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Improved understanding of decadal surface mass balance, recent climate variability, and future ice core sites along coastal West Antarctica using NASA Operation IceBridge airborne snow radar

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The coastal margin of the West Antarctic Ice Sheet (WAIS) is a dynamic and critical region where ice, ocean, and atmosphere converge. Persistent regional ice loss is of global concern for sea level rise. Despite its importance, direct climate observations along coastal WAIS are extremely limited. Ice core records are largely unavailable along the coast from the Ross Sea to the Amundsen Sea, restricting observational surface mass balance (SMB) constraints to the continent's inland regions. To address this gap, we utilize NASA Operation IceBridge (OIB) airborne snow radar data to place new observational constraints on coastal WAIS SMB (e.g. snow accumulation).

At eleven coastal WAIS ice rises, we investigate observed layering in OIB radargrams to automatically detect bright subsurface reflectors likely representing annual snow layers. We then apply depth-density corrections to calculate layer thicknesses and thus annual accumulation rates. This radar-derived snow accumulation timeseries is then compared to regional reanalysis precipitation and other variables from 1979 to the time of the OIB overflight (2016 for many locations). Analysis at three ice rises located on the western, central, and eastern regions of the WAIS coast demonstrates the range of climate forcings affecting interannual snowfall variability along this dynamic coastline.

Radar-derived multi-decadal records of interannual snow accumulation variability at these locations are integral to improving the accuracy of ice sheet surface mass balance calculations in the vicinity of ice shelves, validating climate reanalysis products, and exploring fundamental climate variability, trends, and extremes. Spatiotemporal correlations between multi-decadal radar snow accumulation time series and reanalysis variables (e.g., geopotential height, temperature, etc.) will provide new constraints on the climate processes driving surface mass balance patterns and trends along the poorly-sampled WAIS coast. Additionally, this data may provide a better understanding of regional ocean-atmosphere influences on snowfall, particularly at future ice core locations on coastal ice rises. Extracting information about this region through OIB and reanalysis data is the first step in better understanding the WAIS coast and its recent climate history. Future ice cores at several of these ice rises would expand spatial and temporal climate perspective beyond what can be gained from snow accumulation alone–adding insight into past fluctuations in temperature, sea ice conditions, winds, atmospheric river frequency and intensity, and more.

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