

CHANGES IN GROWING SEASON PRODUCTIVITY OF NORTHERN VEGETATION INFERRED FROM LONG-TERM REMOTE SENSING DATA

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ABSTRACT

Changing peak season productivity Satellite-aided studies of vegetation phenology and productivity are becoming increasingly important for monitoring the effects of a changing climate on the biosphere in the arctic, boreal and the boreo-nemoral vegetation zones. We used a 33 year long record of satellite observations to robustly assess changes in productivity expressed as the the seasonal maximum value of NDVI (MAX) and Growing Season Summed NDVI (GSSNDVI) based on the GIMMS NDVI_{3g} data set from Poland in south to Norway in the north. Since the GIMMS data set has too coarse spatial resolution we could not carry out the same study over Svalbard. For the study in Svalbard, a newly developed 30-year 1 km spatial resolution dataset from 1986 to 2015, provided by the NOAA AVHRR series of satellites, was used in order to produce the seasonal maximum NDVI there. The analysis indicates that seasonal total productivity (GSSNDVI, a measure of seasonal gross primary productivity, has increased by 2.97% dec⁻¹ (p<0.01) over the circumpolar region.

For Fennoscandia, the GSSNDVI increased by 1.7% per decade in the north to ca. 10 % in the south. For Poland, the increase in GSSNDVI was about 5-8% dec⁻¹ in the north-east and 10% dec⁻¹ in the south. Statistically significant strong correlations indicate cumulative growing season temperature as the driver of inter-annual and long-term variations in growing season photosynthetic activity. In the inner fjord area of Svalbard the GSSNDVI was estimated to 1.7% dec⁻¹, but here the spatial resolution is too coarse. Using the AVHRR data set over the 30-year period in Svalbard, we find positive trends in both maximum NDVI (average increase of 29%) and mean summer temperature (59%), which were significantly positively correlated with each other. In Fennoscandia and Poland, the trend in Max NDVI varied from 0-20% per decade.

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