WCRP NEWS
World Climate Research Programme

WCRP Workshop on "Seasonal to Multi-Decadal Predictability of Polar Climate", 25-29 October 2010, Bergen, Norway.

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The workshop brought together approximately 80 experts on polar climate to work together to explore the spatial-temporal coherence of polar climate variability, the mechanisms that exhibit long-term memory in climate system, and identify predictable elements of polar climate on time scales from seasons to years and centuries (see full report).

There is a pressing societal need to improve the reliability of climate model predictions in polar regions including the response to anthropogenic forcings and the decadal-timescale variability. Strong coupling between ocean, sea ice, troposphere and stratosphere in polar regions shows that the oceanographic, meteorological and cryospheric scientific communities need to work together to explore the spatial-temporal coherence of polar climate variability and identify its components that might be predictable. This was the main motivation behind the WCRP Workshop on Seasonal to Multi-Decadal Predictability of Polar Climate, which brought together approximately 80 experts on polar climate variability and predictability from around the world, representing not only the above-mentioned range of physical disciplines but also observations, theory, processes, and modelling. The workshop was supported by the Norwegian Research Council and hosted by the Bjerknes Centre of the University of Bergen on 25-29 October 2010.
Early results concerning the extent of polar predictability do show some promise. For example, operational seasonal prediction systems for the Arctic show the impact of summertime sea-ice and fall Eurasian snow-cover anomalies, and September Arctic sea-ice extent appears to be predictable given knowledge of the springtime ice thickness or early to mid summer sea ice extent. Stratospheric sudden warmings provide further predictability during winter and spring once they occur, although the extent to which they are themselves predictable is still unclear. On longer timescales, the first attempts at decadal prediction have identified the Atlantic subpolar gyre as a key source of predictability, with a teleconnection to tropical Atlantic SSTs.
At the same time, we lack a good understanding of many of the feedbacks between the different components of the climate system, such as dynamical mechanisms of stratosphere-troposphere couplings. There are large uncertainties in the magnitude of the surface simulated temperature response arising from uncertainties in the response of Arctic clouds and systematic model biases in boundary-layer stability. Global ocean models have a very poor representation of the transport of surface and bottom water and incorrectly represent deep water formation. As a result of all such weaknesses in our knowledge, we do not well understand the physical causality of the large-scale modes of polar variability that are evident in the observed record.
The workshop started by reviewing the variability in sea-ice, ocean circulation, its gyres, upwelling systems, interactions of the ocean with ice shelves, and its mechanisms, stratospheric dynamical processes and chemistry, and terrestrial feedbacks including ones involving soil moisture and permafrost. The focus of the discussions was to highligth the sources of memory within the different climate system components, and the feedbacks between them. A day was devoted to an analysis of the state-of-the-art models, observations and data assimilation systems for polar regions.
There was a clear consensus at the workshop that a notable gap existed between the scientific communities, as most people knew only a small minority of the other participants. It became

apparent that progress in polar predictability would require crossing disciplinary boundaries to understand the feedbacks between the troposphere and the stratosphere, ocean, land, and sea ice. It also became evident that the nature of these feedbacks appears to be somewhat different in the two hemispheres, because of the different geometries, leading to rather different scientific questions. At the same time, a number of general issues and opportunities were identified which apply to both poles. :

- Understanding of seasonal predictability is needed not only for its societal benefits but also for understanding the seasonality of longer-term variability and changes. The WCRP's Working Group on Seasonal to Interannual Prediction has the infrastructure to perform prediction studies but needs the expertise of polar scientists to interpret the results of those studies in polar regions and design new experiments.

- The WCRP's Working Group on Coupled Modelling (WGCM) has defined a set of coordinated experiments focusing on the near term (i.e. several decade) time horizon within its CMIP5 activity . This large archive of model simulations can be analyzed from this perspective to better understand and partitioning of the decadal variability between internally generated and externally forced components.

- Potential improvements in existing observations (or their availability) need to be identified for action by the relevant agencies. Coupled assimilation systems including snow and sea ice need to be developed, in collaboration with weather prediction centres who are wrestling with this issue as part of their efforts to improve polar weather prediction. Sensitivity of polar predictability on decadal timescales to initial-state error in the ocean needs to be studied to guide ocean observational network design.

- In cases where models have some basic credibility, the "perfect model" methodology can be exploited to determine where the predictability lies. In other cases, key processes that are holding back model improvement need to be identified.

The conclusion of the workshop was that a cross-cutting WCRP initiative was needed in the area of polar predictability. A focused meeting to develop an implementation plan concerning the above issues in partner with relevant research bodies is required.