European Association of Remote Sensing Laboratories
33rd EARSeL Symposium
Towards Horizon 2020: Earth Observation and Social Perspectives

# Modelling precipitation and anthropogenic influence on vegetation productivity trends in the African Sahel

**Thomas Higginbottom, Elias Symeonakis**

**School of Science and the Environment, Manchester Metropolitan University,**

**Manchester M15GD, UK**

T.Higginbottom@mmu.ac.uk, E.Symeonakis@mmu.ac.uk

Changes in vegetation productivity are a major concern for a range of disciplines, such as climate studies, food security and global ecological change. Whereas methods for detecting trends and variation in vegetation productivity using remote sensing are fairly well established, there remains considerable debate about the relative influence of climatic and anthropogenic variables upon observed changes. These debates are primarily concerned with the detection of land degradation and desertification in semi-arid regions, with the Sahel belt of Africa being the epicentre of disputation. Over the past decade, studies have trialled a number of methods including quotient, trend break, pixel-regression and additive models to separate the anthropogenic and climatic influences on vegetation trends.

However, these methods are all based on an "evidence by absence" approach, whereby anthropogenic land degradation is postulated by the failure of, most commonly, rainfall to explain the observed changes in vegetation productivity. In order to overcome this issue, here we incorporate spatially explicit data quantifying agricultural intensity and population in addition to Meteosat-based precipitation estimates, to explain variation in the AVHRR 1km$^2$ normalised difference vegetation index (NDVI) trends, as a proxy for net primary production of the Sahel. We demonstrate two spatial geographically weighted regression models: one climatic and a combined climate-anthropogenic, to explain changes in Sahelian vegetation productivity from 1983 to 2005. Results highlight that the majority (>80%) of productivity change in the Sahel is explained by purely climatic factors. However, the combined climate-anthropogenic model preforms better over a number of hot-spots, thus indicating anthropogenic influences on the vegetation system. These hot-spots are clustered in the Mali-Niger border region, potentially indicating land degradation due to agricultural intensification and increasing population. For the regions where climatic factors solely explained productivity there a dominance of positive trends with both NDVI and rainfall increasing. The failure of anthropogenic factors to increase the explanation of productivity trends indicates a strong resilience of the Sahelian ecosystem. This research highlights the advantages of combining additional datasets related to anthropogenic activity with climatic variables into explanatory models to explain vegetation variability.