Seasonality of the air-sea-ice-land environment of Arctic tundra in Northern Eurasia and North America

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Main Results

- Vegetation productivity increases have occurred at different times of the growing season throughout the Arctic.
- Sea ice declines are largest during spring and fall consistent with the periods of largest variability.
- North America displays large year round warming while Eurasia displays largest warming in fall/winter.
- Eurasia displays largest NDVI increases in spring and fall while N. America has largest increases in spring.

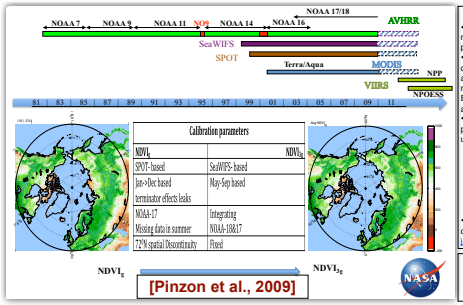
Motivation and Methods

Goal: Investigate the role of seasonality in current understanding of tundra-climate relationships

Data: Use 25 km resolution SSMI passive microwave Bootstrap Sea Ice Concentration (SIC), AVHRR Surface Temperature (T_s), and new GIMMS $NDVI_{3g}$ for the Arctic over the 1982-2008 period.

Methods: Standard climate analysis techniques applied to regional time series constructed using data within 50-km of Arctic coastlines (ocean & land) .

New GIMMS-$NDVI_{3g}$ for the Arctic

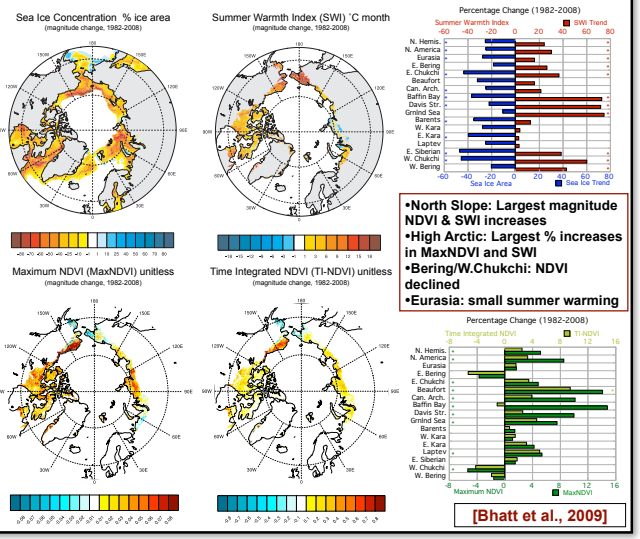


Technical Information

- The GIMMS data set uses a histogram matching approach with periodogram parameter regularization
- To ensure spatial coherence, temporal consistency among the AVHRR NDVI record and ensure continuity for the coming missions: National Polar Orbiting Operational Environmental Satellite System (NPOESS) and Preparatory project (NPP).
- An apparent 72N spatial discontinuity in the previous GIMMS-NDVIg product was fixed by using histogram matching from:
  - SeaWIFS instead of SPOT which doesn't collect data above 720N
  - May-September instead of January-December to avoid terminator effects leaking into the parameters.
  - An integration of NOAA-18 and NOAA-17 NDVI data.
- **NDVI3g** is ready for distribution for all continents (for more information contact jorge.e.pinzon@nasa.gov).

NDVI = (NIR-R)/(NIR+R) NIR: spectral reflectance in near-infrared band (0.725-1.1 μm) & R: red chlorophyll absorbing portion of spectrum (0.58-0.68 μm)

