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Fisher-Shannon Analysis of MODIS Terra Evapotranspiration Satellite Data to Reveal Status of Plant Infection

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Extended Abstract

The increase of the global trade and the worsening of climate change have favoured the spread of plant infections across the world, impacting very crucially on agriculture, environment, economy and society. The detection of plant diseases is extremely important for assessing tempestive measures to contrast them [1].

Among the many phytopathogens, the bacterium Xylella Fastidiosa is one of the most dangerous, due to its capability of infecting several hundreds of species, among which olive trees, vines, and some species of citrus fruits. Xylella fastidiosa was identified in Italy for the first time in the south–eastern Apulia in 2013 in olive trees; since then, it has been rapidly spreading across the Southern Italy.

In the recent years, remote sensing technologies were used to monitor vegetation, especially when affected by plant diseases [2], pointing out to the development of multi-temporal and multi-spectral satellite data approaches, complemented by statistical methodologies, like principal component analysis and curve fitting methods, for monitoring changes in vegetation and land surface [3, 4].

In this paper we present the application of the Fisher-Shannon analysis of the time series of MODIS satellite evapotranspiration data to reveal the impact of Xylella Fastidiosa on olive trees in Southern Italy. The Fisher-Shannon analysis combines two statistical quantities: the Fisher Information Measure (FIM) [5] and the Shannon entropy (SE) [6]. The FIM and the SE furnish information about the local and global properties of the probability density function, respectively. We selected sites affected and not affected by Xylella Fastidiosa, and analysing about two thousands of MODIS 500m resolution pixel time series we found a significant discrimination between sites affected by those not affected by Xylella Fastidiosa. This could suggest that this statistical method might be employed as a tool to be included within an operational system for early diagnosis of the status of deterioration of olive trees.

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