Supplementary Materials

Swanson, D.K. Trends in greenness and snow cover in Alaska's arctic National Parks, 2000–2016. *Remote Sens.* **2017**, 9.

Table S1. Dates in the fall and spring when the solar zenith angle is less than 90°, 70°, and 80° at time of the MODIS Terra pass (10:30 AM local time)*

Season	Solar Zenith Angle	Ordinal (Calendar) Date at Latitude	
		66 °N	**68 °N**
Spring	90 °	8 (Jan 8)	20 (Jan 20)
Spring	80 °	50 (Feb 19)	55 (Feb 24)
Spring	70 °	76 (Mar 17)	81 (Mar 22)
Fall	70 °	268 (Sep 25)	264 (Sep 21)
Fall	80 °	295 (Oct 22)	290 (Oct 17)
Fall	90 °	337 (Dec 3)	325 (Nov 21)

*Computations by [1]. Latitude 66°N is representative of BELA and 68 °N is representative of NOAT and GAAR (Figure 3). Spring dates are the first day in the year when the the solar zenith angle is less than the value indicated. Fall dates are the last day in the fall when the solar zenith angle is less than the value indicated.

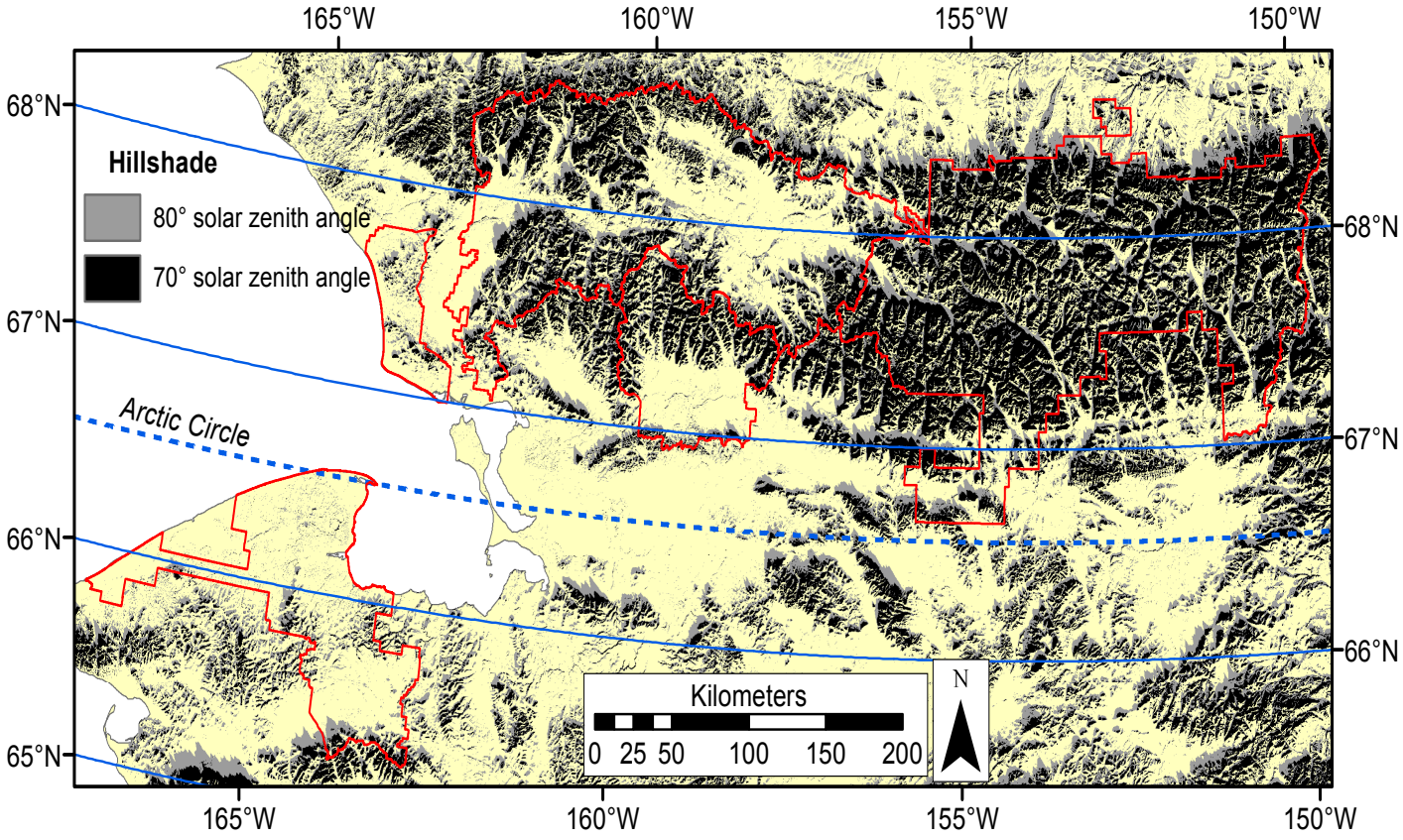

Figure S1. Terrain shadowing in the study area under different solar zenith angles. Shadows under solar zenith angles of 80° and 70° (10° and 20° above horizontal and azimuth of 158° (corresponding to 10:30 AM local time, the time of the MODIS Terra satellite pass) were computed using the hillshade geoprocessing tool in ArcGIS 10.2 [2]. Black areas are in terrain shadow with 70° solar zenith angle and gray areas are the additional terrain shadow at 80° solar zenith angle. Dates when these sun angles occur in the study area are given in Table 1.

