Climatology and variability of the ice-ocean-atmosphere-terrestrial system on the Yamal

Uma Bhatt[1], Donald A. Walker[2], Martha K. Raynolds[2], Howard E. Epstein[4], Gensuo Jia[5], Josefino C. Comiso[6] Jorge E Pinzon[6], Compton J. Tucker[6]

[1]Geophysical Institute & Dept. Atmospheric Sciences at U. Alaska Fairbanks (UAF), [2]Institute of Arctic Biology at UAF, [4]Dept. of Env. Sci. at University of VA, [5]CAS, Beijing China, [6]NASA Goddard Space Flight Center

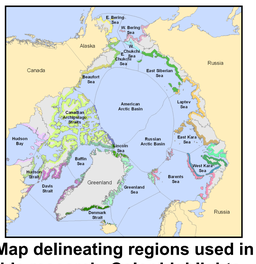
Poster presented at the LCLUC Science Team Meeting, Bethesda, MD, 20-22 April 2010

Motivation and Methods

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

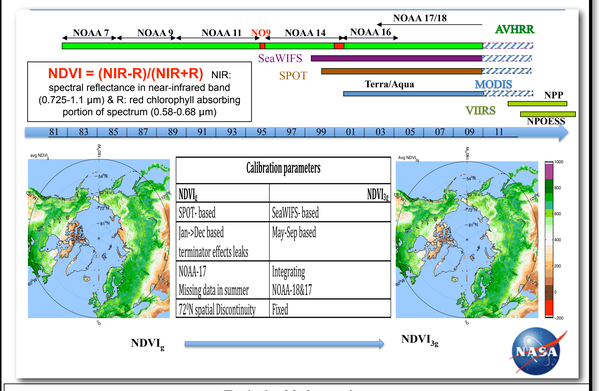
Data: Use 25 km resolution SSMI passive microwave Bootstrap Sea Ice Concentration (SIC), AVHRR Surface Temperature (T_s), and new GIMMS $NDVI_{3g}$ for the Arctic over the 1982-2008 period.

Methods: Standard climate trend and correlation analysis techniques applied to regional (Modified Treshnikov basins) time series of Maximum NDVI, Time Integrated NDVI, Summer Warmth Index, and sea ice concentration constructed using data within 50-km of Arctic coastlines (ocean & land) .



Map delineating regions used in this research. Color highlights 50-km coastal regions.

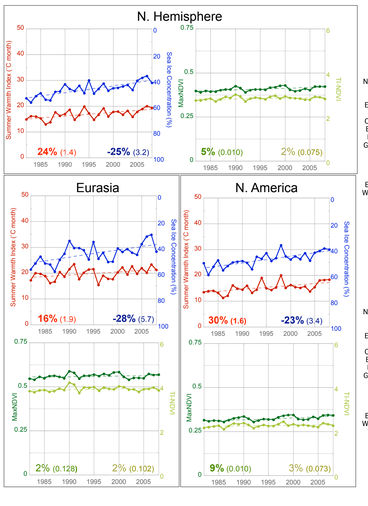
New GIMMS-$NDVI_{3g}$ for the Arctic

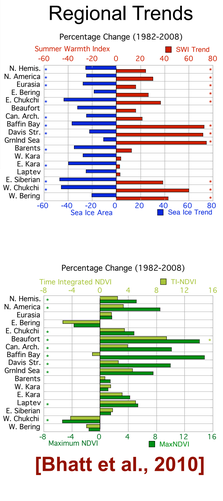


Technical Information

- 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).

