The Role of Atmospheric Circulation in the Seasonal Melt of Snow and Sea Ice in the Pacific Arctic

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Recent springtime climate extremes have been observed along the northern coast of Alaska. The dates when snow melted at Barrow in 2015 and 2016 were the 4th and 1st earliest recorded, respectively, since 1901. These early years were followed in 2017 by the latest date of snow melt since 1988, nearly seven weeks later than in 2016. However, unlike the previous anomalies, in 2017 the late melt was more confined to the western North Slope, whereas ~250 km to the east at Oliktok Point, the timing of the melt was about 25 days earlier than at Barrow. Previous work implicates the northward advection of warm air circulating around the Aleutian Low during years of early melt and blocking by the Beaufort High during years of later melt. The juxtaposition of the two pressure centers resulted in the late melt at Barrow in 2017, while favoring the advection of warmer air to Oliktok, which contributed to an earlier melt there. The existence and relative position of a high-pressure ridge to the east of the Aleutian Low appears to be a key factor in when snow melts along Alaska's northern coast. Spatial and temporal variability of snow melt is linked to subtle variations in the way air circulates around these dominant pressure centers. Here, we investigate these relationships using reanalysis, satellite retrievals, and surface-based data sets. Anomalies are further investigated by analysis of the resulting spatial patterns of the timing of snow melt over land areas and ice melt onset in the Chukchi and Beaufort seas that are affected by the same regional circulation patterns. We introduce a new climate index that explains some of the variance in those variables. This index is suitable for monitoring changes in regional circulation and may be useful for developing seasonal-scale predictive tools.

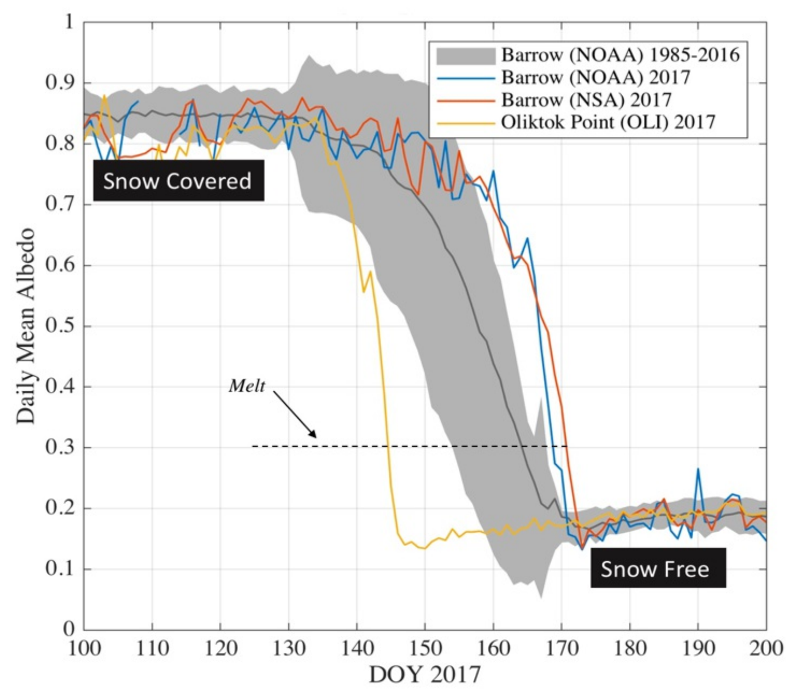

Figure 1. Daily mean albedo in 2017 from April 10 (Day of Year [DOY] 100) through July 19 (DOY 200) measured at the NOAA Atmospheric Baseline Observatory at Utqiaġvik (Barrow), Alaska (blue); at the Department of Energy Atmospheric Radiation Measurement (ARM) North Slope Alaska observatory, also in Utqiaġvik (red); and at the ARM mobile facility east at Oliktok Point (yellow). For reference, the gray line and shading are the mean and standard deviation of the daily albedo climatology from the ESRL/GMD station, 1985-2016. The date of melt is defined as the first date when the albedo falls below 0.3.