TECHNISCHE UNIVERSITÄT WIEN
DEPARTMENT OF GEODESY AND GEOINFORMATION
CLIMATE AND ENVIRONMENTAL REMOTE SENSING

What controls fire?

Evaluating emergent relationships in satellite observations and global vegetation models using machine learning

Matthias Forkel

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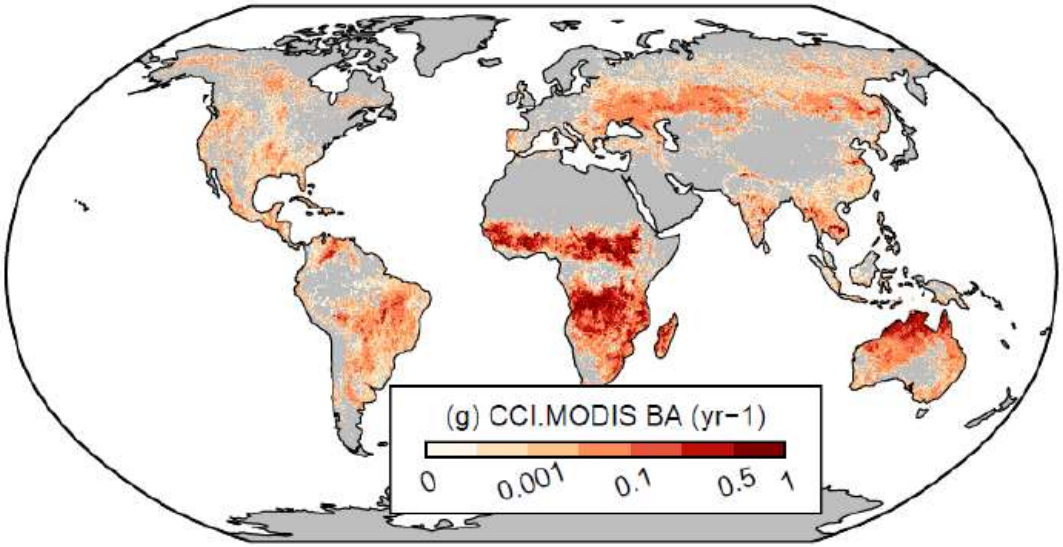
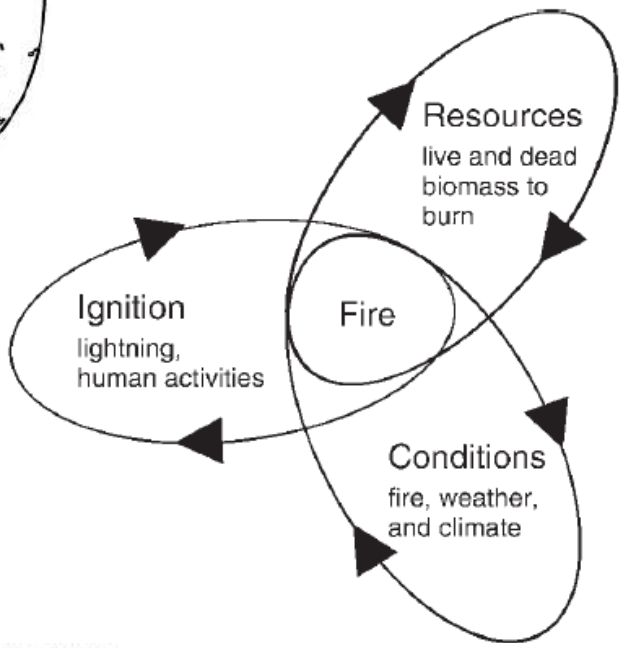
10th International Conference on Ecological Informatics, Jena, Germany

What controls fire?



Mean annual burned area
(ESA Fire CCI dataset)



Ecology, 92(1), 2011, pp. 121–132

Constraints on global fire activity vary across a resource gradient

Meg A. Krawchuk[1] and Max A. Moritz

What controls fire?

Geosci. Model Dev., 10, 4443–4476, 2017
https://doi.org/10.5194/gmd-10-4443-2017

Geoscientific Model Development

A data-driven approach to identify controls on global fire activity from satellite and climate observations (SOFIA V1)

Matthias Forkel[1], Wouter Dorigo[1], Gitta Lasslop[2], Irene Teubner[1], Emilio Chuvieco[3], and Kirsten Thonicke[4]

