RCOF Review 2017

[Polar Arctic Regional Climate Outlook Forum]

Status Report (Survey)

Specific Climate Features of Concerned Region

The current climate change impacts are seen most strongly over the Arctic regions with sea ice extent trending toward lower values almost year-after-year, leaving increasing larger areas of open-ocean during the northern summer season. Whereas in warmer parts of the World the start and the end of the rainy season is the most important climate feature of interest, for the Arctic regions it is the sea ice freeze-up and break-up dates, and their fluctuations, which are of interest because of their socio-economic impacts. These types of climate change impacts are having important subsequent effects such as increased marine transportation; increasing tourism and increased exploitation of natural resources. These enhanced activities bring both benefits and risks, but certainly add to the issues that need to be managed. Even though quantities related to sea ice are crucial climate information in the Arctic, trends and seasonal variability of air temperature, precipitation, snow on the ground, permafrost and sea water conditions are also of major importance for human activities in Polar regions, and should also be part of the information dealt by a RCOF. Here is a list of known user needs for climate monitoring and prediction *(taken from page 35 of the Arctic Polar Regional Climate Centre (PRCC) network Implementation Planning report, Geneva, 7-9 November 2016).*

Specific users and their known needs (but are not limited to):

- Transportation, insurance, Search and Rescue, oil spill combatting: length of open water season, ice movements, sea ice melting/freezing, wave heights, sea currents…;
- Natural Resource Development (energy and mineral extraction and development): length of open water season, sea ice melting/freezing;
- Community Resilience and Adaptation Planning: weekly – seasonal – long-time weather and climate outlooks needed for understanding, adapting and transforming to known and/or predicted changes;
- Infrastructure Protection and Hazard Mitigation (information of e.g. erosion, hydrology/flooding, permafrost thawing);
- Versatile Ecological Changes caused by changes in e.g. sea ice, higher sea-surface temperatures, warmer summers, reduced snow cover, etc.

All in all, there is a growing need for useful and targeted climate information to support effective decisions and to help mitigate risks to people, governments, businesses and the environment.

Current status of seasonal forecasting capability and sources of seasonal predictability

The climate of the Arctic is profoundly influenced by the sea ice cover of the Arctic Ocean and adjacent seas, together with its strong seasonality and decreasing trend [1]. Although the large ongoing decline in ice

cover especially late in the melt season provides some measure of predictability—the far more extensive ice cover of previous decades isn't likely to return any time soon—other sources of seasonal predictability also exist. For example, wintertime Arctic temperatures and sea ice motion are strongly influenced by the Arctic Oscillation (AO) which along with the related North Atlantic Oscillation (NAO) has proven to be relatively predictable [2]-[3], and this influence persists in subsequent seasons [4]. In addition, certain sea ice properties in a particular season have been shown to predict future sea ice behavior. Such properties include sea ice thickness and volume [5]-[7], ice export from the Eurasian coast [8], melt-pond fraction in the spring [9], the timing of melt onset [10], and persistence of sea surface temperature anomalies [5]. As mentioned in the introduction, one sector particularly sensitive to Arctic sea ice and climate variations include the marine transportation sector [e.g. 11], which could benefit from skillful forecasts of sea ice concentration, strength, and multi-year ice presence on multi-week to multi-seasonal time scales.

The Polar Arctic Regional Climate Outlook Forum (PARCOF) Background

Acknowledging the growing need for reliable and timely information on the status of, and threats of the Arctic environment, in support of decisions of governments on mitigating the impact of climate change and sustaining the economic development, in particular in the remote area of the Arctic, the WMO Executive Council has recently (EC-69, May 2017) endorsed the development and implementation of an Arctic Polar Regional Climate Centre Network (Arctic PRCC-Network) and the organization of ***Polar Arctic Regional Climate Outlook Forums (PARCOFs)*****.**

The Implementation plan of the PRCC-Network was developed during a workshop held in November 2016 in Geneva, Switzerland: (http://www.wmo.int/pages/prog/wcp/wcasp/meetings/PRCC_IPMeeting.html). Noting that much of the effort deployed during the workshop was on the overall PRCC-Network implementation plan itself, and not so much on the organization of associated PARCOFs. That said, a preliminary PARCOF Concept Note has been created since then by the proposed first hosting WMO member (Canada), and circulated among the PRCC-network members for feedback. Most of the Concept Note content is reflected in this Survey document, and the 2017 Global RCOF Review workshop is surely a great opportunity to share the concept and improve it by getting feedback from experienced RCOFs present at the meeting.

The agreed PRCC-Network structure will consist of three sub-regional geographical nodes, namely North America, Northern Europe and Greenland and Eurasia. By necessity there will be significant cross-node activities for the whole Arctic domain and the PARCOF will have to take that into consideration. It is proposed that the demonstration phase of this RCC be launched during the first PARCOF to be hosted by Canada in spring 2018.

