

Drivers and environmental responses to the changing annual snow cycle of northern Alaska

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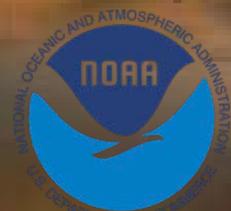
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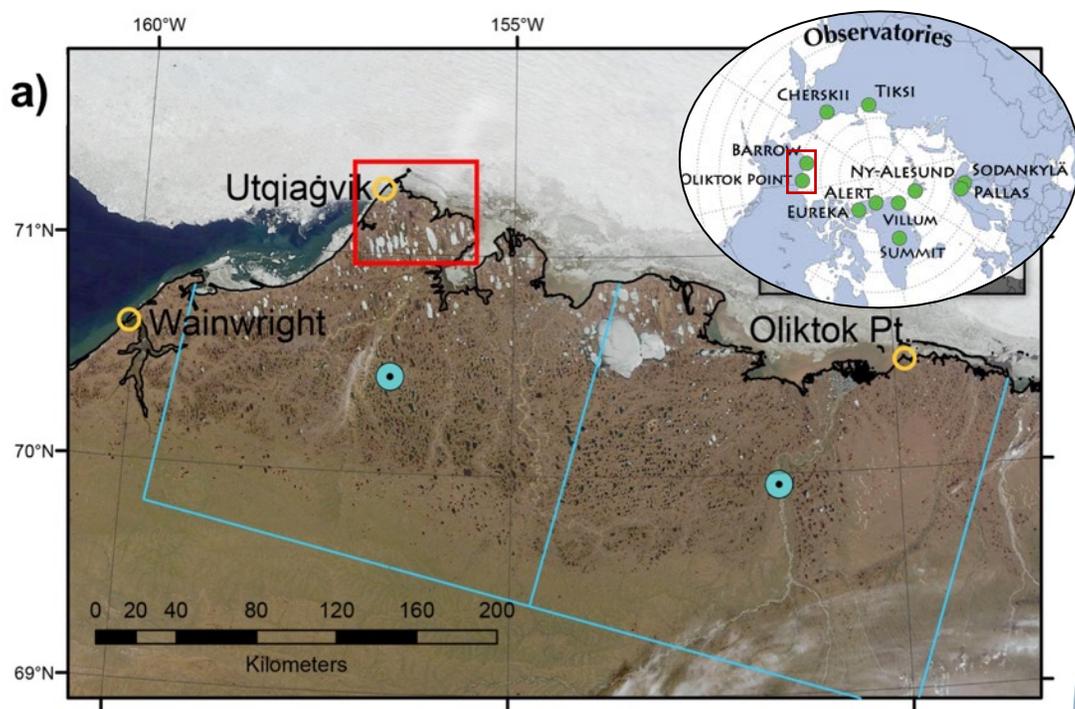
⁶Friends of Cooper Island, Seattle, WA

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Photo: <http://www.cooperisland.org>

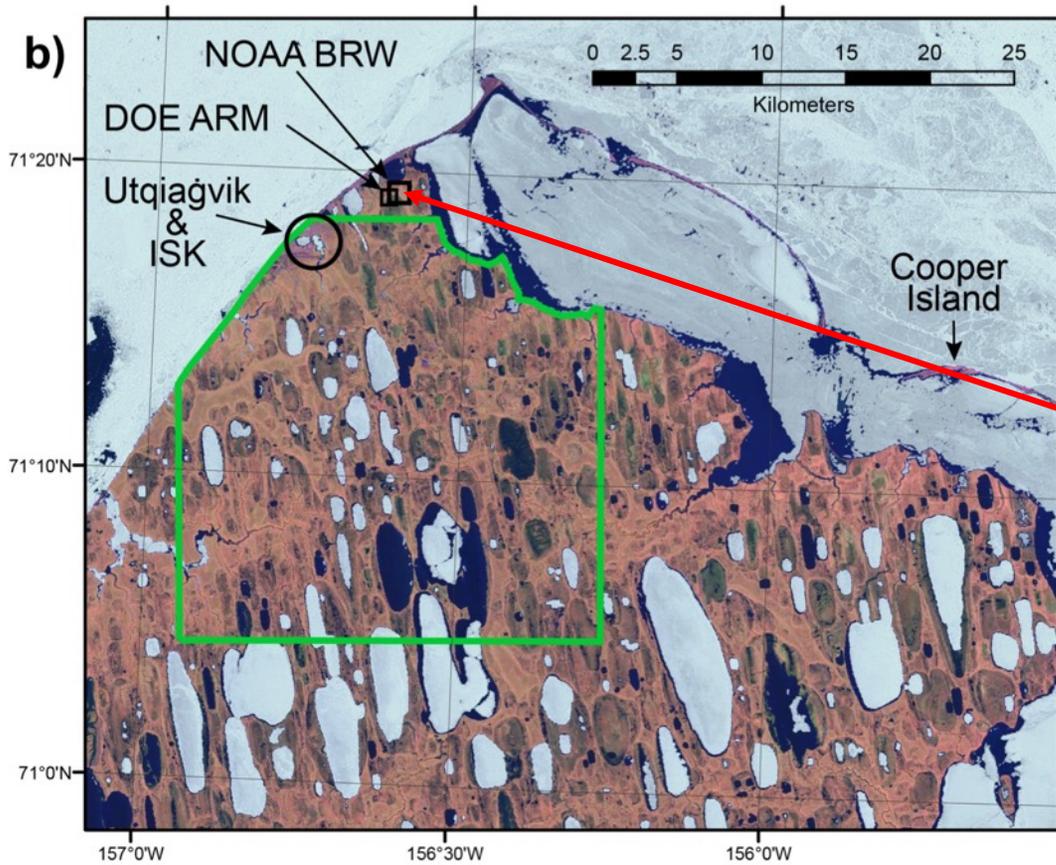
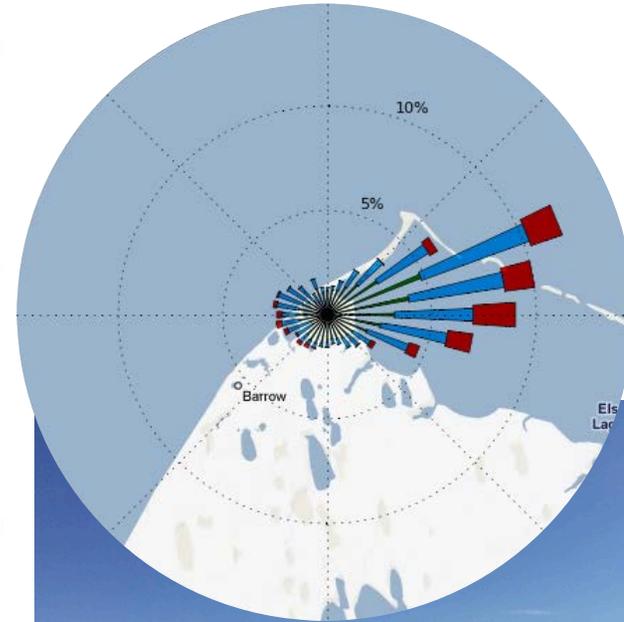


