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Vegetation productivity patterns at high northern latitudes: do different satellite data sets agree?

Pieter Beck (1), Kevin Guay (2), Wolfgang Buermann (3), Alessandro Baccini (2), and Scott Goetz (2)

(1) Joint Research Centre, Ispra, VA, Italy, (2) Woods Hole Research Center, Falmouth, MA, USA, (3) School of Earth and Environment, University of Leeds, Leeds, UK

Satellite records of NDVI form the primary data source to study changes in global vegetation productivity in the last three decades. Creating coherent long-term NDVI records from legacy satellite data sets is challenging because of a.o. the influences of orbital drift, sensor degradation, aerosol spikes from volcanic eruptions, and changing instrument design on reflectance measurements. These issues require corrections to reduce uncertainties in long-term NDVI records. We compared depictions of long-term changes in vegetation productivity over high northern latitudes (>50°N), estimated as trends in growing season NDVI of the most widely used global NDVI data sets. These included the AVHRR based GIMMS-NDVI version G data, and its recent successor version 3g, as well as the shorter NDVI records generated from more modern sensors: SeaWiFS, SPOT-VGT, and MODIS, with the data sets from the latter two sensors adjusted to reduce Bidirectional Reflectance Distribution (BRDF) effects. Our analysis reveals both large geographic areas, totaling 40% of the region, where all data sets indicate similar changes in vegetation productivity over their common temporal record (2002-2008), as well as areas where data sets show conflicting patterns. The newer GIMMS data set (version 3g) shows statistically significant (α = 0.05%) increases in vegetation productivity not seen in its predecessor (version g) in >15% of the study area whereas the reverse is very rare (<3%). The latter has implications for earlier reports based on GIMMS version G, particularly in Eurasia where 'greening' is particularly pronounced in the GIMMS 3g data. Furthermore, the two BRDF-adjusted data sets studied here show diverging patterns of high latitude vegetation productivity, with SPOT-VGT D10 showing much more vegetation 'greening' than either of the GIMMS data sets, and the MODIS data set showing slightly less. We discuss the implications of these findings for inferences made from global NDVI data sets regarding primary productivity changes, and encourage users to combine the analysis of NDVI time series data with complementary data sources where possible, such as field measurements of growth, mortality, vegetation cover and composition, tree and shrub rings, and carbon dioxide exchange.