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A multi-dataset approach to documenting variability and change in Arctic spring snow cover extent, 1967-2008

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A new multi-dataset estimate of Arctic monthly snow cover extent (SCE) in the May-June melt period was derived from 10 data sources covering different time periods between 1967 to 2008. The data sources include visible and microwave satellite observations, objective analyses of surface snow depth observations, reconstructed snow cover from daily temperature and precipitation, and proxy information derived from thaw dates. Trend analysis of the multi-dataset series (including an annually varying estimate of error) revealed that June SCE has decreased 46% over the pan-Arctic region over the 1967-2008 period in response to earlier snow melt. The snow cover temperature sensitivity over the pan-Arctic region during this period was estimated to be -1.00 x 10ˆ6 kmˆ2 °Cˆ-1 suggesting a snow-free June Arctic before the end of 2100 based on current climate model warming projections.

This analysis of an ensemble of datasets provides a new perspective on the trend in pan-Arctic SCE. Previous estimates focused on a single dataset (NOAA weekly snow charts) which identified a step change reduction in SCE during the mid-1980s linked to a regime change of the Arctic Oscillation (AO). Multiple regression analysis of the multi-dataset Arctic SCE in May and June with winter (JFM) AO and monthly temperature anomalies, however, revealed that air temperature was the dominant influence explaining 49% of the variability in Arctic SCE in May and 56% of the variability in June. Observed reductions in June SCE over the 1979-2008 period were also found to be of the same magnitude as reductions in June sea ice extent with both series strongly linked to temperature changes over the Arctic region. This result underscores the tight coupling between the cryosphere and surface air temperatures over the Arctic region in June when albedo feedback potential is at a maximum.