GLOBAL FIRE MODELING

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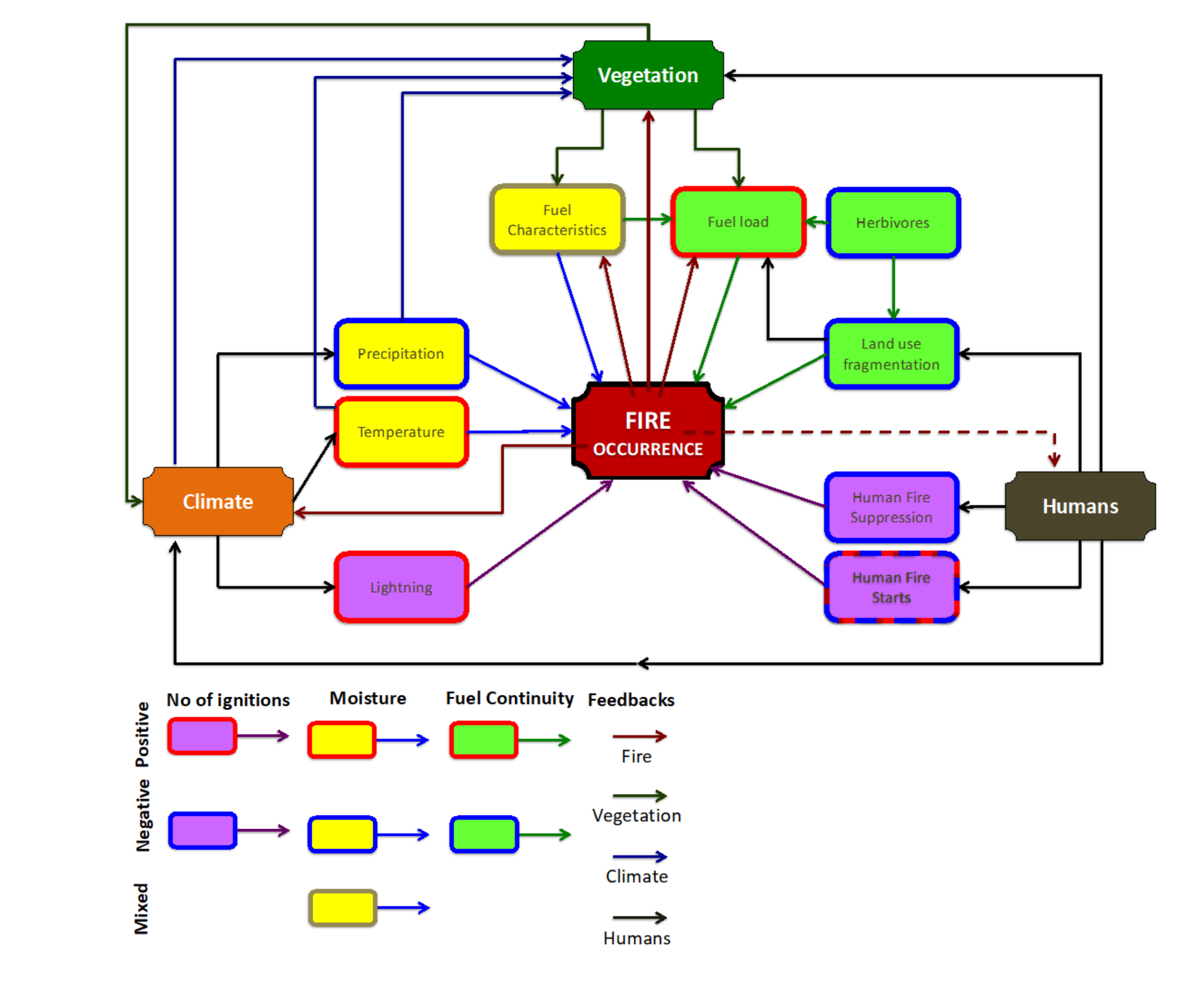
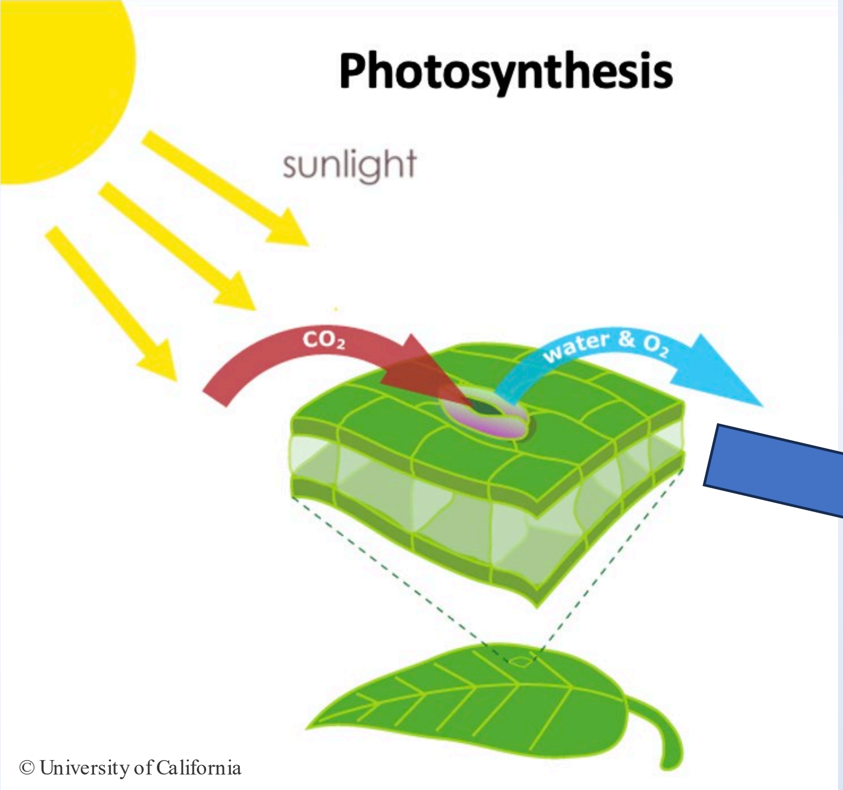
Drivers of global fire occurrence

