Geophysical Research Abstracts
Vol. 20, EGU2018-2265, 2018
EGU General Assembly 2018

A study of air convection in the snow cover of sea ice

Petr Bogorodskii (1), Vladimir Borodkin (1), Vasilii Kustov (1), and Aleksandra Sumkina (2)

(1) Arctic and Antarctic Research Institute, St.Petersburg, Russian Federation (aaricoop@aari.ru), (2) Institute of Earth Sciences, Saint-Petersburg State University, Russian Federation (spbu@spbu.ru)

The temperature difference between the sea and the atmosphere during the cold season provides favorable conditions for the macroscopic movement of the water-vapor mixture (pore air) in the snow cover of floating ice. To determine the conditions for the appearance of convection in the framework of the linear theory, an integral solution of the Galerkin method was used to construct an analytical solution of the stability problem taking into account its oceanographic aspect. It was shown that the stability criteria (Rayleigh filtration numbers) obtained with allowance for heat exchange with the atmosphere and ice can differ significantly from the value of 4pi2 for a horizontal porous layer with impermeable isothermal boundaries, often taken to assess the conditions for the occurrence of convective filtration in snow. The qualitative uniqueness of the problem in comparison with a similar problem for a homogeneous fluid was revealed. According to the detailed measurements of the thermal structure and metric characteristics of the immobile snow-ice cover of the Shokalsky Strait (Severnaya Zemlya archipelago) during winter 2015-2016, and calculations of its evolution in the thermodynamic model, the values and time variability of the Rayleigh numbers were calculated. Based on the data of observations and modeling, the existence of a convective mode of heat transfer in the snow cover was revealed. It was concluded that it is necessary to take into account its contribution to the thermal and mass balance of sea ice during winter period.
This study was supported by the Russian Foundation for Basic Research with award RFBR 14-05-00677, the Ministry of Education and Science of the Russian Federation (Projects 201714-588-0005-003 and RFMEFI61617X0076), and the Roshydromet (Project CNTP 1.5.3.2).