Geophysical Research Abstracts
Vol. 21, EGU2019-9397, 2019
EGU General Assembly 2019

Circulation and energy distribution in radiatively-heated ice-covered waterbodies: the role of topography

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In-situ observations show that in ice-covered lakes, radiatively-heating drives complex transport mechanisms. Among the identified processes, we observe convective cells, buoyancy-driven flows, and internal waves. Yet, there are only a few observations of basin-scale circulation in such systems. The circulation will depend on the radiative forcing, the background stratification, lake's latitude and the basin topography. Here, we specifically investigate the role of topography on the circulation and energy distribution in radiatively-heated ice-covered freshwater basins. For this, we performed and examined a set high-resolution numerical experiments in which the topographic features were varied. In contrast, we kept the forcing intensity constant, which is characterised by the Rayleigh number, $Ra = 10^5$, and the rotating regime, characterised by the Burger number, $Bu = 10$. The results show an inherent dependence between radiatively-driven convection, buoyancy-driven cross-shore flows, and the internal wavefield developed in deep stratified regions. The outcomes of this work are relevant for understanding the water exchange between ecologically critical regions in radiatively-heated ice-covered lakes.