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Parametrization of convective atmospheric boundary layer height over polynyas and leads

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According to some earlier estimations of role of polynyas and leads on atmospheric-ocean heat transfer it is shown that though leads an polynyas cover only 3% of Arctic territory they can contribute up to 50% of total heat flux from the Artic ocean surface [1]. Combining this with the well-known fact that Arctic region is very important as one of drivers for global atmospheric circulation leads to the necessity for parametrization of convective boundary layer height formed over by polynyas and leads for global climate and weather-forecasting models since heat flux can be derived from this height. Meanwhile, there were a lot of studies in past decades on developing parametrizations of cold-air outbreaks of different complexity – from [2] to [3], in which the surface was often represented as two semi-infinite planes of ice and open water with a straight boundary of between them. In our study we utilized these previous developments and suggested a new CBL height parameterization for a case of a lead that is bounded in one direction and semi-infinite in the other. This parametrization was validated against high resolution ($\sim$5 m) numerical experiments data and observations. Numerical data was obtained with Large-Eddy Simulation model of Institute of Numerical Mathematics of Russian Academy of Science (LES INM RAS [4],[5]) for different scenarios of wind speed and temperature profiles as well as different size (in our case – width) of open water area.

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