Accumulation is determined by wind

Snow accumulation on the Antarctic Ice Sheet is governed by snow transport by wind. This complex process is challenging to include in models and makes the interpretation of measurements, remote sensing products and simulation results difficult. Here we present model simulations of near surface (uppermost 10 cm) snow density under the influence of drifting and blowing snow.

One-dimensional simulations

SNOWPACK is a detailed, physics based, multi-layer snow model. The model calculates drifting snow based on near surface, centimeter scale, snow microstructure. Drifting snow conditions impact simulated new snow density during accumulation events. The SNOWPACK model, driven by locally measured weather data, correctly simulates the temporal evolution of snow density in accumulation events.

Spatial variability in snow density

Spatial variability in near surface snow density is found, both on 100 km and 10 km scales, with density varying between 314 and 344 kg/m$^3$.

Higher density is found near the plateau, and at the lee side of ice rises. Lower density is found in the sheltered areas of the mountain range, and at the windward side of ice rises.

The large scale variability is reproduced by the simulations forced by MERRA-2, albeit with a significant bias. The small scale variability is reproduced in the opposite way as observed.

Statistical downscaling of wind was found to not correspond to dynamic effects on the local scale near the ice rises, causing a bias in density.

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