Geophysical Research Abstracts
Vol. 15, EGU2013-5029, 2013
EGU General Assembly 2013

On the representation of snow in large scale sea ice models

Olivier Lecomte (1), Thierry Fichefet (1), Martin Vancoppenolle (2), Florent Domine (3), François Massonnet (1), Pierre Mathiot (4), Samuel Morin (5), and Pierre-Yves Barriat (1)

(1) Earth and Life Institute, Université Catholique de Louvain (UCL/ELIC), Center for Earth and Climate Research (TECLIM), Louvain-la-Neuve, Belgium, (2) Laboratoire d'Océanographie et du Climat - LOCEAN - Paris, France, (3) Takuvik Joint International Laboratory, Université Laval (Canada) and CNRS (France), Québec, QC, Canada, (4) British Antarctic Survey, Natural Environment Research Council, Cambridge, UK, (5) Snow Research Center, CNRM-GAME, Météo-France/CNRS, St Martin d'hères, France

An assessment of the performance of a state-of-the-art large-scale coupled sea ice –ocean model, including a new snow multi-layer thermodynamic scheme, in simulating the sea ice thickness and extent over the past three decades in both hemispheres, is performed. Four simulations from the model are compared against each other and against submarine, airborne and satellite observations. Each simulation uses a separate formulation for snow apparent thermal conductivity and density. In the first experiment, the snow density profile is prescribed from observations and the thermal conductivity is constant and equal to 0.31 W m^{-1} K^{-1}, a typical value for such models. Formulations (2) and (3) are typical power-law relationships linking thermal conductivity directly to density (prescribed as in simulation (1)). Parameterization (4) is newly developed and consists of a set of two linear equations relating the snow thermal conductivity and density to the mean seasonal wind speed.

We show that the first simulation leads to an overestimation of the sea ice thickness due to overestimated snow thermal conductivity, particularly in the Northern Hemisphere. Formulation (2) leads to a realistic simulation of the Arctic sea ice mean state while (3) provides the minimum deviations with respect to sea ice extent and thickness observations in the Southern Ocean. Parameterization (4), accounting for the snow packing process in a simple way, is the most promising formulation. In particular, this formulation improves the simulated large-scale snow depth probability density functions. The intercomparison of all simulations suggests that the sea ice model is more sensitive to the snow representation in the Arctic than it is in the Southern Ocean, where both the simulated sea ice mean state and variability seem to be dominantly driven by the ocean.