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Global Trends in Vegetation Dynamics: Lessons Learnt from 25 years of Earth Observation from Space

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The nature of the global terrestrial carbon cycle and hence, the climate, is primarily controlled by vegetation. Terrestrial vegetation is dynamic in space and time with a consequent variability in the C-cycling mechanisms. While the temporal change in vegetation dynamics can be attributed to both natural (climatic and natural disturbances) and anthropogenic (land use change, agricultural practices) factors, we believe that biome-scale vegetation changes could be primarily be attributed to natural controls. A global scale assessment of vegetation dynamics is practically possible only by employing remote sensing techniques. To this end, we used the long-term global GIMMS-NDVI product of Tucker et al. (2005) available at fortnightly interval between 1982 and 2006, to study the spatio-temporal trends of the global vegetation. Firstly we computed the Area under the Annual NDVI Time-series (AANT) of each year. Further, we computed the slope and (r^2) of linear regression constructed using AANT (y) and year (x) in a spatially explicit manner. Our analysis showed that globally, there were unique trends in the vegetation dynamics during the 25 year period.

In general, the North American boreal biome spread in Canada and Alaska showed a declining trend especially in the mid-continental regions (slope=-0.10, r^2=0.50). In the northern sector of the North American landmass, where the boreal-tundra transition is located, an increasing AANT trend was observed (slope=+0.15, r^2=0.80) consistent with Goetz et al., (2005). Similarly, in north eastern Siberia, above the artic circle, AANT showed increasing trends. In general, the North American Great Plains showed trends of increasing AANT whereas the South American Pampas in Argentina showed a declining AANT. The tropical rain forests in Africa and the Great Australian desert showed declining trends in AANT although their r^2 were low.

The largest positive trends in AANT where r^2 of the linear regression was above a 0.5 threshold were observed in the Western parts of the Deccan plateau (India), the Anatolia plateau (Turkey), sub-Saharan Africa, Kalahari Desert, Western Australia and the boreal-tundra transition. We speculate that the vegetation dynamics in these regions are primarily controlled by changes in meso-scale hydrometeorological processes such as variability in the local monsoon. In order to justify the global scale trends obtained using the AVHRR-based GIMMS-NDVI datasets, we plan to compare the AVHRR-based AANT and AANT retrieved from other long-term RS products such as the SPOT-VGT-based NDVI and MODIS-based land products. To this end, we compared GIMMS-NDVI with MODIS-NDVI (MOD13A2) and SPOT-VGT NDVI at those locations where long-term vegetation monitoring are also being monitored on the ground (e.g. the FLUXNET sites). We will present a synthesis of the long-term RS data from an ensemble of sensors and ground based measurements to better understand and confirm the spatio-temporal trends of vegetation dynamics at the global scale.

Tucker et al., (2005) *IJRS,* Vol 26:20, pp 4485-5598.

Goetz et al., (2005) *PNAS* 102:13521–13525.

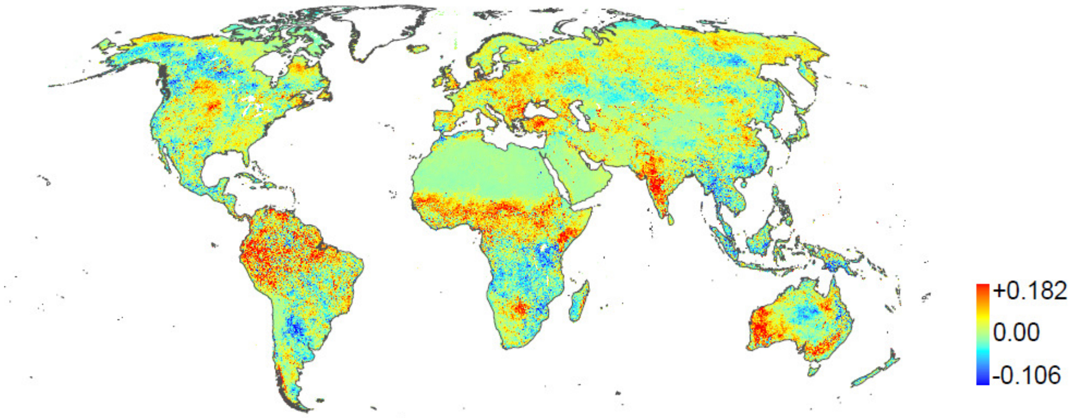

Fig.1 Global patterns of the slope (m) of the linear regression between AANT and Time

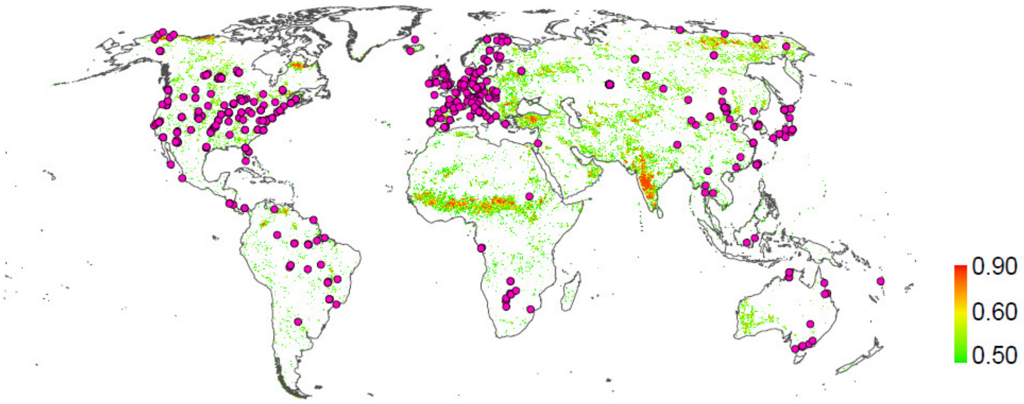

Fig.2 Global distribution of the r^2 *of the linear regression between AANT and Time. Note that the only* r^2*>0.5 are displayed. Purple locations are the FLUXNET tower sites.*

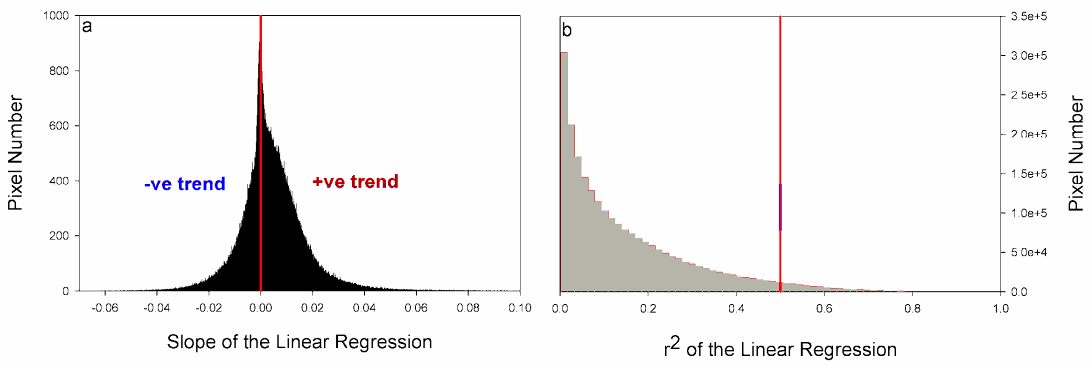

Fig.3 The nature of distribution of Slope and r^2 *for all the pixels in the modelling domain. (a)Note that pixels that showed +ve trends are higher than those with –ve trends. (b)Only a small fraction of the pixels showed* r^2*>0.5.*