- Identifying controls with data-driven approaches

Burning is suppressed by …

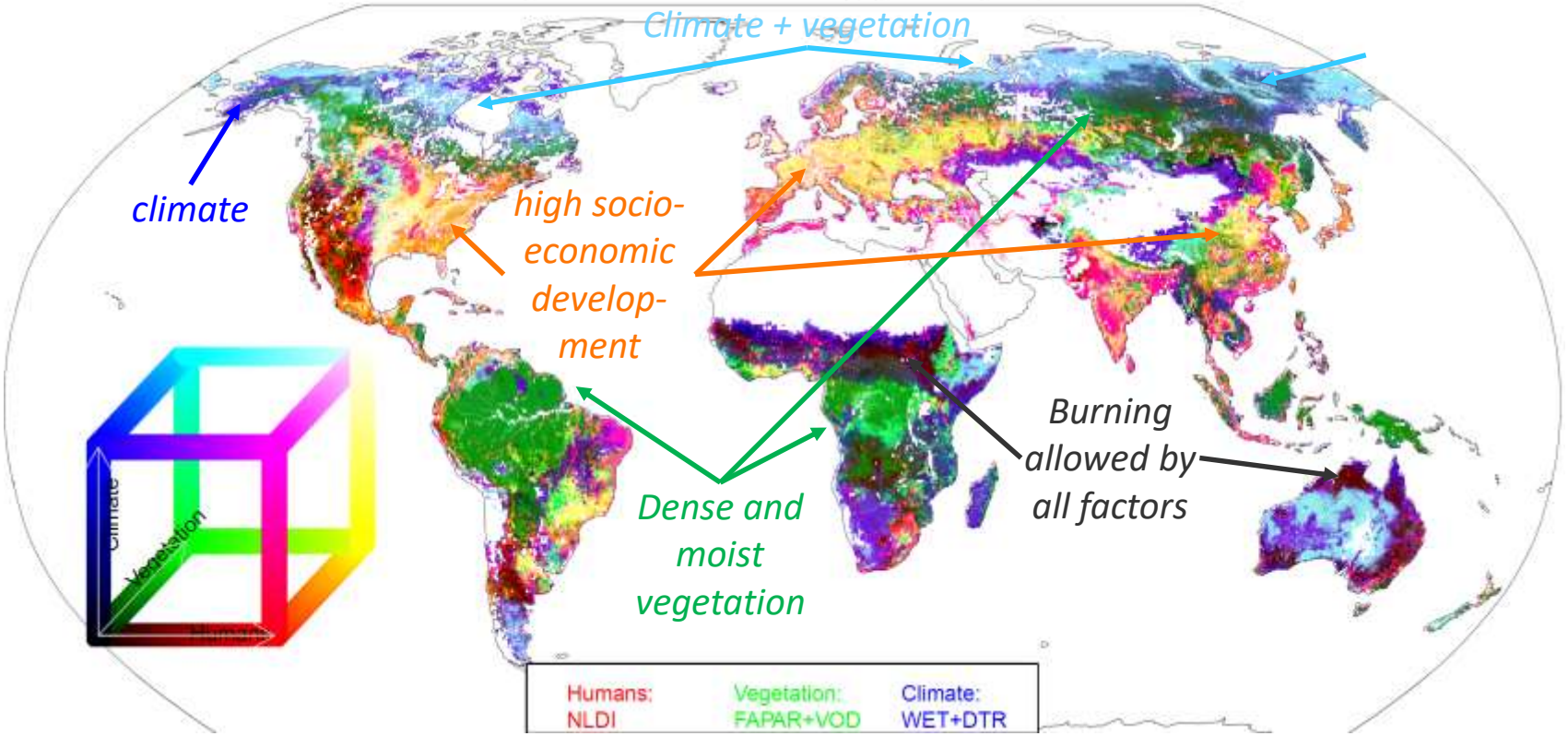
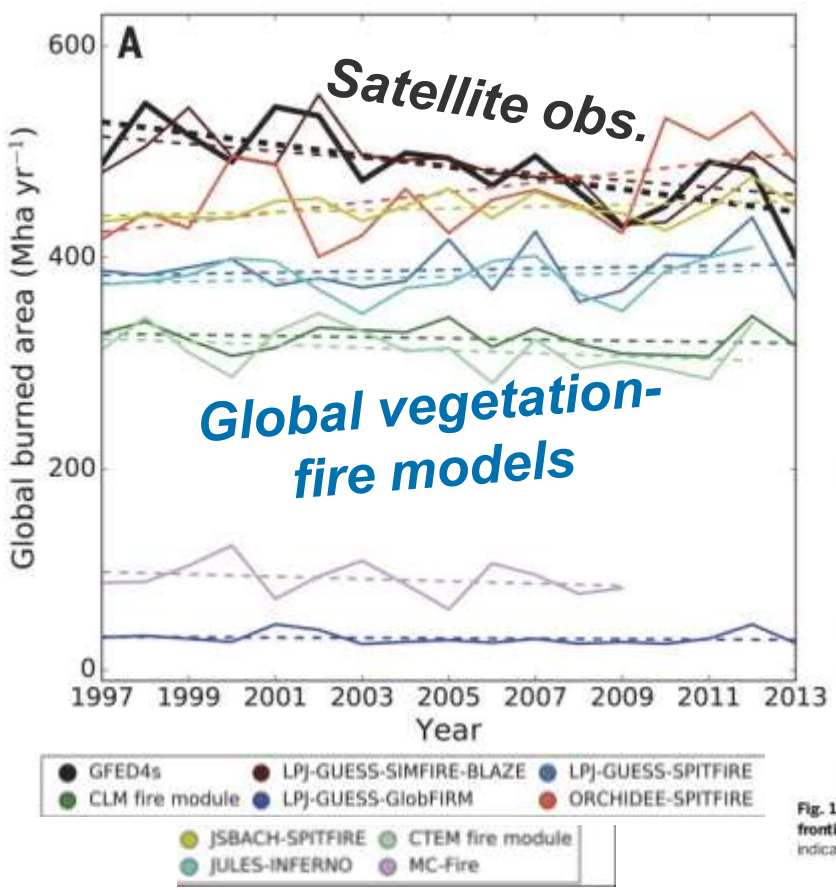


