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Interactive comment on "An assessment of geographical distribution of different plant functional types over North America simulated using the CLASS-CTEM modelling framework" *by* Rudra K. Shrestha et al.

Anonymous Referee #1

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General comments.

R. K. Shrestha and coauthors report the results of testing the CTEM model ability to simulate plant functional types (PFT) distribution over North America at the spatial resolution of 1 degree in the changing climate of 19th and 20th centuries. The results confirm the ability of the model to broadly reproduce the distribution of the major PFTs, LAI, and carbon fluxes. The paper is well written and is suitable for publication after minor revision.

Detailed comments.

1. The CTEM plant competition scheme is intended to simulate effects of climate change on vegetation composition. One aspect of balance between broadleaved deciduous and needle-leaved evergreen PFTs doesn't seem to be addressed here and in (Melton and Arora, 2016). As climate warms up in the boreal region, late succession broadleaved deciduous species are expected to get advantage over late succession needle-leaved evergreen trees. However some needle-leaved evergreen species like jack pine occupy ecological niche of nutrient-poor sandy soils, where change to late-succession broadleaves is less likely. Thus the approach of lumping together (see line 75 in text) "fir (Abies), spruce (Picea) and pine" carries some disadvantages. If there is proper data for the North America, it is useful to provide estimates of the forest area fraction, where current completion scheme may underestimate the resilience of needle-leaved evergreens.

2. Figure 5 shows tree coverage, and much of wetland-dominated Hudson Bay lowland appears covered with trees on both simulated and MODIS maps. Known weakness of the MODIS or GLC2000 vegetation maps is their inability to explicitly represent boreal peatlands. As a result, peatland area is assigned to mixture of grass and tree PFTs, and the model is forced to simulate competition between them as if they grow on mineral soil. In reality tree PFTs perform quite differently on peatland surface, where productivity and biomass are typically lower than in nearby well-drained landscapes. Alternatively to using MODIS or GLC2000 data, wetland area fraction dataset by Matthews and Fung (1987) or Global Lakes and Wetlands Database (Lehner and Doll 2004) are readily available and provide a better view of peatland area fraction than MODIS or GLC2000 vegetation products. As GLC2000 and GLWD have similar resolution, it is possible to separate wetland pixels from the rest. Authors mentioned lack of moss and lichen cover PFT in the model. However, fortunately for DGVMs, the peatland area changes slowly over millennial scale, and vegetation changes there can be considered separately from those occurring on mineral soil. Thus, for fair comparison it is better to omit peatland/wetland area when comparing the modeled vegetation distribution (tree vs grass PFTs) with observations, if that is technically possible.

3. Figure 9 shows broadleaved evergreen tree coverage. While simulated pattern looks reasonable, the observed one shows some unexpected broadleaved evergreen presence in the North of Canada and Alaska. Although authors point to the map of Wang et al 2006 for assigning the northern evergreen shrubs to the broadleaved evergreen tree PFT, it is recommended to correct the map, and remove broadleaved evergreen tree type north of its known area before comparing with model simulation.

4. In the introduction (line 96-97), authors define using 1 degree spatial resolution as major difference between this and Melton and Arora (2016) studies. Using higher spatial resolution appears as a major motivation for the study. However there is no clear statement or conclusion on the effect of resolution on improving simulated distributions of PFT, LAI or carbon fluxes. Even if there is no significant improvement, which is possible, the result should be stated clearly.

Minor, technical corrections

Line 35. Authors point that some processes need further development. Suggest to briefly mention which actual processes need attention.

References

Lehner B. and Döll P., Development and validation of a global database of lakes, reservoirs and wetlands, J. Hydrol., 296, 1–22, 2004

Matthews, E., and I. Fung, Methane emission from natural wetlands: Global distribution, area, and environmental characteristics of sources, Global Biogeochem. Cycles, 1(1), 61–86, doi:10.1029/GB001i001p00061, 1987.

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