Parallel Session Summary

Terrestrial Arctic - Sessions I & II

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Overview. There were two sessions devoted to the terrestrial arctic, with 15 presentations given total. These presentations ranged from the study of hydrological issues along the Beaufort Sea to the carbon balance at Imnavait Creek Alaska, and offered the opportunity for diverse discussion during the period following the presentations. Below are summaries of the two sessions combined, organized around the questions provided by the organizing committee.

Question 1: What scientific or operational advances have been facilitated by the network(s) of Arctic observations?

Many of the presentations described the use of Arctic observation networks to facilitate and advance research in the Arctic. It was noted that scientific advances have been made in measuring and monitoring gas exchange and carbon flux in the Arctic through such networks as AmeriFlux and FluxNet. However, it was also discussed that these towers and networks can be sporadic throughout the Arctic and additional towers could increase the scientific and operational effectiveness of these networks. Three networks mentioned during the sessions have a focus on measuring and monitoring changes in arctic permafrost including the Permafrost Carbon Network, Global Terrestrial Network-Permafrost (GTN-P), and the Circumpolar Active Layer Monitoring (CALM) networks. The long-term measurements provided by some of these networks have aided scientists and decision makers in better understanding thaw depth, permafrost temperature, and other aspects of permafrost research. Additionally, advances have been made in measuring other long-term phenomena in the Arctic. Without the long-term measurements and data availability provided by Arctic networks, it would be difficult to study many Arctic phenomena, which can take years to properly document. Two examples discussed in the sessions included a) subsidence of the soil surface (as slumping is measured using long-term methods) and b) understanding Arctic phenology changes over time (the ITEX Network is one example of how these changes are being investigated).

While the discussion participants noted that Arctic networks are being used to make scientific advances, many advances are occurring on a fine to intermediate scale, and large scale measurements and inferences are more difficult to attain for Arctic regions due to the vast areas of the Arctic where no measurements are currently being made (or being contributed to observing networks). One way discussed for closing this

informational gap is the use of satellite remote sensing across the Arctic, which has enable more long-term, and pan-Arctic, observations for this community.

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?

The participants in the two terrestrial Arctic sessions discussed many opportunities to address new questions and challenges. As mentioned in Question 1 above, utilizing new satellite imagery as it becomes available, including high resolution (sub-meter) imagery, is one opportunity that the group discussed. Additionally, the opportunity to use existing measurements, and satellite imagery, to "scale up" results both spatially and temporally was mentioned by the group. Spatially, researchers thought new opportunities existed to move from site-specific phenomena to addressing changes across the pan-Arctic region, through the collection of measurements across sites with differing characteristics (discontinuous/continuous permafrost for example). During the discussion, others mentioned using a geographic framework for research – as current research can be limited to the geographic mandates of different agencies/projects. If researchers were able to utilize a more robust network, including new satellite imagery, it could allow for greater geographic coverage for research. Temporally, participants in the discussion noted that developing datasets with continuous measurements year round (and even having some measurements reported in real time) could offer a new opportunities. Additionally, incorporating paleocommunity data into current research networks was brought forward as a way to aid in both spatial and temporal scaling (the Arctic2K network for example). A new opportunity could also exist in using models (such as the earth system model) to scale up measurements. Researchers questioned whether there are currently enough flux towers located throughout the Arctic region to sufficiently scale measurements and suggested that new opportunities for research would be gained if additional flux towers were added to current networks to extend/expand the network of observations and fill in geographic gaps.