Fig. RGB-composite of climate, vegetation, and human controls on burned area based on the data-driven SOFIA fire model.

Decline in global burned area



GLOBAL FIRE ACTIVITY

A human-driven decline in global burned area

Science, 2017

N. Andela,[1,2*] D. C. Morton,[1] L. Giglio,[3] Y. Chen,[3] G. R. van der Werf,[4] P. S. Kasibhatla,[5] R. S. DeFries,[6] G. J. Collatz,[1] S. Hantson,[7] S. Kloster,[8] D. Bachelet,[9] M. Forrest,[10] G. Lasslop,[8] F. Li,[11] S. Mangeon,[12] J. R. Melton,[13] C. Yue,[14] J. T. Randerson[2]

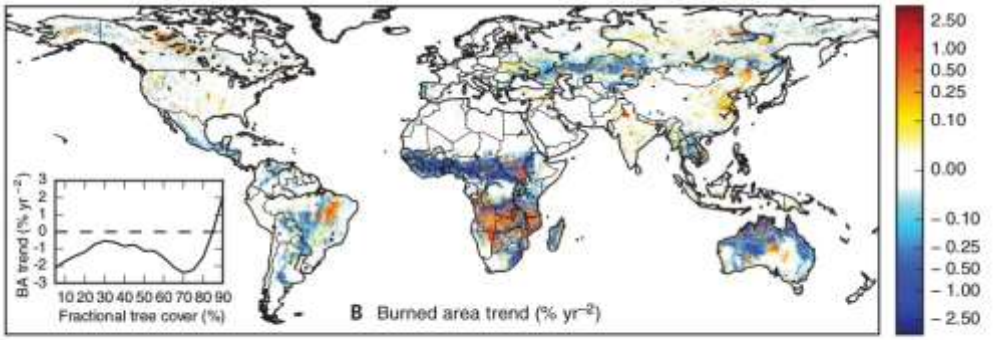
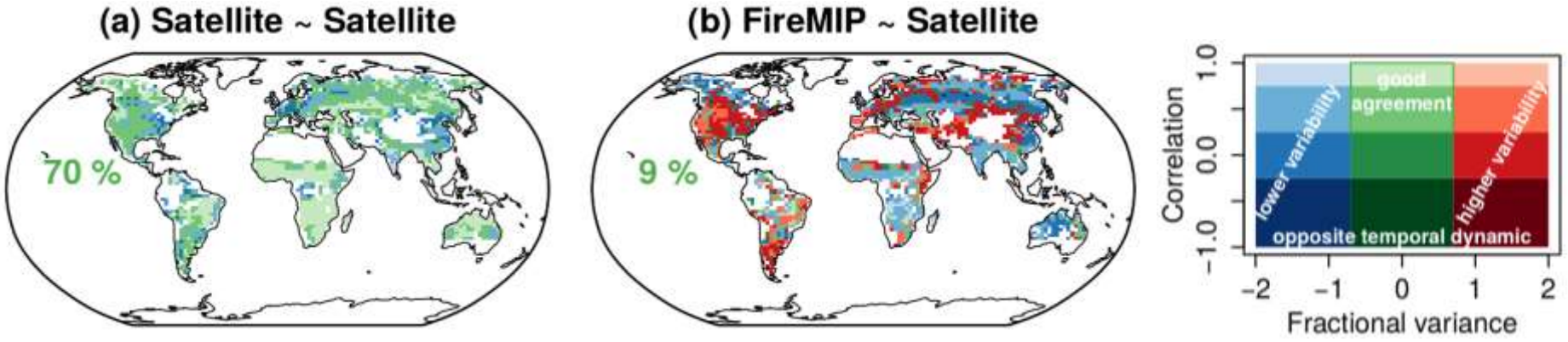


Fig. 1. Satellite observations show a declining trend in fire activity across the world's tropical and temperate grassland ecosystems and land-use frontiers in the Americas and Southeast Asia. (**A**) mean annual burned area and (**B**) trends in burned area (GFED4s, 1998 through 2015). Line plots (inset) indicate global burned area and trend distributions by fractional tree cover (*28*).

