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Changes of the Arctic Oscillation, Vegetation Phenology and Forest Fires in Siberia

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The Arctic Oscillation exhibits a statistically significant trend towards the positive phase since 1950. The positive phase is associated to an acceleration and northward shift of the polar vortex, the band of winds circling the North Pole. A change in the Arctic Oscillation is likely to impact the terrestrial biosphere since it influences the heat transport from the Atlantic to continental Eurasia, influences wind speeds, temperature and precipitation patterns.

A time series of 18 years of satellite-derived fAPAR (fraction of photosynthetically ac-

tive radiation absorbed by the green parts of vegetation) data from the NOAA AVHRR instrument series was analyzed for interannual variations in the start, peak, end and length of the season of photosynthetic activity in Central and East Siberia. A second order local moving window regression model called the “camel back method” was developed to determine the dates of phenological events at subcontinental scale. The algorithm was validated by comparing the estimated dates to phenological field observations. Using spatial correlations with temperature and precipitation data and climatic oscillation indices, we postulate two geographically distinct mechanisms in the system of climatic controls of the biosphere in Siberia: (i) Central Siberia is controlled by an “Arctic Oscillation/temperature mechanism” while (ii) East Siberia is controlled by an “El Niño/precipitation mechanism”.

Data between 1982 and 1991 indicate a slight increase in the length of the growing season for some land cover types due to an earlier beginning of the growing season, but the overall trend from 1982 to 1999 is towards a slightly shorter season for some land cover types caused by an earlier end of season. The Arctic Oscillation tended towards a more positive phase in the Eighties leading to enhanced high pressure system prevalence but towards a less positive phase in the Nineties. We suggest that the two mechanisms also influence the fire regimes in Central and East Siberia. Several extreme fire years in Central Siberia were associated with a highly positive Arctic Oscillation phase, while several years with high fire damage in East Siberia occurred in El Niño years. An analysis of remote sensing data of forest fire partially supports this hypothesis.