# Regional Sea Ice Outlook for the Bering-Chukchi-Beaufort Seas

19 June 2017

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Spring ice retreat in the Chukchi Sea was unusually rapid and extensive in May 2017 (see Figure 1). As of 13 June, open water extended anomalously northward to 72.3°N. This retreat has been attributed to a late onset of ice formation in the Chukchi Sea during the previous fall/winter, warm winter conditions, and potentially to a strong oceanic heat flux through Bering Strait (https://nsidc.org/arcticseaicenews/; Serreze et al., 2016), all of which contribute to below normal ice thicknesses. Similarly, unusually extensive stretches of open water were observed in the eastern Chukchi Sea, offshore of the Alaska Coast, throughout April and May due to east winds.

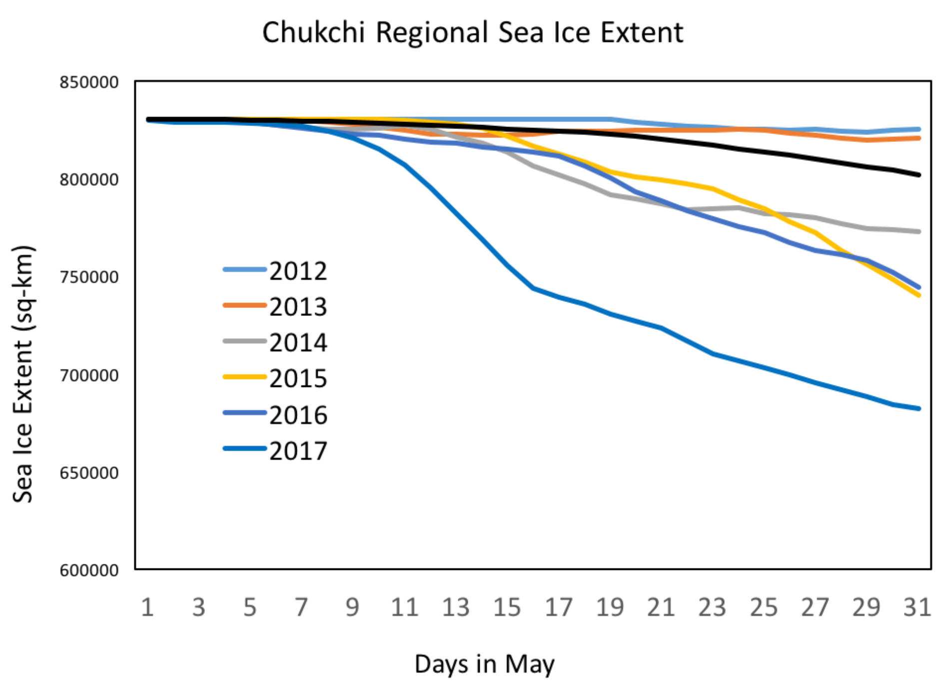


**Figure 1**. May sea ice extent (sq-km) in the Chukchi Sea for 2012 to 2017. Accessed from https://nsidc.org/arcticseaicenews/ (Credit: J. Stroeve/NSIDC).

The amount of open water in the Chukchi Sea, which both may be an indicator of warm water arriving through Bering Strait and a conduit for atmospheric and solar heating of the surface ocean, raised expectations for a rapid onset of bottom ice ablation near Utqiaġvik, Alaska (formerly Barrow). Level first-year (FY) ice thickness observations within the shorefast zone near Utqiaġvik were below normal at between 1.25 and 1.30m, as observed by Chris Polashenski (CRREL) on 12 June. As of this date, however, neither bottom melt nor surface ablation had begun, with the latter slowed by significant snowfall in late May/early June, as reported by local ice observer Billy Adams.

Similar ice thicknesses near Utqiaġvik were observed in early May (see Figure 2), around the time of typical maximum ice thickness, through surface-based electromagnetic (EM) surveys performed along the community's ice trails (See trail map here: https://www.seaiceaction.org/s/Utqiagvik-Ice-Map-20170509.pdf). These ice trail surveys revealed a modal thickness for FY ice at between 1.35 and 1.40m, slightly below normal for the longer-term record (1999-present; see http://seaice.alaska.edu/gi/data/barrow_massbalance), yet well above the maximum thicknesses observed in 2015 and 2016 which were below 1m.

