

SEDNA

Sea ice Experiment: Dynamic Nature of the Arctic

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SEDNA marks one of the initial US International Polar Year (IPY) activities with field work scheduled to begin on March 1st, 2007, the first day of IPY. The primary project objective is to deepen the understanding of the complex interaction between the atmosphere, sea ice cover and ocean and its influence on the mass balance of the ice cover. Results will be used to improve models of the sea ice cover, leading to better predictions of future changes and assessments of the impacts of these changes on regional and global communities.

Global climate models indicate that the Arctic sea ice cover exerts a strong influence on global climate and is also a potential indicator of climate change. There are many indications that Arctic sea ice is undergoing significant changes affecting both its extent and thickness. Satellite-derived estimates of ice extent suggest a net reduction between 1978 and 2006 in both the winter maximum and summer minimum extent, with an accelerated rate of reduction in recent years. Ice thickness data, derived from submarine-based upward looking sonar, also suggest a net thinning of the perennial sea ice since 1958.

The mass balance of the ice cover is of particular interest as a key climate change indicator, since it is an integrator of both the surface heat budget, the ocean heat flux and the dynamic response of the ice pack to winds and currents. A net warming over time causes thinning of the ice cover, while net cooling leads to thicker ice. The mass balance of the sea ice cover reflects the evolution of thickness distribution, which is a function of thermodynamics (ice growth and melt), deformation (lead and ridge formation), and transport. During winter, deformation at leads constantly reworks the ice surface morphology. Net opening over the winter results in thinner ice compared to regions with net closing and ridging. Hence the long term rate of change of sea ice mass balance is controlled by an interaction between dynamic and thermodynamic processes. Improving our understanding of the process of ice deformation and its impact on the mass balance of the sea ice cover is the focus of this project.

SEDNA features a joint field-remote sensing-modeling campaign. The relationships between ice thickness and ice pack deformation will be investigated with a detailed field program involving international collaborations (Haas, Wadhams, Jonsdottir, Maslanik & Zwally). Recent developments in visual analysis of satellite data (Geiger & Kambhmettu) will be entrained with in situ autonomous buoys (Hutchings, Richter-Menge & Geiger) to improve our understanding of the mechanical failure and working of ice on geophysical scales. Near real time satellite data processing will be developed, through collaboration with the National Ice Center (NIC) and the Alaska SAR facility (ASF) to support field work. The synergy resulting from the integrated field effort will result in a unique inter-calibration of ice thickness measurement methods. The overarching goal of the project is to investigate how changes in Arctic climate system affect sea ice, allowing validation of model forecasts of ice cover in this century and developing designs for sea ice monitoring systems in the Beaufort Sea.

The SEDNA field campaign will occur over a 2-month period in spring 2007, taking advantage of a planned U.S. Navy ice camp in the Beaufort Sea at the edge of the perennial ice pack. The season and location of the camp occurs when the dynamic component dominates the mass balance, through the formation of leads and ridges in an ice cover that is nearing its maximum annual mean thickness. The design of the field campaign focuses on integrating measurements over connected scales: 1km-10km-100km-1000km. The measurement suite will be extensive and include an

ice-based array of instruments to monitor the ice deformation and stress, complemented by satellite-based imagery. Repeated transects to investigate the ice thickness distribution will be conducted using on-ice, airborne and underwater equipment. The autonomous data collection and transmission capability of many of the instruments will allow tracking of ice conditions even after the field camp has ended.

The field campaign provides a particularly rich vehicle for outreach activities; the element of adventure can be used to entrain other scientists, decision makers, the general public, and school children. One of our main educational outreach activities will be conducted through the National Science Foundation Polar Teacher and Researchers - Exploring and Collaborating (PolarTREC) program. With PolarTREC support, a high school teacher (Robert Harris of Hartford High School, Hartford, Vermont) will join the field party and relay the events and experiences of the camp to K-12 students using satellite-based technology.

Another novel aspect of the project is the gender composition of the lead research team. When it comes to Arctic field teams investigating sea ice conditions, the presence of one woman is a rarity; four collaborating across disciplines and scales is unique.

This is an admittedly and intentionally ambitious project. Fortunately, technological advances and collaborative opportunities are ripe to successfully complete the work we have outlined and significantly advance the understanding of the dynamic component of the sea ice mass balance. The intriguing aspects of the project can be advantageously used to help convey information that develops a better understanding and appreciation of the role that the Arctic plays in global climate.

For more information on SEDNA, please contact:

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