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Improving the representation of snow over sea-ice in the SI3 model

Theo Brivoal, Virginie Guemas, Clement Rousset, and Martin Vancoppenolle
CNRM, GMGEC, France (theo.brivoal@meteo.fr)

Snow plays a crucial role in the formation and sustainability of sea ice. Due to its thermal properties, snow acts as an insulating layer, shielding the ice from the air above. This insulation reduces the heat transfer between the sea-ice and the atmosphere. Due to its reflective properties, the snow cover also strongly contributes to albedo over ice-covered region, which gives it a significant role in the Earth's climate system.

Current state-of-art climate models use over-simple representations of the snow cover. The snow cover is often represented with a one-layer scheme, assuming a constant density, no wet or dry metamorphism or assuming that no liquid water is stored in the snow. Here, we present the integration of a more advanced snow scheme (ISBA-ES) into the sea-ice model SI3, which serves as the sea-ice component for upcoming versions of the CNRM climate model (CNRM-CM). We compare 1D simulations over the Arctic using this new scheme with observational data and simulations utilizing the previous SI3 snow scheme. Overall, the snow simulated by the ISBA-ES scheme is realistic. We also present a sensitivity analysis of the snow and sea-ice in the SI3 model, exploring various options in the ISBA-ES scheme. Our findings reveal a strong sensitivity of both the snow and the sea-ice to the representation of liquid water in snow and the parameterization employed for calculating snowfall density.