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World distribution of land cover changes during Pre- and Protohistoric times and estimation of induced carbon releases

C. Lemmen
GKSS-Forschungszentrum Geesthacht, KOE, Geesthacht, Germany (carsten.lemmen@gkss.de)

The role of Pre- and Protohistoric anthropogenic land cover changes needs to be quantified i) to establish a baseline for comparison with current human impact on the environment and ii) to separate it from naturally occurring changes in our environment. Results are presented from the simple, adaptation-driven, spatially explicit Global Land Use and technological Evolution Simulator (GLUES) for pre-Bronze age demographic, technological and economic change. Using scaling parameters from the History Database of the Global Environment as well as GLUES-simulated population density and subsistence style, the land requirement for growing crops is estimated. The intrusion of cropland into potentially forested areas is translated into carbon loss due to deforestation with the dynamic global vegetation model VECODE. The land demand in important Prehistoric growth areas - converted from mostly forested areas - led to large-scale regional (country size) deforestation of up to 11% of the potential forest. In total, 29 Gt carbon were lost from global forests between 10 000 BC and 2000 BC and were replaced by crops; this value is consistent with other estimates of Prehistoric deforestation. The generation of realistic (agri-)cultural development trajectories at a regional resolution is a major strength of GLUES. Most of the pre-Bronze age deforestation is simulated in a broad farming belt from Central Europe via India to China. Regional carbon loss is, e.g., 5 Gt in Europe and the Mediterranean, 6 Gt on the Indian subcontinent, 18 Gt in East and Southeast Asia, or 2.3 Gt in subsaharan Africa.