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Can we reconcile differences in estimates of carbon fluxes from land-use change and forestry for the 1990s?

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Abstract. The effect of Land Use Change and Forestry (LUCF) on terrestrial carbon fluxes can be regarded as a carbon credit or debit under the UNFCCC, but scientific uncertainty in the estimates for LUCF remains large. Here, we assess the LUCF estimates by examining a variety of models of different types with different land cover change maps in the 1990s. Annual carbon pools and their changes are separated into different components for separate geographical regions, while annual land cover change areas and carbon fluxes are disaggregated into different LUCF activities and the biospheric response due to CO₂ fertilization and climate change. We developed a consolidated estimate of the terrestrial carbon fluxes that combines book-keeping models with process-based biogeochemical models and inventory estimates and yields an estimate of the global terrestrial carbon flux that is within the uncertainty range developed in the IPCC 4th Assessment Report. We examined the USA and Brazil as case studies in order to assess the cause of differences from the UNFCCC reported carbon fluxes. Major differences in the litter and soil organic matter components are found for the USA. Differences in Brazil result from assumptions about the LUC for agricultural purposes. The effects of CO₂ fertilization and climate change also vary significantly in Brazil. Our consolidated estimate shows that the small sink in Latin America is within the uncertainty range from inverse models, but that the sink in the USA is significantly smaller than the inverse models estimates. Because there are different sources of errors at the country level, there is no easy reconciliation of different estimates of carbon fluxes at the global level. Clearly, further work is required to develop data sets for historical land cover change areas and models of biogeochemical changes for an accurate representation of

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