Agreement of datasets and models

- Burned area: monthly, 2005-2011



Satellite datasets
- ESA Fire CCI MERIS
- ESA Fire CCI MODIS
- GFED4 (MODIS)
- GFED4s (MODIS)
- MCD64C6 (MODIS)

FireMIP models
- CLM-Li
- CTEM
- JSBACH-SPITFIRE
- JULES-Inferno
- LPJ-GUESS-SIMFIRE
- LPJ-GUESS-SPITFIRE
- ORCHIDEE-SPITFIRE

Fig. Comparison of temporal burned area dynamics from satellite datasets, fire-enabled DGVMs, and random forest.

How do fire-enabled dynamic global vegetation models represent emergent relationships with burned area?

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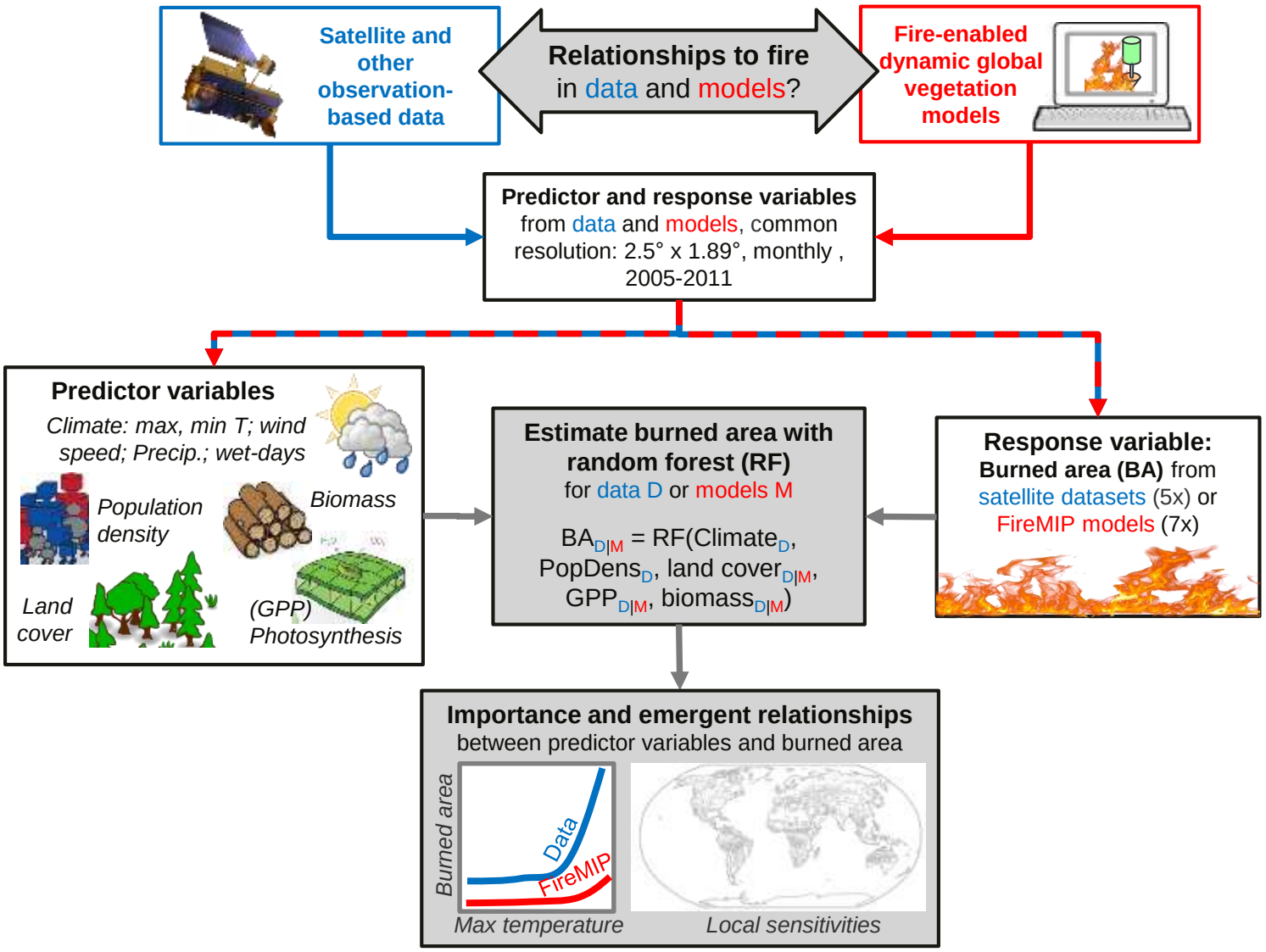


