Geophysical Research Abstracts
Vol. 21, EGU2019-19148, 2019
EGU General Assembly 2019

Heat budget of Greenland firn: observed and simulated changes from 1998-2015

Baptiste Vandecrux (1,2), Robert Fausto (2), Dirk van As (2), William Colgan (2), Peter Langen (3), Kevin Sampson (4), Konrad Steffen (5), Konstanze Haubner (2,6), Thomas Ingemann-Nielsen (1), Masashi Niwano (7), and Jason Box (2)

(1) Department of Civil Engineering, Technical University of Denmark, Lyngby, Denmark, (2) Geological Survey of Denmark and Greenland, Copenhagen, Denmark., (3) Climate and Arctic Research, Danish Meteorological Institute, Copenhagen, Denmark, (4) National Center for Atmospheric Research, Boulder, USA, (5) Swiss Federal Institute for Forest, Snow, and Landscape Research (WSL), Birmensdorf, Switzerland, (6) Université Libre de Bruxelles, Brussels, Belgium, (7) Climate Research Department, Meteorological Research Institute, Japan Meteorological Agency, Tsukuba, Japan

The Greenland land ice's accelerating mass loss contributes to 15-30% of the current sea level rise and mostly originates from increased surface melting and runoff. About 80% of the ice sheet is covered by perennial snow, a.k.a. firn, that retains part of the seasonal surface melt. Firn meltwater retention depends on its physical and thermal state which can be estimated from a firn model driven by weather station observations. We find that increasing air temperatures have driven increasing melt and firn heating at nine GC-Net stations between 1998 and 2015. Accounting for deep preferential meltwater percolation is found to not only to the comparison of simulated firn temperatures to observations modulate the calculated melt and hinder the transmission of heat from the firn to the atmosphere by routing the meltwater at depth where the released latent heat need more time to be conducted back to the surface. We find that, in spite of increasing firn heat influx, the firn refreezing capacity is stable at all sites. At the two warmest sites, firn densification led to the loss of 13-15% of the firn retention capacity. The denser near-surface firn however requires more energy per unit volume to be brought to melting resulting in a stable refreezing capacity at these sites. We find either constant or slightly increasing ($\leq$ 5 %) refreezing capacity and retention capacity at colder sites.