Proceedings of the Eighteenth (2008) International Offshore and Polar Engineering Conference
Vancouver, BC, Canada, July 6-11, 2008

ISBN 978-1-880653-70-8 (Set); ISBN 1-880653-68-0 (Set)

Characteristics of Ice Bottom Topography from the Sea of Okhotsk off Hokkaido - Observation Results in 2007 -

Shinji Kioka, Yasuji Yamamoto
Civil Engineering Research Institute for Cold Region, Sapporo, Japan
Atsushi Sutou
Hokkaido Regional Development Bureau
Takahiro Takeuchi
Hachinohe Institute of Technology, Hachinohe, Japan

ABSTRACT

Bottom-mounted IPS and ADCP were used to monitor the drafts and drifts of the pack ice passing over the mooring site on the Sea of Okhotsk off Hokkaido. A spectrum of sea ice bottom topography (draft profile) with non-stationary characteristics was estimated by *the locally stationary AR model* to compare it with the results in the past. The normalized spectrum of ice bottom topography might be common regardless of spatial and temporal component. Also, we found that the significant amplitude of sea ice draft, which means the standard deviation multiplied by 3.4, would give a subjective/intuitive the height of roughness of the bottom topography.

KEY WORDS: IPS; ADCP; Sea of Okhotsk; Sea ice draft; ice bottom topography; roughness; Spectrum; Significant amplitude

INTRODUCTION

The Okhotsk Sea coast of Hokkaido is known as the southern limit of sea ice in the north Pacific, which for ms in high-latitude waters and arrives at Hokkaido between January and March every year [see Fig.1]. When designing and constructing offshore/coastal structures, pipelines and other underwater and buried structures or winter navigation through pack ice, interaction with sea ice must be fully taken into consideration. It is also necessary to acquire information on the ice bottom topography (ice bottom roughness) in advance for oil spill contingency plans such as prediction of the range and speed of oil spreading under an ice cover or recovery of oil in ice-infested waters [Izumiyama et al.,2004]. The ice bottom roughness could be also used for estimating a drag force between the sea ice bottom and flow. In particular, with the recent progress of oil and natural gas development along the Sakhalin continental shelf, transport of oil and natural gas to Japan by pipelines and vessels as well as accompanying oil spills or other accidents are expected in the future. In the southern part of the Okhotsk Sea, Toyota and Wakatsuchi (2001) and Toyota et al.(2004) carried out ship-based monitoring to measure thickness of ice floes turned into side-up positions with a downward looking video camera in 1996-2004 (Fukamachi et al., 2006). However, it is difficult to measure a large mass of ice such as an ice ridge or a rafted ice by this method. Thus, sea ice observations in the Okhotsk Sea coast of Hokkaido including the ice ridge or the rafted ice have been hardly made. Therefore, we have conducted sea ice surveys in the Okhotsk Sea coast of Hokkaido [see Fig.2] using IPS (Ice Profiling Sonar) and ADCP (Acoustic Doppler Current Profiler) since 2001. While Fukamachi et al.(2003) have also made sea ice surveys using the same measuring instruments (IPS and ADCP) in the southern part of the Okhotsk Sea (more offshore compared to our observation point), sea ice surveys have been conducted in the area off the northern coast of Sakhalin (Birch et al.; 1999, Marko, 2002). Recently, mooring observations of the upward looking sonar (ULS) such the IPS have been carried out in various area [Belliveau et al.,1989; Harms et al.,2001]. Theories and survey methods of these measuring instruments were detailed by Sakikawa et al. (2002), Belliveau et al. (1989) and Birch et al. (1999).

Some of our observation results and their analysis have already been reported (Yamamoto et al., 2002 ; Kioka et al.,2004a, 2004b, 2006). We had quantitatively analyzed the draft data of sea ice (bottom topography) with non-Gaussian and non-stationary characteristics by *discrete wavelet transform* and by *locally stationary AR model* (Kioka et al., 2004a, 2006).

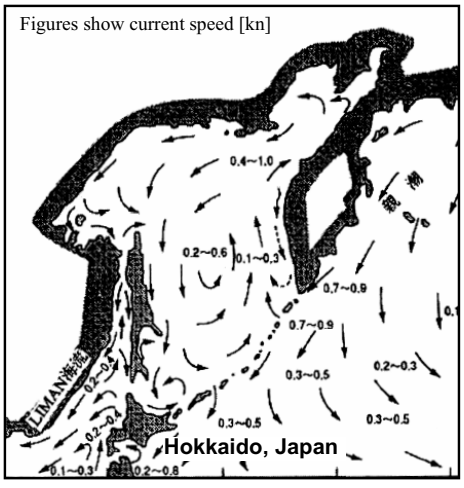

Figure 1 Ocean current chart of Sea of Okhotsk during winter season [Japan coast guard, 1997]