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Global Carbon Fluxes Induced by Agriculture-Related Land-Use and Land Cover Change Activities

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The aim of this study is to estimate the net carbon fluxes from agriculture-related land-use and land cover change (LULCC) activities, which are referred to as emissions from the land due to human activities. These include land use (LU, e.g., farmland for food and feed production, including management) and land cover changes (LCC, e.g., deforestation for and reforestation of agricultural land, and conversion of grasslands and pastureland to agriculture land or vice versa). Agriculture land-use practices could be a source of atmospheric CO2. However, the management of agricultural practices may reduce carbon emissions and increase soil carbon sequestration. Simultaneously, land-cover change activities clear existing ecosystems, their biomass and disturb the soil, generating carbon emissions. Previous earth system models usually have a simple or no representation of land agriculture practices, such as planting crops, fertilization, irrigation, harvesting grains for food and livestock-feed, recovering crop residue for feed and other usages, and grazing, livestock-feed, and manure cycle. This study uses a land surface model with spatially heterogeneous representations of such agricultural land use activities, in addition to land cover change, such as the change from forest to agricultural land. Our study shows the net agricultural land area increase of 0.11 million hectares/yr during 2007-2013, including 2.12 million hectares/yr of other land converted to agricultural land and 2.01 million hectares/yr of agricultural land converted to other lands. The results show that global net carbon flux due to agriculture-related LULCC is 2.26 Pg C/yr (net emission), consisting of 38% due to land-use activities and 62% due to land cover change. South America (22%), North America (19%), and South and Southeast Asia (13%) are the top contributing regions for net carbon flux induced by LULCC. South America has contributed the most flux from land cover change (18%), while North America has generated the most carbon flux due to land-use activities (12%) among all macro geopolitical regions. By quantifying the carbon fluxes induced by different agriculture activities this study provides a complete estimate of the yearly carbon cycle in the agriculture system at the spatial scale, which may improve the representations of agriculture land use activities in Earth System Models.