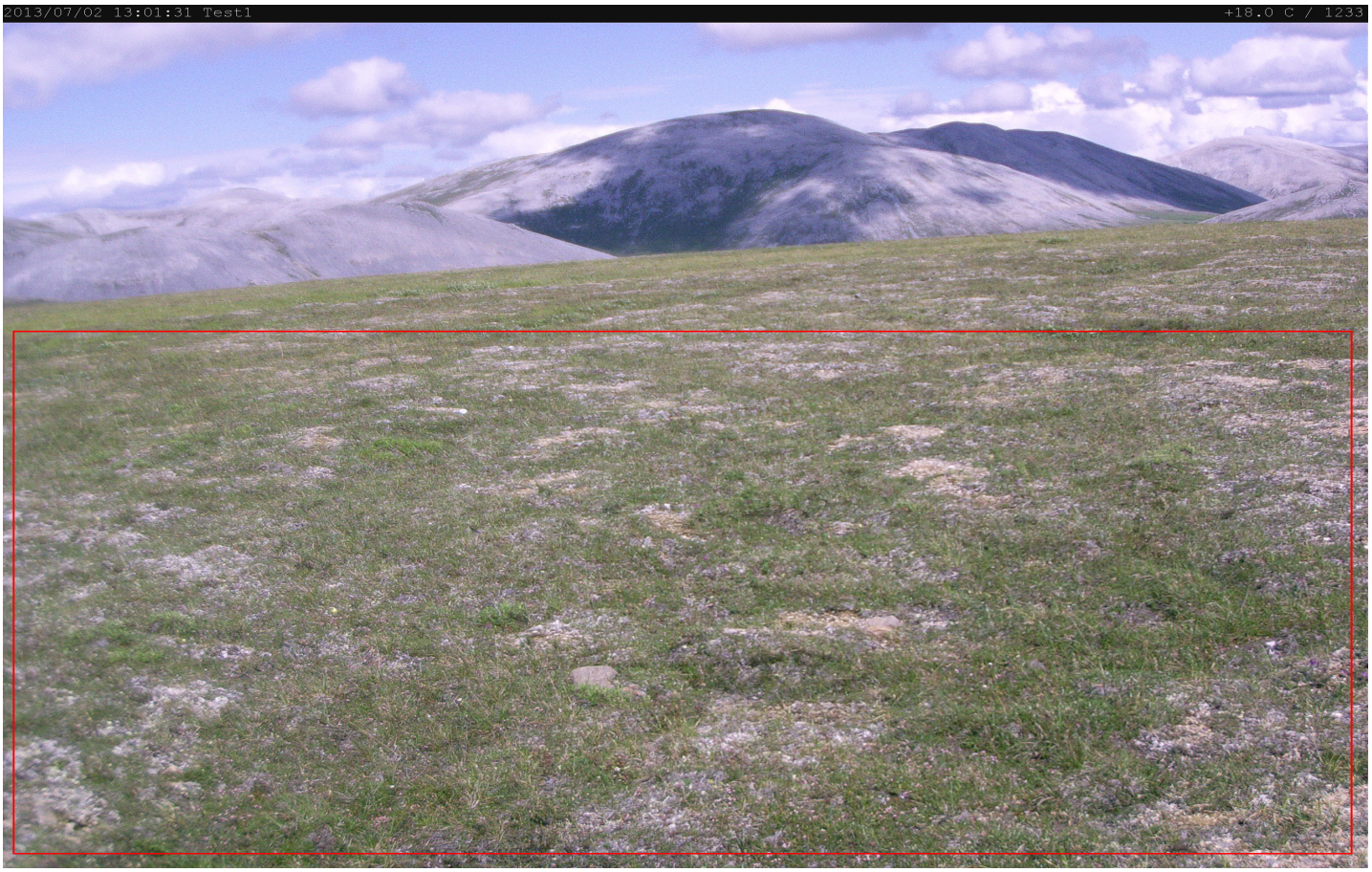

Figure S2. An example automated camera frame with analysis window outlined in red. Pixels within the analysis window were analyzed quantitatively for greenness and snow cover [3].

