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Simulating the mass balance and salinity of Arctic and Antarctic sea ice with LIM3-OPA9

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The new version of the Louvain-la-Neuve sea ice model, LIM3, coupled to the global ocean general circulation model OPA9 is used to investigate the evolution of the mass balance and salinity of Arctic and Antarctic sea ice over the last four decades. LIM3 is a thermodynamic-dynamic sea ice model with an elastic-viscous-plastic rheology on a C-grid. It includes comprehensive representations of the subgrid-scale distributions of ice thickness, enthalpy, salinity and age. The brine entrapment and drainage as well as the brine influence on the ice thermodynamics are explicitly taken into account. The performance of the coupled model is evaluated by performing a hindcast simulation of the Arctic and Antarctic sea ice variability and changes over the period 1970-2007 driven by the NCEP/NCAR reanalysis daily surface air temperatures and winds. Results from this simulation are thoroughly compared to available in-situ and satellite data and to outputs from other models. The mean seasonal cycle of sea ice is relatively well reproduced in both hemispheres, with snow depths and ice concentrations, thicknesses, salinities and drifts in reasonable agreement with observations. The model is also found to capture the high interannual variability of the Arctic and Antarctic ice packs as well as the strong negative trend in summer ice extent observed recently in the Arctic. A detailed analysis of the modeled Arctic and Antarctic sea ice mass balance and salinity indicates that the processes responsible for the growth and decay of sea ice are quite different in the two hemispheres.