Impacts of Accumulation Rate on Firn Properties

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A key factor in the mass balance of the world's ice sheets is the determination of accumulation rate. Remote sensing techniques show great promise, but there is a lack of data for understanding relationships between accumulation rate and snow and firn properties. Results from a recent field campaign in a megadunes region of East Antarctica, an excellent natural laboratory for snow physics, show the impacts of accumulation rate on the physical properties of the firn in areas subject to the same ambient temperatures. Megadunes are surface features caused by varying accumulation patterns. They are not readily apparent when viewed from the ground, with amplitudes of 2-5m and wavelengths of 2-5km. The variation in accumulation rate does appear in photographs and microwave images of the region, with the low accumulation areas appearing dark and the high accumulation areas appearing light. AWS stations installed within 2 kilometers of one another show that while the temperature and wind patterns of the sites are nearly the same, the variation in accumulation rate from site to site causes significant changes in the physical properties. Grain size, pore size and permeability are most affected by accumulation, while the density shows little influence. The variation in firn physical properties caused by accumulation rate differences is expected to be evident in a variety of signals, including microwave signals, which are sensitive to grain size, and in permeability profiles, which are sensitive to a combination of both grain size and pore size. The near-surface firn properties hold clues to present climate as well as influencing the ability of the firn to store climate information over time in ice core records.