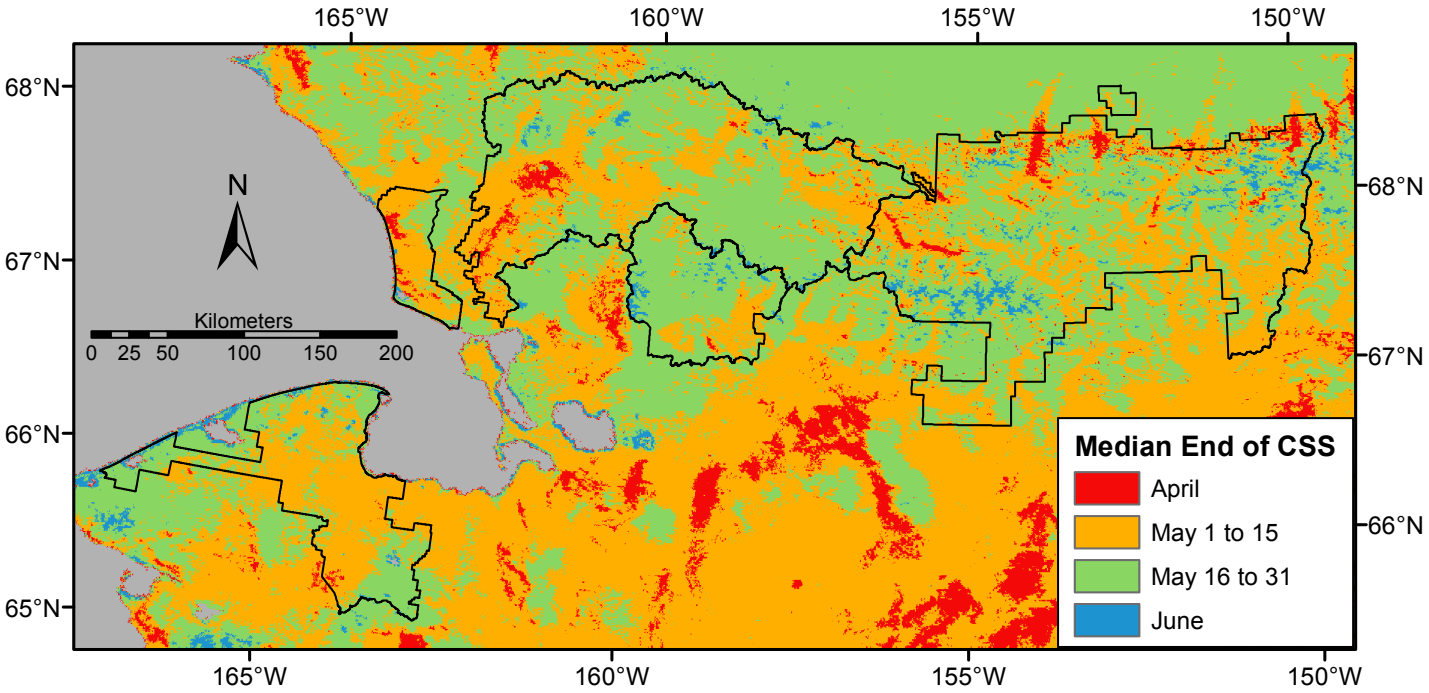

Figure S3. Median for 2001-2016 of the ordinal date of the end of the continuous snow season (CSS).

