USE OF AN INTERNATIONAL FLEET OF POLAR ROVERS TO PERFORM LONG-RANGE TRANSECTS OF POLAR SEAS ACQUIRING KEY CLIMATE SYSTEM DATA

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Sea ice is an interesting material when examined as an environmental integrator as has been discussed recently in papers by Fetterer and Untersteiner and Richter-Menge. The annual cycle of ice production represents a cycle of heat flux for the region north of 70°N of only 20 W/m^2, a very high sensitivity. Investigators monitoring this sea ice thickness using submarine upward-looking sonar find multiyear variation in mean ice thickness to be significant, although there is a vigorous disagreement on the interpretation. Thus, the sea ice thickness is, on the one hand a sensitive integrative indicator of large-scale seasonal fluxes and on the other hand a signal that involves expensive logistics and in the end a variable that is difficult to interpret. The realistic use of sea ice thickness as a valuable climate indicator requires that the numerical simulation of processes controlling thickness be made more accurate and that the measurement of the thickness distribution, required to support model development on the short term and initiate and validate model results on the longer term, be made sufficiently accurate and extensive. Clearly, determination of sea ice thickness distribution from space is highly desirable; however, sea ice, including its snowcover, is spatially and electromagnetically complex such that the development of a spaceborne approach is a significant challenge; it may well be a decade or more before such measurements are made. For the intervening period, and for validation of the instruments designed for space deployment, a surface rover-based strategy is capable and cost effective.

The NASA planetary program relies on rover-based science, and NASA has an aggressive program in the development of scientific and operational autonomy to advance in-situ explorations. These rover designs vary widely, but some are clearly of use in Earth science, and the Inflatable Rover is, in particular, an excellent candidate for long-range solar-powered autonomous transects of the Arctic Ocean (or other ice-covered sea), and there are a number of ice-thickness determination instruments in various stages of development for measuring sea ice thickness distribution with accuracy comparable to the submarine results.

IPY4 is gaining momentum around the world, and a polar rover program constitutes an excellent activity in that program. Ice covered seas are a mix of international and national (EEZ) waters, and the climatological processes of interest that act on them are clearly global; this science is inherently international. The technologies required for an autonomous scientific transect of the Arctic Ocean or the Southern Ocean are similarly of wide interest. Participation in the polar rover fleet can be at a variety of levels; a nation or agency can supply an entire instrumented rover or a subsystem such as an instrument. A workable fleet would be 2-4 vehicles, each addressing a separate aspect of the sea ice-atmosphere-ocean system (e.g. ice thickness, radiation balance, microwave properties, snow character, weather, air chemistry) and collaborating where appropriate.

We will discuss rover design issues, progress in polar rover deployments to date, instrumentation possibilities, and an approach to forming an international team of ice and climate rovers for an opportunity such as IPY4.