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Biogeosciences Discussions

Interactive comment on "Ignoring detailed fast-changing dynamics of land use overestimates regional terrestrial carbon sequestration" *by* S. Zhao et al.

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This is a good observation. We added the following section in discussion in the revision. Our land cover change model is not setup to run "reverse mode" at the moment.

From the land cover map (Fig. 1), we can see that land use in the west (i.e., Russell County in Alabama) had more lands in pasture/hay, grasslands, and shrub/scrub than in the eastern part of the region (i.e., three counties in Georgia). Although forest was the dominant land cover in the eastern part, active and widespread forest cutting only happened in Marion County (see Figs. 1 and 3) while land use change in other two counties was relatively small (except urbanization). This east-to-west difference in land

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use practices across political boundaries resulted in obvious differences in carbon dynamics. First, land use pattern has a significant impact on the spatial pattern of carbon sequestration. In the western part, grassland and shrub/scrub lands were usually carbon sources from 1992 to 2007 (shown in red in Fig. 4). This general source pattern was rather consistent across different intervals and not affected by the length of time interval between land cover maps. This is because these sources were associated with specific land covers, in this case grasslands and shrub/scrub lands, and not with land cover changes or transitions. Second, the change of spatial pattern of carbon sequestration in the eastern part (especially in Marion County, Fig. 4) was caused by fast land use change activities (i.e., forest cutting under short rotation forestry) and temporal interval of the land cover maps. It was apparent that carbon source strength was under-estimated when land cover change map interval was longer than one year, implying that the recovery of spectral signals of land cover took less than five years in the region. Third, the carbon sequestration pattern under the static land cover scenario probably reflected the long-term impacts of land cover change (i.e., longer than 15 years with disturbances occurred before 1992). For example, the carbon sources associated with grasslands and shrub/scrub lands in the western part might be converted or abandoned from forestry or agriculture, and they were generally sustained by low ecosystem production (Fig. 1) and continuing decomposition of SOC which cannot be offset by low production. If the model keeps running forward under static scenario, the region should become carbon neutral as the ecosystems reach their equilibriums. The difference in carbon sequestration between static and other time intervals reflects short-term impacts of land use change that occurred between 1992 and 2007.

Minor: Fig 1: At which time step this map represents the study area? [Response]: The land cover in the image is from the 2001 National Land Cover Database (NLCD). We added a reference to 2001 NLCD in the caption.

The study period needs to be explicitly mentioned under Methods. [Response]: Yes, we clearly mentioned the study period of 1992-2007 under method in the revision.

BGD

6, C1208–C1210, 2009

Is it correct, that different land use change scenarios include no change for 1992 (section 2.3), than this should be explicitly mentioned. [Response]: "We used four land use change scenarios to drive GEMS ... " has been changed to "We used four land use change scenarios (land use in 1992 was the same under all scenarios) to drive GEMS ... "

Interactive comment on Biogeosciences Discuss., 6, 3215, 2009.