Long period swells break up the Canadian Beaufort Sea pack ice in September 2009

Simon Prinsenberg¹, Ingrid Peterson¹, David Barber² and Matthew Asplin²

¹Bedford Inst. of Oceanography, Dept. of Fisheries and Oceans Canada
Dartmouth, Nova Scotia
²Centre for Earth Observation Science, University of Manitoba
Winnipeg, Manitoba

ABSTRACT

During the summer of 2009, ice observations were made using Electromagnetic, Video and Laser sensors mounted on an helicopter that was stationed on the CCGS Amundsen while she traversed the Canadian Beaufort Sea pack ice from August 28 to September 12. The Arctic pack ice encountered was made up of thin “rotten” first year ice, 50-75cm thick and thicker second year ice 2-3m thick containing melt ponds. The pack ice did not represent an obstacle to the icebreaker which moved at full speed to well above 75°N latitude (Fig. 1).

Upon arriving on September 6 at the “Multi-Year Ice” station within the thicker, consolidated pack ice, long period swells with a period of 13.5sec at the start and reducing in time appeared coming from the NW. They were present for 2 days and broke up the large 2-3km ice floes into smaller floes of less than 100m. The video camera and laser mounted on the helicopter documented the break-up of the floes. Data collected along long West-East flight paths showed that the long period swells, generated by a distant storm, penetrated 350km into the pack ice, breaking up and diverging the pack ice without any ridging. This process will enhance the thermodynamic and dynamic processes of pack ice decay (Toyota et al., 2006 and Squire et al., 2009) that should be included in ice-ocean climate models.

Key words: Long period swells, pack ice break up, Canadian Beaufort Sea

INTRODUCTION

In the Canadian Beaufort Sea, sea ice is present for most of the year and represents a hazard to navigation and offshore oil&gas development. It is now generally accepted that due to climate change, the Arctic polar ice cap is melting (ACIA, 2005 and IPCC, 2007). The Arctic ice extent is decreasing (Serreze et al., 2007) and the remaining ice is thinning (Kwok and Rothrock, 2009). Indeed, in 2007 and 2008 the Arctic Ocean ice extent in September was at a record low for the past 30yr period when satellite imagery was available to document its extent (National Snow and Ice Data Centre, www.nsidc.org). However ice extent only provides the spatial ice coverage, not its thickness nor its ice strength, two main inputs to a navigation ice hazard.

Fig. 1 Beaufort Sea ice chart for Sept. 4, 2009 produced by Canadian Ice Service with the CCGS’s icebreaker “Amundsen” ship track overlain. The relative location of ice chart within the Beaufort Sea is shown in Fig.8.

Since the early 1990s, ice thickness data have been collected with helicopter-borne sensors by personnel of the Bedford Institute of (Peterson et al., 2003). Ice-plus-snow thickness and ice-surface roughness profiles are collected using a helicopter-borne Electromagnetic-Laser (HEM) system. HEM ice thickness represents an ice thickness average of 20m, the footprint of the EM at normal surveying height of 6m over 2m thick ice. A