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East African rainfall and vegetation dynamics in response to a changing El Nino

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In recent years, a number of studies have presented evidence that toward the end of the 20th century El Nino events exhibit a significant change in both spatial location of maximum SSTs and tropical-midlatitude teleconnections. Classical El Nino events, characterised by warm SST anomalies in the eastern Pacific, are considered to be the most important cyclic climatic feature on interannual time scales and have been shown to influence regional climates worldwide. However, over the last two decades, maximum Pacific SST anomalies have been more frequently observed in the central Pacific. These anomalies are generally flanked by cooler SSTs towards the east and west and it has been shown that the nature of associated teleconnection patterns differs from those associated with classical El Nino events. Furthermore, a continued frequency increase in these central Pacific El Nino events has been projected for the 21st century.

Here, we investigate whether changes in response patterns to such a shift in El Nino can be observed over tropical East Africa. There is a wealth of studies in the international literature that establish clear links between climatic and ecological dynamics of the eastern African equatorial region and El Nino. It has been shown that Indian Ocean SST dynamics are closely linked to SST dynamics of the equatorial Pacific. Furthermore, precipitation and vegetation dynamics in the region respond clearly to El Nino (and La Nina) events. Therefore, it can be expected that a change in the inherent characteristics of El Nino will affect climatic and ecological responses in equatorial East Africa. In a novel approach we investigate whether such effects are observable and quantifiable.

Space-time characteristics, such as classical correlation, principal components, decadal and seasonal trends and empirical orthogonal teleconnections of Indian Ocean SSTs, precipitation and vegetation greenness at various spatial resolutions are investigated over a period of 30 years (1980 – 2010). To identify potential changes over time within this period (whether continuous or abrupt), a moving-average-like approach is applied. Starting with the first observation datum, we analyse ten years of monthly observations of the aforementioned parameters in a fixed spatial domain. We repeat this analysis successively by moving the ten year window forward in time through the complete 30 year time period. The window is moved forward at annual steps so that the analysis is carried out for 21 successive time intervals (1980 – 1989, 1981 – 1990, 1982 – 1991, ...).

Each instance of the moving window application produces a standardised set of results. Statistics of these results (e.g. the slope of slopes of the OLS trends) are investigated as to whether a change over time can be characterised qualitatetively and quantitatively.