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Trends in vegetation changes over diverse land use environments over Greece using remote sensing data

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Land use and climate changes impact various ecosystems. Detection of vegetation changes is a key process for sustainable environmental management. Remote sensing has been providing relevant information regarding spatial and temporal changes on earth's surface. The present work aims at determining trends of vegetation productivity in the form of remotely sensed Normalized Difference Vegetation Index (NDVI) over Greece. Vegetation changes are attributed to both global and local scale drivers. Global drivers are increased temperature and increased CO_2 concentration, both related to climate change. Local scale drivers are land use changes attributed to human activities such as urban expansion and deforestation as well as increased fertilized and irrigated land, among others. To assess the role of climate and land use change in vegetation productivity, we examined trends in MODerate Resolution Imaging Spectroradiometer (MODIS) NDVI from 2000 to 2017, in two diverse land cover types, i.e. protected by the Natura 2000 network sites and urban areas. Natura 2000 are environmentally protected by legislation and these represent areas of minimum human intervention, and vegetation changes can be attributed mostly to climate change. Urban areas are regarded as sites where human impact is significant and local scale drivers dominate vegetation changes. Results showed that there is a significant ($p < 0.01$) increasing NDVI trend in all examined areas irrespective of their land cover type. Nevertheless, urban areas exhibited a higher increasing NDVI trend with magnitude greater than of Natura 2000 sites. Overall, Natura 2000 sites demonstrated a mean NDVI trend of 9.3 * 10-5/year whereas the computed mean NDVI trend in urban areas is 13.8 * 10-5/year. Spatially, Natura 2000 sites demonstrate a higher increasing trend in Northern Greece compared those in the southern parts of the country. Urban areas do not demonstrate any spatial trend of NDVI changes. The difference of vegetation productivity trends in urban areas compared to Natura 2000 sites, is indicative of the combined effect of human and climate in those urbanized locations. Our results indicate that the Urban Heat Island might be a possible reason for increased vegetation productivity in urbanized locations. Regarding protected sites, it seems that protection policies in combination with global scale drivers resulted in increased vegetation productivity and sustained ecosystem quality.
The process has been developed integrating two popular and open source computer packages, i.e. QGIS and R, and using publicly available MODIS NDVI and CORINE land cover data. Results showed that the methodology constitutes an efficient and inexpensive tool of monitoring vegetation trends and ecosystem conditions.