Parallel Session Summary

Application of High Latitude Observations and Experiments in Regional to Global Climate Modeling

Session Chairs: An Nguyen and Cathy Wilson

Overview. The presentations in this session covered a wide range of efforts including terrestrial, atmospheric, and oceanic and sea ice modeling. A few of modeling efforts were still in early stages of development and do not yet have available measurements for validation. A couple of presentations demonstrated how independent efforts using complimentary data sets and validations have helped improving the quality of models (e.g., modeling effort to validate atmospheric data sets help constraining inputs to ocean and sea ice models). Below is a summary of the discussion within the group to address the following three key questions.

Question 1: What scientific or operational advances have been facilitated by networks of Arctic observations?

As highlighted by one of the talks, the network has enabled the modeling community to use data both in real-time (e.g., satellite-derived sea ice observations) and post-processing to validate the models. Data alone are too sparse both in time and space to build a coherent dynamically evolving state in the Arctic and thus models are needed. However models are not useful if they cannot be validated. On this point, the group noted that improved data accessibility and distribution is still needed for the community. One possible way to do so is to have a centralized repository with announcement of when the data have been submitted / become available. This could be via subscription (e.g., to the CRYOLIST or AON mailing list, or via NSIDC).

Question 2: What opportunities exist to address new science questions, operational challenges, or questions of Arctic communities through enhanced collaboration and a robust interagency observing system?

Currently there exists opportunity through private and public funding agencies to incorporate observations to improve/understand model strengths and weaknesses. Depending on the agencies' targets the opportunities vary ranging from real time prediction applications to understanding climate dynamics. Challenges identified by the participants include mistrusts between the modeling and observing communities, lack of communication, lack of platform/meetings to bring the two communities together. The idea of improving the development for a "network of people" in addition to developing the network(s) of data was brought up.

On the point of enhancing "a robust interagency observing system", the group thought there is a need to bring in agency representatives and other science community members to discuss innovative ways we can use existing data.

A significant challenge to the community is the quantification of the uncertainties associated with both the observations and model representations. Without a concerted effort to understand how certain we are regarding what we observe / model, the arguments / mistrusts can widen the gaps both in communication between the communities and lack of understanding of the dynamical processes governing the Arctic system. Related to this point, any set of observations can be useful as long as we understand its limitation, thus limiting the perceived potential issue of having "too much data". Lastly, it was noted that many of the "products" such as satellite-derived quantities or atmospheric reanalyses should be treated with care and understanding of their uncertainties.

While formal quantification of uncertainties can potentially be beyond our current capability due to lack of data coverage and understanding of the processes governing the noise/signals, the group suggested that a development of a user forum to discuss product uncertainty may be useful to the science community. Some modeling groups are also currently actively pursuing both formal and other methods to quantify uncertainties, e.g., CCSM has paid support staff to provide answers to questions from data users, ECCO has extensive experience quantifying satellite and in-situ observations in their data/model inversion efforts.

Regarding the challenges accessing the data sets by general users, suggestions include the development of data services that would allow user to identify and select possible sets (some of these do exists but are quite scattered, e.g., WOCE, ICES, PANGEA, NSIDC, AON). In addition, with the development of Google applications, there might be an opportunity for the Arctic science community to work with Google to develop an integrated Arctic database and repository and/or taking advantage of EarthCube.

On the modeling side, challenges facing the modeling community include misrepresentation of processes due to lack of understanding of physics, lack of observations, and scaling issues. Examples of misrepresentations include atmospheric lower boundaries, ocean sediment diffusion, oceanic diffusion, sea ice physics. Examples of scaling issues (both temporal and spatial) include bridging the gaps of exchange between coarse-resolution global and fine-resolution regional models to cover the range across the complex Arctic systems. These challenges limit the model's current capability in "predicting" both in real-time and hind-/fore-casts.

On the last note, the group suggested the need to develop a "wants & needs" list by the Arctic modeling community to identify and target data gaps and to identify new problems and questions that we can tackle collectively as a community.

<u>Question 3:</u> How have observing activities contributed to the science needs of mission agencies or stakeholders?

The group identified the need for real-time or short-term model forecasting and to provide predictions to stakeholders. However for scientific research questions, the group was uncertain as to what stakeholders need from the science/model community.