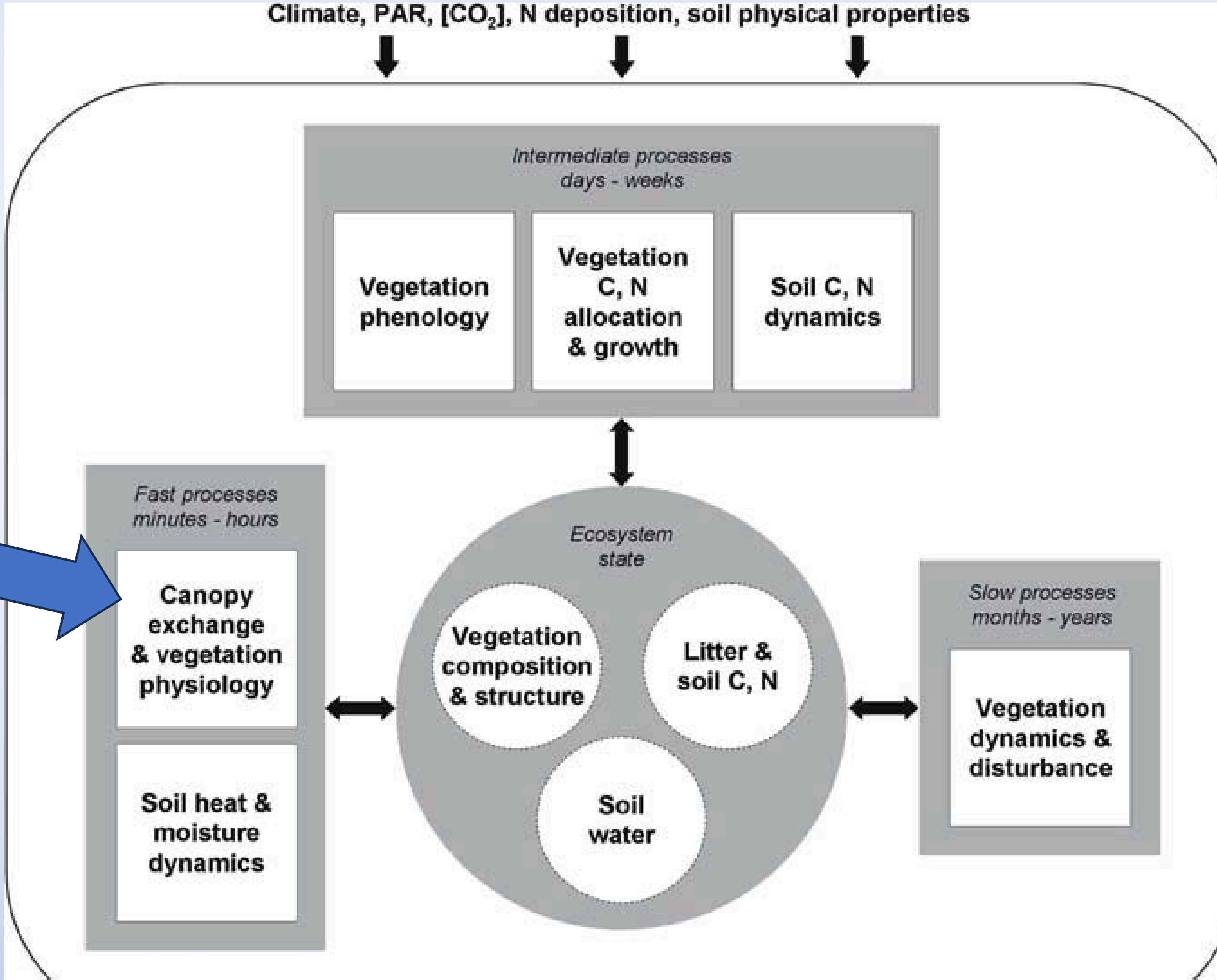
- Fire models need to represent all main drivers of global fire occurrence.
- Fire models not coupled to a vegetation model cannot take all into account (e.g. impact of changing climate & CO_2 on vegetation status).
- Here we will only consider global fire models incorporated within Dynamic Global Vegetation Models (DGVM's).



Hantson et al., 2016

Dynamic Global Vegetation Models (DGVMs)





Prentice, I.C. *et al.* (2007)