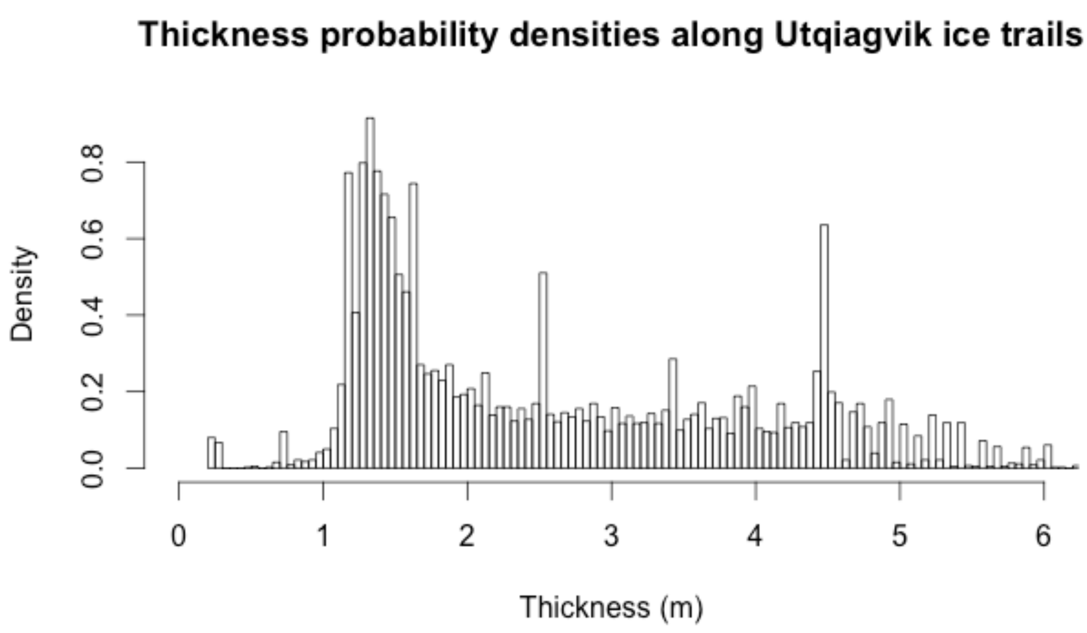


**Figure 2**. Ice thickness distribution of ice trails used by Utqiaġvik hunters to access the edge of shorefast sea ice. Data obtained through EM surface-based surveys between 3-8 May 2017. Thicknesses include minimal influence of snow depth because the snow cover is considerably compressed and eroded by snowmobile traffic. Thickness of level first-year ice is between 1.35 and 1.40m. Thicknesses > 6m are excluded. ***All data are preliminary.***

Further north in the Beaufort Sea, a CRREL buoy deployed in level FY ice revealed maximum thickness of only 1.19m on 14 May (Source: http://imb-crrel-dartmouth.org/imb.crrel/2017A.htm). Despite its far north location (above 75ºN) relative to Utqiaġvik (71.3ºN), bottom ice melt began on 30 May and as of 12 June had melted back to 1.15 m. This raises the question as to whether the ocean heat flux in response to spring solar heating and Bering Strait inflow may be more pronounced in the waters entering the Arctic Basin via the Central Channel, as opposed the waters entering the southern Beaufort Sea via Barrow Canyon (e.g., see Woodgate et al. 2010) due to regional buffering along the Alaska coastline. This question may be answered once a mooring deployed off Utqiaġvik is retrieved in late summer.

Arctic spring ice thickness distributions measured by airborne EM in the western Beaufort Sea (near Point Barrow) and eastern Beaufort Sea (the region north of the Mackenzie Delta up to approximately 72ºN) revealed a FY ice cover thinner than normal at approximately 1.5m. In the eastern Beaufort, the modal thickness for FY ice was the lowest observed since surveys began in 2007, except for the 2016 anomaly. Perhaps not surprising, no multi-year ice was observed in either location. The western Beaufort, however, was marked with high concentrations of thicker ice, likely due to usually high rates of deformation, which was perhaps influenced by the proximity of the surveys to the coast. (Source: Stefan Hendricks's 2017 report "AEM Timeseries: Arctic spring ice thickness distributions in key regions measured by airborne EM")

