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SIM2: a numerical model of sea-ice halo-thermodynamics for biogeochemical studies

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The Sea Ice Model version 2 (SIM2) is directly derived from version 1, which was basically a refined Semtner 0-layer model. SIM1 was developed to study the interannual sea ice growth/decay in land-fast areas of the Baltic Sea and it was validated with observations. It was able to simulate seasonal changes of snow (two density classes), snow ice, superimposed ice and sea ice. In SIM2 we added new thermodynamic features in order to improve the model results and we included an halodynamic submodel for more general applications. SIM2 has two sea-ice layers with a time-varying thickness. Snow compaction is simulated by means of a bucket model, which allows precipitation to accumulate as fresh snow until it reaches a maximum thickness and age and thus it compacts. Solar radiation is allowed to penetrate every layer with a different extinction coefficient, which is function of ice/snow type, sky conditions and temperature. The halodynamic submodel includes the computation of thermal conductivity, heat capacity and density of sea ice as function of both temperature and salinity. Brines salinity is assumed to be a linear function of the ice/brines temperature. Sea ice bulk salinity is computed considering the initial salt entrapment, gravity drainage and flushing processes. Simulation results in several stations are presented and indicate substantial improvements with respect to SIM1. SIM2 has been developed with the aim to be coupled to BFM (Biogeochemical Flux Model). The innovative approach consists in simulating the temporal evolution of the biologically active layer (BAL), that is the sea-ice layer with connected brines and where the majority of the biomass

(bottom communities) is found. The coupling is done by passing to the BFM the daily averages of the sea-ice thickness, temperature and salinity, brines volume fraction and salinity and the amount of PAR in the BAL. The strategy of coupling SIM2 to BFM and some preliminary results of the implementation of the sea-ice system into the BFM are shown as well.