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Spatiotemporal patterns of global land use change: Understanding processes and drivers

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Land use change is a major contributor to greenhouse gas emissions and biodiversity loss and, hence, a key topic for current sustainability debates and climate change mitigation. To understand its impacts, accurate data of global land use change and an assessment of its extent, dynamics, causes and interrelations are crucial. However, although numerous observational data is publicly available (e.g. from remote sensing), the processes and drivers of land use change are not yet fully understood. In particular, current global-scale land change assessments still lack either temporal consistency, spatial explicitness or thematic detail.

Here, we analyse the patterns of global land use change and its underlying drivers based on our novel high-resolution (~1x1 km) dataset of global land use/cover (LULC) change from 1960-2019, HILDA+ (Historic Land Dynamics Assessment+). The data harmonises multiple Earth Observation products and FAO land use statistics. It covers all transitions between six major LULC categories (urban areas, cropland, pasture/rangeland, forest, unmanaged grass-/shrubland and no/sparse vegetation).

On this basis, we show (1) a classification of global LULC transitions into major processes of land use change, (2) a quantification of their spatiotemporal patterns and (3) an identification of their major socioeconomic and environmental drivers across the globe. By using temporal cross-correlation, we study the influence of selected drivers on processes such as agricultural land abandonment, deforestation, forest degradation or urbanisation.

With this, we are able to map the patterns and drivers of global land use change at unprecedented resolution and compare them for different world regions. Giving new data-driven and quantitative insights into a largely untouched field, we identify tele-coupled globalisation patterns and climate change as important influencing factors for land use dynamics. Learning from the recent past, understanding how socio-economic and environmental factors affect the way humans use the land surface is essential for estimating future impacts of land use change and implementing measures of climate mitigation and sustainable land use policies.