



# International Arctic Science Committee Cryosphere Working Group

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## IASC Cryosphere Working Group Work Plan:

The 5-year Work Plan of the IASC Cryosphere Working Group, designed as a contribution to the IASC strategy, is structured along three main scientific foci, and complemented by some additional scientific themes. For each one, we briefly describe below its focus, its link with the three strategic goals of IASC (the three 3 key science priorities defined by ICARP III) and its 5-year plan of activities.

### 1) Atmosphere-glacier-ocean interactions: implications on the pan-Arctic glacier mass budget

**Main scientific focus:** To improve estimates of the pan-Arctic glacier mass budget for past, present and future projections (according to RCPs). These estimates include the impact of atmosphere-glacier-ocean interactions.

**Research topics linking with the strategic goals of IASC:**

- *Role of the Arctic in the Global System:* glacier contribution to sea-level rise, role of albedo changes in Arctic climate amplification, effect on atmospheric flow patterns, effect of runoff of fresh water on the strength of the local and larger-scale ocean circulation, impacts of glacier changes on the marine ecosystem.

**5-year plan of activities:**

- Strengthen the already established and well connected forum of the IASC-NAG network by organising thematic workshops and setting special sessions in the annual NAG meeting.
- Reduce uncertainties in the mass loss of Arctic glaciers (including peripheral Greenlandic glaciers and ice caps) and the Greenland ice sheet, and their contribution to sea-level rise.
- When possible contribute with improved mass-loss estimates to inter-comparison projects such as GlacierMIP.
- Contribute to a better understanding of the role of the Greenland ice sheet in a changing climate with focus on the role of melt water retention in moderating the impact on sea-level rise
- Make a comprehensive overview of the state of the pan-Arctic glaciers.
- Promote the integration of explicit surface mass balance descriptions in (regional) climate models in aid of studying the effect of atmospheric changes under future projections on surface processes such as melt.
- Foster the development of glacier-ocean interaction models including processes such as frontal ablation and calving processes.
- Collaborate with Earth System Model (ESM) developers to realistically include pan-Arctic glacier mass budget in ESMs.

### 2) Extreme Cryospheric Events

**Main scientific focus:** In addition to an overall change of snow and sea ice conditions, climate warming is expected to impact also on the frequency and/or intensity of



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cryospheric extremes like heavy snow falls, icing, avalanches, glacier outburst floods (jökulhlaups), thawing season of permafrost and permafrost coastal erosion, and sea ice motion, compression and ridging. We aim to enhance our understanding of these phenomena.

### **Research topics linking with the strategic goals of IASC:**

- *Role of the Arctic in the Global System:* Improving understanding how cryospheric extremes are formed and developed, and what are their impacts on mid-latitudes weather and climate.
- *Observing and Predicting Future Climate Dynamics and Ecosystem Responses:* Enhance satellite monitoring capabilities of the sea ice and snow conditions as well as representation of cryospheric processes in the Earth-system models.
- *Understanding the Vulnerability and Resilience of Arctic Environments and Societies and Supporting Sustainable Development:* Provide knowledge on snow and sea ice extremes for a long-term planning. Land cover change implications of permafrost degradation (including geomorphological, ecological and hydrological). Dynamics of permafrost coasts in a changing Arctic. Improve monitoring of hazards related to extreme floods from ice caps (jökulhlaups).

### **5-year plan of activities:**

- Promote and facilitate the exchange of research methods and findings via organizing workshops and linking together ongoing national research activities.
- Produce a white paper on research needs of cryospheric extreme events for an initialization of joint international research programmes.

### **3) Cutting Barriers in Snow Science**

**Main scientific focus:** Snow is a key element of the arctic regions. Most research topics of all working groups are directly or indirectly affected by snow. The overarching goal of this topic is to establish an improved common knowledge on snow related processes by linking snow-interested specialists in the different fields by different means. A second goal is to establish a snow measuring network at INTERACT-stations, especially for non-standard snow properties (stratigraphy, chemistry, spectral reflectance and albedo).

### **Research topics linking with the strategic goals of IASC:**

- *Role of the Arctic in the Global System:* snow as a key element reacts very sensitive to extreme weather and climate changes, especially concerning the radiation and energy budget. This affects sea ice, river flow, permafrost freeze and thaw, as well as the entire biosphere. All these processes are finally reflected in the global system. As an example, rain-on-snow events have not only a hydrological effect, but the changed mechanical properties of snow may affect mobility and grazing of reindeer and caribou.
- *Observing and Predicting Future Climate Dynamics and Ecosystem Responses:* snow integrates the winter weather. Improved quantification of the snow cover, the snow



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mass, and physical and chemical properties by remote sensing and modelling, as well as by ground measurements, is necessary. The physical and chemical state of snowpack has far reaching effect in sea ice (e.g. phytoplankton growth), permafrost (e.g. thermal conductivity), atmospheric chemistry (e.g. deposition and emission), vegetation (e.g. frost and wind protection), animals (e.g. mobility), microbes (e.g. change in albedo during melt) and in pollution propagation (e.g., volatilisation of POP). Improving the representation of snow in global and regional land and sea surface models is necessary to model complex feedbacks.

- *Understanding the Vulnerability and Resilience of Arctic Environments and Societies and Supporting Sustainable Development*: recent changes in snow cover and its properties already affect snow roads and winter transportation, relevant for a large part of the northern countries. Developing a local forecast for snow mechanical properties and hazards, snow load and wet snow on roofs will become a required tool in the future.

### **5-year plan of activities:**

- Continue to develop snow science winter schools (currently Europe and North America).
- Develop a cross-disciplinary “snow platform” in the form of blogs and workshops.
- Improve methods and standardized protocols to measure snowpack physical and chemical properties by targeted workshops.
- Implement a comprehensive program of measurement of key snowpack properties (physical and chemical) at INTERACT stations, as well as to super sites (CryoNet) and IASOA-stations.

Approved (voting by e-mail) by the Cryosphere Working Group, 15 Sep. 2017.