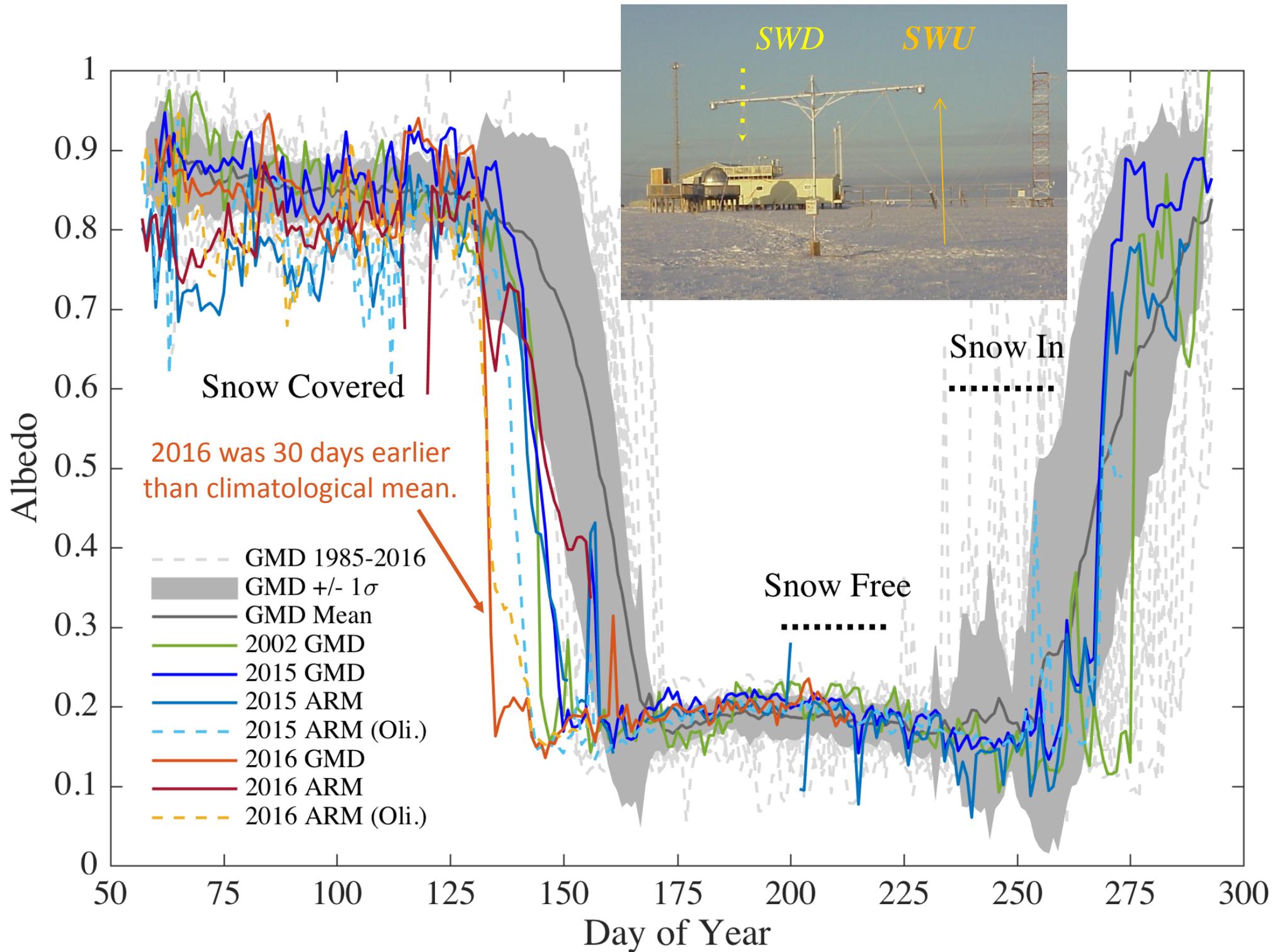
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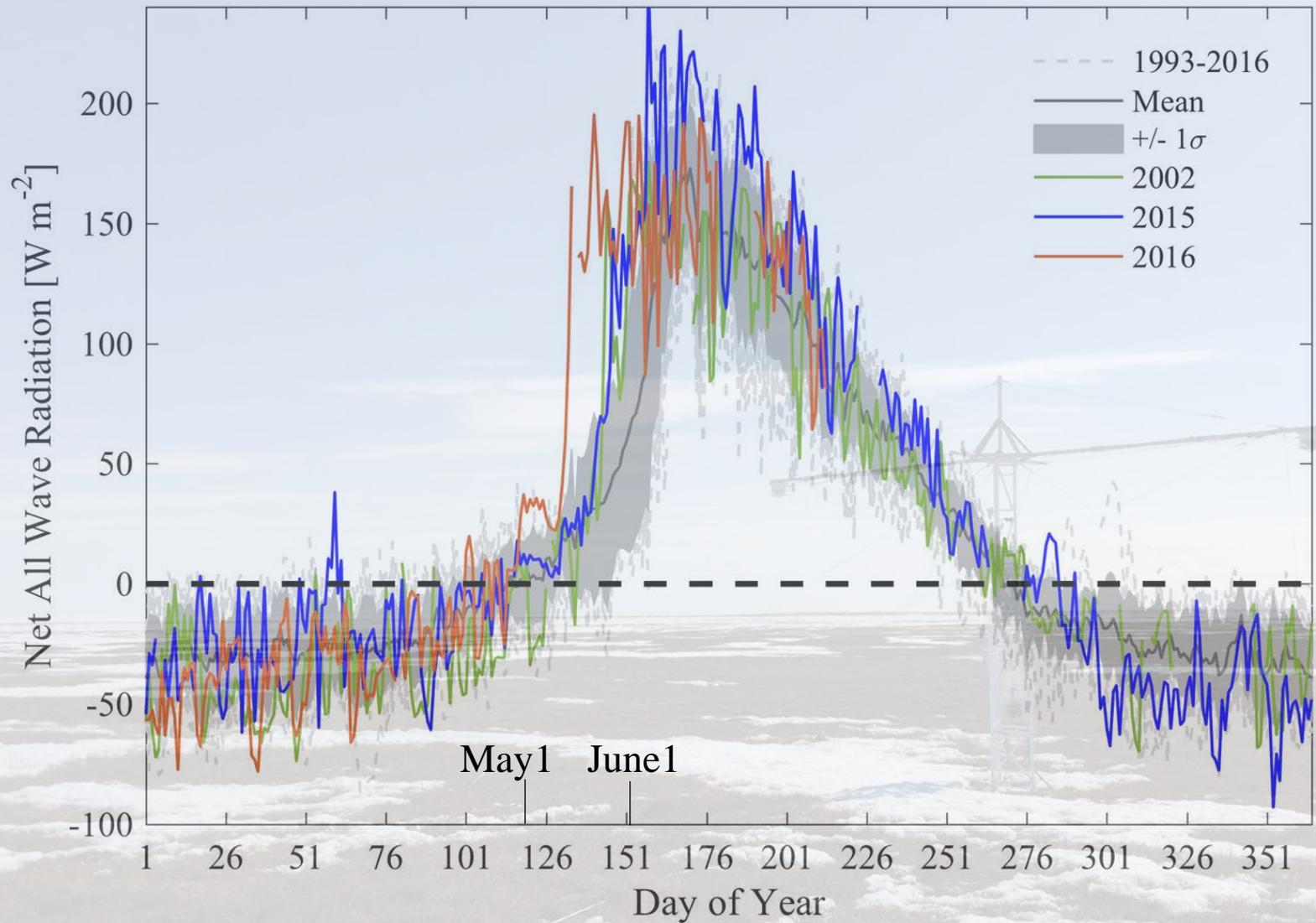


