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Effects of plant functional type and land cover uncertainty on global carbon fluxes

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Ocean and terrestrial systems offset 35-40% of global anthropogenic carbon emissions. Year to year variability of this offset results from climate variability and increasing CO2 and its effects on ocean or plant fertilization. In addition, much of the uncertainty from estimating global carbon fluxes is due to differences in DGVM model structure and parameter uncertainty, although, land cover, especially managed lands, have a considerable impact on the magnitude of the global carbon cycle and its component fluxes. Here we investigate the effects of global land cover uncertainty, arising from differences in satellite sensors and classification systems, on global carbon fluxes using the LPJ DGVM. Plant functional type fractions (PFT), including managed lands, are fixed based on four different satellite derived products and compared to a dynamic PFT simulation. The carbon balance from fixing PFT fractions is maintain through additional corrections for PFT establishment and mortality allowing a full investigation on component fluxes of NEE to be addressed. We find that differences in land cover are insensitive to climate variability and extremes, but that the local to global differences in carbon fluxes are large and that this spatial pattern varies distinctly. At the local scale (individual pixel) variability of NPP can reach 600 Kg C m2 yr-1, while at the global scale, this variability can reach $\sim$4 Pg C yr-1. The savannahs of South America, croplands of the mid-western USA, and larch forests of Siberia exhibit the most regional uncertainty because of classification differences for deciduous and evergreen species, and croplands versus natural grasslands. MODIS derived classifications result in higher global NPP because of a greater abundance of grasslands, but global NEE is relatively similar across all classifications (-6.0 to -4.7 Pg C yr-1). Because the relationship between land cover uncertainty and carbon fluxes appears to be constant, these errors can be considered invariable with future climate projections (assuming land cover change is negligible). Reductions of error for the global carbon cycle will benefit from reducing land cover uncertainty, especially in regions vulnerable to projected climate change (tropics, croplands, and boreal forest).