

On the Spreading of Old Ice in the Barents Sea

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This article contains an analysis of the distribution of old ice in the Barents Sea for the 1955–2007 period. The archived, comprehensive ice charts, drawn on the basis of the results of ice air reconnaissance and satellite data, have been analyzed. Cases of intrusion of old ice southward of 78°N have been examined, coordinates of boundaries of its distribution zones measured, and information on old-ice partial concentration and floe sizes obtained. These data were used to reflect old-ice spatial and temporal variations of concentration and floe sizes, and to get probability assessments of its distribution in the Barents Sea as well.

INTRODUCTION

Ice thickness is an essential characteristic for designing Arctic offshore structures. The thickness of level old ice (both multiyear and 2nd-year ice) can reach 2.5 to 3 m and more (WMO, 2004). Thickness and high strength make this ice hazardous to offshore structures. Recorded cases of 2nd-year ice appearance in regions adjoining the Shtokman Gas Condensed Field (GCF) toughen the requirements for strength properties of offshore platforms and the system of metocean forecast and support. The problem of properties and distribution of old ice in the Barents Sea is still insufficiently studied. In this study, the attempt is made to systematize available materials, supplement them with new data, and obtain preliminary estimates of old-ice distribution in the Barents Sea.

BACKGROUND: PRE-STUDY FACTS

Distribution of old ice (both multiyear and 2nd-year ice) in the Barents Sea is defined by the character of its ice exchange with the Arctic Basin and the Kara Sea. Over the course of a year, the basic flux of old ice comes to the Barents Sea from the Arctic Basin through the strait between the Spitsbergen (Svalbard) and Franz Josef Land (FJL) archipelagoes; it is then spread by the East-Spitsbergen and Bear Isle currents to the southwest of the sea (Borodachev, 1988; Borodachev and Frolov, 1997; Romanov, 1992). According to the upward-looking sonar data, the ice thickness in this ice stream could greatly exceed 2 m (Abrahamsen et al., 2006). The second flux of old ice—less significant because of its area—is carried from the Kara Sea by the Makarov current, which flows in the northern part of the strait between Novaya Zemlya and FJL. During the seasonal maximum (spring), old ice as a rule expands in the narrow zone along the eastern coast of the Spitsbergen archipelago and to the south of FJL. This scheme (Fig. 1) reflects the average long-term conditions; however, in heavy seasons the distribution of old ice is determined by the action of additional mechanisms, and it occurs over a greater water area, as discussed below. Gudkovich et al. (1972) estimated the characteristics of the ice-cover development stage at the end of May in separate parts of the Barents Sea. According to these

authors, old ice is observed in the western and northeastern parts of the sea (1.7% and 0.6%, respectively). By Mironov’s estimations (2004), for the period of the seasonal maximum (April), old ice makes up to 10% of all the sea ice cover. Although the portion of old ice in the Barents Sea ice cover is not significant, information on its quantity, concentration and distribution is important for designing offshore structures and estimating risks to production platforms.

Throughout the 20th century and up to the present, the Barents Sea ice cover has decreased (Vinje, 2001; Shapiro et al., 2003; Alekseev et al., 2004; Divine and Dick, 2006). It is known that much more severe ice conditions were observed in this region in the 19th century; a detailed review, performed by V. F. Zakharov, can be found in Alekseev et al. (2004). Two described events, characterizing the 19th century, should be noted as examples.

- From the end of July to the beginning of August, 1824, the Russian polar explorer F. P. Litke observed ice that had been “... absolutely like the polar ice joining the coasts of Spitsbergen and Greenland” at 76°3′N and 43°49′E (Litke, 1948). According to his descriptions, at the time close to the seasonal minimum, the Russian explorers met with multiyear (MY) ice with icebergs and bergy bits frozen into it.

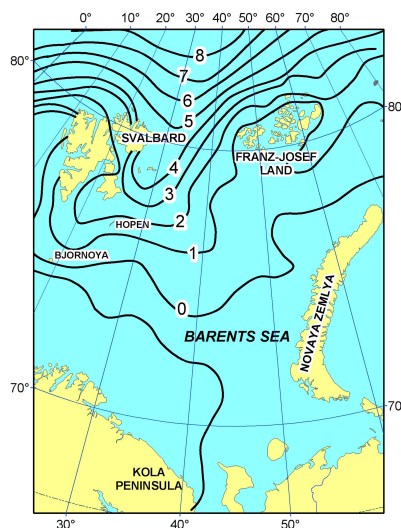


Fig. 1 Average field of old-ice concentration (tenths) in February in Barents Sea (according to Fig. 3.1 in Frolov et al., 2005)

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