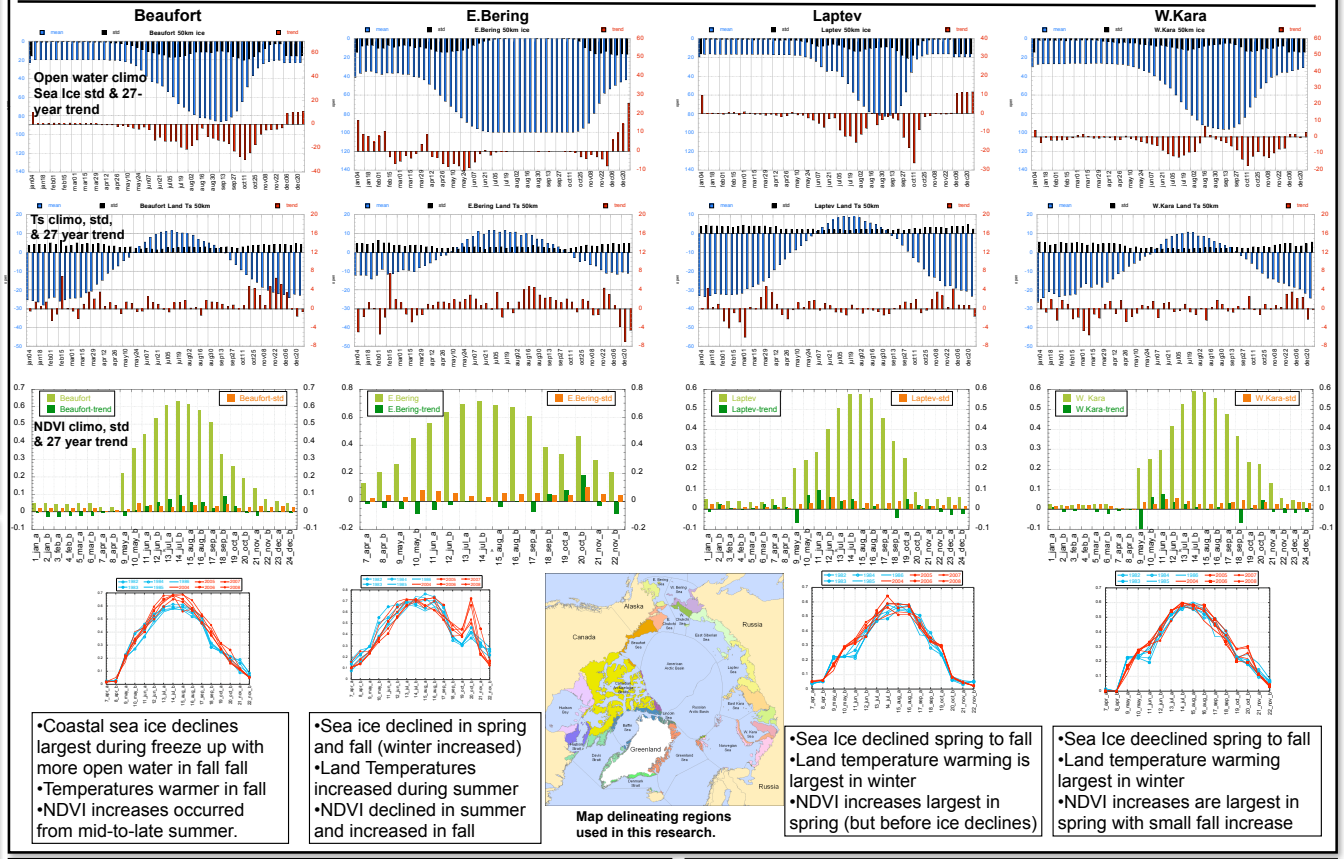
Sea ice declines are driving vegetation increases



- **North Slope: Largest magnitude NDVI & SWI increases**
- **High Arctic: Largest % increases in MaxNDVI and SWI**
- **Bering/W.Chukchi: NDVI declined**
- **Eurasia: small summer warming**

[Bhatt et al., 2009]

Weekly & Biweekly Trends in the Arctic Coastal Zone for the Beaufort, E. Bering, Laptev and W. Kara Seas



Map delineating regions used in this research.

- Coastal sea ice declines largest during freeze up with more open water in fall fall
- Temperatures warmer in fall
- NDVI increases occurred from mid-to-late summer.

- Sea ice declined in spring and fall (winter increased)
- Land Temperatures increased during summer
- NDVI declined in summer and increased in fall

- Sea Ice declined spring to fall
- Land temperature warming is largest in winter
- NDVI increases largest in spring (but before ice declines)

- Sea Ice deeclined spring to fall
- Land temperature warming largest in winter
- NDVI increases are largest in spring with small fall increase

References

- Pinzon, J. E., E. Pak, C.J. Tucker, 2009 (submitted), A revised AVHRR 8-km NDVI Data Set - Compatibility with MODIS and SPOT Vegetation NDVI Data, American Geophysical Union EOS Transactions.
- U.S. Bhatt, D.A. Walker, M.K. Raynolds, J.C. Comiso, H.E. Epstein, G.Jia, R. Gens, J.E. Pinzon, C.J. Tucker, C.E. Tweedie, and P.J. Webber, 2009 (submitted 12/2009): Circumpolar Arctic tundra vegetation change is linked to sea-ice decline, Earth Interactions.

Acknowledgements

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Points Requiring Further Thought

- NDVI declined during first half of May throughout the Arctic: Is this due to some phenomena (late snowfall) that leads to delayed greenup?
- What is the cause of the secondary NDVI fall peak (e.g. E. Bering)?
- Why are NDVI increases larger in North America than Eurasia?
- What role is played by the local atmospheric circulations in these results?