Agreement of datasets and models

- Compare monthly burned area in 2005-2011

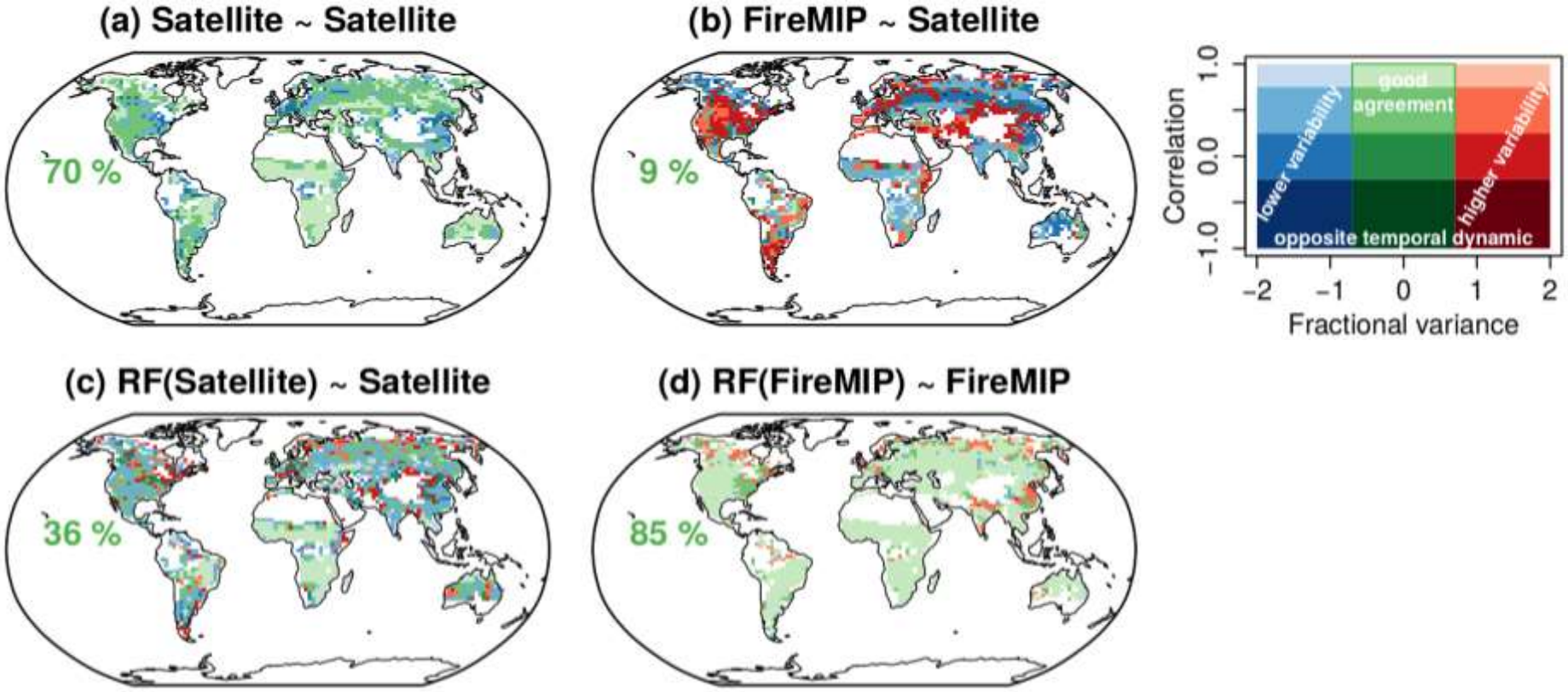


Fig. Comparison of temporal burned area dynamics from satellite datasets, fire-enabled DGVMs, and random forest.

