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Estimation of persistence properties of vegetation activity trends at regional scale

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The characterization of vegetation cover dynamics represents key information for understanding vegetation responses to climate change and, more in general, the complex feedbacks between vegetation and climate variables. Persistence analysis is able to capture possible characteristic time scales from the persistence probability and/or highlight possible non-stationary dynamics. In the first case, vegetation that efficiently recovers from shock describes long-term stationary patterns. On the contrary, long lasting anomalies in vegetation activity may suggest non-stationary dynamics, which might be linked to climate change and or anthropic stress.

At present, the usefulness of NOAA-AVHRR satellite time series for investigating vegetation cover dynamics is still confirmed being the main source of long-term information at global scale. In particular, we investigated the NDVI (Normalized Difference Vegetation Index) time series (1982-2006) derived from the GIMMS (Global Inventory Modeling and Mapping Studies) dataset (8 km resolution) one of the most widely used AVHRR-NDVI global dataset, since we were interested in evaluating long-term vegetation dynamics at regional scale. NDVI trends over Europe were generated per pixel in order to evaluate vegetation persistence according to a methodology we developed for full resolution dataset (1.1 km) (Lanfredi et al., 2004) and successfully applied on 8 km data at national scale (Simoniello et al. 2008; Coppola et al., 2009). This method allows for studying the stability properties of vegetation dynamics by evaluating the first passage time across a reference level of the NDVI trend field. The sign of any given trend, which expresses the tendency of NDVI to increase or decrease, lasts in time until inter-annual variations do not integrate destructively. As a reference period for trend signs, a 10-year period (1982-1991) was selected in order to have sufficient sample and to consider at least two satellite platforms. Then, we constructed the total persistence map by evaluating the signs of trends last for longer periods.

We found a high variability in the distribution of negative and positive values with some homogenous clusters, which represent areas having collective dynamic behaviours of vegetation cover. Some aggregations of persistent negative trends were found in northern Spain, centre of Germany, along both the coasts of English Channel; a very large cluster of persistent positive trends was located in Eastern Europe, whereas smaller patches were found in southern Spain and northern Italy. Finally, we estimated the persistence probability and derived the mean life time of negative and positive trends for different covers, altitude and ecoregions. Such characteristic decay times are strictly related to vegetation resilience and could represent precious information for land surface models in the context of climate studies.

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