marine records)
- The use of recorded and anecdotal human observations: needs critical review with respect to quantitative applications (ref. recommendation of ACIA to utilise indigenous peoples' information)
- Filling the gaps in the climate and related ecological record: further use of older, archived instrumental records: standardisation of different types of instruments/methods; surveys for "new" datasets to be included in re-analysis exercises

We recommend that AMAP continue to promote the use of geohistorical information in Arctic climate studies, with specific emphasis on obtaining higher-resolution information from all regions of the Arctic. In addition, we recommend that the AMAP Climate Expert Group should support future planning with regard to the use of geohistoric information from specific warm periods for intercomparison with modern climate change, and that AMAP evaluate the results of the CCSP Synthesis and Assessment Product 1.2 (Arctic paleoclimate history, due to be produced in 2008) to determine its value for supporting the next ACIA-like assessment. Determine needs unmet by this product and promote additional efforts as needed. a mechanism for developing future priorities for geohistorical research in the Arctic

**Recommendations for a monitoring network of in-situ
mass-balance observations of the Greenland Ice Sheet
and Arctic glaciers/ice caps.
(Editor – Andreas Ahlstrom)**

The Arctic Climate Impact Assessment Report identified a number of critical research needs pertaining to the state of glaciers and ice sheets in the Arctic region. An emphasized task was to obtain additional mass-balance observations from regions where the existing data are particularly sparse while continuing the existing in-situ glacier mass-balance monitoring efforts.

Regions with particularly sparse coverage in terms of mass-balance observations are the glaciers and ice caps in the Russian Arctic and the margin of the Greenland Ice Sheet. Existing mass-balance monitoring programmes that should be continued are currently

running in the Canadian Arctic, on the Scandinavian Peninsula, on Svalbard and in Alaska.

As two near-term feasible tasks that fit within the scope of AMAP we recommend the establishment of a monitoring network of in-situ observations of mass-balance on the Greenland Ice-Sheet margin and on the ice caps in the Russian Arctic archipelagos Franz Josef Land, Novaya Zemlya and Severnaya Zemlya, respectively. Obtaining a continuous data series of mass-balance from these regions would fill an important gap in our observational knowledge of the response of the Arctic ice masses to climate change and provide much-needed ground-truth data for satellite and airborne measurements of elevation change. Such data is absolutely necessary to facilitate modelling efforts to predict future changes in the global sea-level as well as changes in the magnitude of the Arctic freshwater fluxes to the ocean.

The lead countries for the proposed tasks would be Denmark/Greenland for the Greenland Ice Sheet monitoring network and Russia for the Russian Archipelagos monitoring network.

As a longer term activity it is proposed to build an inventory of Arctic glaciers and ice caps, including the local glaciers and ice caps in Greenland and the marginal position of the Greenland Ice Sheet. Building an Arctic glacier inventory is identified in the Arctic Climate Impact Assessment as a critical research need, and should be supported by AMAP, as it provides an important baseline for future studies of climate change impacts in the Arctic region.

Coupled UV/Biological Monitoring (Editor - Georg Hansen)

The Arctic has, in the last 15 years, experienced episodes of up to 40% ozone reduction compared to the climatological mean in late winter and spring and a respective increase of UV. Although most of the ozone depleting compounds have levelled out and in fact started to decrease slightly, it is estimated that severe ozone depletion episodes can occur in the Arctic for the next 40 years. It is also important to keep in mind the expected changes of the stratosphere due to climate change which might modify the ozone recovery scenarios significantly.

Recognising that research activities in this field have decreased in recent years, especially in polar regions, AMAP recommends that vital activities are continued in the Arctic, both long-term monitoring by a representative network with well-documented calibration routines and UV impact studies (terrestrial and aquatic) at sites selected for their suitability for this specific purpose (observatories?).

From previous experience it appears as extremely important that effect studies are planned and performed by interdisciplinary research groups consisting of biologists and physicists in order to ensure the necessary data quality. Effect studies should also put

strong emphasis on environmentally realistic set-ups (be critical about “idealised” laboratory studies). UV impacts on humans is also a serious concern.

New techniques and approaches are needed in order to conduct a useful monitoring program. AMAP should support an effort to design such a monitoring program, perhaps as part of broader ecosystem monitoring efforts.

Climate change – Human Health Issues (Editor – Jon Odland)

- Focus on scenarios and modelling – link between environment and human activities – special concern for the dietary chain
- Diet is always based on availability – indigenous people get new opportunities
- New human activities will bring new contaminants – shipping, tourism, oil and gas exploration
- Increased activity bring new species and diseases to affect the Arctic people by increased communication
- Increased commercial fisheries – also altering the food availability
- Vector spread diseases will increase – the disease patterns will change dramatically – new use of pesticides?
- Increased agriculture –increased industrial activities
- Increasing population in the Arctic – increased release of local contaminants
- Impacts of increased UVB on human health
- Positive impacts may occur as well, e.g. improved socio-economic conditions, increased resources available to support health care, or better dietary options.

AMAP should develop a multidisciplinary study group to consider human health impacts under projected climate change and recommend future AMAP actions. Modelling will be important for several of these issues. Also need to consider societal adaptation actions and their human health effects.