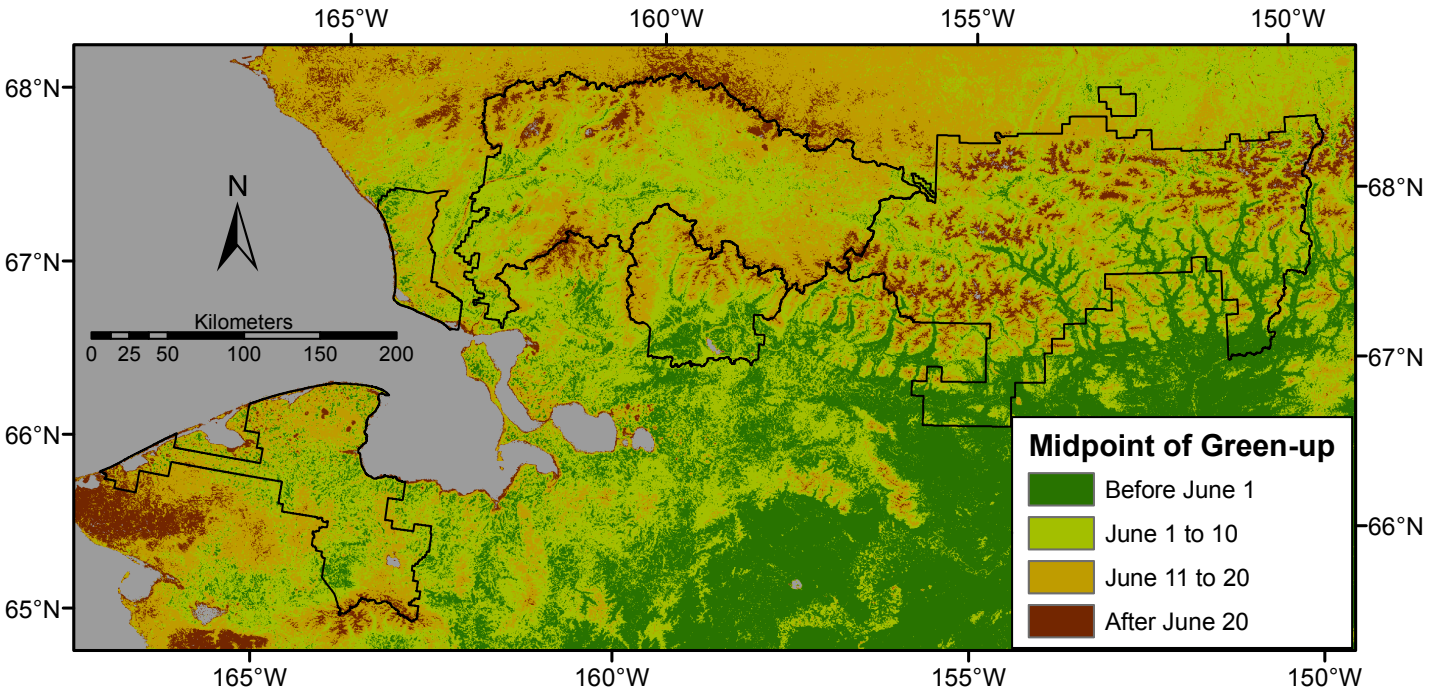

Figure S4. Median date of midpoint of spring green-up for years 2000-2015

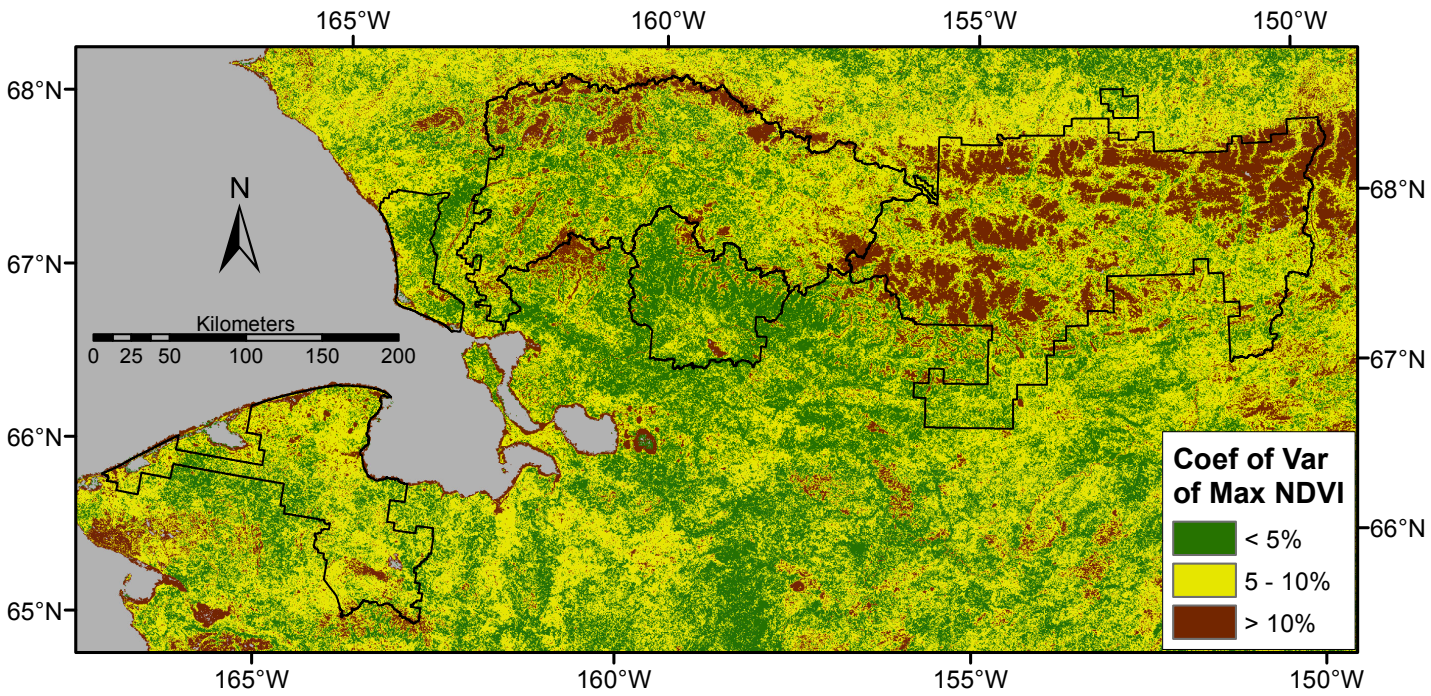

Figure S5. Coefficient of variation in maximum NDVI, 2000-2015.

