Geophysical Research Abstracts
Vol. 16, EGU2014-13017-2, 2014
EGU General Assembly 2014

Assessing land-use change in Ireland using the Land-Parcel Identification System

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Carbon dynamics linked to Land-Use and Land-Use Change (LULUC) are considered a major factor in the global Greenhouse Gas (GHG) budget. The major sources of carbon to the atmosphere are the loss of above and below ground biomass as well as the loss of soil organic carbon. Estimates have shown that in the decade between 1990 and 2000 emissions related to LULUC and forestry have been between 0.5 and 2.7 Gt C yr^{-1}. The major sources are conversion from forestry to agriculture and grasslands to cropland; conversely land-use change from cropland to grassland can facilitate soil carbon sequestration. While the effects of different types of land-use change on the GHG budget have been well studied, assessing land-use change at a national level is subject to uncertainty. In Ireland LULUC are currently modelled using national statistical data on total land-uses as well as socio-economic data. This may lead to inaccuracies as it neither provides information on direct land-use change trajectories nor spatially explicit information such as soil properties. The aim of this study is to assess the suitability of the land-parcel identification system (LPIS) to assess overall inter-annual land-use change as well as the immediate trajectory of change reported, and to provide tools for this purpose. For the available LPIS datasets (2000 to 2012) a number of issues have been identified. (1) Duplication of parcels led to a major overestimation of the agricultural area. On average 20917.7 $\pm$7157.6 parcels showed one or multiple duplicates, leading to an overestimation of the agricultural area by 58194.2 $\pm$11578.4km^2, (2) no continuous identification of parcels through time complicates tracking land-use change, and (3) parcel outline changes over time without indication if the changes represent real-world changes or corrections of the LPIS database. Geoinformation Systems tools have been developed to address those issues, including a tool to remove duplicate parcels and a tool that assigns unique parcels identification codes based on spatial stability. To differentiate between real-world change and corrections in the database minimum criteria based on differences in parcel area (5% of the parcel area) and shifts in the parcel centroid over time (12m) have been introduced. Using the newly assigned parcel identification codes it could be shown that parcel stability between consecutive years is very high (on average 90.5% $\pm$3.2 of the parcels in any year are present in the following year). When looking at the whole timeframe only 48.5% $\pm$7.2 of the parcels recorded in 2000 are still present in 2012. These results indicate that LPIS has a strong potential for identifying inter-annual land-use change between consecutive years, however changes in parcel outlines lead to difficulties when comparing non-consecutive years. Further research will be conducted to adapt the available tools to estimate land-use change from changing parcels.