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Synoptic Drivers of Landfalling Atmospheric Rivers Near Dronning Maud Land, Antarctica

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Atmospheric rivers (ARs) that reach the Antarctic Ice Sheet (AIS) transport anomalous moisture from lower latitudes and can impact the AIS via extreme precipitation and increased downward longwave radiation. ARs contribute significantly to the interannual variability of precipitation over the AIS and thus are likely to play a key role in understanding future changes in the surface mass balance of the AIS. While ARs impact the entire coastal AIS, coastal Dronning Maud Land (DML) is one of four East Antarctic maxima in AR frequency. Along with the high frequency of ARs, the variability of large-scale flow patterns associated with ARs around DML motivates further investigation of synoptic regimes favoring ARs in this region.

This study utilizes a self-organizing map (SOM) to identify synoptic-scale regimes associated with landfalling ARs in and near DML. The catalogue of ARs used in this research is output from a detection algorithm developed specifically for Antarctic ARs, and AR landfalls are identified at timesteps in which an AR overlaps with the AIS between 30°W and 30°E. To determine synoptic regimes conducive to AR landfall, sea level pressure anomalies between 60°W and 60°E from MERRA-2 at the time of AR landfalls are used to train a 16 node SOM. Analysis of precipitation attributable to each SOM node reveals three out of the 16 synoptic regimes are responsible for 28% of the AR precipitation despite representing only 24% of the AR timesteps. Subsequent analysis of this SOM will provide insight into the synoptic drivers and thermodynamic characteristics of the synoptic regimes conducive to the most impactful ARs in the region.