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Interactive comment on "Emergent relationships on burned area in global satellite observations and fire-enabled vegetation models" *by* Matthias Forkel et al.

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We thank the referee for the positive review. In the following we cite comments by the referee and provide our responses in normal font.

[Referee 1: "The authors used direct rainfall quantities as a predictor variable in the model - both DGVMs and many fire behaviour models and simulation use a measure of soil moisture (as a proxy for fuel moisture) that takes into account rainfall in- put, and evaporation over time. Soil moisture content is also a variable available in global climate model output. Why did the authors not include soil moisture content as a predictor variable in the random forest modelling, in addition to precipitation, as it may

provide a more physically relevant correlate of fire activity?"]

Initially, we indeed considered to use soil moisture as predictor for burned area. However, the FireMIP models only provided simulations of soil moisture as the total soil moisture content (kg m-2) integrated over the entire soil depth. Each model uses a different definition for soil depth and also the soil hydrology schemes differ. Hence soil moisture simulations from the different models are not directly comparable. The relative soil moisture of the upper soil layer will be a new output from FireMIP models in a next release of model results.

We also rely in our analysis for each predictor variable on an observational dataset or data-driven estimate. For soil moisture, we initially used the ESA CCI soil moisture dataset which is an estimate of volumetric surface (upper < 5 cm) soil moisture (m^3/m^3) from active and passive microwave satellites (Dorigo et al., 2017). We have been shown that the ESA CCI soil moisture dataset can be used as a predictor for burned area at the global scale (Forkel et al., 2017). However, we also found that the number of wet days resulted in better performances at the global scale. We did not further use the ESA CCI soil moisture dataset in this study because the volumetric surface soil moisture (ESA CCI) is only to a limited extent comparable with the column-integrated total soil moisture content from the FireMIP models. In summary, we did not include soil moisture as predictor because of the limited comparability of observational and modelled soil moisture datasets.

[Referee 1: "What defines the white, presumably "missing data" cells in maps, eg. Figure 2? It is notable that no data appears availabe for south-eastern and south-western Australia, which are both fire-prone areas with comparable climates to eg. South Africa, western United States, mediterranean. I see tht there is a brief comment in the caption for figure 6 explaining there was "missing data" in the vegetation carbon dataset for Australia and New Zealand, but I feel this needs more expla- nation given the importance of fire in this area. What would need to be done to include this area - is there another potential data source that could be used as a replacement?"]

We used a map of forest and herbaceous vegetation carbon as predictor for burned area. This map (Carvalhais et al., 2014) is based on the map of tropical aboveground forest biomass by Saatchi et al. (2011). The Saatchi et al. map does not cover southern Australia and New Zealand and hence these regions appear as “missing data” in the random forest-based results. Alternative maps of tropical forest biomass do not include Southern Australia and New Zealand (Avitabile et al., 2016; Baccini et al., 2012) and global maps of forest biomass do not account for herbaceous biomass (e.g. http://globbiomass.org/products/global-mapping/). Regional maps of vegetation carbon or forest biomass might be available for Australia and could be potentially mosaicked with the used global map. However, such a mosaicking will likely introduce artefacts (e.g. edges between both biomass maps) that might propagate in maps of controls on burned area and associated data-model comparisons. Because of these reasons, we did not try to create or integrate an additional vegetation carbon map that covers the missing regions. Global maps of vegetation carbon will hopefully become available with recently launched (e.g. ICESat-2) and future satellite missions (e.g. BIOMASS). We now provide the following explanation in chapter 2.5:

“The vegetation biomass dataset does not cover southern Australia and New Zealand. Although fire is common in these regions, we did not fill the global vegetation biomass map with a regional map to avoid potential artefacts in the derived sensitivities that would likely result from merging different biomass maps.”

In addition, we added the following sentence in the captions of Figures 2, 3 and 6:

“Regions with missing data (white) are either without vegetation cover (e.g. deserts, ice sheets), had not burned area (e.g. parts of the Amazon and tundra), or were not covered by the used vegetation carbon map (i.e. regions in southern Australia and New Zealand).”

We changed the proposed Technical Corrections.

References

Avitabile, V., Herold, M., Heuvelink, G. B. M., Lewis, S. L., Phillips, O. L., Asner, G. P., Armston, J., Ashton, P. S., Banin, L., Bayol, N., Berry, N. J., Boeckx, P., Jong, D., J, B. H., DeVries, B., Girardin, C. A. J., Kearsley, E., Lindsell, J. A., LopezâĂŘGonzalez, G., Lucas, R., Malhi, Y., Morel, A., Mitchard, E. T. A., Nagy, L., Qie, L., Quinones, M. J., Ryan, C. M., Ferry, S. J. W., Sunderland, T., Laurin, G. V., Gatti, R. C., Valentini, R., Verbeeck, H., Wijaya, A. and Willcock, S.: An integrated panâĂŘtropical biomass map using multiple reference datasets, Glob. Change Biol., 22(4), 1406–1420, doi:10.1111/gcb.13139, 2016.

Baccini, A., Goetz, S. J., Walker, W. S., Laporte, N. T., Sun, M., Sulla-Menashe, D., Hackler, J., Beck, P. S. A., Dubayah, R., Friedl, M. A., Samanta, S. and Houghton, R. A.: Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps, Nat. Clim. Change, 2(3), 182–185, doi:10.1038/nclimate1354, 2012. Carvalhais, N., Forkel, M., Khomik, M., Bellarby, J., Jung, M., Migliavacca, M., ÎIJu, M., Saatchi, S., Santoro, M., Thurner, M., Weber, U., Ahrens, B., Beer, C., Cescatti, A., Randerson, J. T. and Reichstein, M.: Global covariation of carbon turnover times with climate in terrestrial ecosystems, Nature, 514(7521), 213–217, doi:10.1038/nature13731, 2014.

Dorigo, W., Wagner, W., Albergel, C., Albrecht, F., Balsamo, G., Brocca, L., Chung, D., Ertl, M., Forkel, M., Gruber, A., Haas, E., Hamer, P. D., Hirschi, M., Ikonen, J., de Jeu, R., Kidd, R., Lahoz, W., Liu, Y. Y., Miralles, D., Mistelbauer, T., Nicolai-Shaw, N., Parinussa, R., Pratola, C., Reimer, C., van der Schalie, R., Seneviratne, S. I., Smolander, T. and Lecomte, P.: ESA CCI Soil Moisture for improved Earth system understanding: State-of-the art and future directions, Remote Sens. Environ., doi:10.1016/j.rse.2017.07.001, 2017.

Forkel, M., Dorigo, W., Lasslop, G., Teubner, I., Chuvieco, E. and Thonicke, K.: A data-driven approach to identify controls on global fire activity from satellite and climate observations (SOFIA V1), Geosci Model Dev, 10(12), 4443–4476, doi:10.5194/gmd-10-4443-2017, 2017.

Saatchi, S. S., Harris, N. L., Brown, S., Lefsky, M., Mitchard, E. T. A., Salas, W., Zutta, B. R., Buermann, W., Lewis, S. L., Hagen, S., Petrova, S., White, L., Silman, M. and Morel, A.: Benchmark map of forest carbon stocks in tropical regions across three continents, Proc. Natl. Acad. Sci., 108(24), 9899–9904, doi:10.1073/pnas.1019576108, 2011.

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