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Analysis and mapping of spatio-temporal land use dynamics in Andalusia, Spain using the Google Earth Engine cloud computing platform and the Landsat archive

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Soils are recognised as key resource for human well-being. There is an ongoing debate about the influence of land use (LU) and land use change (LUC) on soil properties. Especially for sustainable LU it is important to implement soil-adopted management systems to avoid soil degradation and, therefore, a decrease in soil quality. LUC is mostly initiated by socio-economic as well as political factors such as export oriented farming or urban development, which may threat soil resources. LU classification is a common method to identify different types of ground cover, where the application of machine learning (ML) based supervised-classification techniques has growing significance. In the past decades, the availability of remote sensing data, as well as the fast progress in computer architectures and cloud computing is constantly increasing and allows fast and parallel processing of large data sets. Existing land cover maps (e.g. CORINE and SIOSE) typically have an appropriate spatial resolution, but the temporal resolution is limited. This is of great concern in Mediterranean countries where LU is very heterogenous and dynamic over time. The objective of this study was to identify annual land use change over the past 30 years in the middle Guadalquivir basin, Andalusia, Spain, by applying random forests (RF) and support vector machines (SVM) on the Google Earth Engine (GEE) cloud computing platform. Furthermore, we evaluated how GEE can be utilized for big data processing for land use change detection with high temporal resolution. We used remote sensing data from the Surface Reflectance Tier 1 archives of Landsat 5 ETM and Landsat 8 OLI from 1984 to 2018. The Surface Reflectance Tier 1 products are atmospherically and geometrically corrected. Following the CORINE land cover classification scheme, we used four classes which cover the main types of agricultural LU in the study area. These were arable land, permanent crops (plantations), pastures/grassland and forests. The non-agricultural classes artificial surfaces and water bodies were excluded. For the calibration of the classification models we sampled 130 ground truth points in October 2018. We generated land use maps for the years 1984 to 2018 with the classification methods RF and SVM. For the change detection post-classification comparison was used. Preliminary results show a very high temporal resolution and high data quality for LUC in the middle Guadalquivir basin. The overall area of plantations increased compared to the area of arable land. Furthermore, the percentage of forest also increased, while the share of pastures decreased. We concluded that using GEE is an appropriate tool for big data in high temporal resolution as it provides different classification techniques and fast processing as well as direct access to the Landsat and CORINE archives. The LUC maps can be used to characterise the temporal dynamic on pixel level. Further studies will focus on the implementation of LUC as environmental covariate in soil property mapping in the study area.