

FUTUREFOCUS **WILDFIRES**

Community forum on Earth Observation for wildfires monitoring

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Sense4Fire – novel fuel, fire and emission products

26-28 November 2024, Darmstadt, Germany

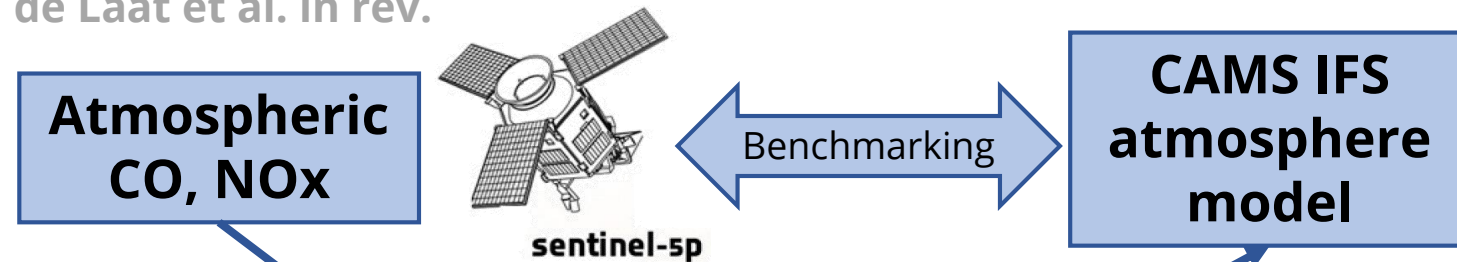




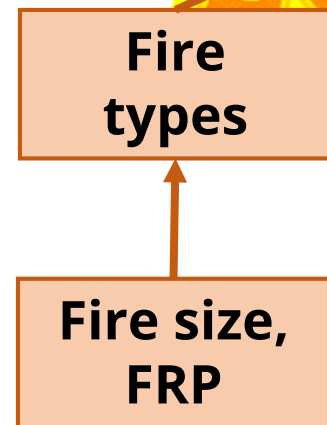
Brazil, 2020

Sense4Fire approaches

KNMI-S5p (0.1°, daily)
de Laat et al. in rev.



GFA-S4F
(500m, daily)
Andela et al. 2022



Fire emissions

Fuel consumption

Fuel loads

Fuel moisture

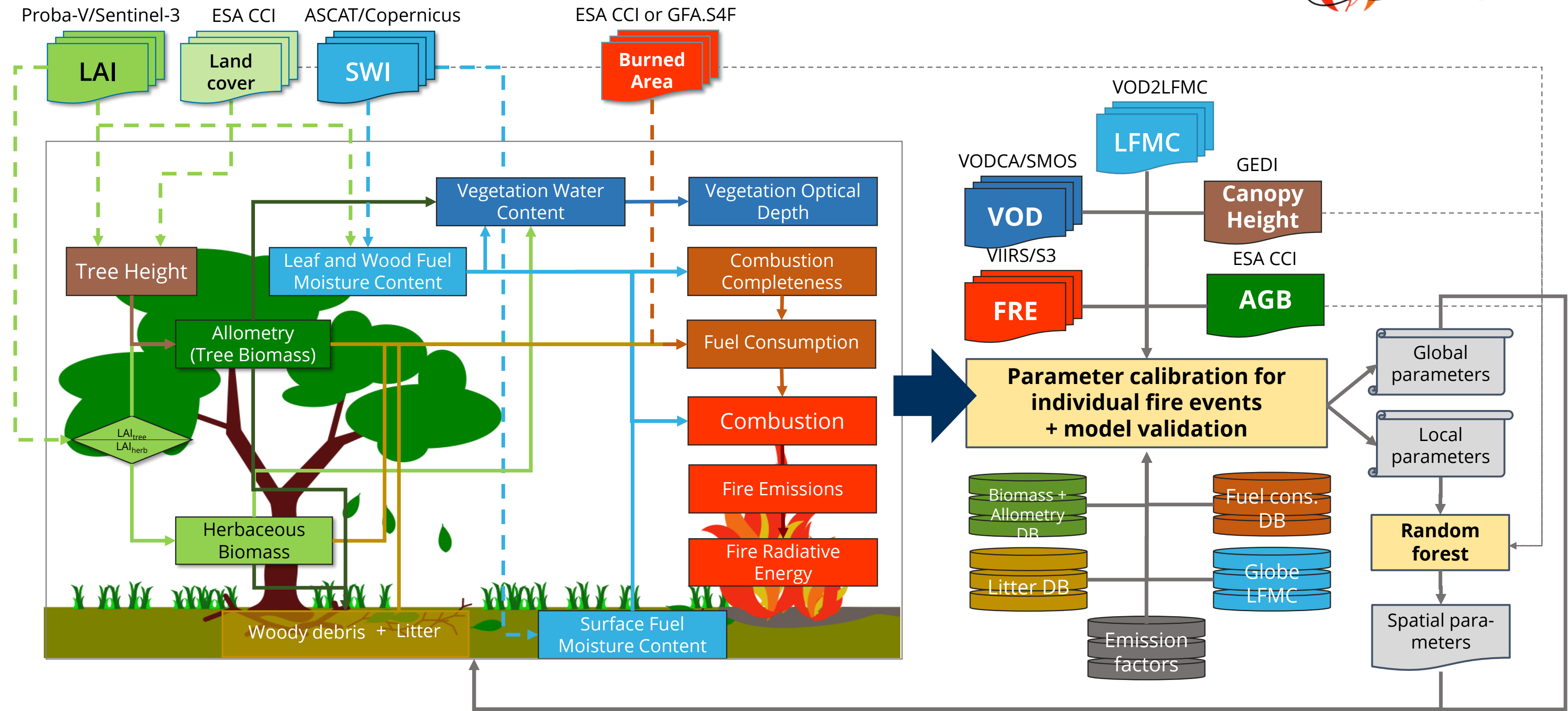
TUD-S4F
(333m, 10-daily)
Forkel et al. accepted
Nature Geoscience

