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Updated land use and land cover change (LULCC) emission estimates based on new high-resolution LULCC forcing data

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Land use and land cover change (LULCC) has a significant role for the global carbon cycle. Despite big improvements in LULCC emission modelling, related uncertainties remain relatively high. Major uncertainties in quantifying LULCC emissions stem from uncertainties in underlying LULCC datasets. The novel, high-resolution (~1 km×1 km) LULCC dataset HIstoric Land Dynamics Assessment+ (HILDA+) reflects gross transitions derived from multiple remote sensing products and offers an alternative to existing land use change datasets, serving as forcing for process-based and bookkeeping models. By incorporating HILDA+ in the “bookkeeping of land use emissions” (BLUE) model, which is one of the three bookkeeping models used in the Global Carbon Budget 2020, we gain a different temporal and spatial perspective on LULCC estimates and related sources of uncertainty.

We compare our results to emission estimates based on LUH2, which is broadly used as LULCC forcing for process-based and bookkeeping models. First results of our analysis show overall lower LULCC emissions for the estimates based on HILDA+. For the time period 1990-2019, mean yearly emission estimates based on HILDA+ are 0.595 GtC yr^{-1} compared to 1.368 GtC yr^{-1} based on LUH2. Reasons are lower emissions from cropland expansion and less carbon uptake from vegetation regrowth after abandonment of managed land (i.e. a smaller carbon sink). Furthermore, fewer discontinuities in the BLUE runs with the HILDA+ forcing compared to the LUH2-based estimates suggests a better representation of land use dynamics and their effects. Overall, the simulations based on HILDA+ capture spatial heterogeneity to a greater degree and provide a more detailed picture of local sources and sinks, which is crucial for (1) a better representation of component fluxes (e.g. deforestation, degradation) and (2) effective mitigation and adaptation policies.