Seasonal changes of the ice-ocean-atmosphere-terrestrial system on the Yamal Uma Bhatt¹, Donald A. Walker², Martha K. Raynolds², Peter Bieniek¹, Howard E. Epstein⁴, Gensuo Jia⁵, Josefino C. Comiso⁶ Jorge E Pinzon⁶, Compton J. Tucker⁶

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

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Main Points for Yamal: Strong increase in summer coastal open water, but weak land temperature and NDVI trends Positive fall increases in open water, land temperatures and NDVI. FALASKA

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 **1982-2010** period.

Methods:

• Trend and correlation analysis applied time series of Maximum NDVI, Time Integrated NDVI, Summer Warmth Index and Sea ice concentration. • Full tundra domain over land and over ocean within 100-km of Arctic coastlines.



Seasonality of Trends & Variability



Map delineating study regions.

Trends in Open Water, MaxNDVI & SWI



- Largest sea ice declines are in spring and fall.
- Surface temperatures show fall warming and primarily cooling during spring and summer.
- MaxNDVI increases most near peak and in fall. In contrast, Beaufort region MaxNDVI increased more and the increases are largest during summer peak season.

Yamal SWI & NDVIs by Bioclimate Subzone



- MaxNDVI and temperature trends are larger in N. America
- SWI trends very small from Barents to Laptev, consistent with TI-NDVI trends.
- E. Bering/W.Chukchi display MaxNDVI & Ti-NDVI decline.

• W. Kara displays increases as well as decreases in SWI and MaxNDVI (spatial trend plots).

Large Variability and Significant **Correlations**

Take Home Message

- Greening over Yamal is smaller than that in other parts of the Arctic.
- Large decrease in the North Kara Sea May-Aug open water corresponds to virtually no change in land temperatures or NDVI.



Detrended Correlations (Significance bold(95) & italic (90))		
	TI-NDVI	Sea-Ice
SWI	0.62	-0.39
TI-NDVI		-0.34

 MaxNDVI weakly correlated with sea ice and SWI.

• Correlations using summer open water area are similar to those with sea ice.

•Sea ice concentration (100km coastal zone) displays significant decreases (blue).

•SWI shows a small decrease from 1982-2010 (red).

•NDVI (greens) displays small positive trend but show a decline since 2007.

- There is generally good correspondence between changes in both max NDVI and TI-NDVI with changes in SWI.
- Land temperatures have warmed slightly in fall and even cooled in summer.
- Large amplitude natural variability strongly influences year-to-year values.

References

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