Another new opportunity for this research community exists in addressing terrestrial connections with other parts of the earth system (land-ocean, -aquatic, -coastal, -nearshore marine, -river, and -atmosphere). One example discussed in detail during the session was addressing connections between the land and nearshore marine/costal systems. This connection contains many human dimensions (including food web and local economic issues). Participants in the discussion noted that more research is needed to understand groundwater (and nutrient) flow into lagoons. Others discussed the need for more research to better understand small/intermediate rivers, river deltas, and estuaries. There has been focused research on larger rivers and the oceans in the Arctic region (such as the Yukon River), but more research could be done to understand small/intermediate rivers and coastal areas in the region. It was pointed out that small/intermediate rivers and coastal areas can be greatly impacted by climate change and environmental issues (such as oil spills). While more research in these regions is

needed, the research in these areas can be difficult, as multi-discipline teams are often needed. Due to agency requirements, there is often one agency responsible for monitoring land areas, and another responsible for monitoring ocean areas, leaving the nearshore environment unstudied (or sparsely studied).

The discussion focused on a number of new science questions/issues that could be addressed by Arctic networks. One issue that was mentioned frequently was the importance of addressing trophic level interaction questions through better understanding Arctic communities, which rely on local resources (such as subsistence lifestyle issues). Other issues discussed included ensuring that networks are ready to measure extreme events (such as the flooding on the Sag River in Alaska, 2015) as they become more common in the Arctic, and the importance of being able to use natural experiments to investigate positive feedbacks in the region (such as experiments with permafrost and vegetation). One investigator encouraged terrestrial networks to be prepared to study even more unique issues, which are now emerging with climate change, such as the study of former land areas (including permafrost areas) which are now under water due to rising sea levels. Researchers discussed the importance of engaging other agencies/countries to further extend networks (Russia, Canada, others). It was noted that the GTN-P and CALM networks have had successes engaging with other countries (including Russia), and other networks should strive for the same level of engagement across multiple agencies and countries. Engaging the public and a diverse community of stakeholders in an understanding of Arctic issues emerged in both terrestrial sessions as an issue which networks should be prepared to address.

Finally, two additional research metadata issues emerged throughout the discussion: 1) developing observational and metadata standards for observing networks, and 2) utilizing advances in technology to better share data among groups. These two issues are essential to observing networks as they allow for coordination across groups studying the Arctic. The discussion participants discussed the use of observational networks and communities of practice to set standards for measurements, and the use of tools such as ARMAP, Imiq, Arctic Observing Viewer, and the work by ADiWIG to develop a metadata crosswalk as just some of the examples of potential methods of standardizing aspects of Arctic research. Some “best practices” were suggested to encourage better data sharing, such as encouraging data sharing soon after a dataset is gathered, and it was noted that data embargos can slow this process. Faster authorship and data archiving can allow for faster dissemination of results to the community. An aspirational goal for some in the discussion was to have a single data portal or a single set of metadata standards that are consistent across data portals.

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

Overall, it was noted that a better understanding of the Arctic, including ecosystem drivers and processes, has aided many agencies. The discussion participants noted that

terrestrial Arctic observing networks have been particularly successful in providing information on gas exchanges and fluxes (AmeriFlux and FluxNet), as well as permafrost/thermokarst information (CALM, GTN-P, Permafrost Carbon Network). Observing networks have also aided in the development of web resources, such as the AON-CADIS web portal, which is providing the opportunity for researchers to view the locations where others are working. Others noted that terrestrial networks have been used to address local issues, such as the spread of invasive species. The Arctic Council is developing a strategy for managing and preventing invasive species, and additional efforts have been made to understand and manage invasive species along the Dalton Highway and at Toolik Field Station. Networks are also working to be responsive to the needs of local residents, and this has aided agency efforts to meet the needs of local groups. Examples addressed by the discussion participants included 1) incorporating indigenous knowledge into long-term monitoring (this can lengthen the temporal scale of networks), 2) including local residents in the collection of measurements (this is a way to extend measurement collections throughout the year, resulting in a more robust networks with more complete datasets), and 3) considering alternate funding sources for Arctic research which includes a local component (the Canadian NSERC program funds a scientist residency for the north, and NSF allows for this type of research as well). It was noted that many of the observing activities which contribute to the science needs of mission agencies and stakeholders require stable and consistent funding, which can be difficult with grant funding, where funding support can change from year to year. Observing networks must strive to maintain funding and continue to address new opportunities for funding as they develop.