

The BErgen Snow SImulator (BESSI)

Andreas Born (1,2,3), Michael A. Imhof (3,4), Thomas F. Stocker (3,5)

(1) Department of Earth Science, University of Bergen, Norway (andreas.born@uib.no), (2) Bjerknes Centre for Climate Research, Bergen, Norway, (3) Climate and Environmental Physics, University of Bern, Switzerland, (4) Laboratory of Hydraulics, Hydrology and Glaciology, ETH Zürich, Switzerland, (5) Oeschger Centre for Climate Change Research, University of Bern, Switzerland

A comprehensive understanding of the state and dynamics of the land cryosphere and associated sea level rise is not possible without taking into consideration the intrinsic time scales of the continental ice sheets. At the same time, the ice sheet mass balance is the result of meteorological conditions that vary on seasonal and shorter time periods. Simulations of the coupled climate ice sheet system thus face the dilemma of skillfully resolving short-lived phenomena, while also being computationally fast enough to run over tens of thousands of years.

As a possible solution, we present the BErgen Snow SImulator (BESSI), a surface energy and mass balance model that achieves computational efficiency while simulating all surface and internal fluxes of heat and mass explicitly and based on physical first principles. In its current configuration it covers most land areas of the Northern Hemisphere with an equidistant resolution of 40 km and 15 vertical layers. The model is calibrated using observational data and a large ensemble of simulations. The regional extent of seasonal and perennial snow, the densification of the snow pack, and the regional distribution of perennial liquid water is captured realistically.