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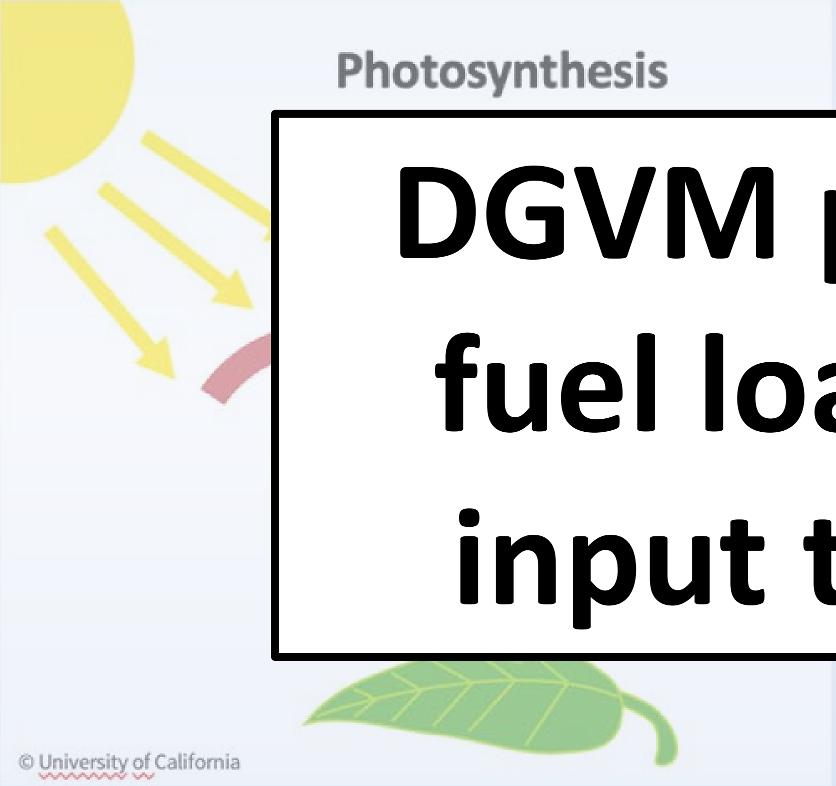
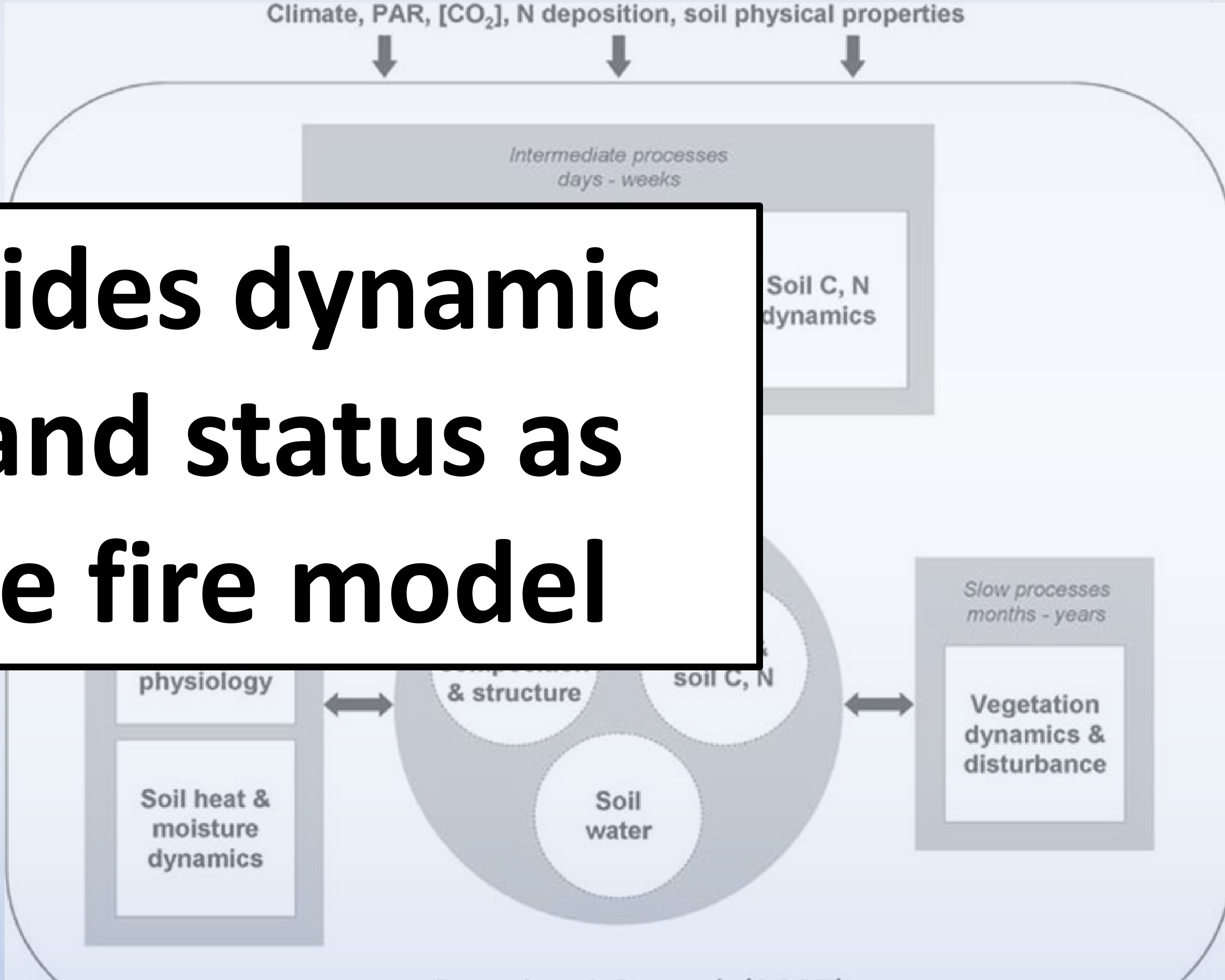


DGVM provides dynamic fuel loads and status as input to the fire model



Prentice, I.C. *et al.* (2007)

Global fire models

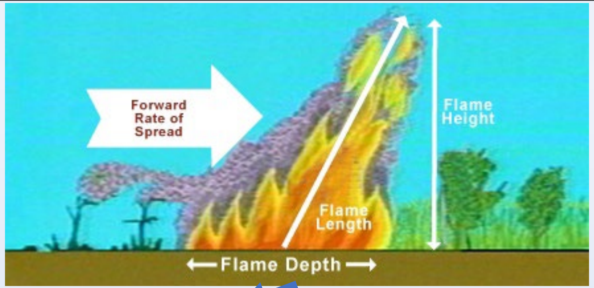
Vegetation characteristics (fuel etc.), climate, human population, land cover, etc.

