

Environmental Change in Barrow, Alaska Resulting from a 2015 Record Heat Wave

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The May 2015 average temperature at the NOAA ESRL/GMD Barrow Observatory (BRW), Alaska, set a 90+ year record high, averaging -2.2°C , nearly 5°C above average. The 2015 spring transition in Barrow was notable with the second earliest date of snow melt on record (JD 148, May 28) and earliest ice-free conditions on a local lagoon (JD 178, 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, as is the ice-out date at the Isaktoak Lagoon (ISK) (*see Figure*). In 2015, the first egg was observed on JD 159 (June 8), the earliest in the 41-year record (source: *Friends of Cooper Island*, <http://cooperisland.org/>).

Each day of advance in the melt date at BRW results in a significant increase in net radiation at the surface, which in turn influences biogeochemical cycles, permafrost temperatures, and potentially the release of stored carbon and methane and the production of chloroform.

The 2015 melt at BRW was very early due mainly to an unusually intense heat wave affecting all of Alaska. In 2015, BRW permafrost temperatures were warmer than the three previous years; the active layer depth was ~ 6 cm deeper than in 2014; and the temperature at 120 cm was $\sim 0.5^{\circ}\text{C}$ warmer. The anomalous warmth that prevailed during spring 2015 across Alaska is attributed to a combination of factors. Abnormal warmth of the North Pacific and a perturbed jet stream combined with a pattern of circulation that favored the advection of warm air into the Arctic. Warming was likely amplified regionally 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 presented. 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 both over land and the adjacent seas.

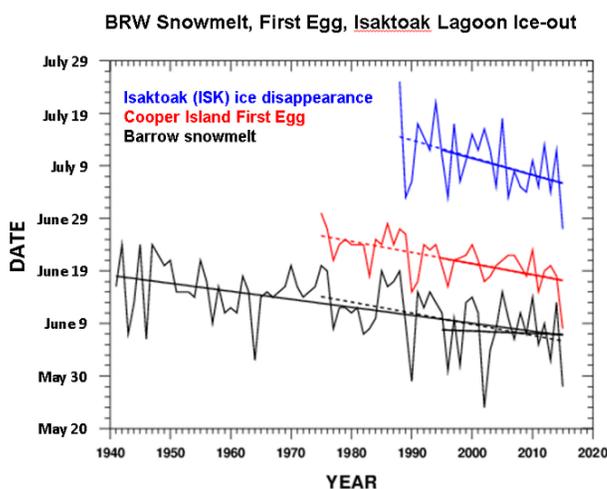


Figure 1. Correlated but independent time series, fitted linearly, showing how the annual snow/ice cycle has changed in the vicinity of Barrow. 2015 was a record or near record year for respective periods of observation.