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Title: *Towards Understanding Recent Pan-Arctic Tundra Vegetation Change and it's Associated Climate Variability*

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The paper presents a seasonality analysis of primarily using long-term remotely sensed data of tundra vegetation variability and associated climate parameters. An overall increase of Pan-Arctic tundra vegetation greenness has been documented using the remotely sensed Normalized Difference Vegetation Index (NDVI). The coherent variability between NDVI, springtime coastal sea ice (passive microwave) and land surface temperatures (AVHRR) has been documented, but these relationships appear to be non-stationary.

The Arctic tundra is divided into domains based on Treshnikov divisions that are modified based on floristic provinces, since the Pan-Arctic landscape is heterogeneous. This study uses remotely sensed weekly 25-km sea ice concentration, weekly surface temperature, and bi-weekly NDVI from 1982 to 2011. The GIMMS NDVI3g data has been corrected for biases during the spring and fall, with special focus on the Arctic. Trends of Maximum NDVI (MaxNDVI), Time Integrated NDVI (TI-NDVI), Summer Warmth Index (SWI, sum of degree months above freezing during May-August), and open water area are explored.

Overall, we find that trends over the 30-year record are not steady as evidenced by the following examples from recent years. The sea ice decline has increased in Eurasia and slowed in North America. The weekly AVHRR landsurface temperatures reveal that there has been summer cooling over Eurasia in recent years and that the warming over North America has slowed. The MaxNDVI rates of change have diverged between N. America and Eurasia while TI-NDVI has declined for both in recent years. Most remarkable is the midsummer cooling trends throughout Arctic divisions that have experienced summer sea ice declines. Trends based on the last 15-year period show recent cooling and NDVI declines during shoulder seasons. We are performing analysis to support the hypothesis that the summer cooling occurs in areas of substantial sea ice decline so that cloud cover is enhanced. Research is

ongoing to understand the climate mechanisms associated with these trend patterns.