Empirical global fire models

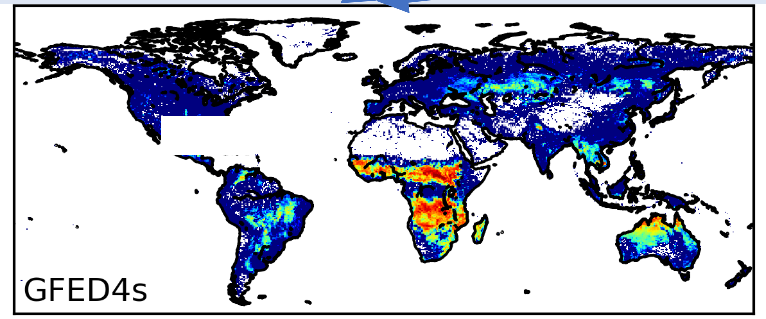
e.g. BA = climate * fuel * humans

Process based global fire models

Modeling individual fire spread

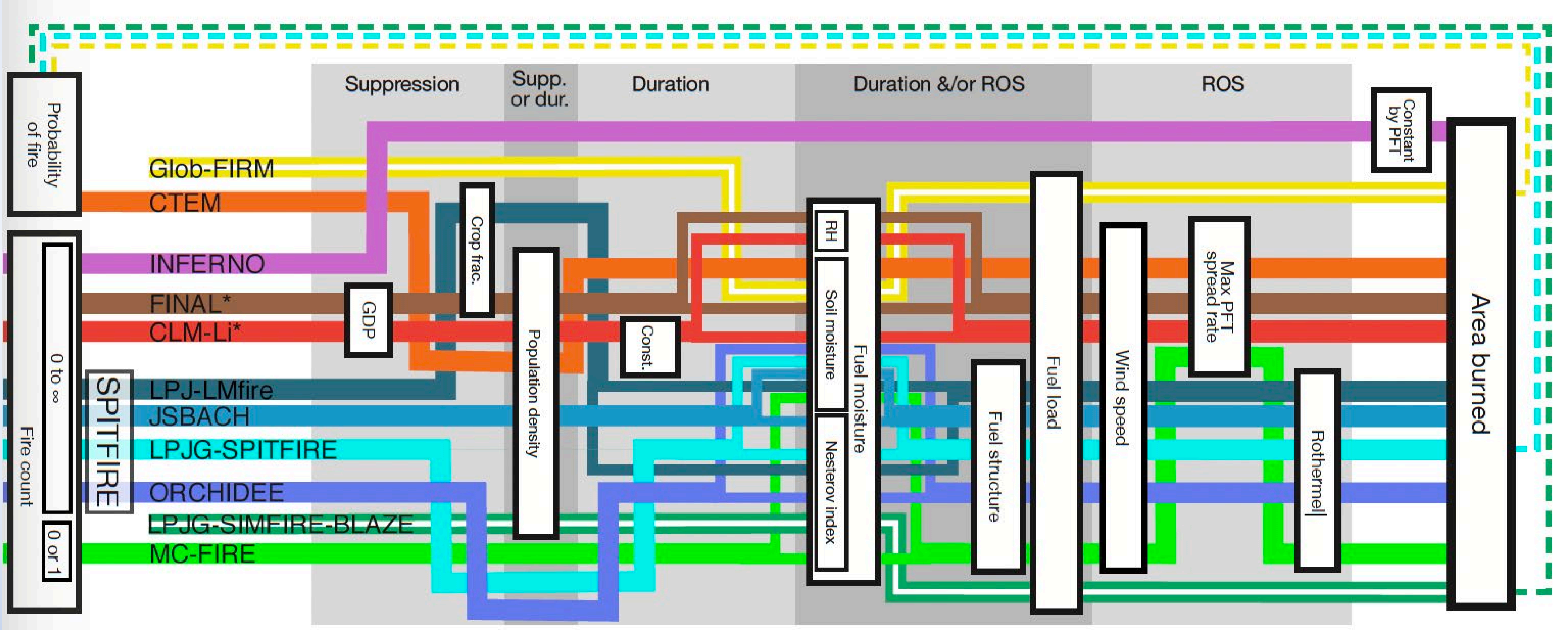


Upscaling to gridcell level



Global burnt area

Complexity of global fire model



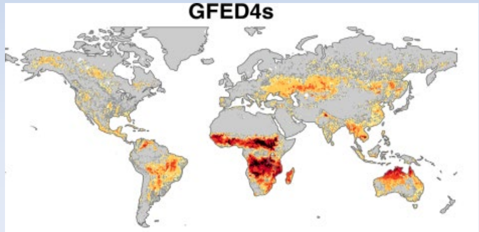
Rabin et al., 2017

Fire Model Intercomparison Project (FireMIP)

- Many global fire models have been developed over the last decades.
- No systematic evaluation of these global fire models had been conducted:
  - No assessment of how these models compare to available observations.
  - No comparison of different model hindcasts and future projections, and their sensitivity to different drivers.
- A community effort to analyze & benchmark existing global fire models.
- Systematically understand and decrease uncertainty in fire model projections

Hantson et al., 2016; Rabin et al., 2017

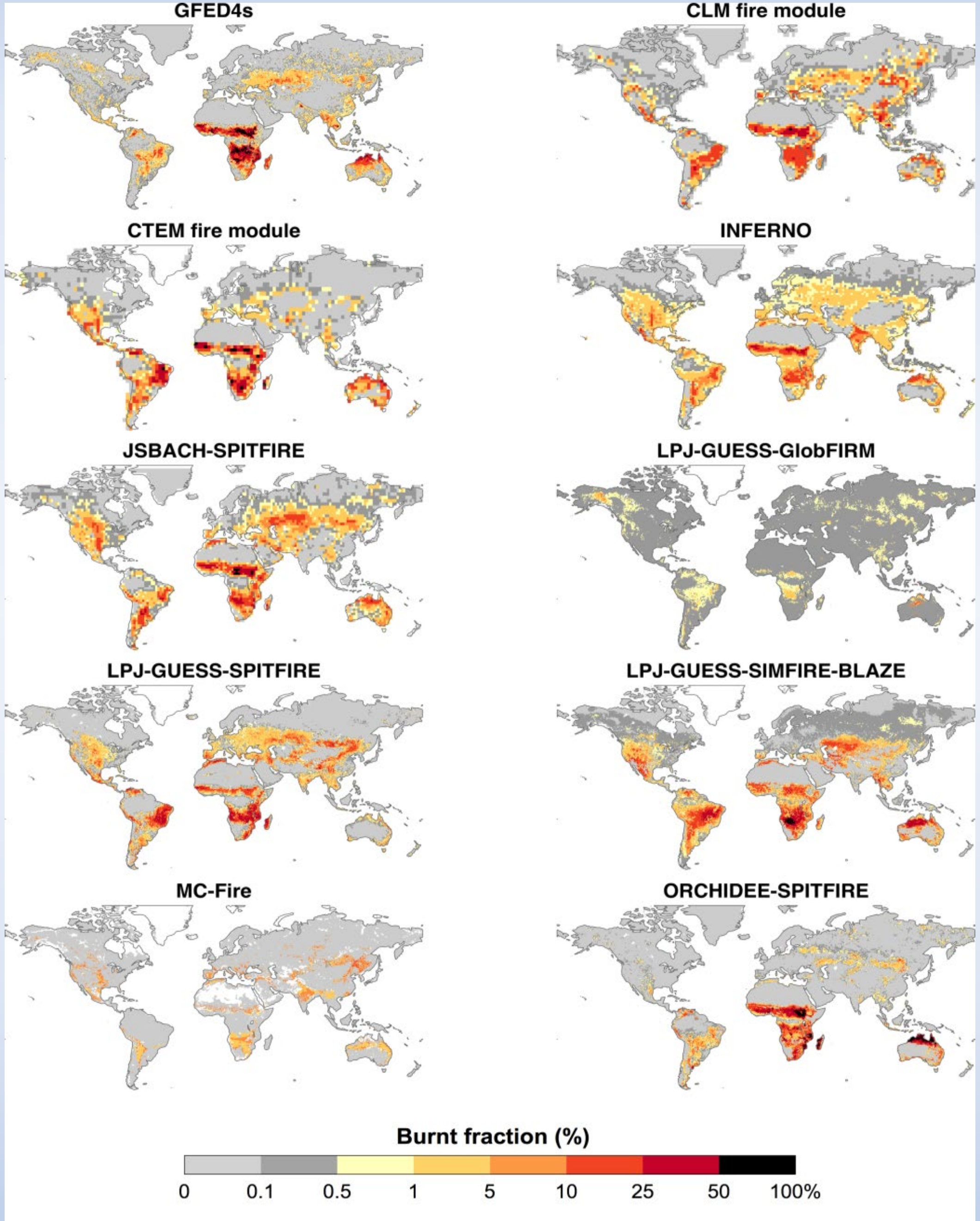
How well do models simulated burned area



