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Air mass source regions associated with enhanced surface melting of the Greenland Ice Sheet

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The Greenland ice sheet has experienced increased surface melt and mass loss since the mid-1990s. Surface melt and surface mass balance are partially driven by large-scale changes in atmospheric circulation, which can direct anomalously warm and humid air masses over the ice sheet and lead to pulses of extensive melt and high runoff rates. However, the connection between the air mass source regions and ice sheet surface melt is poorly understood. Here we examine extreme melt pulses (>95th percentile melt extent for 3 or more days) for topographically defined regions of the ice sheet during the months of June, July, and August. Daily melt extent is determined from a satellite passive microwave product. The NOAA Air Resources Laboratory HYSPLIT model is used to calculate 10-day back-trajectories leading up to melt pulses. We apply a clustering algorithm separately for each region and initialization altitude to visualize the predominant tracks of air masses that impact the ice sheet during extensive melt events. Potential temperature at 2 PVU is used to trace atmospheric motion prior to melt onset. Particular attention is given to extreme events that led to melt at the highest elevations of the ice sheet, Summit Station. Results show the difference in source region east and west of the ice divide, and the important role of air mass source regions from North America and Europe.