The Secret of the Svalbard Sea Ice Barrier

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Abstract- **An elongated sea ice feature called the Svalbard sea ice barrier rapidly formed over an area in the Barents Sea to the east of Sbalbard posing navigation hazards. The secret of its formation lies in the bottom bathemetry that governs the distribution of cold Arctic waters masses, which impacts sea ice growth on the water surface.**

I. Introduction

During the 2001 Arctic field validation campaign for sea ice remote sensing and modeling [1], QuikSCAT/SeaWinds scatterometer images, transferred to the U.S. Coast Guard Healy icebreaker, helped to identify a peculiar elongated sea ice formation over an area in the Barents Sea to the east of Svalbard. This paper explains its formation.

II. Observations

QuikSCAT/SeaWinds scatterometer data were used to observed sea ice formation over the Barents Sea. In sun-synchronous orbits, QSCAT accurately measures global Ku-band backscatter for horizontal and vertical polarizations with the respective swaths of 1400 and 1800 km [2] allowing coverage of the Arctic twice per day. Such a high temporal resolution allows observations of rapid sea ice growth processes. The peculiar elongated sea ice formation east of Svalbard, called 'the Svalbard sea ice barrier', formed very rapidly in 1-2 days in November 2001. It spanned several degrees in latitude and longitude, and could restrict the sea route and pose navigation hazards.

III. Secret of the Svalbard Sea Ice Barrier

The secret of the formation of the Svalbard sea ice barrier lies in the bottom of the sea: A comparison between the bottom bathymetry from the International Bathymetric Chart of the Arctic Ocean (IBCAO) data and the pattern of sea ice formation from scatterometer data reveals that the sea-ice barrier amazingly well conforms with and stretches above a deep elongated channel connecting the Franz Josef-Victoria Trough to the Hinlopen Basin between Svalbard and Franz Josef Land. Hydrographic data show that the bottom bathymetry controls the distribution of cold Arctic water in the sea channel in this region. When atmospheric conditions such as cold northerly winds force heat fluxes out of the ocean, sea ice preferentially grows over colder water resulting in the formation of the Svalbard sea ice barrier that resembles an imprint of the channel in the bottom of the sea. This case illustrates that the bottom solid earth structure can strongly influence ice formation on the sea surface through its control of water masses. Results from scatterometer data in the past half decade (1999-2003) show large variabilities in the timing (October to December) of sea ice formation in this area.

IV. Conclusions

Because the formation of Svalbard sea ice formation is controlled by atmospheric and oceanic conditions and by the bottom bathymetry, such sea ice feature can be recurrent in its location and formation pattern while the timing of sea ice growth can be quite variable. Thus, continuous high-temporal resolution remote sensing observations are necessary to monitor the rapid sea ice formation. Understanding the earth-ocean-ice-atmosphere interactions responsible for the sea ice formation helps to select appropriate locations for in-situ instrument deployment and facilitates sea ice monitoring, modeling, and forecast.

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