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Observed Anomalous Atmospheric Circulation in Summers of Unusual Arctic Sea Ice Reduction

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This study presents the atmospheric patterns (circulation, precipitation and temperature) associated with changes in Arctic sea ice extent (SIE) in summertime. Significant features and dynamical linkages of the parameter fields are presented.

Sea ice extent and concentration are from the National Snow & Ice Data Center (NSIDC), while sea level pressure, winds, temperature, radiation, precipitation and snowfall – used to characterize storms, cloud cover, warming/cooling effects, large-scale wave trains and jet streams – come from the European Re-Analysis Interim (ERA-Interim) re-analysis. The storm track characteristic is analyzed using the Kevin Hodges TRACK algorithm, based on zonal and meridional winds at 850 hPa.

Significant patterns result from compositing anomalous high (+1 STD, 23 months) and low (-1 STD, 17 months) standardized SIE reduction months in summer (May-August, MJJA) over 1979-2013. For high SIE reduction months, a relative anticyclonic circulation over the Arctic Ocean emerges. Resulting is a tendency for storms to shun the Arctic Ocean, following a more zonal path, and hence contributing to a weakening of the climatological Arctic Ocean Cyclone Maximum.

For the Arctic Ocean, a reduced cloud cover results in less precipitation, where the particular decrease in snowfall over sea ice in August lowers the albedo and hence increases the ice reduction. The warming over the continents increases the land-sea temperature contrast, resulting in increased cyclogenesis especially along the Siberian coast. In mid-latitudes, the shift in storm tracks results in an increase in storms and rainfall over northwestern Europe and southern Scandinavia.

The presentation adds to the ongoing discussion on Arctic sea ice and mid-latitude extreme weather, and also contributes to the understanding of feedback mechanisms in the region. With the current declining trend in sea ice expected to continue in the coming decades, the understanding of anomalous circulation patterns associated to sea-ice loss is important for assessing changes in the Arctic climate system and their impacts.