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Challenges and limitations in interpreting climate proxies in snow of low accumulation areas – insights from a traverse on the East Antarctic Plateau

Alexander Weinhart, Johannes Freitag, Maria Hörhold, and Sepp Kipfstuhl
Alfred-Wegener-Institute, Helmholtz Centre for Polar and Marine Research, Bremen, Germany

Ice cores can give us precious information about past climate conditions. Proxies obtained from ice cores, such as stable water isotopes, are used to reconstruct paleoclimate records. Depending on the accumulation rate, even seasonal cycles can be resolved in some regions of Greenland and coastal Antarctica. But in areas with low accumulation it becomes difficult to resolve these proxies even on annual to decadal time scales.
For the Coldest Firn project at AWI two traverses have been carried out in season 12/13 and 16/17 on the East Antarctic Plateau, covering the barely sampled region between Kohnen Station and Dome Fuji / Plateau Station. Five firn cores of 200 meters length each have been drilled to investigate the firn metamorphosis at low-temperature and low accumulation.
Additionally in 16/17, 115 snow profiles have been taken along the traverse using the snow liner technique. From the snow surface up to two meters depth samples in a high spatial coverage are available to investigate several climate proxies. The snow liners have been analyzed for density and microstructure with the non-destructive Ice-CT at AWI. Cut into discrete samples in two centimeter resolution, they are further analyzed for stable water isotopes as well as several trace species using CRDS and IC measurements.
Accumulation rates for the area are estimated from comparing dated and extrapolated DEP data of the drilled firn cores and existing satellite derived data. In some regions of the investigated area, values can easily fall below 25 kg/m2/a. Still, our isotope and impurity record does not show consecutive annual or seasonal layering. With structural features derived from the CT analysis we are able to partly resolve the snowpack history. While wind crusts form with long exposition time at the snow surface and without any precipitation, finely stratified or cross bedded layers are indicators for coherent precipitation events in a certain time interval. Our findings clearly imply unequally distributed precipitation over the year and re-deposition of snow, which strongly affects the stable water isotope and impurity record in the snowpack. Interpretation of seasonal or annual cycles is barely possible and challenges the reconstruction of paleo-climate records from proxies in low accumulation areas.