Multi-temporal satellite imagery for monitoring productivity trend in Mediterranean coastal forest ecosystems: the state natural reserve "Duna Feniglia" (Italy) study case

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**Abstract.** Forests play an important economic and social role in the development of many parts of the world, representing an important resource for countering the effects of climate change, allowing to achieve the future goals of sustainable development. Those within protected areas also represent a historical and cultural landscape asset that characterizes the landscape in many areas of the Mediterranean basin, especially in the coastal zones. Other than the transformations made by humans in the past, many factors influence the ecological stability of these forest ecosystems, such as an increase in the pressure of wild animals or the increase in global warming. In this scenario, the forests show high vulnerability and a subsequent decline in their natural renewal rate.

This study aims to detect the changes in the forest vegetation growth rate that took place over 20 years, from 2000 to 2020, by a remote sensing multi-temporal satellite imagery monitoring approach, analyzing their effect on structural properties. The proposed framework was tested and validated in the state natural reserve “Duna Feniglia” forest in the province of Grosseto (central Italy), dominated by umbrella pine (Pinus pinea L.), characteristic of the Italian coastal landscape. Multispectral vegetation indices were evaluated as a proxy of forest productivity by means of trend curves analysis, indicating potential improvement and significant negative trends. Forest vigor was also evaluated by developing a productivity state indicator, allowing for the detection of recent changes in primary productivity as compared to a baseline period. Monitoring results and data from this research could represent an important decision-making tool for sustainable forest management of the study area, as well as identify potential areas of high forest vulnerability, in which to decode and apply suitable silvicultural models to promote natural forest renewal.