Submitted Abstract

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Abstract

High mountains can serve as natural laboratories to disentangle the effects of different global change drivers, such as climate and land-use change, on biodiversity distribution and vegetation cover. The fusion of remote sensing data and artificial intelligence can facilitate the automated analysis and monitoring of these changes. This work presents two main studies within the projects DETECTOR and LIFEWATCH ERIC SmartEcoMountains in the Sierra Nevada (Spain): (1) automatic change detection in high mountain shrubs (Juniperus sp.) by applying deep learning to historical orthophotography and very high-resolution satellite imagery; and (2) automatic land-use and land-cover (LULC) mapping by applying deep learning to coarse (MODIS) and high (Sentinel-2) resolution satellite imagery. In the first study, we digitized 1000 individuals of Juniperus sp. from six zones using orthophotography between 1977 and 2020. The digitized images were used to train state-of-the-art segmentation models based on Convolution Neural Networks (CNNs) to automatically detect high mountain juniper shrubs. The created models were then deployed on images from different decades to analyze the overall change in the plant size, distribution, expansion, and decay. Shrubs near human infrastructures experienced higher growth than in natural environments while lower growth rate occurred in higher altitudes surrounded by bare soil. The reported increase in temperatures does not seem to have favored growth at higher elevations more than at lower elevations, but the other way around. In the second study, we created the TimeSpec4LULC dataset containing a 22-year monthly multispectral time series extracted from merging Terra and Aqua data of Modis sensor at 500 m resolution. In addition, the Sentinel2GlobalLULC dataset was created using RGB images of size 224x224 pixels from Sentinel-2 at 10 m resolution. Both datasets were preprocessed to eliminate the disruptions created by atmospheric conditions, then were annotated using spatial-temporal consensus over 15 global LULC products available in Google Earth Engine. Afterward, these datasets were employed to train deep learning-based models for LULC mapping at 10 m resolution.

This work is part of Smart EcoMountains, the Thematic Center on Mountain Ecosystems of LifeWatch-ERIC.