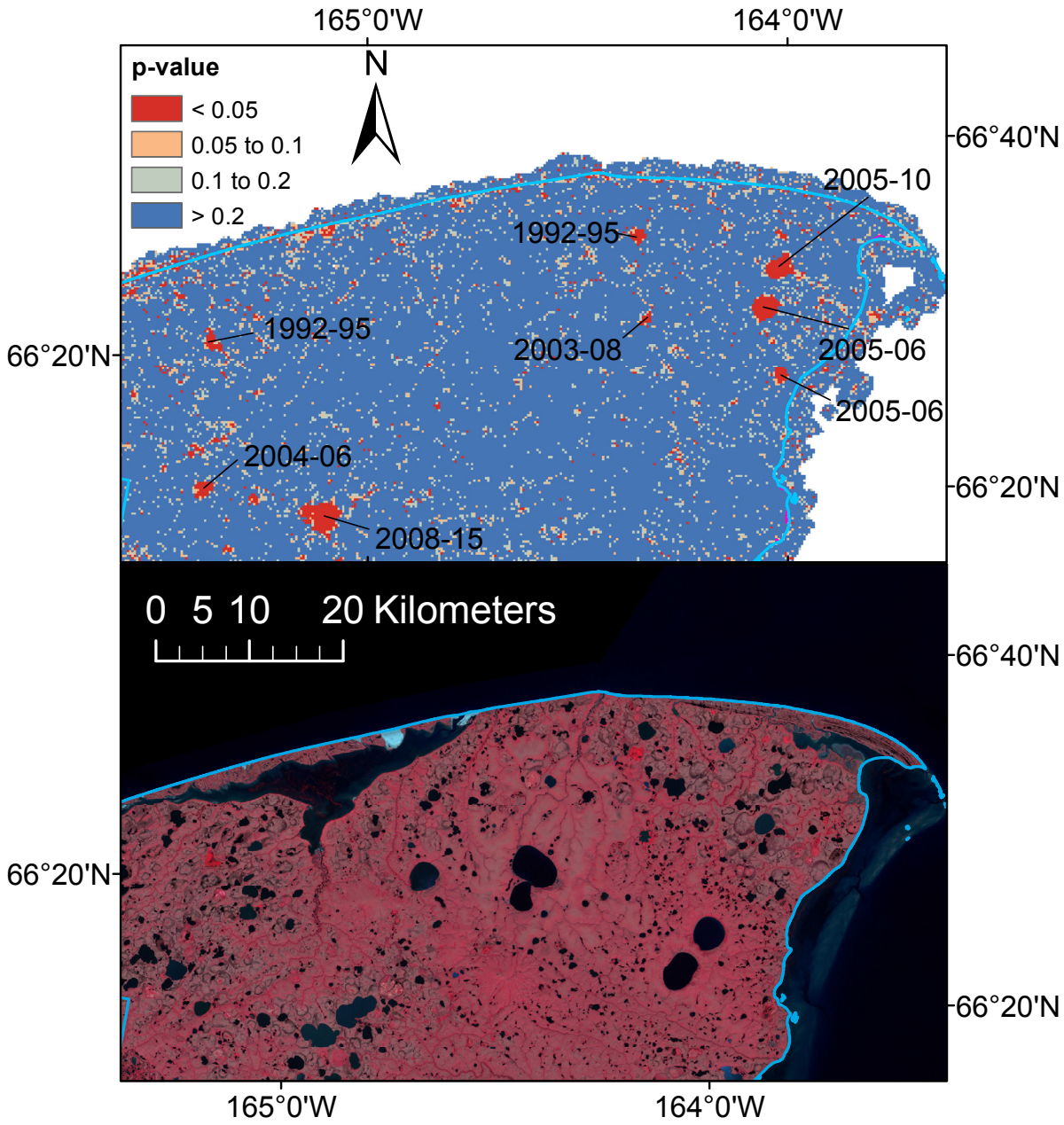

Figure S6. Significance (Mann_Kendall test) of trend in maximum NDVI in BELA, 2000-2015 (upper) and a 2002 Landsat image, color-infrared color scheme (lower). Patches with high significance ($p < 0.05$) correspond to perimeters of lakes that drained during the years indicated. The two lakes that drained in the 1990s (visible as bright red areas in the Landsat image) had a significant decrease in NDVI from 2000 to 2015. The remaining lakes drained in the 2000 decade. They appear dark and water-filled on the 2002 Landsat image and had significant NDVI increases between 2000 and 2015.

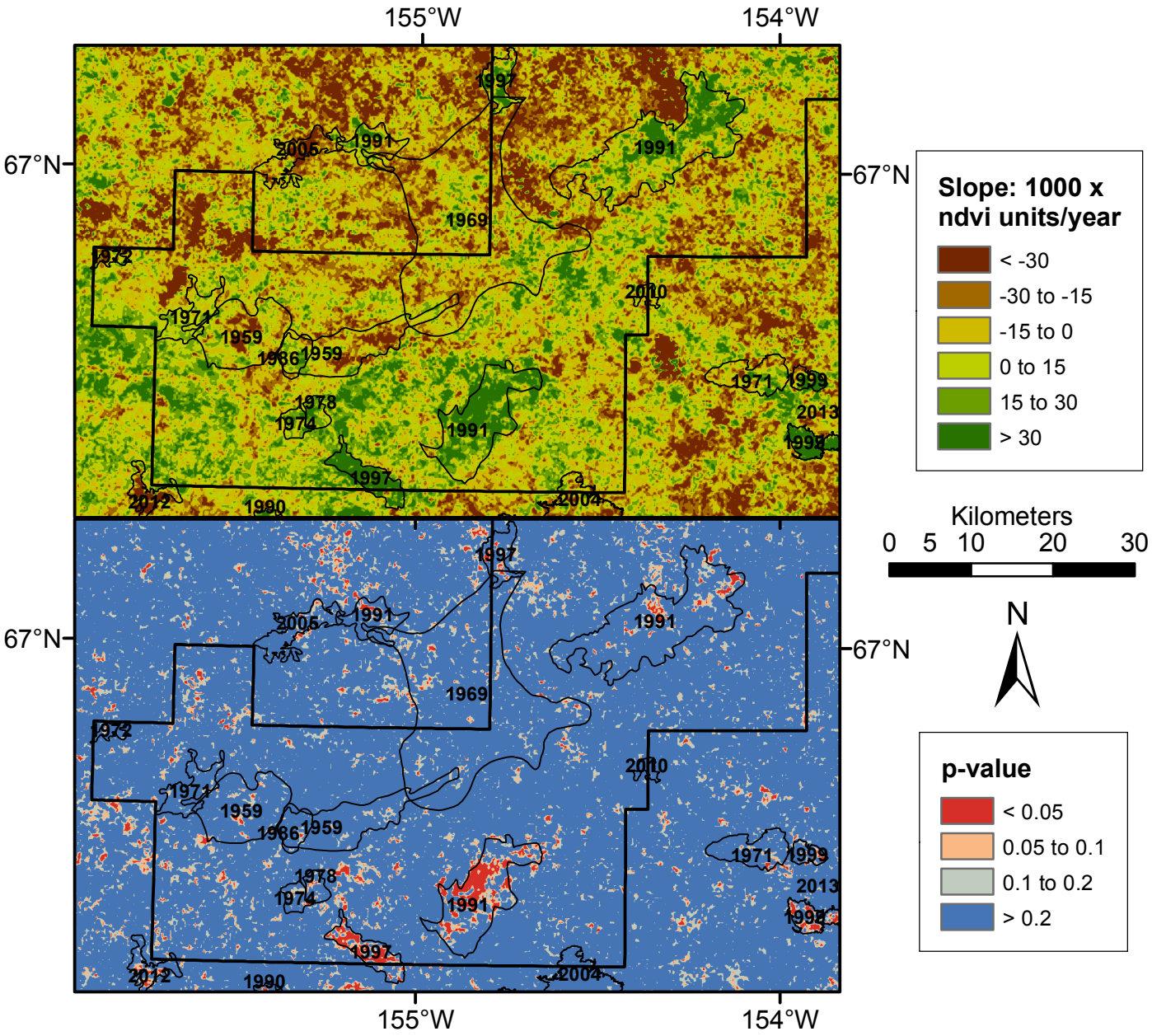

Figure S7. Trend of maximum NDVI in southwestern GAAR, 2000-2015. The upper map is Theil-Sen's slope of maximum NDVI (times 1000) vs. year. Brown indicates decreasing and green an increasing NDVI over time. The lower map is the Mann-Kendall test of significance of the trend (two-tailed test). Perimeters Figure S8. Median date of the midpoint of senescence, 2000-2015. of wildfires with the indicated years are provided.

