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On the use of satellite VEGETATION time series for vegetation disturbance recovery assessment

A. Lanorte (1), R. Coluzzi (2), F. De Santis (3), and I. Didonna (4)

(1) CNR-IMAA, Potenza, Italy (alanorte@imaa.cnr.it), (2) CNR-IMAA, Potenza, Italy, (3) CNR-IMAA, Potenza, Italy, (4) CNR-IMAA, Potenza, Italy

The characterization of vegetation reaction to disturbance is of primary importance since changes in the status or types of vegetation play an active role in ecological processes (such as productivity level, creation of altered patches, modification in vegetation structure and shifts in vegetation cover composition), as well as in land surface processes (such as surface energy, water balance, carbon cycle).
The assessment of disturbance impacts on ecological resources requires investigations performed at different temporal and spatial scales, from local up to regional level.
In such a context, satellite technologies can be profitably used for investigating the dynamics of vegetation after disturbance at different temporal and spatial scales; although, dynamical processes induced by disturbance are very difficult to study since they affect the complex soil-surface-atmosphere system, due to the existence of feedback mechanisms involving human activity, ecological patterns and different subsystems of climate.
In this study, a time series of normalized difference vegetation index (NDVI) data derived from SPOT-VEGETATION was used to examine the recovery characteristics of drought and fire affected vegetation in some test areas of the Mediterranean ecosystems of Southern Italy.

The vegetation indices operate by contrasting intense chlorophyll pigment absorption in the red against the high reflectance of leaf mesophyll in the near infrared. The simplest form of vegetation index is simply a ratio between two digital values from these two spectral bands. The most widely used index is the well-known normalized difference vegetation index NDVI = [NIR-R]/ [NIR+R]. The normalization of the NDVI reduces the effects of variations caused by atmospheric contaminations. High values of the vegetation index identify pixels covered by substantial proportions of healthy vegetation. NDVI is indicative of plant photosynthetic activity and has been found to be related to the green leaf area index and the fraction of photosynthetically active radiation absorbed by vegetation. Therefore variations in NDVI values become indicative of variations in vegetation composition and dynamics.
In this study, we analyze the temporal series from 1998 to 2005 of NDVI satellite SPOT VEGETATION data acquired for a shrubland test site
In order to eliminate the phenological fluctuations, for each decadal composition of each pixel, we focused on the departure NDVId = [NDVI - <NDVI>]/[U+F073], where <NDVI> is the decadal mean and [U+F073] is the decadal standard deviation. The decadal mean <NDVI> and the standard deviation were calculated for each decade, e.g. 1st decade of January, by averaging over all years in the record.
We analyzed both:

1) Post-disturbance NDVI spatial patterns on each image date were compared to the pre-disturbace pattern to determine the extent to which the pre-disturbance pattern was re-established, and the rate of this recovery.
2) time variation of NDVI from 1998 to 2005 of two pixels for the disturbance affected and disturbance unaffected areas.

Results show the ability of NDVI time series to capture the different impacts/effects of different disturbances (drought and fire in the current case) and the capability of VEGETATION-NDVI data set to monitoring vegetation status from local up to a global scale.