The RCOF Concept for the Circumpolar Arctic

The PARCOF will by a mechanism by which climate experts interact with climate-sensitive users and decision makers having interest in the Pan-Arctic region. The main outcome will be to produce an integrated bulletin to describe the current climatological conditions, the seasonal and sub-seasonal predictions ("outlook") as well as the potential implications or risks for various sectors. Participants will be selected to engage organizations that could further disseminate and translate the information for decision makers at national and subnational scales for various sectors.

The PRCC Network that will support the PARCOF will have a unique design to address challenges associated with a rapidly changing and remote environment by combining the capabilities, skills and investments of its Members. The PARCOF will consequently have a unique format as well, by focusing on the current predictability and also on the foreseeable improvements in skills and spatial resolution of climate models. The PARCOF will also provide a forum to discuss priority products for climate-sensitive users by bringing together the science community, key decision makers and important partner organizations.

While climate change in the Arctic is affecting the entire Earth system, Northerners, indigenous communities, industry and wildlife are experiencing significant and direct impacts. For example, temperature increases have led to significant reductions of sea ice, thawing permafrost and coastal erosion. The traditional knowledge (TK)[1] of those who have lived for generations in the Arctic and community engagement is invaluable to the success of this initiative. Their observations and skills are essential inputs to the Arctic RCC. The PARCOF intends to engage the Arctic Council and, in particular, the Permanent Participants to the Arctic Council, to seek a means to integrate TK into the process in a meaningful way.

The first PARCOF objectives are:

- To review the recent Arctic climate conditions and their possible impacts on the coming season.
- To asses and interpret monthly and seasonal forecast products for the region (temperature, precipitation as well as various operational and experimental sea ice products) and develop outlook statements in plain language to communicate the information as well as communicating risks;

[1] The use of the term *Indigenous Knowledge (IK)* might be more suitable than *Traditional Knowledge (TK)* since *Traditional* is too restricting and can have a pejorative connotation (i.e. old or outdated). Indigenous Knowledge includes past and actual knowledge, and is still evolving due to the changing environment. But for the sake of consistency with previous WMO Polar Arctic RCC related reports, the term TK is still used throughout this document. For a good definition of Indigenous knowledge, see page 15 of this document: *Inuit Circumpolar Council-Alaska. 2015. Alaskan Inuit Food Security Conceptual Framework: How to Assess the Arctic From an Inuit Perspective. Technical Report. Anchorage, AK.*

- To engage with key users, decision makers and traditional knowledge holders in a dialogue to better understand their needs and for them to explore how they can integrate the information produced by the PRCC Network; and
- To discuss with the polar scientific community, especially those involved in the PPP and YOPP, how advances in knowledge will translate into improvements in regional-scale services delivered through the PRCC.

Expected outcomes of the PARCOF

- Communicating risks and opportunities via an integrated bulletin;
- Exploring the use of Traditional Knowledge;
- Improving understanding of users' needs;
- Understanding Science Plans to improve predictions – A YOPP's perspective

Key participants

This first PARCOF would be by invitation only to a maximum 50 participants. It would include representatives from each Member of the network (each node and each mandatory functional area), representatives from other contributing organizations, namely the Global Cryosphere Watch, the International Ice Charting Working Group, the Arctic Council through the Arctic Monitoring and Assessment Program (AMAP) and science representatives from various YOPP subcommittees. Other stakeholders, such as the World Meteorological Organization (WMO) secretariat, other UN bodies (WHO, UNEP and UNESCO-IOC), other pan-arctic organizations such as the Sustaining Arctic Observing Networks (SAON), the International Arctic Science Committee (IASC), the International Arctic Social Sciences Association (IASSA) and the International Association of Cryospheric Sciences (IACS) may be interested to attend.

The need to consider Traditional Knowledge (TK) from Indigenous people has been recognized and ways to include them in the PARCOF process is under assessment.

Main seasons and PARCOF dates

The presence or absence of ice regulates many activities in the Arctic such as transportation, fishing and hunting, tourism, resource extraction, etc. It may be said that the Arctic experiences two main seasons: a long and icy winter of about 9 months and a short and cool summer of about 3 months. Freezing and thawing periods on the fringes of these two seasons are among the most important considerations for many sectors. Since key stakeholders are spread across the circumpolar Arctic, a face to face meeting is proposed for the spring of 2018, likely in April/May. This timeframe is ideal as it would typically precede the summer ice break up by a few weeks. The exact date would need to be carefully decided by considering the user's decision-making timelines. The bulletins have to be issued early enough for the information to be usable by the countries and sectorial users, but not too early such that the forecast skill is not too low to be useful. It is proposed to hold a virtual meeting with stakeholders at the end of the summer – a few weeks before the ice returns.

PARCOF dependencies on the PRCC-Network:

The PARCOF will depend heavily on the PRCC-Network for products and services. It is therefore important to understand the PRCC-Network structure. The PRCC-Network is a hybrid RCC: 1) members will have defined areas of responsibility for delivering the mandatory RCC functions; 2) some members also have significant functional cross-node responsibilities.

