Decadal Changes of Phenological Patterns over Arctic Tundra Biome

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BACKGROUND

The northern high latitudes have experienced a continuous and accelerated trend of warming during the past 30 years, with most recent decade ranks the warmest years since 1850. Warmer springs are especially evident throughout the Arctic.

Meanwhile, Arctic sea ice declined rapidly to unprecedented low extents in all months, with late summer experiences the most significant declining. Warming in the north is also evident from observations of early melting of snow and reducing snow cover.

QUESTIONS AND OBJECTIVES

Key question is: in the warmest limited northern biome, what will happen to the phenological patterns of tundra vegetation as the global climate warms and seasonality of air temperature, sea ice, and snow cover shift?

To answer the question we examine the onset of vegetation greenness, senescence of greenness, length of growing season, and dates of peak greenness along Arctic bioclimatic gradients (subzones) to see how they change over years.

MATERIALS AND METHODS

DATA: The major datasets used here are NASA ERIMs data time series at 8 km pixel resolution, MODIS land cover data, Landsat ETM+ data, and geolocation data of field sites.

ANALYSIS: The analysis of seasonal patterns of vegetation greenness was performed with a 1982-2006 time series, stratified by bioclimatic subzone and land cover. We examined average values of hibernally NDVI over the 25 yr Period, length of growing season, time of onset greenness, time of peak greenness, and peak greenness values along bioclimatic gradient spanning Low Arctic, High Arctic and polar desert ecosystems.

CHANGING LENGTH OF GROWING SEASON

There were clear circumpolar latitudinal patterns in length of growing season: longer in the south and shorter northward, with less than 75 days in polar desert. Onset of vegetation started along tundra-taiga ecotone in early May and gradually moved north until entire Arctic tundra biome turned green in late June.

Length of growing season virtually changed in past two decades. Most of tundra biome enjoyed longer growing season, though Alaska and Canadian Arctic experienced stronger changes than Eurasia.

DISCUSSIONS

The key changes in arctic tundra seasonality are likely related to retreat/accumulate dates of ice and length of ice free period over several case areas (e.g. nearshore ice), to melt/accumulate dates of snow cover and length of snow free period over bioclimatic gradients.

Changes in seasonality of tundra biome have important implications by altering surface albedo and heat budget, modifying plant photosynthesis/respiration and soil microbial activities, and even changing hydrological patterns in the arctic.

PROJECT SUPPORT

NSF Arctic Program "Greening of the Arctic - Synthesis and models to examine pan-Arctic vegetation change: climate, sea-ice, and terrain linkages".

NASA Land Cover/Use Change Program "Application of space-based technologies and models to address land-cover/land-use change problems on the Yamal Peninsula, Russia".