



## **Estimation of the relation between ice thickness and ice freeboard**

**V.Y. Alexandrov** (1) and S. Sandven (2)

(1) Nansen International Environmental and Remote Sensing Centre, St.Petersburg, Russia

(2) Nansen Environmental and Remote Sensing Centre, Bergen, Norway

Techniques of ice thickness retrieval from altimeter data are based on measuring the sea ice freeboard from the difference between the surface heights of the larger ice floes and the thin ice or water surface in the major leads. Then the ice thickness is calculated based on relation  $R$  between the freeboard and thickness of the ice. The ratio  $R$  varies significantly and depends on sea ice and sea water densities, snow depth and density. Different  $R$  values are reported in literature: 9.1 - Rothrock, 8.7 - Bourke and Paquette, 7.8 – Wadhams.

Our measurements of ice thickness and ice freeboard, as well as other sea ice and snow parameters, were made during several field campaigns in the Arctic. Based on these data ratio  $R$  was estimated for different sea ice types. The variations of  $R$  and accuracy of ice thickness retrieval using this parameter is assessed from hydrostatic equilibrium equation using data on ice, snow, and water parameters. The calculations show significant influence of snow loading on ice freeboard. The typical interannual variations of multiyear ice freeboard due to changes in snow cover amount to 3 cm in the Central and Canadian Arctic and up to (6-9 cm) in the Greenland region. Due to snow the multiyear ice freeboard in the central Arctic changes during the season and can decrease up to 11-12 cm in April-June. Conducted estimates revealed significant spatial difference of this decrease - from 6-9 cm in the Canadian Basin to 9-18 cm in the Greenland region. The calculations reveal significant dependence of  $R$  on ice density. The seasonal dependence of ice density, as well as its dependence on ice type (thickness) is discussed. Regional and seasonal variations of snow loading, as well as seasonal variations of ice density and its dependence on ice type need to be taken into consideration in of ice thickness retrieval algorithm from radar altimeter data.