Importance of predictors

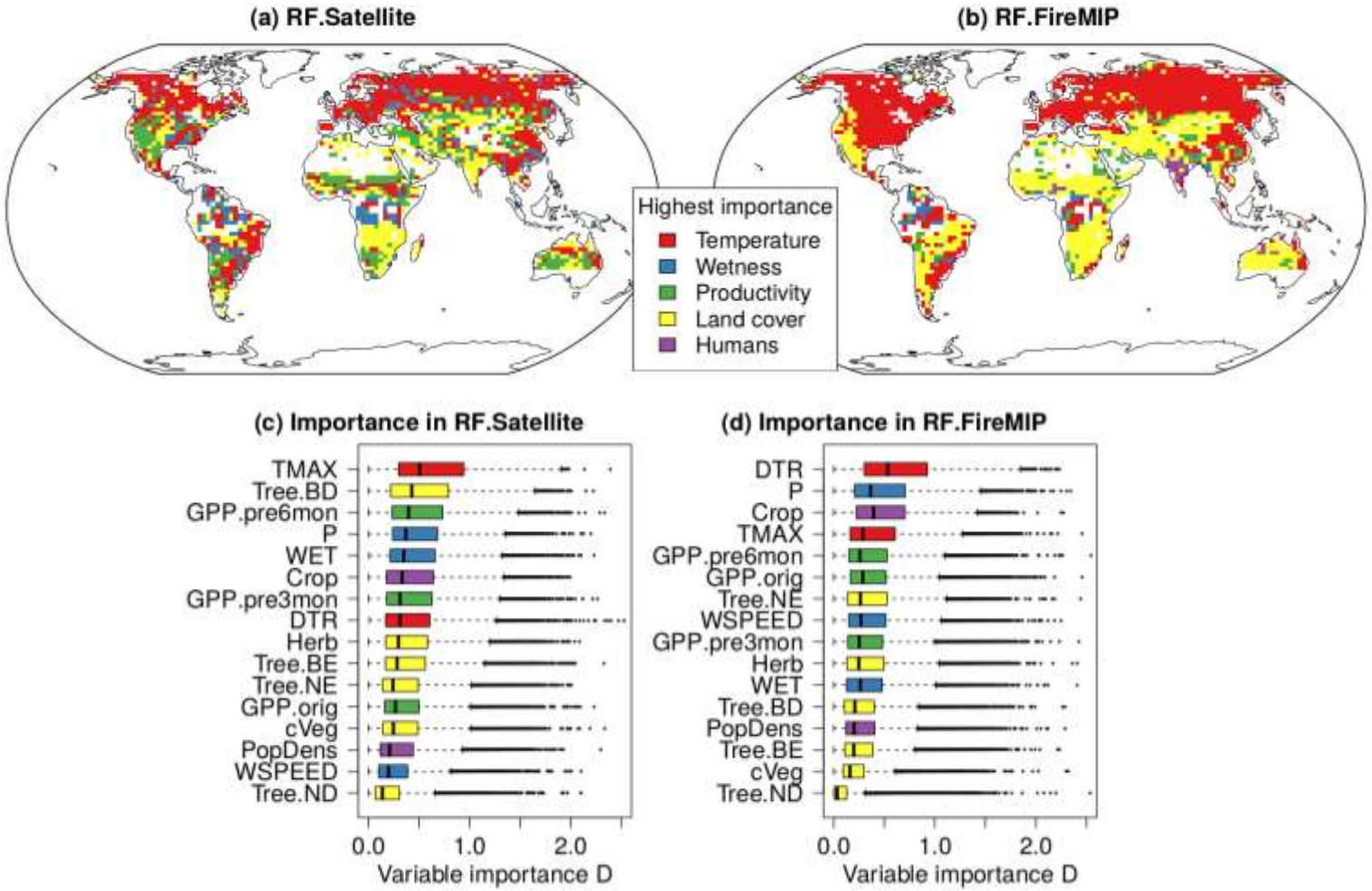


Fig. Grid cell-level importance of predictor variables in satellite- and FireMIP-derived RF experiments.