Hantson et al., 2020, GMD

How well do models simulated burned area

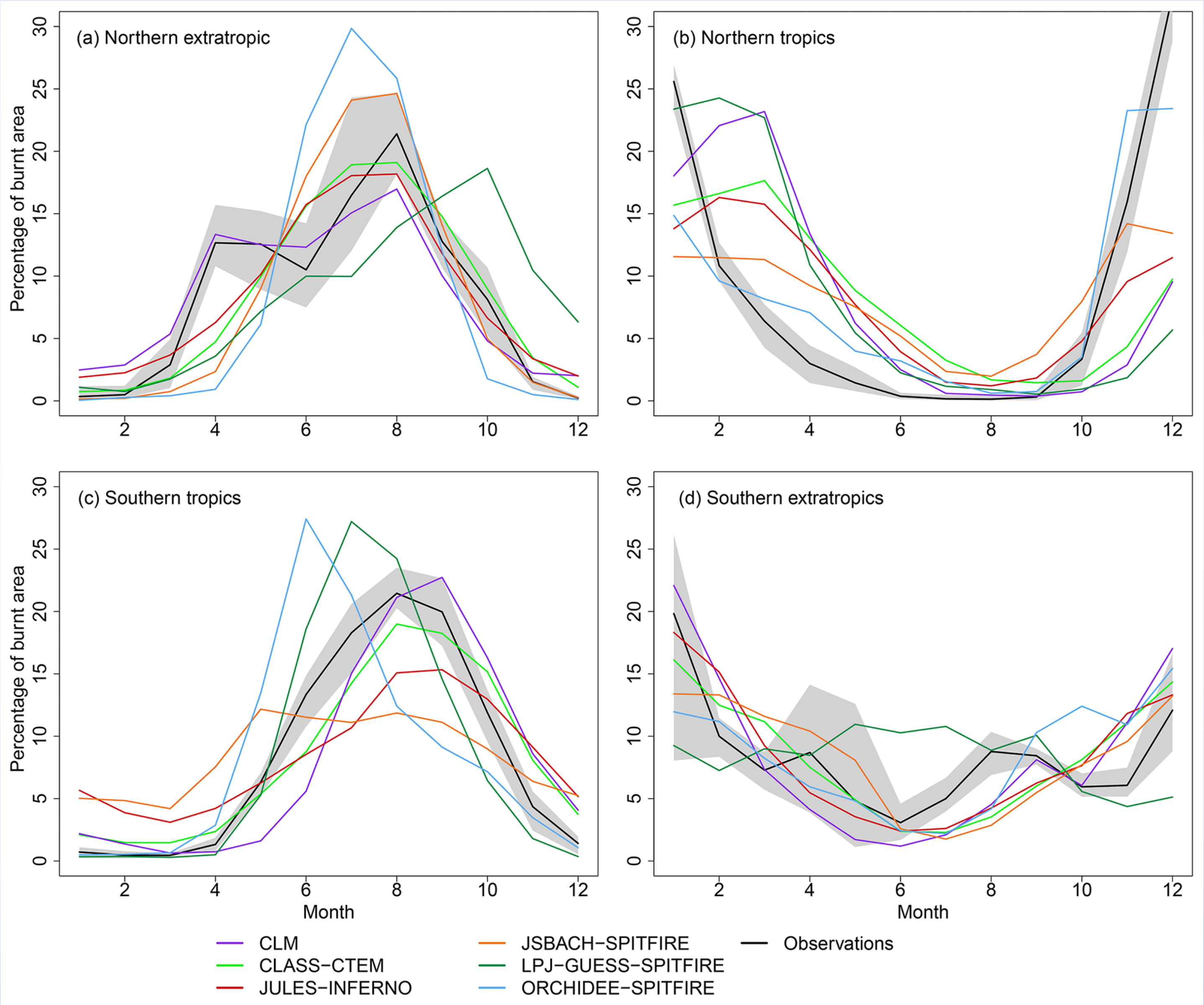
- Most models simulate global burnt area within the range of reference datasets (345-465 Mha).
- Overall, models reproduce the global distribution of burnt area, with most burning across the tropical savannas.
- Overestimation in the extra-tropics, partially due to high burnt area in the Mediterranean basin and W-USA.
- Benchmarking results show models perform better than a set of null-models.
- Similar results for fire emissions.



