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ABSTRACT: OCEANS, ICE AND ATMOSPHERE

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Arctic Change in the Flow of Global Warming: Need for Long-Term Monitoring Observations

The Arctic, confronted by global warming, has shown an abrupt warming in the thirty years since 1980s. The warming in the Arctic is seen in a number of climate processes such as air temperature rise, ground temperature rise, decrease of sea ice extent and so on. The Arctic sea ice extent shows a drastic decrease and has reached a record minimum in summer 2007. The rate of reduction in ice cover exceeds twice that predicted by climate models, and has already reached the level simulated for 2040. Permafrost on the Arctic land has melted in a wide area, and is expected to release greenhouse gases such as methane, and outflow of large rivers to the Arctic Ocean has greatly increased. Retreats and melting of glaciers and ice caps surrounding the Arctic and Greenland ice sheet are contributing to the sea level rise. Following these changes, ecosystem/ biosphere will be changed and it will alter the exchange of greenhouse gases and surface albedo, and then feed back to the climate and environment. Additionally, there are many extreme changes such as decrease in the area and period of snow fall, reduction of snow surface albedo by anthropogenic black carbon and acidification of surface sea water due to the increase of atmospheric CO_2 concentration, and we are anxious about their effect on human life and the natural ecosystem.

A large warming during the 1920s and 40s in the Arctic, comparable to the recent 30-year warming is known. This was only concentrated to the high latitudes. Several explanations have been made; however, external forcings such as solar forcing and low aerosol loading, which were once able to explain global averages, failed to explain this, and one of the possible explanations is internal atmospheric variability of low frequency. Another candidate for the explanation was black carbon deposited on the snow and ice surfaces. We have to continue our study in discovering historical meteorological, aerological, and radiation data; investigating the PDO which shows

similar resemblance to the temperature curve; ice core analysis; Arctic system reanalysis together with long term reanalysis back to 1880s. Anyway, it is indispensable to recover historical data and to study these early twenty century warming in order to understand the recent abrupt warming and to predict future change in the Arctic.

Observing systems for monitoring change are essential for validating and improving predictions, especially of future global warming and its impacts. Starting from the first International Polar Year (IPY) in 1882/83 and through the second IPY 1932/33 up to the International Geophysical Year (IGY) 1957/58, a large part of the observation station network was established in the Arctic. However, a large amount of stations, especially in the Russian Arctic, have been closed since then due possibly to lack of financial support. Now, just at the end of our IPY 2007-2008, we should start to remake our solid network in the Arctic as a legacy of IPY, following the State of Polar Research (the statement from the ICSU/WMO Joint Committee for the IPY 207-2008) and Sustaining Arctic Observing Networks (SAON) initiatives.

Recommendations:

- Establish or enhance and maintain multidisciplinary sustained long-term observing systems in the Arctic
- Establish and maintain drifting ice or ship stations in the central Arctic Ocean
- Collect and analyze historical data archives in the Arctic, especially of early 20th century
- Increase communication between scientists and politicians about the Arctic change and keep the Arctic safe, peaceful and free area for science (need for "Arctic Treaty"? just similar as the "Antarctic Treaty")