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Emergent relationships between burned area and controls in global satellite observations and FireMIP models

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Recent climate changes have increased fire-prone weather conditions in many regions and have likely affected fire occurrence, which might impact ecosystem functioning, biogeochemical cycles, and society. Prediction of how fire impacts may change in the future is difficult because of the complexity of the controls on fire occurrence and burned area. Here we aim to assess how process-based fire-enabled dynamic global vegetation models (DGVMs) (Hantson et al., 2016) represent sensitivities between controls on fire and burned area. We used a machine learning algorithm (random forest, RF) to identify emergent relationships between climate, vegetation, and socio-economic predictor variables and burned area (Forkel et al., 2018). We applied RF to monthly burned area time series for the period from 2005 to 2011 from satellite observations and from DGVMs from the "Fire Modeling Intercomparison Project" (FireMIP) (Rabin et al., 2017). The satellite-derived relationships indicate strong sensitivity to climate variables (e.g. maximum temperature, number of wet days), vegetation properties (e.g. vegetation type, previous-season plant productivity and leaf area, woody litter), and to socio-economic variables (e.g. human population density). DGVMs broadly reproduce the relationships with climate variables and, for some models, with population density. Interestingly, satellite-derived responses show a strong increase in burned area with an increase in previous-season leaf area index and plant productivity in most fire-prone ecosystems. This sensitivity was largely underestimated by most DGVMs. Hence, our novel pattern-oriented model evaluation approach allowed us to diagnose that vegetation effects on fire are a main deficiency regarding fire-enabled dynamic global vegetation models' ability to accurately simulate the role of fire under global environmental change.

References
Forkel, M., Andela, N., Harrison, S. P., Lasslop, G., Marle, M. van, Chuvieco, E., Dorigo, W., Forrest, M., Hantson, S., Heil, A., Li, F., Melton, J., Sitch, S., Yue, C. and Arneth, A.: Emergent relationships on burned area in global satellite observations and fire-enabled vegetation models, Biogeosciences Discussions, 1–31, doi:https://doi.org/10.5194/bg-2018-427, 2018.
Hantson, S., Arneth, A., Harrison, S. P., Kelley, D. I., Prentice, I. C., Rabin, S. S., Archibald, S., Mouillot, F., Arnold, S. R., Artaxo, P., Bachelet, D., Ciais, P., Forrest, M., Friedlingstein, P., Hickler, T., Kaplan, J. O., Kloster, S., Knorr, W., Lasslop, G., Li, F., Mangeon, S., Melton, J. R., Meyn, A., Sitch, S., Spessa, A., van der Werf, G. R., Voulgarakis, A. and Yue, C.: The status and challenge of global fire modelling, Biogeosciences, 13(11), 3359–3375, doi:10.5194/bg-13-3359-2016, 2016.
Rabin, S. S., Melton, J. R., Lasslop, G., Bachelet, D., Forrest, M., Hantson, S., Kaplan, J. O., Li, F., Mangeon, S., Ward, D. S., Yue, C., Arora, V. K., Hickler, T., Kloster, S., Knorr, W., Nieradzik, L., Spessa, A., Folberth, G. A., Sheehan, T., Voulgarakis, A., Kelley, D. I., Prentice, I. C., Sitch, S., Harrison, S. and Arneth, A.: The Fire Modeling Intercomparison Project (FireMIP), phase 1: experimental and analytical protocols with detailed model

descriptions, Geosci. Model Dev., 10(3), 1175–1197, doi:10.5194/gmd-10-1175-2017, 2017.