Hantson et al., 2020, GMD

Fire seasonality

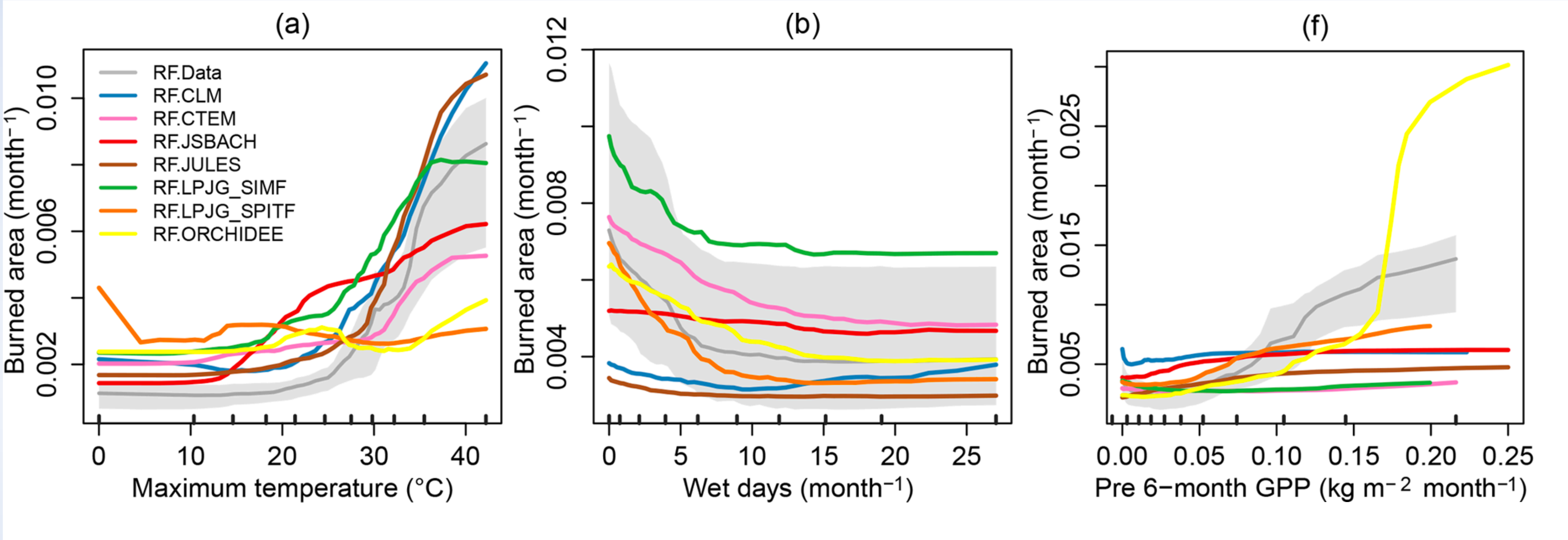
- Seasonality in burnt area relatively well represented by models.
- Except for northern extratropic spring peak.
- Peak burning better represented than length of the fire season.
- Similar results for fire C emission seasonality.



Hantson et al., 2020, GMD

Do models represent global fire activity for the right reasons?

Evaluation of emergent relationships

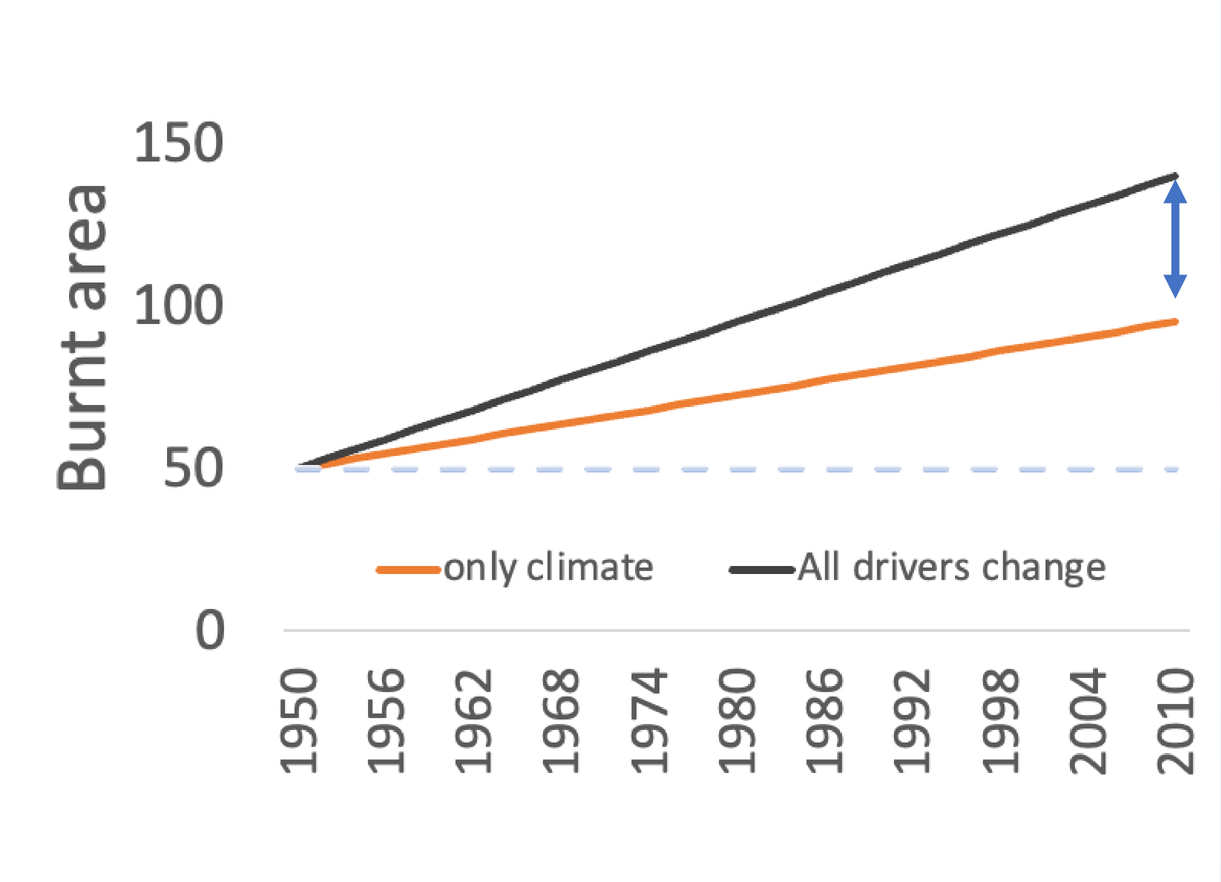


- DGVMs broadly reproduce the relationships with climate variables
- Models underestimate increase in burned area with an increase in previous-season plant productivity