Contrast N. America and Eurasia

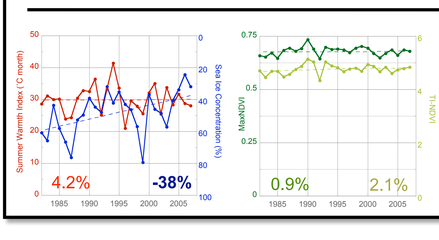




[Bhatt et al., 2010]

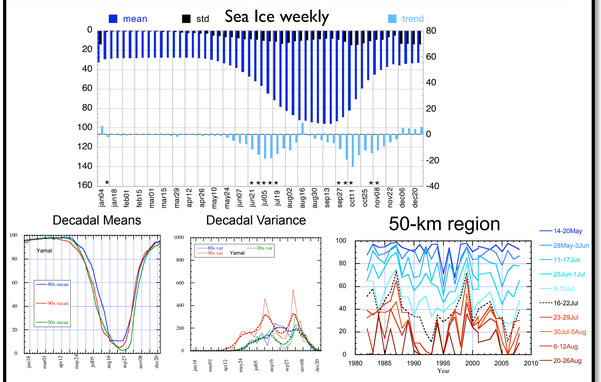
- **Trends are larger in N. America**
- **Variability is larger in Eurasia**
- **North Slope: Largest magnitude NDVI & SWI increases**
- **High Arctic: Largest % increases in MaxNDVI and SWI**
- **Bering/W.Chukchi: NDVI decline**
- **Eurasia: small summer warming**

50-km and full tundra domains similar



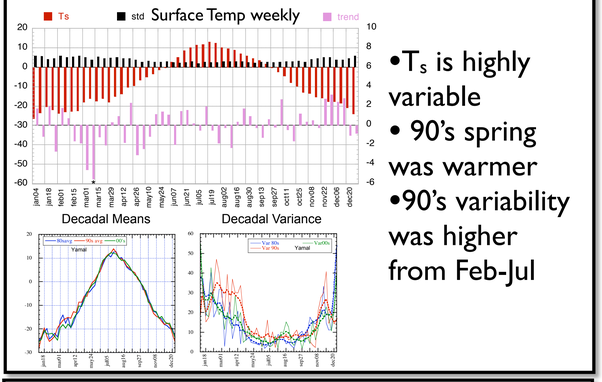
- **Sea ice (blue) shows significant decreases.**
- **SWI (red) and NDVI (greens) display very small positive trend.**

Weekly Sea Ice Trends & Variability



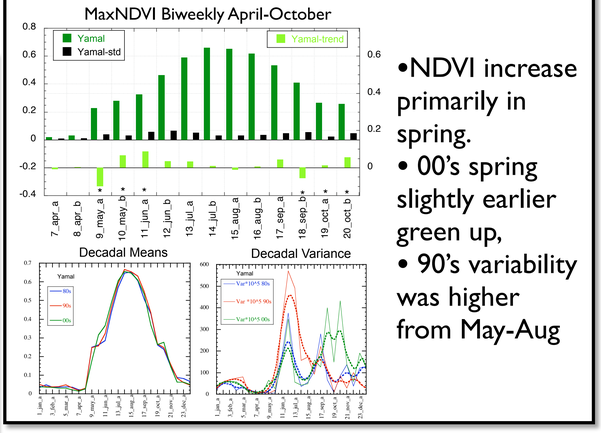
- Ice decreasing trends in spring and fall
- 90's spring earlier & 00s spring earlier and fall later
- 90's variability was higher from Mar-Aug & Sep-Nov

Weekly T_s Trends & Variability



- T_s is highly variable
- 90's spring was warmer
- 90's variability was higher from Feb-Jul

Bi-weekly NDVI Trends & Variability



- NDVI increase primarily in spring.
- 00's spring slightly earlier green up,
- 90's variability was higher from May-Aug

Main Findings

- Greening has not changed much on Yamal
- Land temperatures have warmed slightly in fall and even cooled in spring
- Sea ice shows significant declines with earlier melt and later freeze up.
- On a weekly (biweekly) time scale the 1990s had the most variability (El Niño and Pinatubo?)

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, 2010 (in revision): Circumpolar Arctic tundra vegetation change is linked to sea-ice decline, Earth Interactions.

Acknowledgements

This study was supported by grants NSF ARC-0531180, NASA NNG6NE00A, NSF ANS-0732885, NSF ARC-0902175, NASA Land Cover Land Use Change on the Yamal Peninsula.