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Green vegetation cover trends in Sahelian Western Africa observed from SPOT VGT 2001-2010

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From several studies relying on the analysis of NOAA-AVHRR Normalized Difference Vegetation Index (NDVI) time series since 1982, it has been concluded that there is a consistent trend of increasing vegetation greenness in much of the Sahelian region. Increasing rainfall in the recent years emerges as the dominant causative factor in the dynamics of vegetation greenness. However, other factors, such as land cover-land use changes and migrations, may also contribute. It is generally suggested that there are no signs of large human-induced land degradation at this scale of observation (whole Sahelian zone observed at an 8km resolution).
The aim of the paper is to identify seasonal and multi-annual trends in green vegetation cover of Sahelian Western Africa during the last decade, on the basis of 1km resolution SPOT-VEGETATION data, and using Green Vegetation Fraction (GVF) as indicator instead of NDVI. Green Vegetation Fraction is an intrinsic canopy attribute which is a very good candidate for substitution of classical vegetation indices. When compared with NDVI, GVF has been seen to be more sensitive to photosynthetic activity, because it is solely an indication of the fraction of a pixel that is covered by green vegetation. In semi-arid and arid environments, GVF can be a coherent tool for monitoring vegetation dynamics and performs much better than NDVI in detection of low green vegetation levels. A simple method for retrieving GVF from multispectral data is to re-scale NDVI as a fractional value between 0 and 1, using a linear relationship:
GVF = (NDVI – NDVIsoil)/(NDVImax – NDVIsoil) (1)
This approach has been applied to SPOT VEGETATION time series in the framework of the GEOSUCCESS (Global Earth Observation in Support of Climate Change and Environmental Security Studies) initiative, developed by VITO (Belgium). The product is the apparent green cover percentage fCover. Dekadal values of fCover are obtained from SPOT-VEGETATION S10 NDVI temporal composites, using equation (1). Identification of the per-pixel NDVIsoil value is achieved by computing the average bare soil NDVI value using an iterative process that eliminates high values in the temporal NDVI profile and using a default value of 0.1 in case of a perennial green vegetation cover. NDVImax is assumed to be a constant value (0.85). Data are available on a 10-day basis since June 2001.
A comparison is made between trends observed from SPOT-VEGETATION NDVI and GVF. The effect of spatial resolution is investigated from the analysis of NDVI multisource data : MSG-SEVIRI (0.05°), NOAA-AVHRR (8km), SPOT-VEGETATION (1km) and TERRA-MODIS (250m). Finally, we discuss the observed spatial patterns of green vegetation dynamics across the Western Sahel during the 2001-2010 period and suggest several potential causative factors, including rainfall variability, population density, topography and soil properties.
Reference:
VITO, Global Earth Observation in Support of Climate Change and Environmental Security Studies (GEOSUCCESS) Website, available from http://www.geosuccess.net/geosuccess/, assessed 5 January 2011.