Deriving relationships from random forest

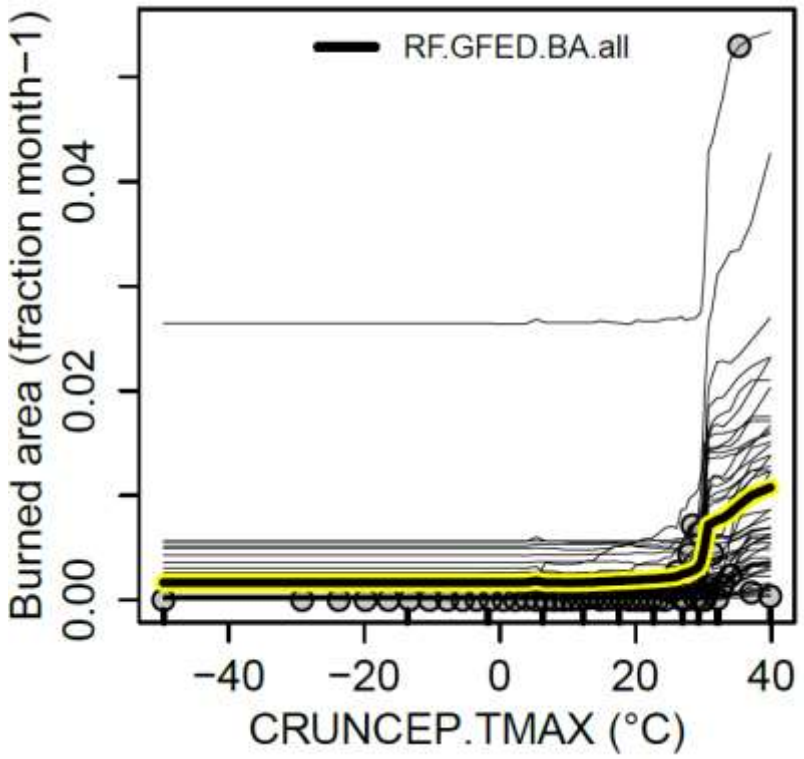


Fig.: Individual conditional expectation curves for burned area against mean monthly maximum temperature

Peeking Inside the Black Box: Visualizing Statistical Learning with Plots of Individual Conditional Expectation

