Geophysical Research Abstracts
Vol. 17, EGU2015-4984, 2015
EGU General Assembly 2015

The dynamics of frazil ice formation in leads and its role in the mass balance of the sea ice pack.

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Lead are cracks in sea ice that expose the ocean to the cold atmosphere resulting in the supercooling of the ocean and the formation of frazil ice crystals within the mixed layer. Here we present two studies of ice formation in leads: a single lead model focussing on frazil crystals of varying size within the vertical structure of the mixed layer; a new module explicitly describing frazil ice formation in leads incorporated into the Los Alamos sea ice model (CICE). Both studies consider the supercooling of the ocean, the concentration of frazil crystals within the ocean and their precipitation to the ocean surface as grease ice pushed against one of the lead edges by wind and water drag.

The results from the single lead model show how the vertical structure of the mixed layer develops after the lead opens. Sensitivity studies reveal how changing wind speeds play the greatest role in the time taken to refreeze a lead. In the CICE model the new module slows down the refreezing of leads resulting in an longer period of frazil ice production when compared to the original model code. The fraction of frazil-derived sea ice increases from 10% to 50% with the inclusion of the new module. Ice formation rates are increased in areas of high ice concentration and thus has a greater impact within multiyear ice than in the marginal seas. The thickness of sea ice in the central Arctic increases by over 0.5 m whereas within the Antarctic it remains unchanged.