Utqiagvik (Barrow), Alaska

NOAA-GMD Baseline Atmospheric Observatory

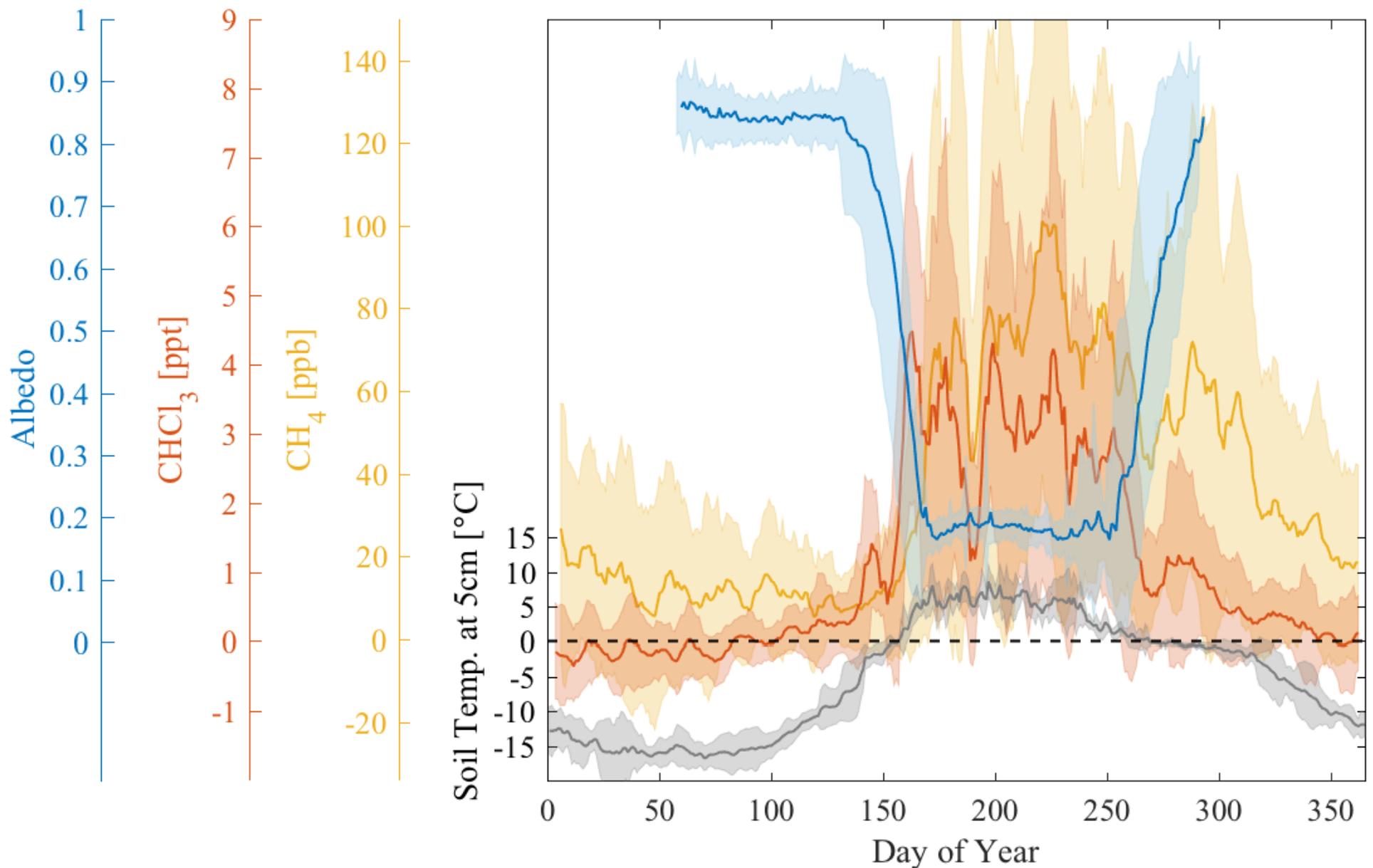




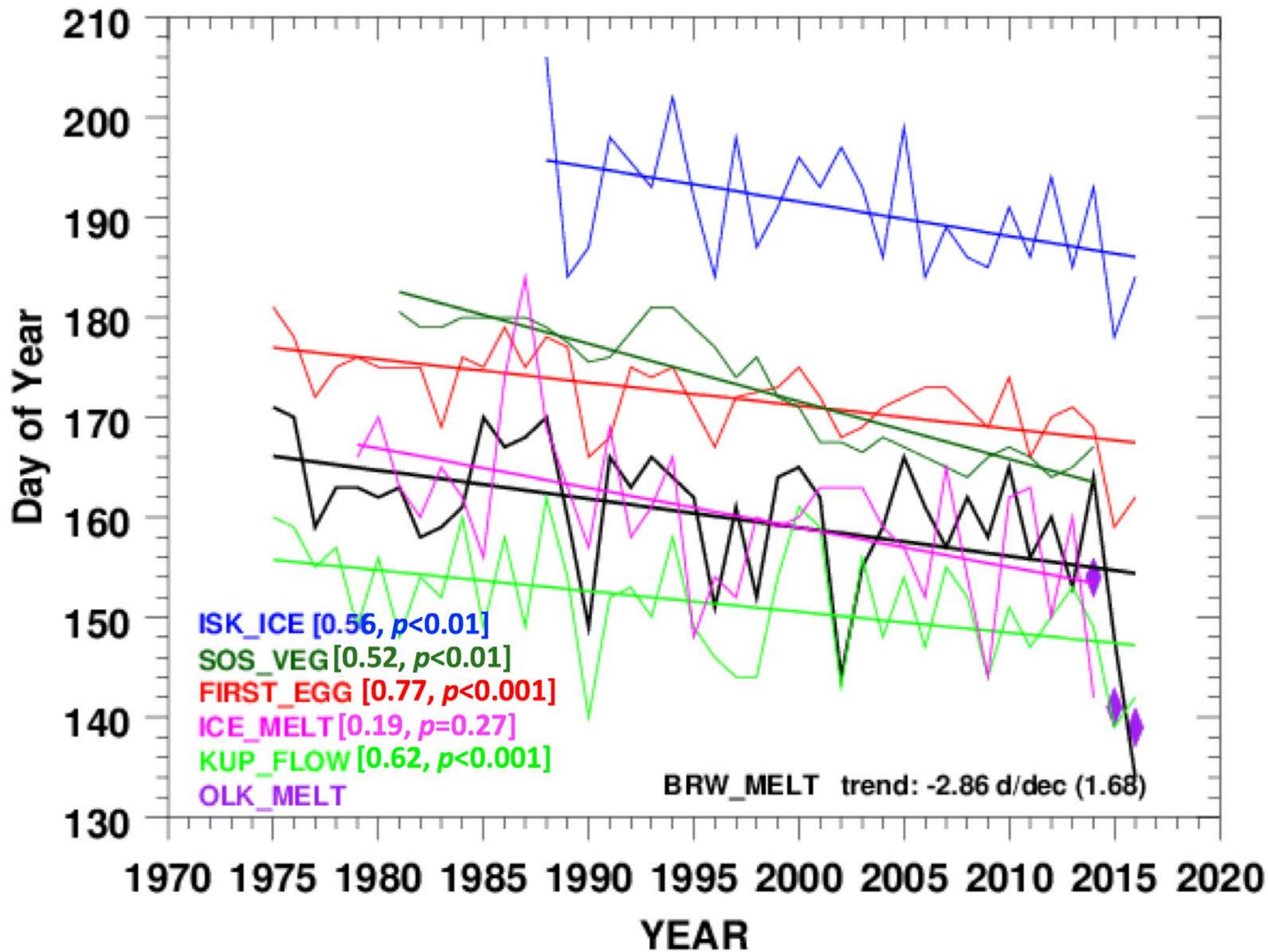


Net all-wave radiation seasonal cycle

- Duration of seasonal of net radiative warming sensitive to timing of snowmelt
- 2016 very anomalous



