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The Influence of a Record Heat Wave on Environmental Change in Barrow, Alaska

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The May 2015 average temperature at the NOAA Global Monitoring Division's Barrow Observatory (BRW), Alaska, set a 90+ year record high, averaging -2.2°C (28°F), nearly 5°C (9°F) above average. The 2015 spring transition in Barrow was notable with the second earliest date of snow melt on record (JD148, May 28) and earliest ice free conditions on a local lagoon (JD178, June 27). Anomalous early snowmelt was also observed at nearby Cooper Island where a colony of sea birds, the Black Guillemot, nests each year once snow disappears. The appearance of "first egg" is well correlated with the date of snowmelt at BRW (Fig. 1), as is the ice-out date at the Isaktoak Lagoon (ISK). In 2015, the first egg was observed on JD159 (June 8), the earliest in the 40-year record (source: Friends of Cooper Island, http://cooperisland.org/). The 2015 melt at BRW was very early due mainly to an unusually intense heat wave affecting all of Alaska.

Each day of advance in the melt date at BRW results in an annual net radiation increase at the surface of about 1%. The documented changes can influence biogeochemical cycles, permafrost temperatures, and potentially the release of stored carbon. BRW permafrost temperatures were warmer than the three previous years; the active layer depth (ALD) was ~6 cm deeper in 2015 than in 2014; and the temperature at 120 cm was ~0.5°C warmer. The anomalous warmth that prevailed during spring 2015 can be primarily attributed to atmospheric circulation. Abnormal warmth of the North Pacific and a perturbed jet stream underlie the heat wave and advection of warm air into the Arctic. Warming was likely amplified locally as the early melting of snow increased absorption of solar radiation. Key factors contributing to the anomalous 2015 spring at BRW and the impact early melt had on the 2015 summer surface radiation budget will be discussed. The role of circulation anomalies reported by reanalysis data over the course of the Barrow observational record will be presented. Analysis of interactions underlying this anomaly will aid in developing strategies for improving predictability of interannual variability of the melt season and long-term change.