Relationships among sea level, hydrography and circulation in coastal waters near Utqiaġvik (Barrow), Alaska

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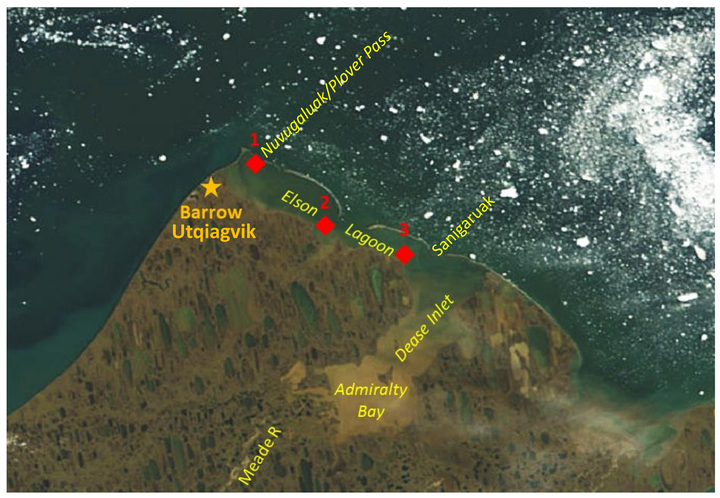
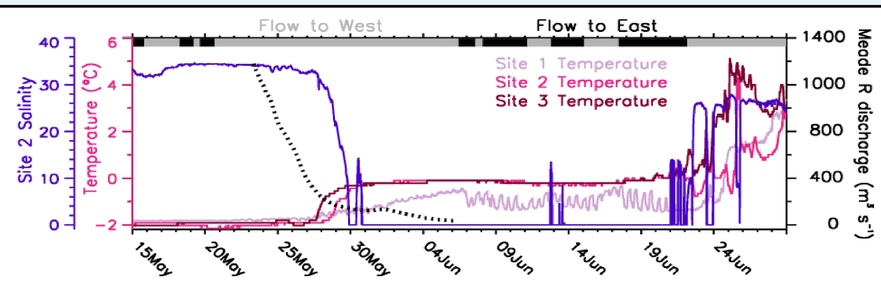
ABSTRACT

Sea level estimates derived from pressure gauges deployed in Elson Lagoon near Utqiagvik (Barrow), Alaska along with concurrent measurements of temperature and salinity indicate that the Meade River freshet occurring in late May and early June 2015 elevated the sea ice cover in Dease Inlet by ~40 cm. The absence of corresponding sea level changes at sites in central and western Elson Lagoon, along with MODIS satellite imagery, suggest that the freshet exited the lagoon primarily through the eastern barrier island passages and contributed to the melting and breakup of the landfast sea ice immediately seaward of these passages.



MODIS image of the Utqiagvik (Barrow) area with place names and pressure gauge mooring locations (red diamonds). The Site 2 mooring included a CTD. Moorings were deployed from September 2014 – September 2015. This study focuses on the period encompassing the Meade River spring freshet, May-June 2015. The Meade River discharges into Admiralty Bay/Dease Inlet.



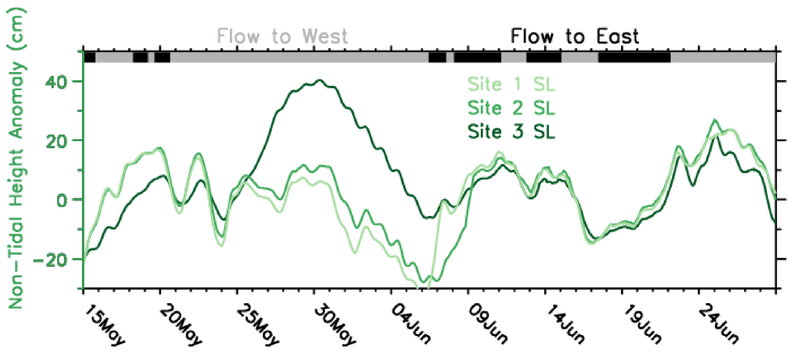
Meade River discharge (black dotted line) falls rapidly from ~1200 m^3 s^{-1} on 23 May to < 200 m^3 s^{-1} on 28 May.

The displacement of seawater by the arrival of the freshet at Site 3 is signaled by a temperature increase from -1.8°C (freezing point of seawater) to ~0°C (freezing point of freshwater) on 27-28 May.

A similar temperature increase and concurrent salinity decrease from ~32 to 0 on 28-29 May 2015 signal the arrival of the freshet at Site 2. Temperature at Site 1 increases from -1.8°C on 20 May to -0.5°C on 6 June; indicative of westward propagation of the freshet in Elson Lagoon.

The Site 1 temperature trend is employed as a proxy for flow in Elson Lagoon and exchange with shelf waters: increasing temperatures at Site 1 imply westward flow within the lagoon (gray bars at top of plot) with inflow of shelf waters through Sanigaruak and outflow of lagoon waters through Nuvugaluak; decreasing temperatures at Site 1 imply eastward flow within the lagoon (black bars at the top of the plot) with inflow of shelf waters through Nuvugaluak and outflow of lagoon waters through Sanigaruak.

From 6 June to 22 June, the inferred flow of warm (~0°C) freshet waters is generally from the lagoon through the Sanigaruak to the shelf beneath the landfast sea ice .



The sea level anomaly (SL) at Site 3 begins to increase relative to SL at Sites 1 & 2 on 26 May.

From 30 May to 6 June, Site 3 SL is 20-30 cm greater than at Sites 1 & 2 suggesting that Dease Inlet acts as a reservoir for the Meade River freshet during this time period.

Between ~6-9 June, the SL differences among the sites fall to near zero and the Site 1 temperature falls from -0.5°C to -1.2°C suggesting that the freshwater stored in Dease Inlet was rapidly discharged through the eastern passages of Elson Lagoon into the Beaufort Sea shelf waters.

17 June 2015 MODIS image. Note open water seaward of Dease Inlet. As noted above, the inferred flow of warm (~0°C) freshet waters is generally from the lagoon through the Sanigaruak from 6-22 June.

21 June 2015 MODIS image. Note increasing open water area seaward of Dease Inlet.

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