Alex Goldstein*, Adam Kapelner†, Justin Bleich†, and Emil Pitkin§

Emergent relationships with burned area

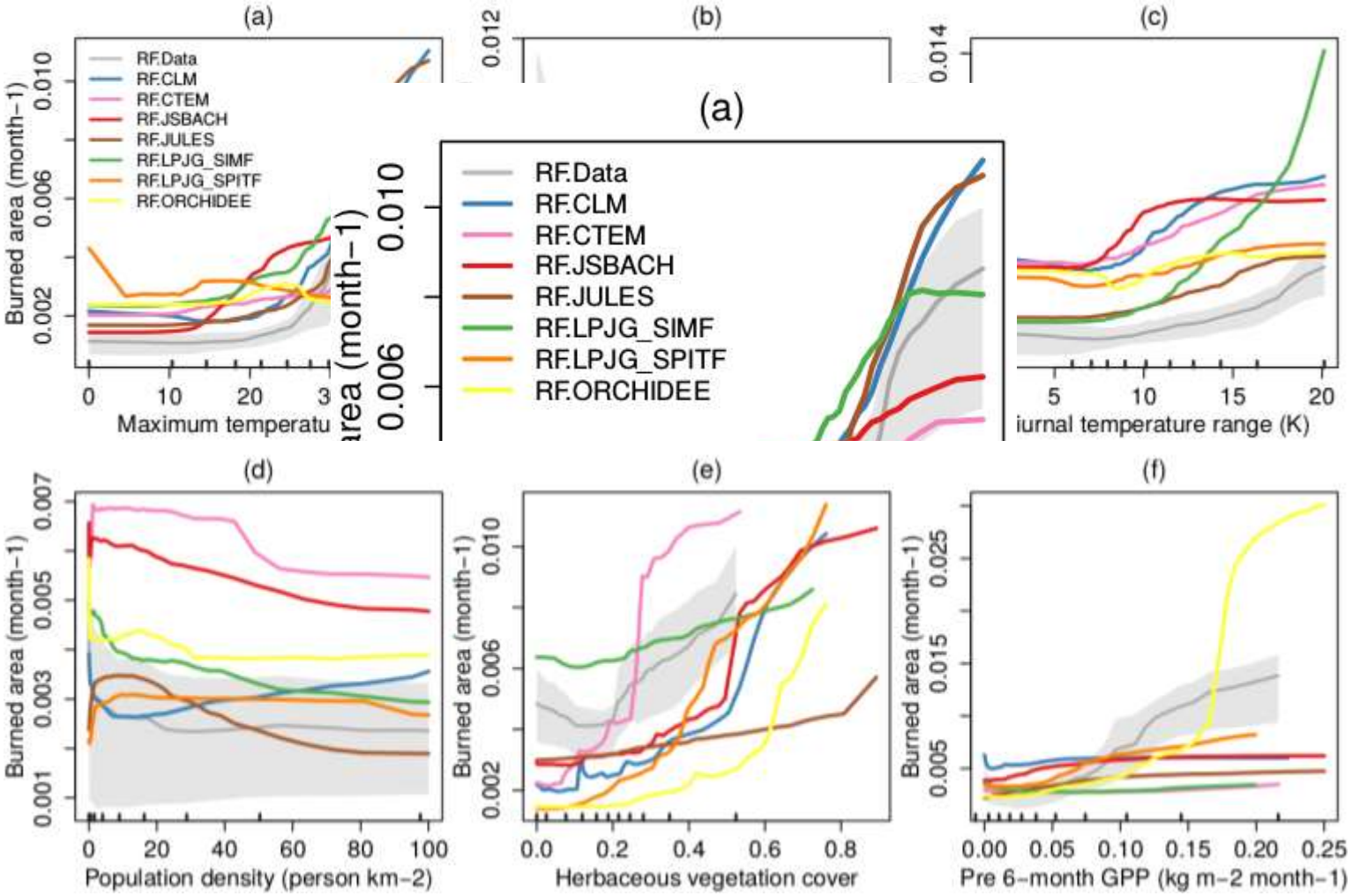
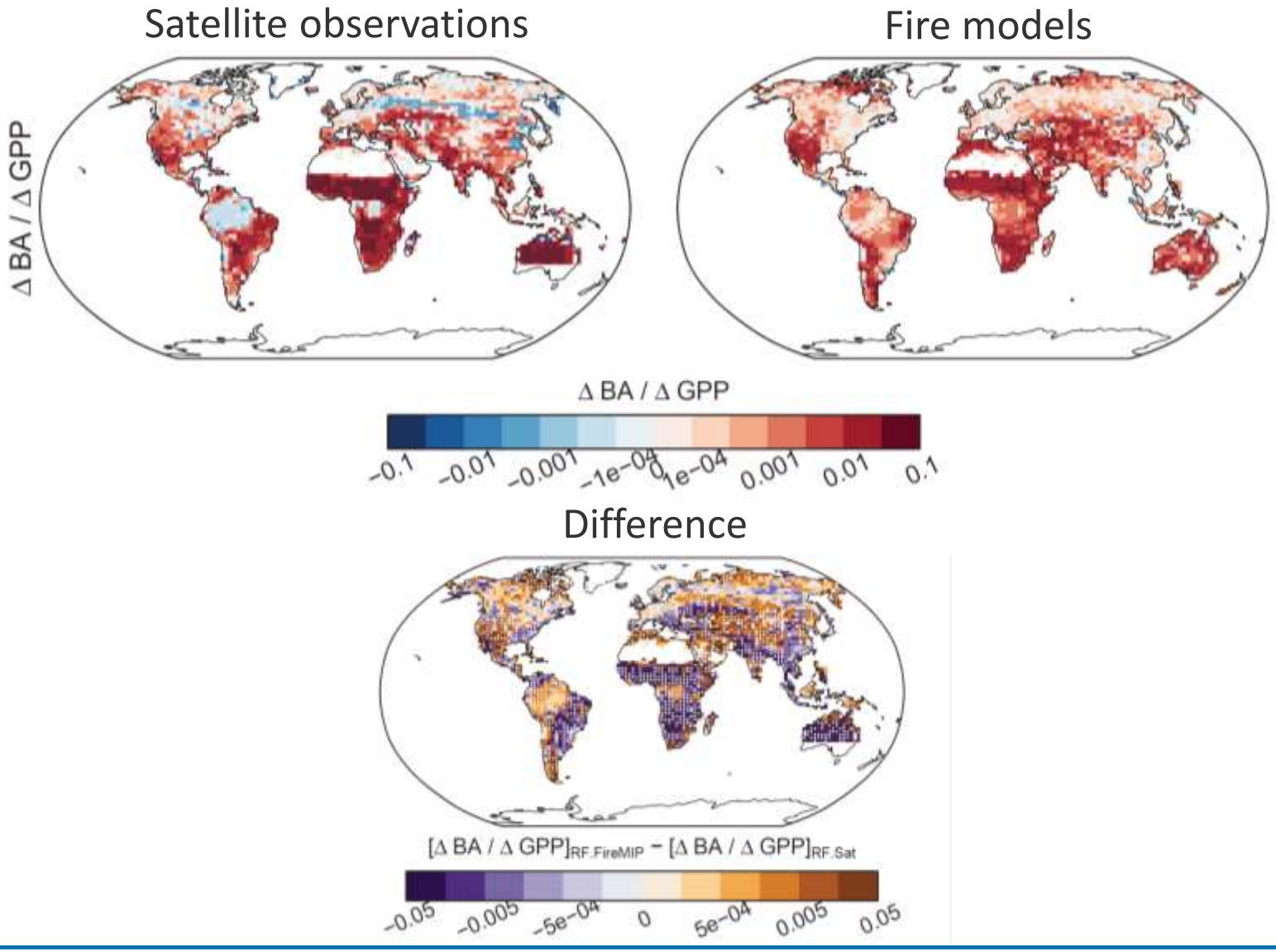


Fig. Examples of global emergent relationships of the fractional burned area per month to predictors from satellite-derived and FireMIP model-derived random forest experiments.

Sensitivity to pre-season plant productivity



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Conclusions

Vegetation models broadly reproduce relationships with climate, some models also with population density

Strong increase of burned area with previous season plant productivity was underestimated by most vegetation models

Need to improve links between plant types, vegetation productivity and fire occurrence