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Estimation of vegetation cover resilience from satellite time series

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Abstract. Resilience is a fundamental concept for understanding vegetation as a dynamic component of the climate system. It expresses the ability of ecosystems to tolerate disturbances and to recover their initial state. Recovery times are basic parameters of the vegetation's response to forcing and, therefore, are essential for describing realistic vegetation within dynamical models. Healthy vegetation tends to rapidly recover from shock and to persist in growth and expansion. On the contrary, climatic and anthropic stress can reduce resilience thus favouring persistent decrease in vegetation activity.

In order to characterize resilience, we analyzed the time series 1982–2003 of 8 km GIMMS AVHRR-NDVI maps of the Italian territory. Persistence probability of negative and positive trends was estimated according to the vegetation cover class, altitude, and climate. Generally, mean recovery times from negative trends were shorter than those estimated for positive trends, as expected for vegetation of healthy status. Some signatures of inefficient resilience were found in high-level mountainous areas and in the Mediterranean sub-tropical ones. This analysis was refined by aggregating pixels according to phenology. This multitemporal clustering synthesized information on vegetation cover, climate, and orography rather well. The consequent persistence estimations confirmed and detailed hints obtained from the previous analyses. Under the same climatic regime, different vegetation resilience levels were found. In particular, within the Mediterranean sub-tropical climate, clustering was able to identify features with different persistence levels in areas that are liable to different levels of anthropic pressure. Moreover, it was capable of enhancing reduced vegetation resilience also in the southern areas under Warm Temperate sub-continental climate. The general consistency of the obtained results showed that, with the help of suited analysis methodologies, 8 km AVHRR-NDVI data could be useful for capturing details on vegetation cover activity at local scale even in complex territories such as that of the Italian peninsula.

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