Land Use Land Cover change detection in support of the Greek National micro-satellite project

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SUMMARY

Change detection methods are important for monitoring and analyzing transformations in land use and land cover (LULC) over time. These methods utilize advancements in remote sensing and Geographic Information Systems (GIS) to evaluate environmental and anthropogenic impacts across different landscapes. In the frame of the SAT4GAIA project, funded by the European Space Agency in the frame of Greece's National Microsatellite Program: Axis 3 Land Service, a post-classification comparison method was utilized to identify land cover changes, which involves the independent classification of multi-temporal digital datasets, followed by a pixel-by-pixel comparison of the classified images. Unlike simpler techniques such as image differencing, which highlights spectral differences between images, post-classification comparison focuses on detecting semantic changes as it identifies transitions between distinct land cover or land use categories. To refine the results, remove inherent noise in the change detection data and enhance the map's readability, a sieve filter was applied on the LULC change detection map. The filter threshold was carefully selected to balance the retention of meaningful information across land cover classes while effectively removing isolated noise pixels. The methodology is based on first retrieval of image metadata including georeferencing information, pixel size, and image dimensions to ensure compatibility for further processing. The processing phase starts by applying the post-classification comparison and the sieve filter to refine the initial change detection map. This step removes noise and small, irrelevant changes, ensuring the map focuses on significant land cover transitions. Once this procedure is finished, a transition matrix is created to summarize the type and extent of changes. In the post- processing statistical tests and a significance analysis are performed to identify the most prominent signals of land change. Moreover a Markov model is performed to exclude unlikely transitions, based on the land cover changes from selected multi-temporal LULC classifications. A Markov chain is a stochastic model that estimates the probability of LULC changes, considering past trends in LULC transitions across different spatio-temporal scales. Lastly,

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the slope map derived from the DEM is incorporated into the algorithm in order to improve the model's accuracy. Finally, the output of the procedure consists of the change detection maps, transition matrices and relative plots. In this work we focus on results acquired from Sentinel-2 imagery spanning the period 2014-2025, covering an area under study in Greece. We present results from both the internal algorithm validation and external validation (Producer's Accuracy (PA), User's Accuracy (UA), and Kappa Coefficient) that contribute to improved change analysis towards the implementation of the procedure within the Greek micro-satellite program.

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