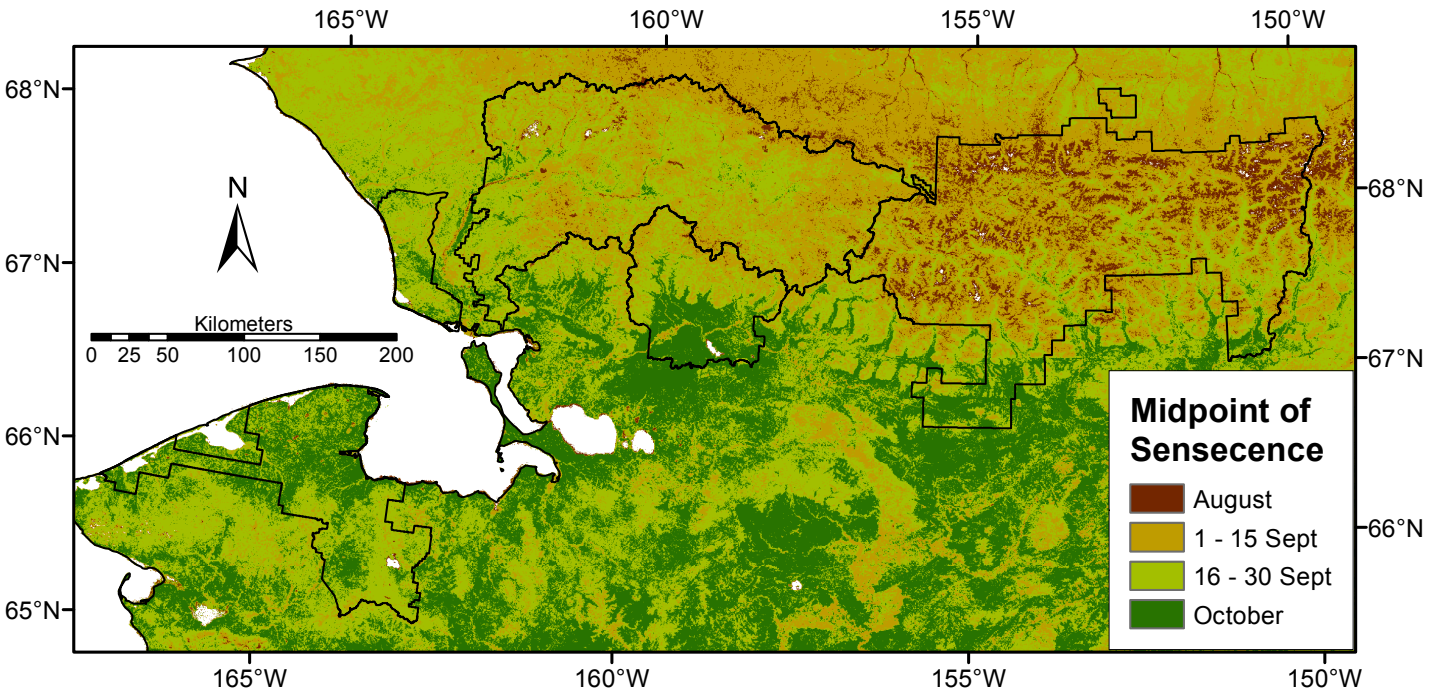

Figure S8. Median date of the midpoint of senescence, 2000-2015.

