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Evaluating temporal consistency of long-term global NDVI datasets for trend analysis

Feng Tian [a,*], Rasmus Fensholt [a], Jan Verbesselt [b], Kenneth Grogan [a], Stephanie Horion [a], Yunjia Wang [c]

[a] Department of Geosciences and Natural Resource Management (IGN), University of Copenhagen, Øster Voldgade 10, Copenhagen K 1350, Denmark

[b] Laboratory of Geo-Information Science and Remote Sensing, Wageningen University, Droevendaalsesteeg 3, Wageningen 6708 PB, The Netherlands

[c] School of Environment Science and Spatial Informatics, China University of Mining and Technology, Daxue Road 1, Xuzhou 221116, China

To understand environmental changes, vegetation trend analysis using long-term NDVI datasets derived from multiple sensor systems have been widely performed at regional to global scales. However, these long-term datasets may be temporal inconsistent due to incomplete sensor cross-calibration or inadequate correction of known issues, such as orbital drift, which can introduce substantial uncertainties and artifacts to the analysis of trends. In addition, the development of trend analysis methods from simple to piece-wise linear regression or non-linearity fitting requires more accurate data since the latter ones are more sensitive to such artifacts. In this study we evaluate the temporal consistency of multi-sensor NDVI time series by analyzing the co-occurrence between breaks in the NDVI time series and sensor shifts from GIMMS3g (Global Inventory Modeling and Mapping Studies 3rd generation), LTDR4 (Long Term Data Record version 4), VIP3 (Vegetation Index and Phenology version 3) and SPOT-VGT (Système Pour l'Observation de la Terre VEGETATION).

Single sensor time series from MODIS (MODerate resolution Imaging Spectroradiometer) Terra and Aqua are used as reference datasets. The global land surface is divided into six regions according to the world humidity classes and averaged NDVI time series in each region are analyzed separately using the BFAST (Breaks For Additive Seasonal and Trend) analysis. We find potential artifacts in GIMMS3g, VIP3, LTDR4 and SPOT-VGT NDVI datasets. Orbital drift effects are evident in the humid region of GIMMS3g and in the dry regions of VIP3 and LTDR4. Sensor change from VGT-1 to VGT-2 is found to cause a significant break in the SPOT-VGT NDVI time series. Sensor degradation effects are found in Terra-MODIS seasonal averaged NDVI time series when compared to Aqua-MODIS data. Although advanced platforms and sensors have been used since 2000, different trends are found among datasets at the global scale. The reasons behind such dissimilarities need to be further explored since a growing volume of studies within vegetation and climate research make use of these long term datasets.