Similarly, high amounts of deformation were observed within the Chukchi Sea shorefast ice zone (see the mode between 4.45 and 4.50m in Figure 2). The mean ice thickness of 2.8m observed by the surface-based EM surveys along Utqiaġvik's ice trails was in close agreement with the 2.9m observed through the airborne EM surveys in the western Beaufort Sea. Deformation was likely driven by persistent west winds with few easterlies during December through March. Utqiaġvik hunters observed lots of rubble and large ridges north of Point Barrow, which made the routing of ice trails very difficult. However, the observed ridging led to fairly stable shorefast ice cover in the Chukchi Sea throughout spring. The shorefast ice along Alaska's northern Chukchi coast experienced its first major late spring breakout period between 2 and 12 June when large sections detached (see Figure 3). Most likely, these events were initiated by the deterioration of grounded ridge keels by the arrival of warmer water and the melting of cracks (or accretion interfaces) that were active earlier in spring. It is likely that bottom ice melt in the eastern Chukchi near Utqiaġvik is now well underway, even if the onset has been recent.

The early melt season (mid-May through mid-June) in the Beaufort Sea has been driven by temperatures of 1 to 3 degrees C above normal (see Figure 4). The most extreme departures from normal were in the eastern Beaufort Sea, congruent with the timing and location of large polynyas within Amundsen Gulf and west of Banks Island, allowing for effective ocean heating that will support enhanced early season melt in this region.

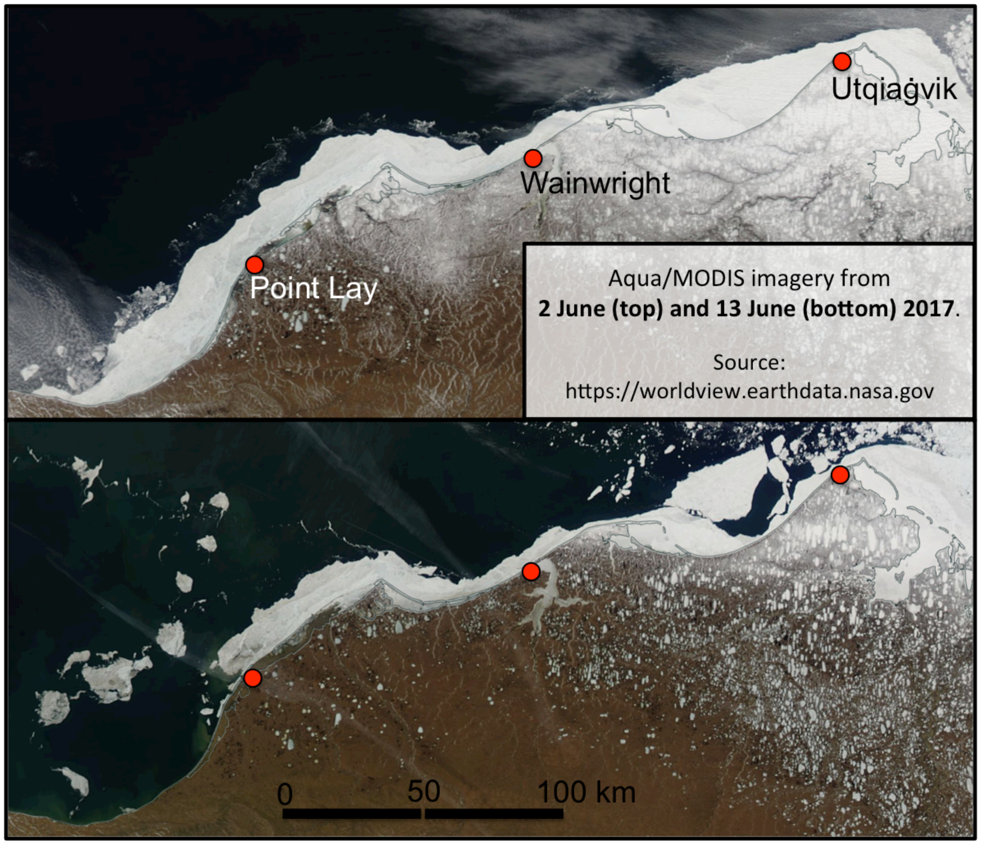


**Figure 3**. Shorefast ice breakup along the coastal Chukchi Sea between June 2 (top) and 13 (bottom) 2017. The shorefast ice in this region had remained largely intact since mid-March.