Countries by areas of responsibility:

- **Canada** will lead the **North American Node** (with Canada and the USA as members of the consortium);
- **Norway** will lead the **Northern Europe and Greenland Node** (with Denmark, Finland, Iceland, Norway, Sweden and possibly other interested European countries as members of the consortium)
- **Russian Federation** will lead the **Eurasian Node**.

Countries by functional cross-node responsibility:

- **Canada** will lead development of **Long-Range Forecasts (LRF)**
- **Norway** will lead **operational Data Services**
- **Russian Federation** will lead the **Climate Monitoring**.

Sources of Long-range Forecasts for the PARCOF Bulletin

The main PARCOF products will include long-range forecasts of temperature and precipitation covering the whole Pan-Arctic region. It must be noted that these forecasts are at this moment the only WMO mandatory forecast products that the PRCC have to make available to the PARCOF. These forecasts will be based on the WMO Multi-Model Ensemble Long Range Forecasts and therefore produced objectively from a combination of Global Climate Models from the WMO Global Producing Centers (GPCs-LRF). Concerning sea ice forecasts, the same multi-model ensemble approach using global climate models is planned to be used experimentally. A Canadian project called FRAMS (Forecasting Regional Arctic Sea Ice from a Month to Seasons) has been recently undertaken and should provide the PARCOF with one of the best source of long-range Pan-Arctic sea ice predictions. FRAMS is funded by MEOPAR and endorsed by YOPP. It is expected that statistical downscaling techniques would be applied to the sub-regional and local areas by some of the countries involved in the PARCOF.

Evaluation of the Previous Seasonal Forecasts

Review of the previous season (winter or summer) will be done at the beginning of the PARCOF. Diverse PRCC verification products would be used. The forecast verification will use standard metrics on grids as well as at station locations. Sea ice forecast verification is a relatively new scientific domain and will require special attention. Verification of sea ice freeze-up and break-up/melting dates would be of great interest.

Communication of Expected Skill and Forecast Confidence

To the possible extent, calibrated probabilistic forecasts would be used. The probabilistic approach allows for the communication of forecast confidence, and when they are calibrated, unskillful probabilistic

forecast regions are reduced to equal chances, expressing an expected low forecast skill. Furthermore, since the goal is to produce and communicate objectively made (no human subjectivity involved) forecasts, historical skill measures from model hindcasts could be communicated as expected skill maps (correlation, RMSE or Brier Scores, ROC scores) accompanying forecast maps. The use of masks applied on forecast maps where the skill is estimated too low could be done too.

Capacity Development Activities

In addition to activities focusing on certain sector or user groups, we plan to hold a one or two-day capacity-building workshop preceding the PARCOF program. Such workshops are already planned within the FRAMS project, to engage, co-develop and to train users of new experimental long-range sea ice forecast products. Workshops on the use of Traditional Knowledge and climate information communication with Indigenous People might as well be organized.

Downstream Use of the PARCOF Information at the National Level

It is expected that the PARCOF Bulletin will be further refined at the National levels, for example by the applications of some downscaling methods, and/or be considering additional observations not available in time to be considered in the PARCOF process. The need for a Climate Watch for the Arctic has been expressed at the PRCC-Network Implementation workshop. It would be the responsibility of the PRCC regional nodes to perform a Climate Watch for the regions under their responsibilities and issue appropriate special bulletins. It should be noted that the PRCC has to provide access to operational monthly updated products via the future PRCC-Network portal.

User Involvement

In addition to the user involvement activities and capacity development workshops during PARCOFs, it would be of interest to define a clear feedback mechanism between the PARCOFs event. It could be through an internet forum, on-line chat, email distribution list, social networks, etc. NMHSs have already their own network that would most likely need to be formalized, strengthen and vet (that would be the case in Canada). To be sure that the PARCOF products are used and useful, we may have to perform surveys as well as visiting the users at their work place when possible to better understand their decision-making environment.

SWOT Analysis

Describe the main Strengths (indicate key benefits realized, with some examples of success stories based on user feedback), Weaknesses, Opportunities and Threats (SWOT) pertinent to the RCOF, both on regional and national scales. Recognition of the role of RCOF by the countries in the region

This is too early to be fully performed. No PARCOF has happened yet. One of the main challenges will be to reach a consensus for the forecast statement that would be valid over the whole Pan-Arctic region. The region is so wide and the political interests diversified that producing a common bulletin could be difficult.

Sustainability of RCOF

Role of a Regional Climate Centre (RCC)/RCC-Network functioning in the concerned region in the RCOF process

The PARCOF will be highly dependent on the PRCC-Network products and services

Existing funding mechanisms, need for mobilizing resources to sustain the RCOF; List some of the major projects implemented with support to the RCOF sessions. Suggest approaches for long-term sustainability with minimal dependence on external resources.

Too soon to report but given the economic sectors that operate in the Arctic (transportation, mining, gas exploration, tourism, etc.), there might be possibilities of funding. Also, PARCOFs could be held back-to-back to some of their workshops to minimize the travel costs.

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