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Temporal evolution of sea-ice salinity : a model study

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The results and impact of two different parameterizations of temporal evolution of the vertical salinity in a one-dimensional energy-conserving sea-ice model are assessed. The first parameterization (1) simulates the temporal evolution of the bulk salinity according to brine-drainage processes that are chosen empirically, assuming a vertically constant salinity for first-year (FY) ice and a linear profile of salinity for multi-year (MY) ice. The other one (2), more complex, physically computes the temporal evolution of the non-linear vertical salinity profile. The latter is based on existing litterature for winter drainage processes and, for summer drainage, on a new treatment of transport of brine through porous ice. The energy conserving sea-ice thermodynamic model has one layer of snow on top of several layers of sea ice, with thermal properties depending on salinity and temperature in order to take into account the thermal damping effect of brine pockets on heat transfer in the ice. The model is run with both parameterizations, in two configurations. First, a realistic NCEP-NCAR atmospheric forcing coming from landfast region in Point Barrow is applied to the model to assess the seasonal ability of the model to simulate both winter and summer drainage regimes. Second, a climatologic forcing typical of central Arctic is used to establish the long-run skill of both parameterizations in simulating a stable ice salinity. Salinity bulk values and profiles are validated against data from ice cores in 2 landfast FY ice sites in Point Barrow, for 1999-2000 and 2000-2001 seasons. The analysis of the results show that 1) bulk salinities simulated by (1) fit observations, with rapid desalination for FY ice due to intense initial drainage, and a MY ice seasonal cycle; 2) bulk salinities, shapes of the salinity profile, and multiyear equilibrium salinity profile simulated by (2) agree with observations, except that the summer desalination occurs around 10 days too late ; 3) if the scope of a study does not go beyond ice thickness and temperature profile in the ice, then, (2) does not improve the simulation compared

to (1).