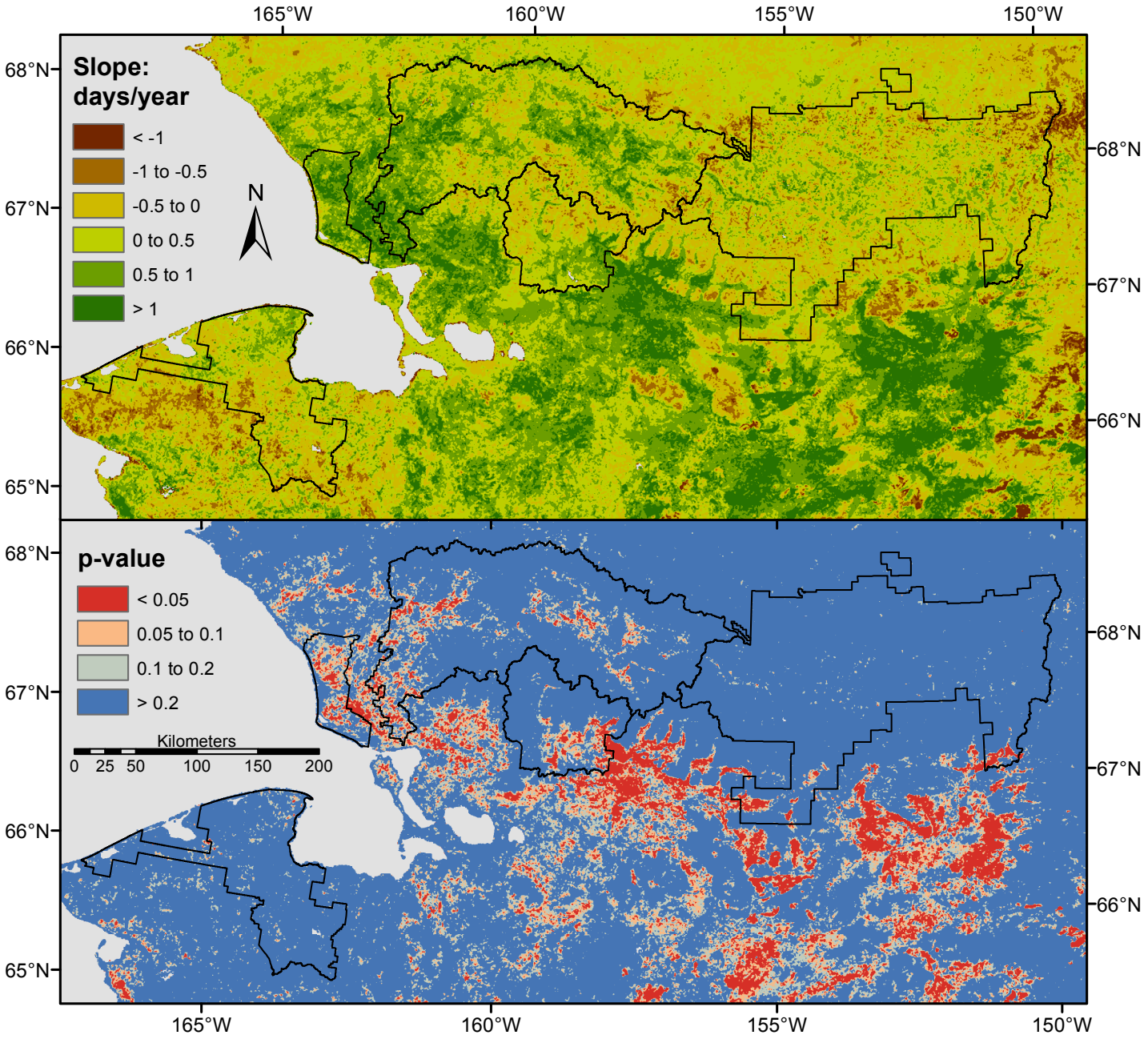

Figure S9. Trend in the date of the midpoint of fall senescence for 2000-2015 The upper map is Theil-Sen's slope for ordinal day of the midpoint of spring green-up vs. year. The lower map is the Mann-Kendall test p-value for this trend (two-tailed test). Both maps had 250 m resolution, smoothed for display with a 5-by-5 median filter.

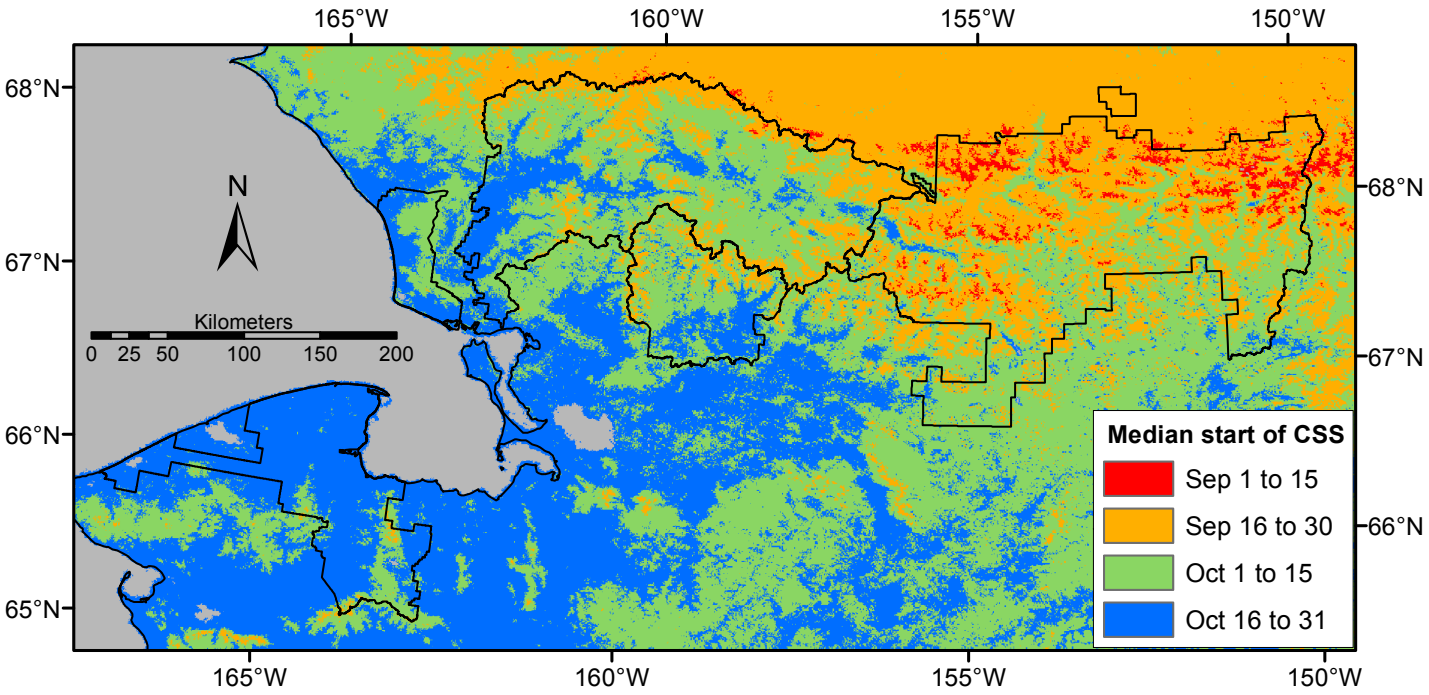

Figure S10. Median date of the start of the continuous snow season (CSS), 2000-2015.