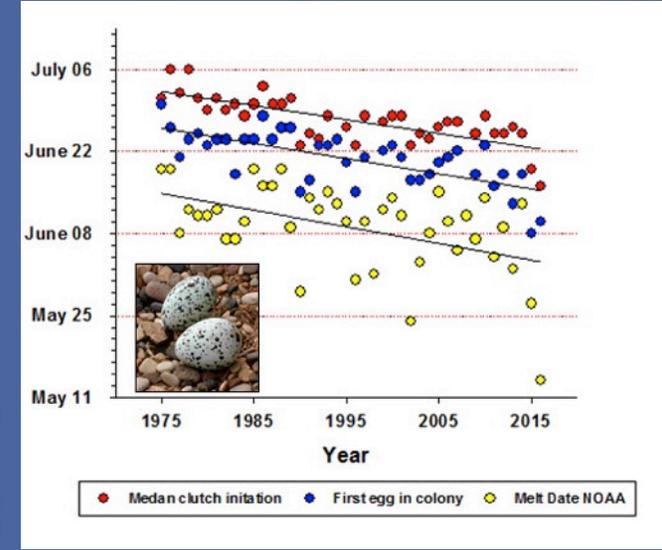
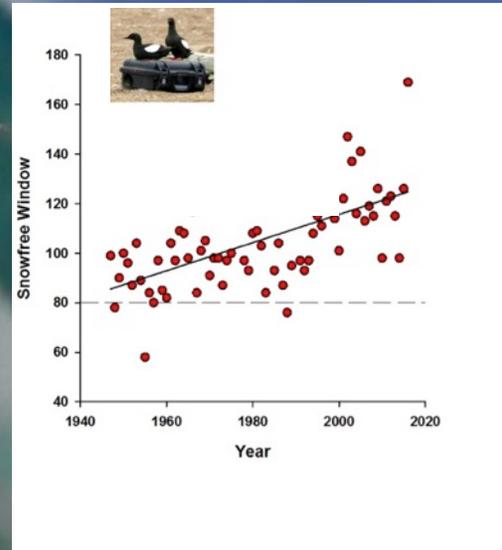
- Biogeochemical cycles are related to seasonal cycle in snow cover in complex ways
- Chloroform (CHCl₃) enhancements drop when ground is covered by snow
- Methane (CH₄) enhancements continue through December – tied to soil freeze cycle, not snow





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Barrow

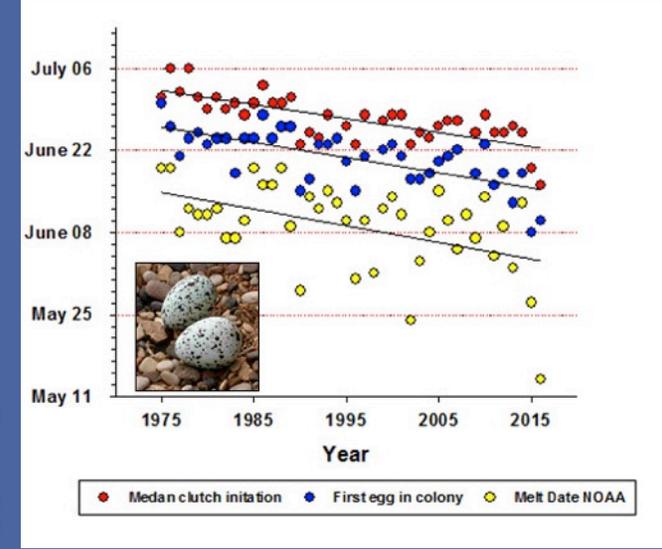
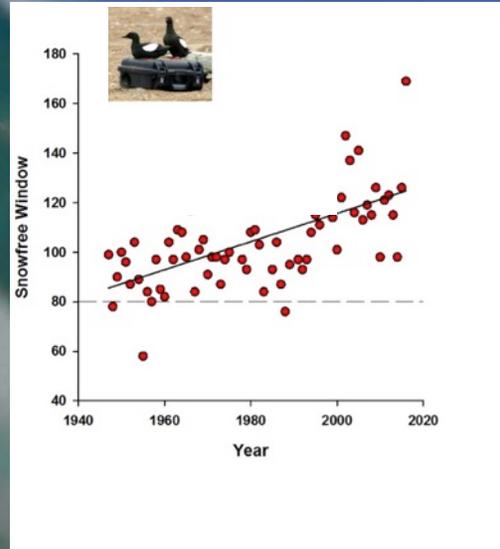


Cooper
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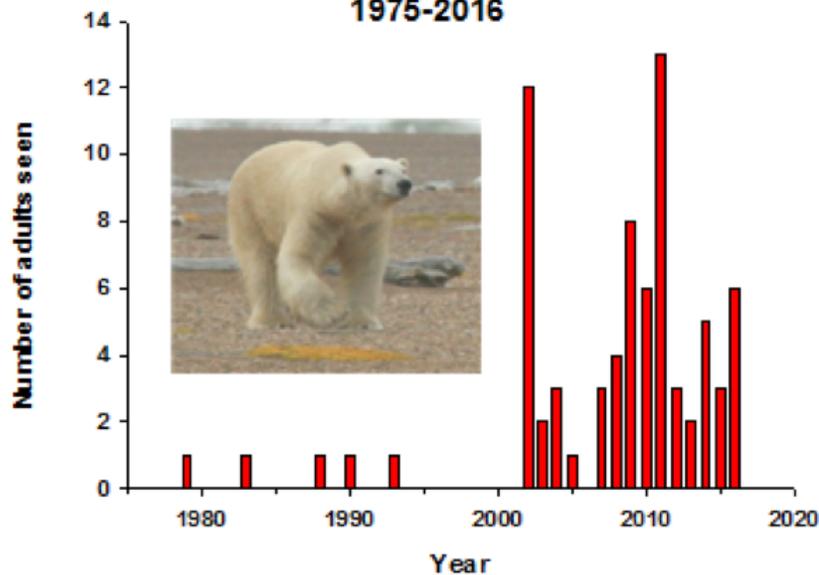


