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An EO-Based Approach to Modelling Ecosystem Health in Response to Wildfire in Central Greece

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Assessment of ecosystem health is becoming more relevant in a world where ecosystems are being used unsustainably and have been showing increased signs of stress and dysfunction. Therefore, this research has set out to establish an Earth Observation (EO) based methodology in conjunction with Geographical Information Systems (GIS) to establish and monitor the indicators of ecosystem health in a region affected by wildfire in Central Greece. A further goal has been to assess the responses of ecosystem health to wildfire and urban expansion in the studied region. The methodology integrated GIS software and EO data to assess ecosystem characteristics including: vigour, organisation and resilience. The characteristics were quantified using remote sensing techniques focusing on Normalised Difference Vegetation Index (NDVI) images derived from Landsat imagery from 1999-2011. Topographic features including slope and aspect were extracted from a digital elevation model (DEM). These elements were then assigned weightings based upon research and combined in a model to produce a map of ecosystem health. The map of ecosystem health was validated against a compound topographic index that was produced for the study region, completed by overlaying the layers in Google Earth. This software allowed for a direct comparison of each layer. The results of the model have demonstrated correlations with past wildfires and the associated recovery. The findings are in agreement with the hypothesis that ecosystem health maps can illustrate the effect wildfires have on ecosystem health, thus providing useful information to land managers and policy makers who manage wildfire. The results further demonstrate that the resolution of Landsat imagery is excellent for obtaining a general overview of ecosystem health mapping. The methods described in this study could provide more detailed information if applied to high resolution imagery such as Worldview or IKONOS data. Results could be further enhanced with hyperspectral sensors due to the possibility of detecting chemical processes associated with ecosystem process. The method is robust enough to be transferable to other regions, with some minor changes based on a specified climate for a given location. The launch of Landsat 8 will ensure the continued acquisition and availability of Landsat data as well as provide high quality images, also making it possible to develop this method to potentially contribute to an operational estimation of ecosystem health recovery after wildfire.