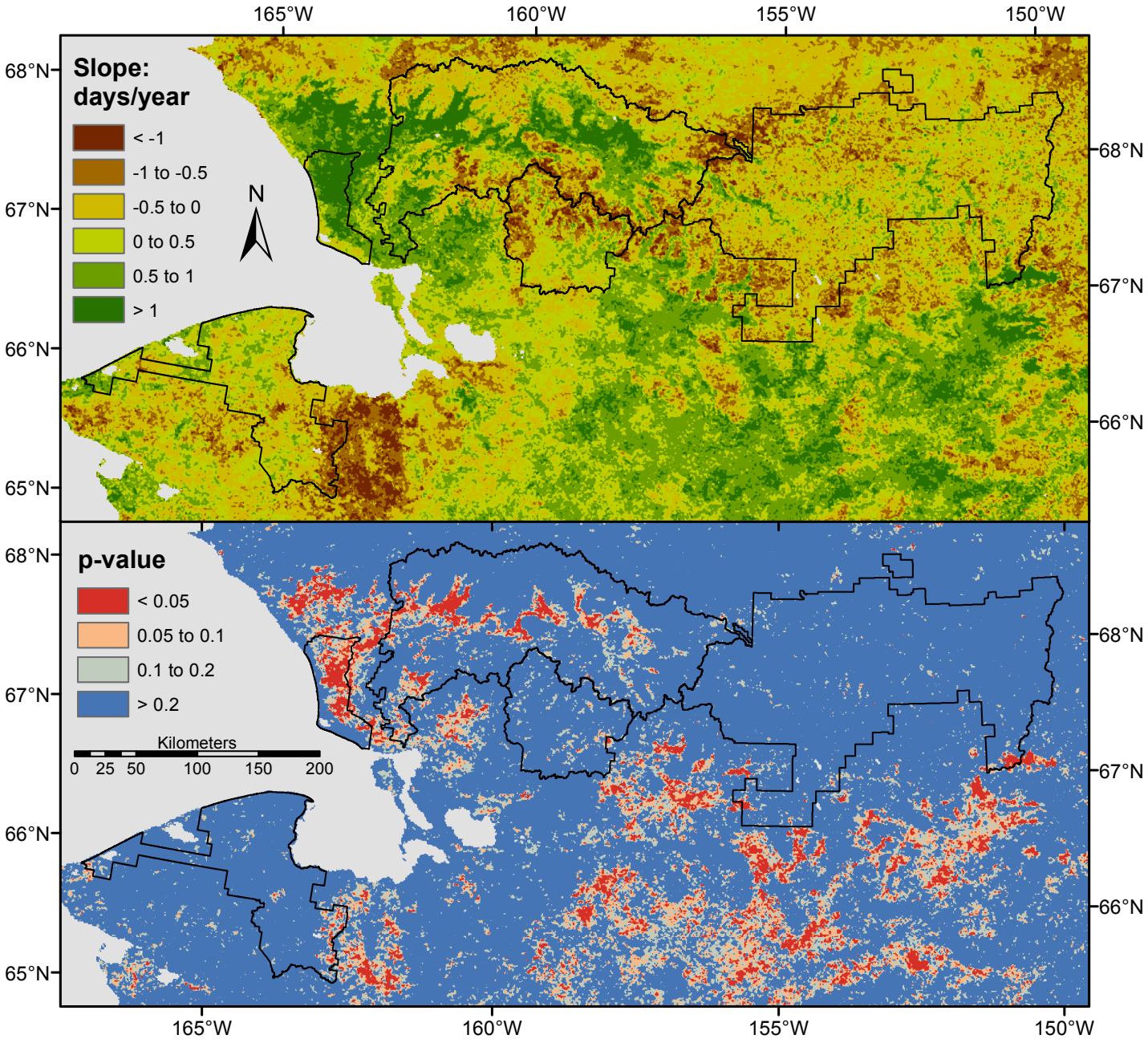

Figure S11. Trend in the date of the establishment of the continuous snow season (CSS) 2000-2015. The upper map is Theil-Sen's slope for ordinal day of the end of the CSS vs. year. The lower map is the Mann-Kendall test p-value for this trend (two-tailed test). Both maps had 500 m resolution, smoothed for display with a 3-by-3 median filter.

Supplementary Materials References

1. ESRL Global Monitoring Division, G. R. G. Solar Calculation Details. Available online: http://www.esrl.noaa.gov/gmd/grad/solcalc/calcdetails.html (accessed on Dec 6, 2016).
2. ESRI *ArcGIS Version 10.2*; ESRI: Redlands, CA, 2013. Available online: www.esri.com (accessed on 14 April 2017).
3. Swanson, D. K. *Monitoring of greenness and snow phenology by remote automated cameras in the NPS Arctic Inventory and Monitoring Network, 2013-14*; Natural Resource Data Series NPS/ARCN/NRDS—2015/798; National Park Service: Fort Collins, Colorado, **2015**. Available online: https://irma.nps.gov/DataStore/Reference/Profile/2222147 (accessed on 18 May 2017).