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Barrow

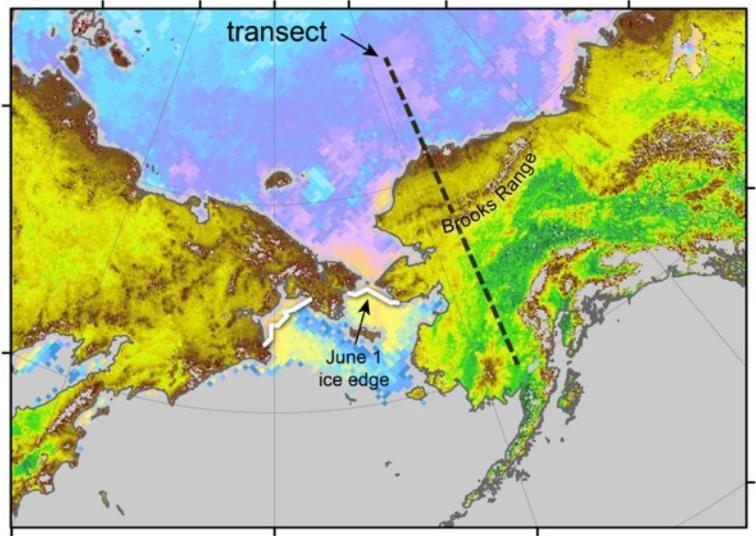


Polar Bears on Cooper Island
1975-2016

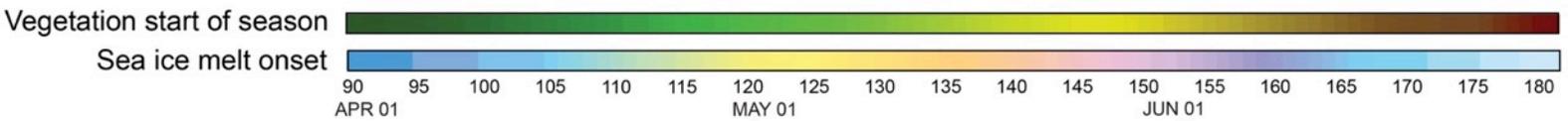
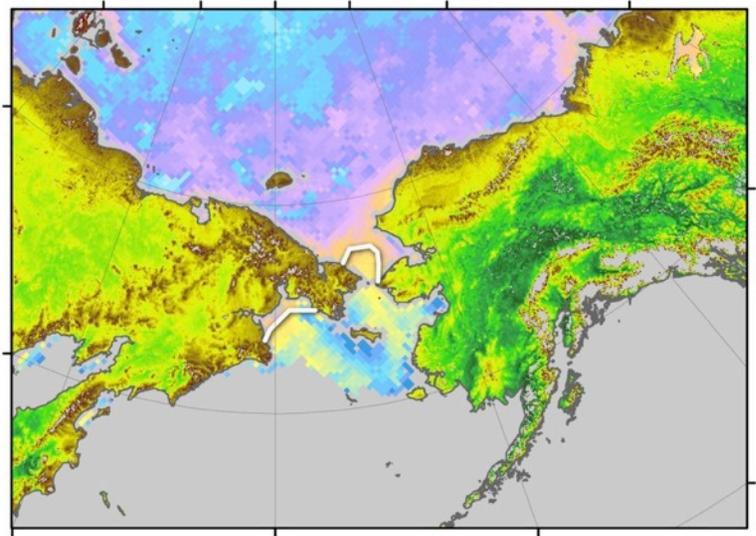


Cooper Island

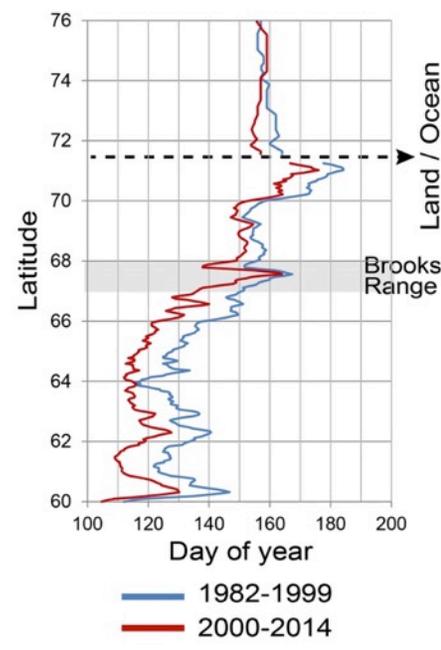
a) Start of season, 1982-1999



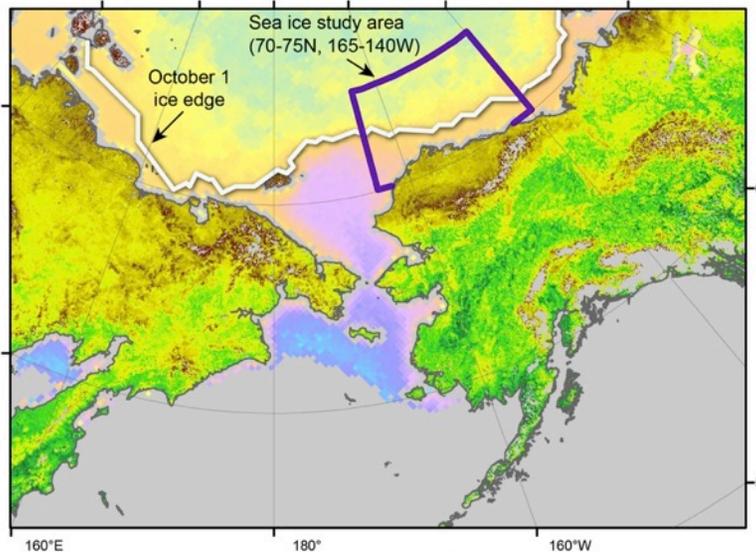
b) Start of season, 2000-2014



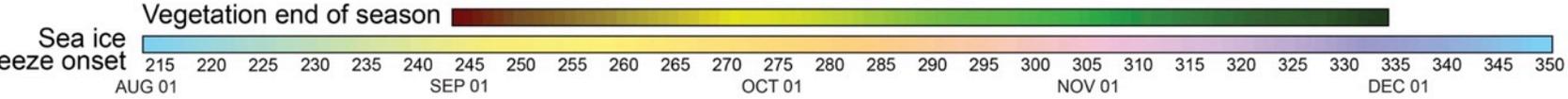
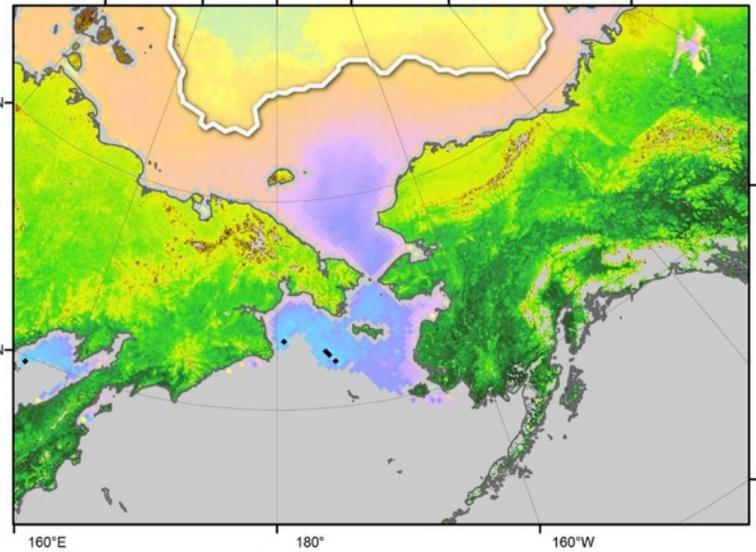
c) SOS transect profiles