Forkel et al., 2019

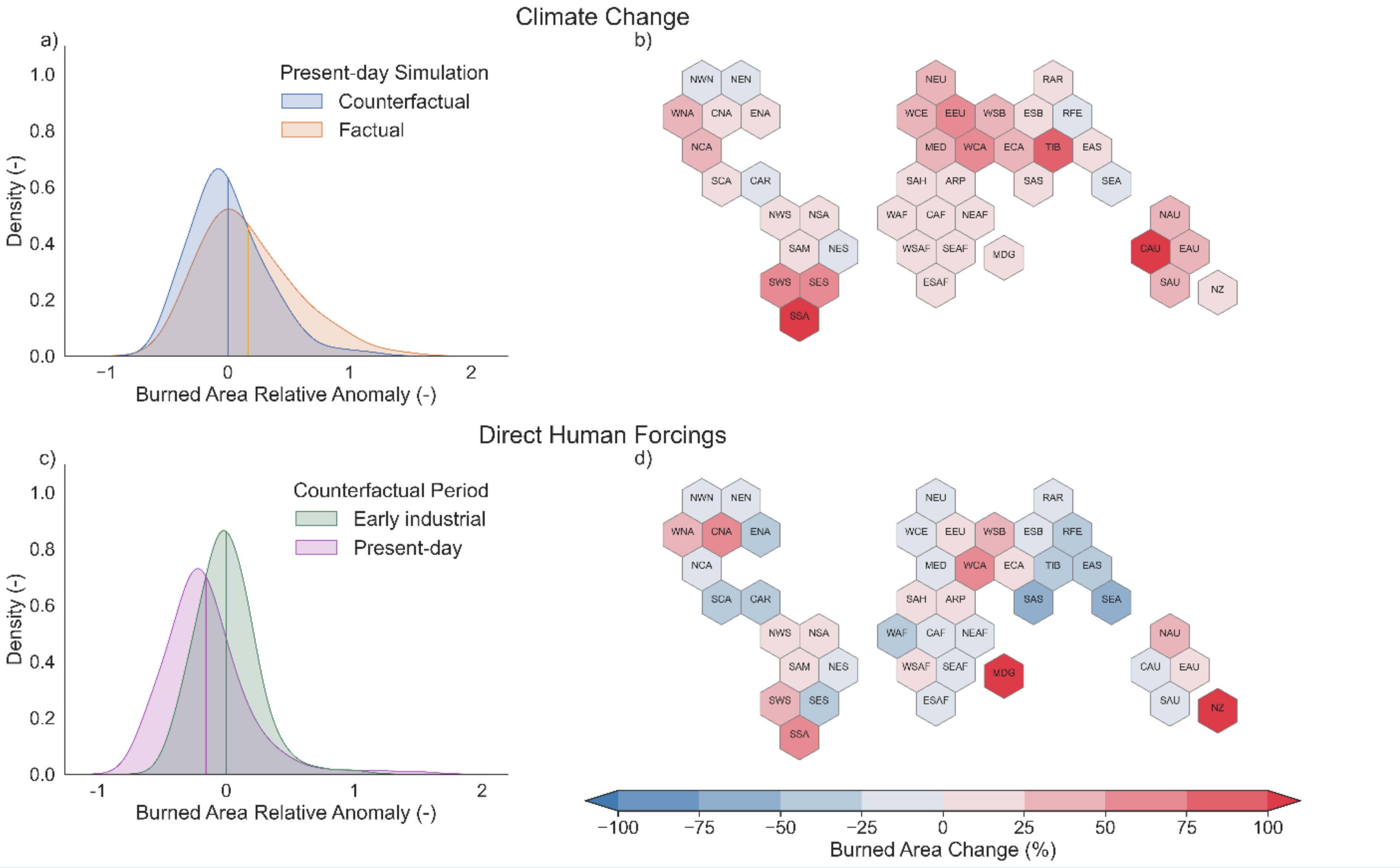
Using fire models to attribute changes in fire occurrence

- Being models, we can perform as many simulations as we want
- E.g We can keep one driving variable constant
  - Compare this with a simulation where all drivers change.
- Understand the drivers of patterns and trends.
- We did this with a historical climate data with and without climate change (factual vs counterfactual)



Impact of climate change on global burnt area

- Based on latest model versions
- Climate change increased present day global burned area by 16%
- Offset by socio-economical dynamics (Direct human forcing)



Chantelle Burton, Seppe Lampe, et al., in review

Future of FireMIP

- Fire sector within ISIMIP (The Inter-Sectoral Impact Model Intercomparison Project)
  - https://www.isimip.org/protocol/3/
- Historic to present day, and sensitivity runs are available (Burnt area, emissions, etc.).
  - Contact: stijn.hantson@urosario.edu.co
- Multi model, multi scenario Future simulations should become available “soon”.

Questions?

Does including fire improves global vegetation models?

- Fires impact on global vegetation distribution?

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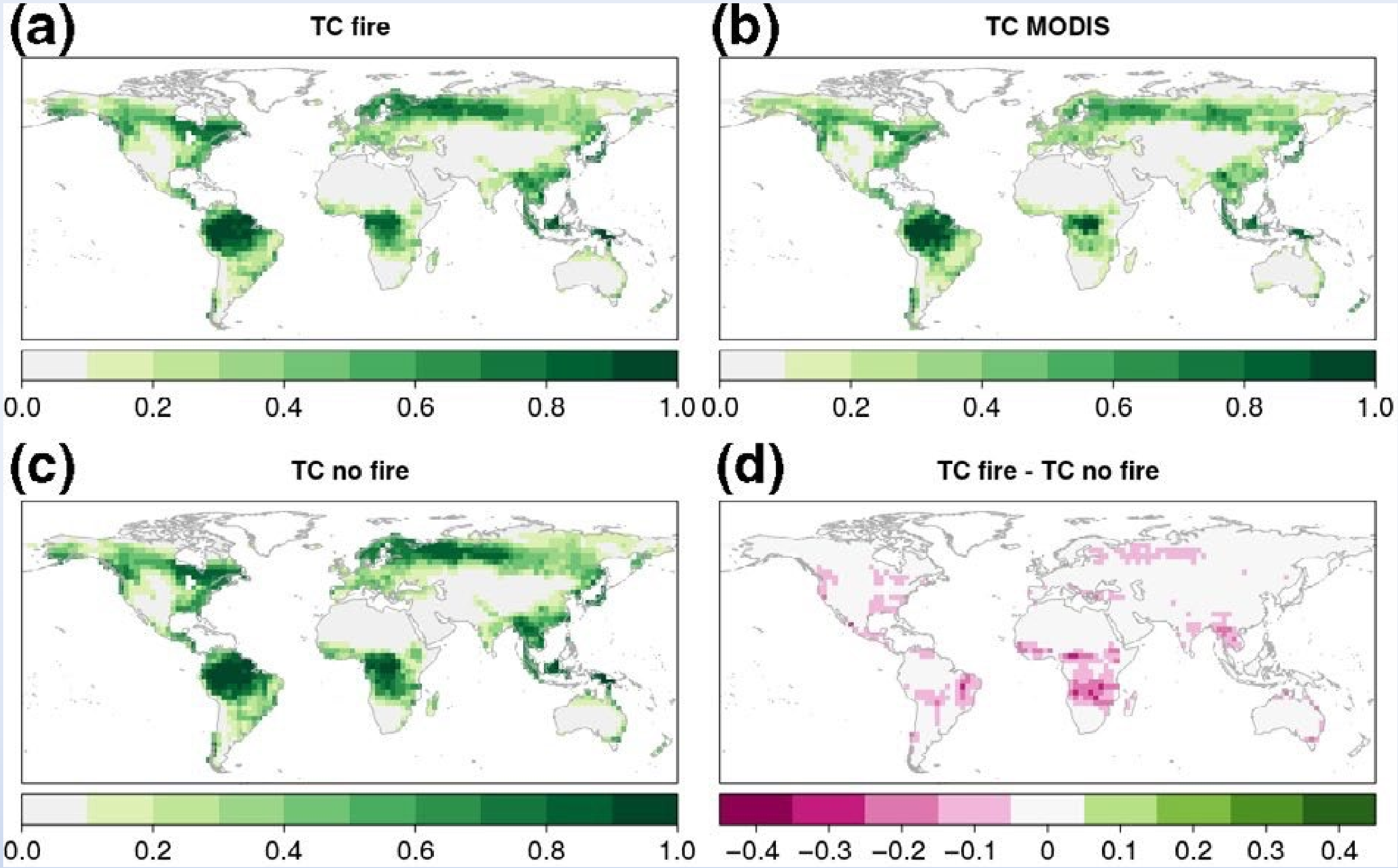
- TC= Tree Cover
- Similar for biomass



