

Firn strain rate observations compared with firn-model predictions in Greenland

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The Firn Compaction Verification and Reconnaissance (FirnCover) project has been continually measuring firn-compaction rates and temperatures at eight sites on the Greenland ice sheet, including six sites in the percolation zone, since 2013. In addition, numerous firn cores to maximum depths of 25 m were recovered and logged for density and stratigraphy between 2015 and 2017. We compare those observations to predictions from the Community Firn Model. We force a suite of firn-densification models with output from a regional climate model and find that the models can generally predict the mass in the top \sim 15 m of firn to within 5 to 10% and the compaction rates to within 15%. We also find that no single model is best at reproducing the observations at all sites. We use our measurements from Summit and EastGRIP to formulate a new dry-firn densification model. We find an optimal activation energy in the Arrhenius temperature factor of near 60 kJ mol⁻¹, the value reported by Arthern et al. (2010, JGR 115, doi:10.1029/2009JF001306). Our results help to constrain the uncertainty of estimates of ice-sheet mass change from satellite altimetry, which rely on predictions of firn-air content from firn models.