

Correlation Dependences of Level Ice Strength Properties in the Kara, Laptev, and East Siberian Seas

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The article investigates dependences of level ice strength properties in the Kara, Laptev, and East Siberian Seas on ice structure and physical parameters (primarily the ice temperature). Research was based on an array of experimental data on the level ice properties studied during expeditions in the Kara, Laptev, and East Siberian Seas in 2013–2017 and work on a research site in the Khatanga Bay of the Laptev Sea in 2016–2019. Analysis of various ice strength characteristics showed similarity of ice in the Russian Arctic seas and the Sea of Okhotsk. The differences in the ice strength properties at different loading rates were determined, and the variation coefficients of ice strength parameters were estimated. Dependences on ice temperature were obtained for all ice strength characteristics and show a good approximation that can be described by a linear law.

INTRODUCTION

Information on level ice strength properties is essential for the assessment of ice loads on vessels' hulls and offshore facilities. It can be obtained either during large-scale field studies across the seas or at a special ice research site. Each of these methods has advantages and disadvantages (Timco and Weeks, 2010). Expeditionary surveys accumulate significant statistics on ice properties but are time limited to one or two months (mostly by economic factors). At a research site, it is possible to study ice for seven or eight months but in one geographical location; only one type of ice can be studied. For a high-quality numerical assessment of the level ice strength properties under various environmental conditions, a combination of both of these methods is required. At the same time, there is an important scientific problem: achieving a trustful correlation between expeditionary results obtained with icebreaker and site results. In 2013–2015 and 2017, we carried out expeditionary ice studies in the Kara, Laptev, and East Siberian Seas (Pavlov et al., 2016; Smirnov, Kovalev, Chernov, et al., 2019; Smirnov, Kovalev, Znamensky, et al., 2019). During 2016–2019, ice studies were conducted at these research sites: “Khastyr” (Khatanga Bay of the Laptev Sea), “Baranova Cape” (Severnaya Zemlya archipelago along the Kara Sea), and “Nog-

liki” (Sakhalin Island in the Sea of Okhotsk). Locations of ice stations studied for a duration of one or two days each and research sites of continuous ice study are shown in Fig. 1. Detailed descriptions of these works can be found in Kovalev et al. (2019), Buzin et al. (2019), Bekker et al. (2020), and Guzenko et al. (2020). This paper focuses on the study of combined data and on the development of adequate correlations for arctic ice. The main goal of the work is to determine the sea ice strength as a function of its temperature and salinity.

Classification of the studied ice by salinity is given in Table 1. For ice thicker than 120 cm, salinity values are also given at the

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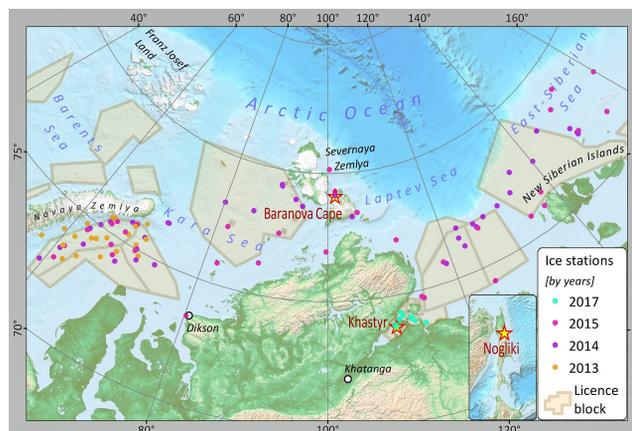


Fig. 1 Location of ice stations and ice research sites