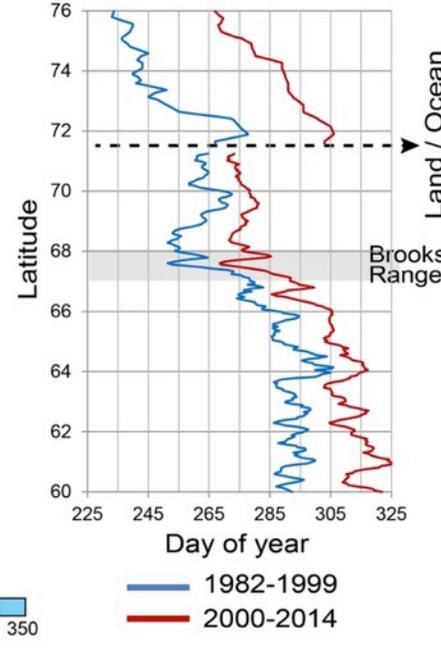
d) End of season, 1982-1999

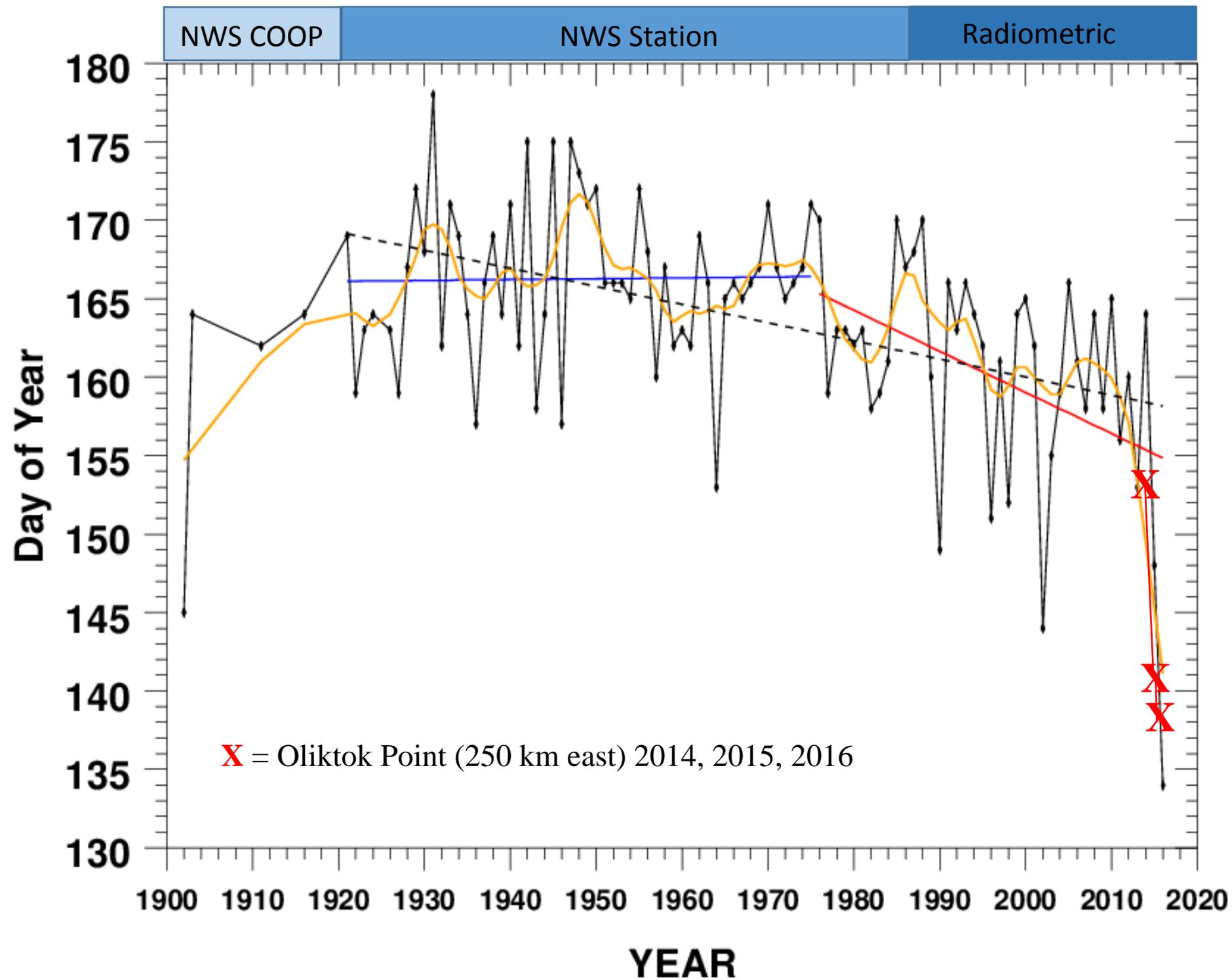


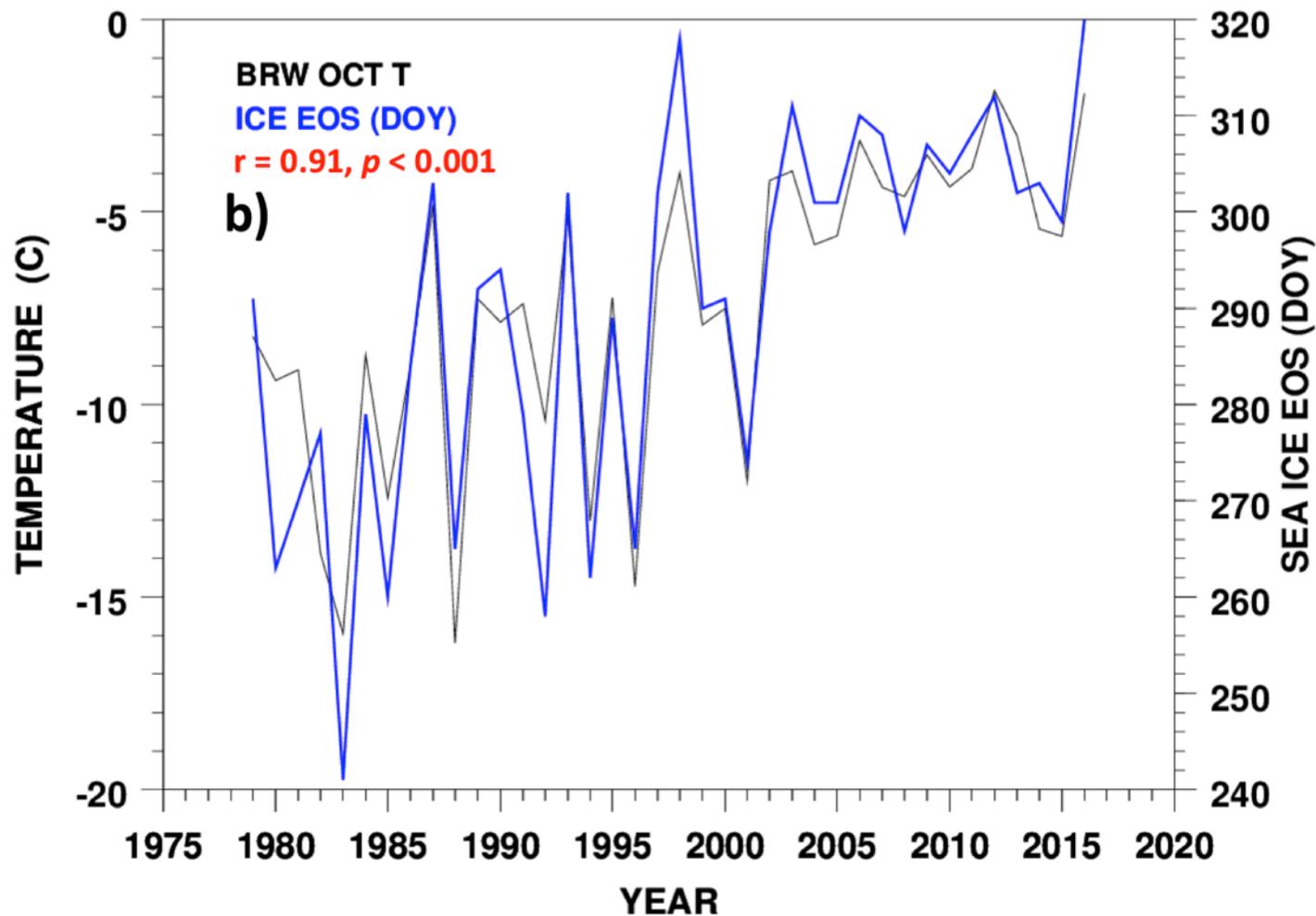
e) End of season, 2000-2014



f) EOS transect profiles



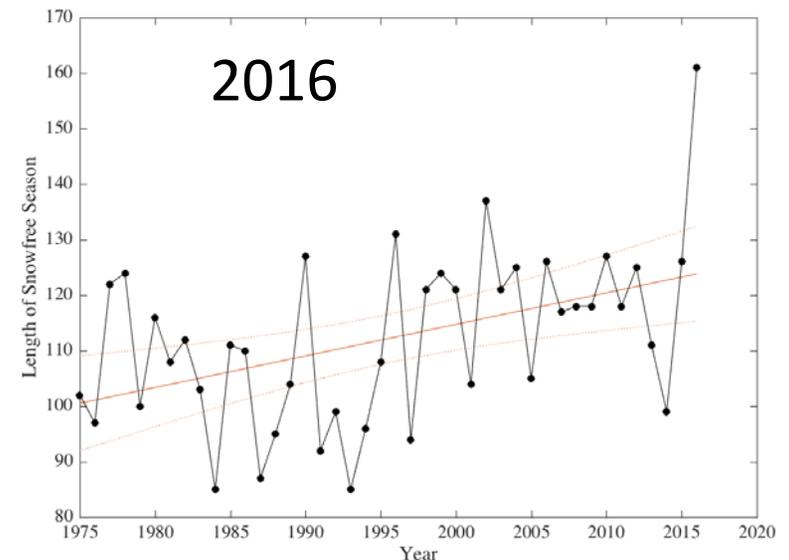




- Sea ice conditions in the Beaufort/Chukchi seas control temperature in October at Barrow, and by extension the timing of the onset of snowpack
- Trends leveled off since ~2000. Approaching physical limit?

Conclusions

- NOAA and others have supported a long legacy of climatological measurements at Utqiagvik suitable for analysis of long-term variability in NSA snow cover and relationships to the environment, which we investigate here.
- 2015 and 2016 were the 4th and 1st earliest snow-out dates and 2016 was also the record latest snow-in date.
 - The length of the 2016 snowfree season was **54 days** longer than the 1975-2015 average (see figure)
- Atmospheric circulation is important in determining the timing of snow melt in spring, signaling the importance of internal climate variability: note that 8/10 earliest years are after 1990, pointing to the influence of warming Arctic temperatures.
 - *More on this in Bob Stone's talk, next.*
- In autumn, the timing of the onset of snowpack is influenced by the amount of open water, which has increased in association with declining summer sea ice, a signal linked to Arctic amplification.



Combined record early snow out and late snow-in dates in 2016 resulted in a snow free season of 161 days (1975-2000 average 106.7 +/-13.6)

May 11, 2017

Thanks!

