

# Vegetation condition assessment and monitoring in Mediterranean agro-pastoral regions

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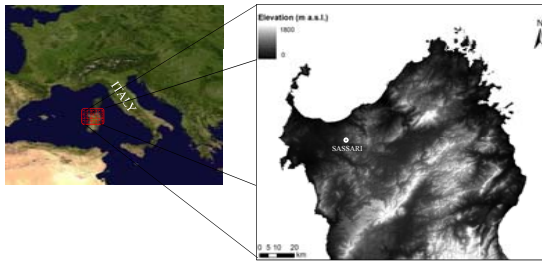
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## BACKGROUND AND OBJECTIVE

The development of operational techniques for assessing and monitoring pasture condition at landscape level is fundamental to implement efficient territorial management policies and to determinate the right compromise between resource exploitation and ecosystem service maintenance in Mediterranean regions affected by land degradation problems (del Barrio *et al.*, 2010).

The general objective of this study is the development of a pasture condition diagnostic tool at landscape scale based on satellite remote sensing data suitable for Northern Sardinia agro-pastoral regions.

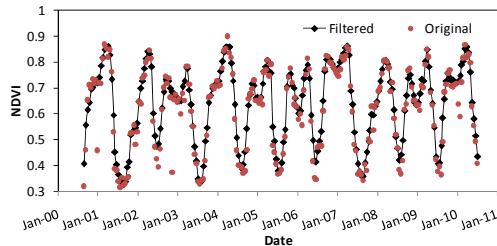
## STUDY AREA



The study was conducted in the Northern Sardinia Island (Italy). Agro-pastoral systems represent a major component of the landscape and livestock farming is one of the main economic activities. Intensification of the agro-pastoral activities on unsuited lands on the one hand and land abandonment on the other are considerably affecting the structure and function of ecosystems, leading in some case to severe land degradation processes.

## SATELLITE DATA PROCESSING

Ten hydrological years (2000-2010) of MODerate Resolution Imaging Spectrometer (MODIS) 250 m 16-days composite Normalized Difference Vegetation Index (NDVI) images (MOD13Q1) acquired from the TERRA satellite platform were analyzed. Multitemporal NDVI images were filtered using the methodology proposed by Chen *et al.* (2005) to generate high quality profiles.



The hydrological year NDVI profile exhibits the double peak seasonality typical of Mediterranean ecosystems.

## REFERENCES

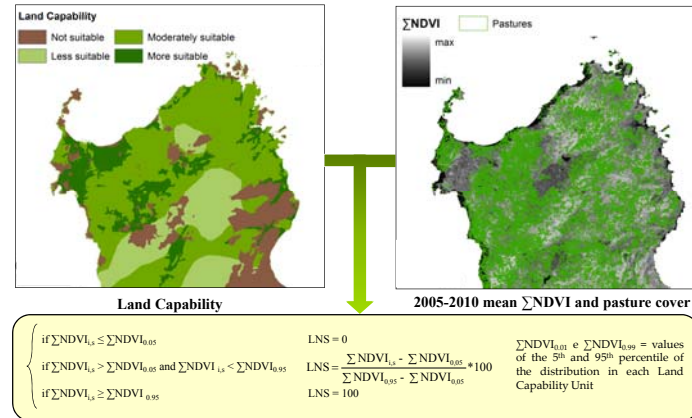
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## RESULTS

### ASSESSMENT

The assessment component of the methodology aims at quantifying the relative condition of each pasture area with respect to a reference potential status. The local Net Primary Productivity Scaling method (LNS) (Prince, 2009) assumes that a reduction in pasture productivity below the potential, set by bio-geo-physical conditions, can be an effective indicator of pasture condition.

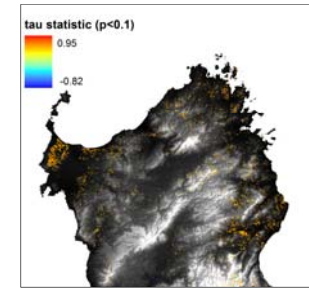
Pasture productivity is estimated from the sum of NDVI values over each hydrological year ( $\sum NDVI$ ). Homogeneous bio-geo-physical conditions are derived from the Land Capability for agriculture map of Sardinia (ARPAS Sardegna). The area covered by pastures was obtained by the Land Cover Map of Sardinia at scale 1:10000. LNS values are calculated as:



### MONITORING

The monitoring component of the methodology deals with the temporal evolution of pasture productivity, and it is based on a diachronic comparison of  $\sum NDVI$  values during the 2000-2010 period.

To evaluate significant positive or negative trends, a Mann-Kendall test was performed (Hipel and McLeod, 2005) using the Kendall package in R.



Significant trend map

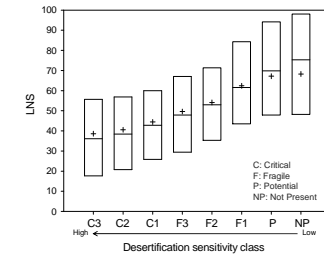
Statistically significant trends of  $\sum NDVI$  were evidenced in about 16% of Northern Sardinian pastures, and more than 15% were positive. This result suggests a staple increase of pasture productivity in some regions within the study area, partially explained by the increase in early spring precipitation in the last years (ARPAS Sardegna agro-meteorological report 2009-2010, <http://www.sar.sardegna.it/>).

Almost no negative trends were observed, indicating that pasture condition is generally stable or improving.

### VALIDATION

A field evaluation of LNS assessment methodology was conducted in 2007-2008, showing a good accuracy of the proposed approach in estimating pasture condition (Fava *et al.*, 2009).

Furthermore, the LNS map is consistent with the map of the environmental sensitive areas to desertification of Sardinia (ESA, ARPAS Sardegna) developed using the set of indicators proposed by Kosmas *et al.* (1999).



LNS mean value is 46, indicating that in the area LNS values are not positively or negatively biased. No evident spatial patterns are observed, while some hotspots of poor pasture conditions are clearly located in the central and north-western part of the island.

## CONCLUSIONS

The integrated use of MODIS NDVI time series analysis and LNS methodology is an attractive approach to develop a diagnostic tool to assess and monitor pasture condition and degradation at regional scale. Future efforts will address the integration of meteorological data in the procedure (i.e. Rain Use Efficiency), the evaluation of high resolution satellite data, and further validation activity based on field surveys.

## ACKNOWLEDGEMENTS

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