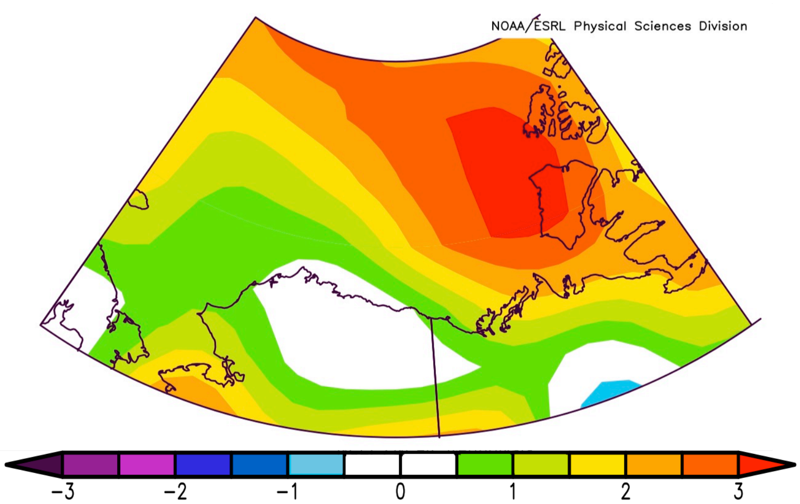


**Figure 4**. Surface air temperature composite anomaly in degrees C (1981-2010 climatology) for last 30 days (14 May to 13 June 2017), based on NCEP/NCAR Reanalysis.

Currently, ice concentration in the Beaufort Sea is well below normal but remains over 20% greater than the anomalous conditions of 2016 (see Figure 5). In summary, regional ice conditions align with general trends toward thinner FY ice, low to non-existent multi-year ice, and earlier ice retreat. Whether ice retreat in the region will be a key contributor to Arctic wide ice extent values will substantially depend on weather conditions—both the extent of wind-driven ice advection from the region and whether the predominant high pressure system, the Beaufort High, sets up to allow the solar heating of surface waters unencumbered by cloud cover.

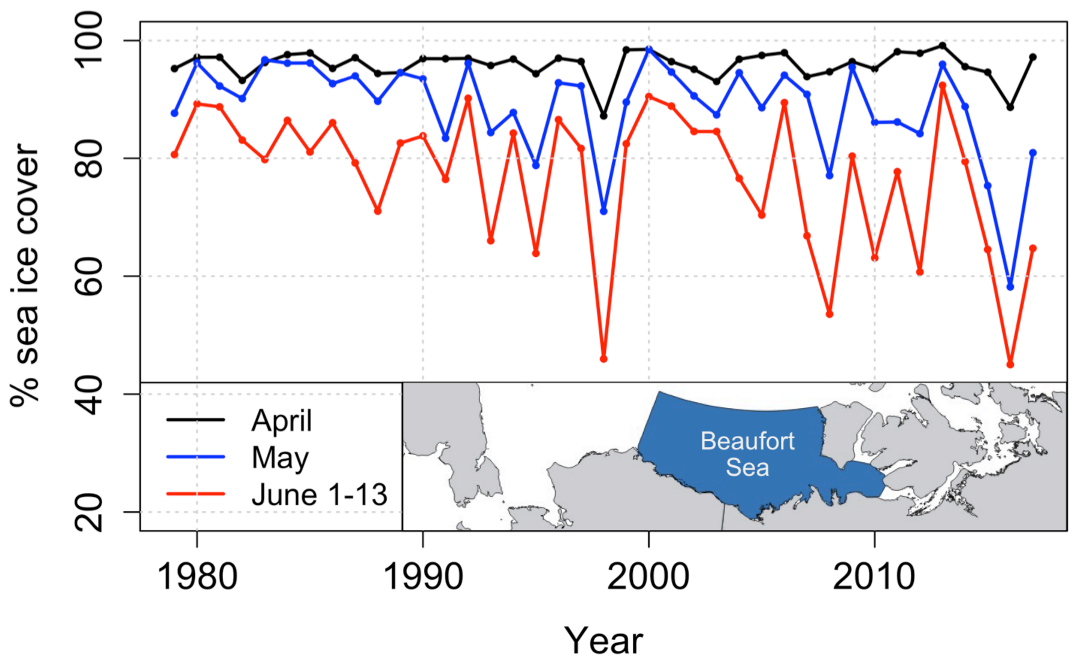


**Figure 5**. Mean ice concentration in the Beaufort Sea for April, May, and early June (1979-2017). The Beaufort Sea is defined as extending west-to-east from the longitude at Point Barrow to the eastern edge of Amundsen Gulf proper, and south-to-north from the continental coastline to 74.5°N.

## References

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