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Biogeosciences Discussions

Interactive comment on "Fire dynamics during the 20th century simulated by the Community Land Model" *by* S. Kloster et al.

Anonymous Referee #2

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Kloster et al. ACPD: "Fire dynamics during the 20th century simulated by the Community Land Model" Anonymous Reviewer Comments

Dear Authors,

First, thank you for an interesting and well-written manuscript on your very large and detailed study of global historical fire simulations.

This manuscript describes the comparison of two different weather-based fire activity parameterizations into the NCAR Community Land Model (CLM), one based on Thonicke et al. ((2001), also new paper in Biogeosciences Discussion), and the other based on Arora and Boer (Arora and Boer, 2005). These parameterizations permit reconstruction of burned area and carbon emissions over broad land areas based on forcing

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from meteorological reanalysis. In addition, a number of additional parameterizations are considered, including human effects on fire ignition and suppression, as well as interactions between anthropogenic biofuel extraction, land use change, and wildfire emissions.

The driving force behind the authors' analysis is clear: if decadal-scale variations in the carbon cycle can be modeled accurately, then the effects of climate and other forcings can be simulated into the future at those time scales. This work is an important step in the direction of describing what climate-based descriptions of fire activity can achieve, and giving a first indication of what the effects of anthropogenic modifications of the landscape might be on wildfire and deforestation fluxes.

This work will continue to be refined, and the datasets from the satellite era will also continue to improve. However, I hold out little hope that the quality of retrospective datasets from before the satellite era will advance to a point where they can be used to diagnose errors in a model output such as the one presented here. Simulations like the ones presented in this paper are what we will likely rely on for decadal-scale reconstruction; as the datasets from the satellite era are extended and improved, more and more of the relevant variation can be parameterized and tested.

The challenge for this type of work is locating data sources which can be meaningfully compared to the model output. In this manuscript, the word "observations" is used to apply to these datasets: burned area from the Global Fire Emissions Database (GFED) (Giglio et al., 2006); carbon emissions from GFED (van der Werf et al., 2006); burned area from L3JRC (Tansey et al., 2008); historical burned area from GICCHist (Mieville, 2010 in press, Atmospheric Environment)

Of these datasets, the simplest observation chain is for the L3JRC burned area. These data are prepared from global daily data from SPOT VEGETATION with a burn scar detection algorithm derived from one used in the GBA2000 project (see (Tansey et al., 2004)), based on a normalized temporal change detection method in the near infrared

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(0.83 micron) band. This is a fairly complex processing chain, and the errors in the final product are the result of numerous different interacting sources of uncertainty (see (Tansey et al., 2004), (Simon et al., 2004) for discussion). The L3JRC product has the most extensive validation results reported for any global product, based on high-resolution Landsat data (and some Landsat quicklook data, apparently). The results of this validation, as reported in (Tansey et al., 2008), are very poor (regression slopes between L3JRC and high-resolution burned area estimates between 0.4 and 1.3, except for sparse herbaceous cover, which returned a slope of 0.05). Based on these results, it is very difficult to have confidence in even the broad regional estimates of burned area from this product, although it may still contain the interannual signal of burning activity (this was not directly evaluated by (Tansey et al., 2008)).

The other data sets referred to as "observations" have even more complex processing chains, and in general may be better described as model outputs than observations. The point is not to quibble about nomenclature, the point is that the data sets to which the authors' model output can be directly compared are themselves highly uncertain, and it is important not to draw overbroad conclusions from these comparisons.

The burned area comparisons between the authors' CLM outputs and the GFED database are interesting because the estimation methods are totally independent. Thus, the correlation between the CLM results and the burned area datasets in terms of interannual variability is encouraging, a very positive result for this methodology. But until a more complete validation of the GFED burned area data is published, I would not strive for complete correlation with those data, as the uncertainties are still large even at the scales of this study.

The comparisons of the additional model runs to simulate the effects of anthropogenic ignitions and fire suppression are interesting in light of the large changes in total carbon emissions resulting from these effects. The authors note that inclusion of fire suppression effects gives a better result than inclusion of ignition effects alone. However, results in Table 4 indicate that in most regions, the correlations are not improved by the inclusion of these anthropogenic terms. In general, the 1997-2004 period used for comparison of GFED to the authors' results may be too short to diagnose the signal of anthropogenic effects on fires. Also, I would like to request the authors explicitly state and discuss the spatial scales involved in the parameterization of population density effects. The reference (Klein Goldewijk, GBC 2001) indicates a scale of 0.5 degrees, is that the scale used in the CLM parameterizations?

The longer-term trends are examined by comparison to a dataset GICChist (Mieville et al., 2010 in press Atmospheric Environment). These data are used only in a normalized fashion, which is appropriate. The accumulation of untestable or untested assumptions in the construction of the GICChist long-term dataset renders it thoroughly unsuitable for validation. Based on comparison of the methodologies, I already have higher confidence in the CLM outputs than the GICChist database to describe historical variations in fire activity.

This work contributes to a growing literature aimed at establishing the ability of climate-scale models to reproduce the spatial and temporal patterns of fire emissions obtained from satellite-based inventories. The results shown by the authors are encouraging, and as inventories from the satellite era continue to expand in time, it should be possible to evaluate more sophisticated model parameterizations, such as the anthropogenic effects tested in this study.

Minor notes:

Page 2: "Parameters can be parametrized"

Page 2: PFT == "Plant function type" spell out first use

Page 2: "tress" => "trees"

Page 5: if you report a spatial correlation, you must state the spatial resolution

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Interactive comment on Biogeosciences Discuss., 7, 565, 2010.