Lasslop, Hantson et al., 2020, GCB

Does including fire improves global vegetation models?

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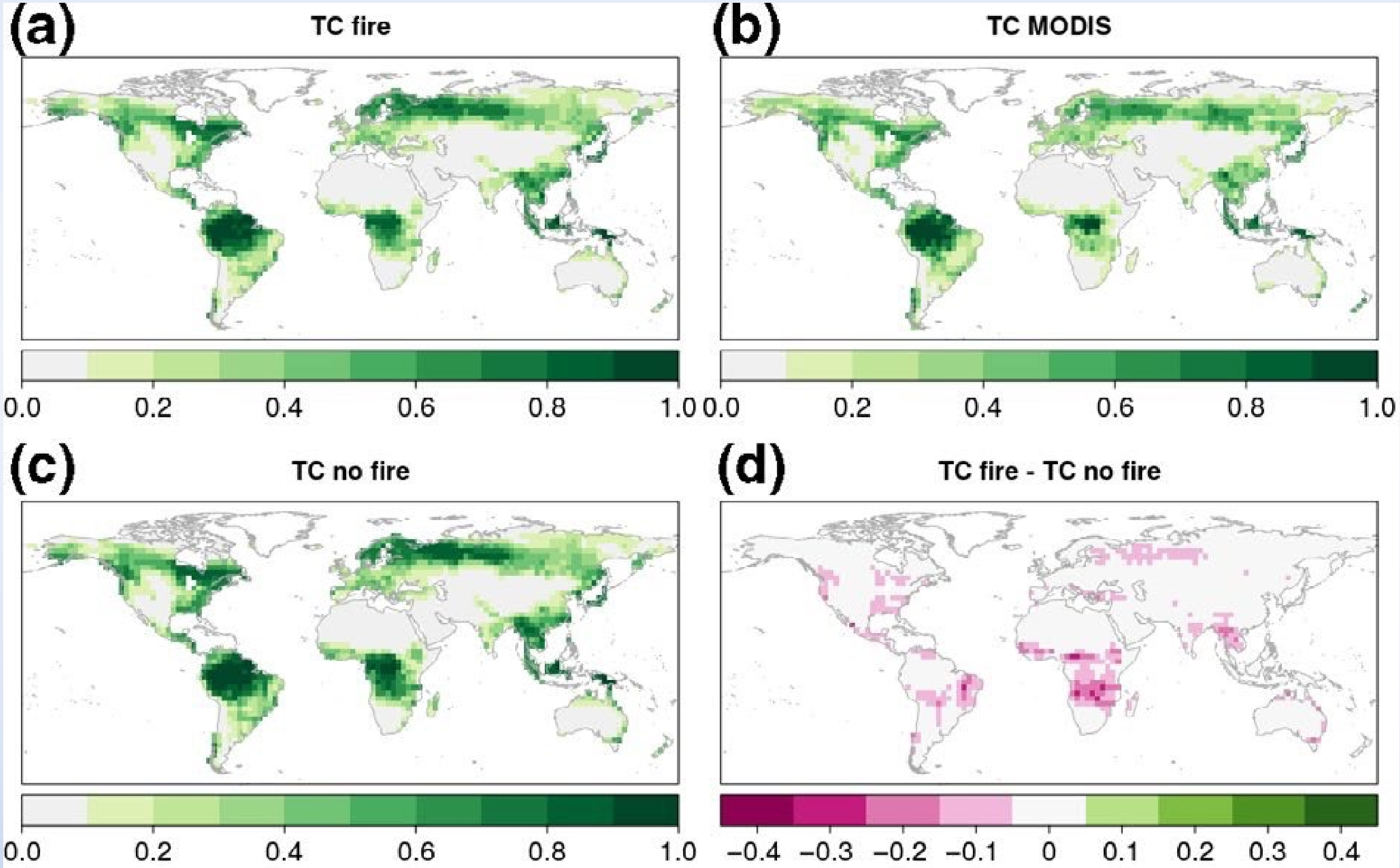
- TC= Tree Cover
- Similar for biomass

	TC fire	TC no fire
INFERNO	0.76**	0.80**
JSBACH-SPITFIRE	0.53**	0.60**
LPJ-GUESS-SIMFIRE-BLAZE	0.44*	0.46*
LPJ-GUESS-SPITFIRE	0.62**	0.70**
Multi-model mean	0.39***	0.47***

Table: Normalized Mean Error for Tree cover (TC) between simulation of fire on and fire off. *p<0.1, **p<0.05, ***<p<0.01



Lasslop, Hantson et al., 2020, GCB