Database at <https://sense4fire.eu/>



Region	GFA-S4F	TUD-S4F	KNMI-S5p
Amazon/Cerrado	2019-2024 (v0.2)	2014-2021 (v0.2) 2024 (vNRT)	2020 (v0.1)
Southern Africa	2020 (v0.1)	2014-2021 (v0.2)	2020 (v0.1)
Southern Europe	2020 (v0.1)	2014-2021 (v0.2)	2020 (v0.1)
Eastern Siberia	2020 (v0.1)	2014-2021 (v0.2)	2020 (v0.1)

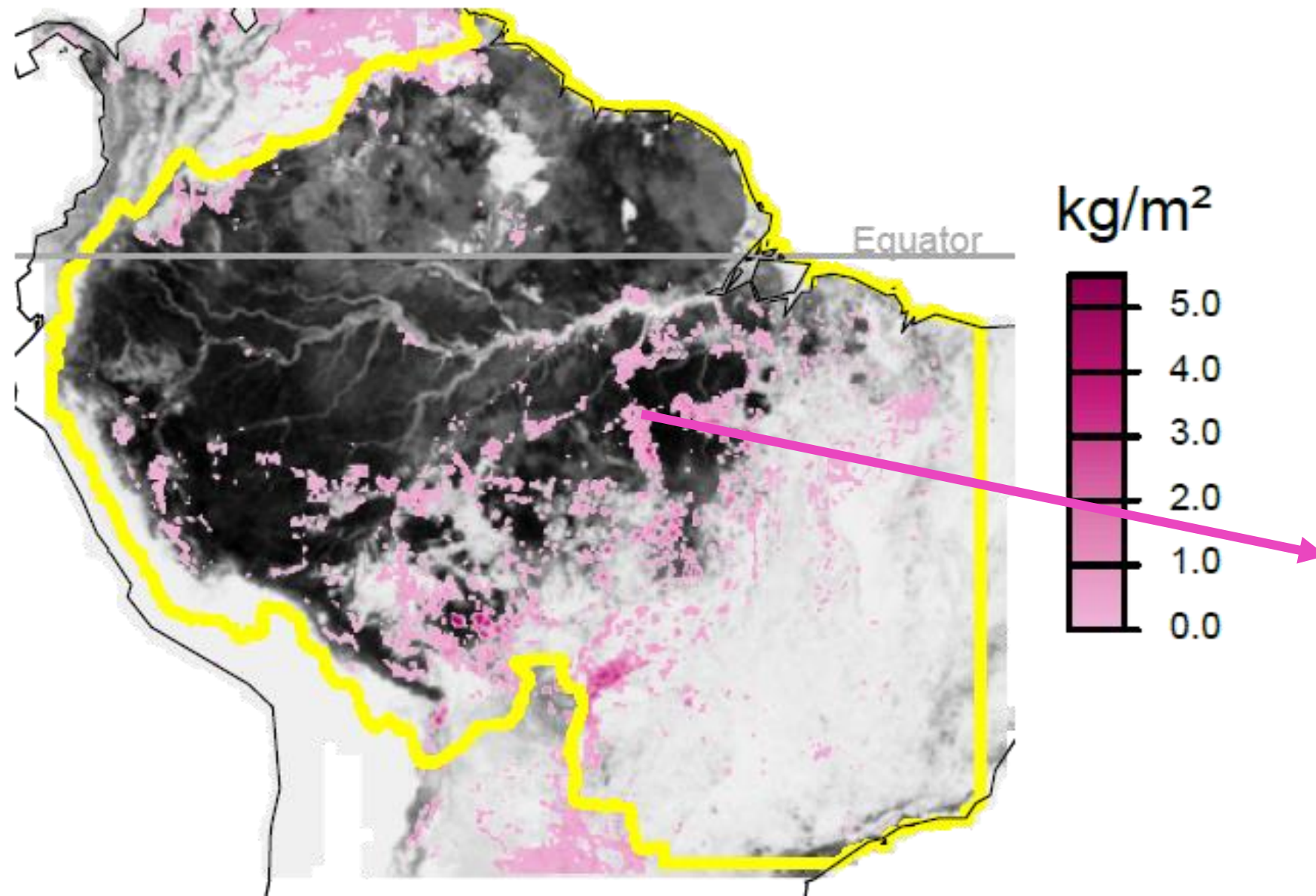
TUD-S4F Data-Model Fusion Approach



Fire emissions in the Amazon/Cerrado 2020



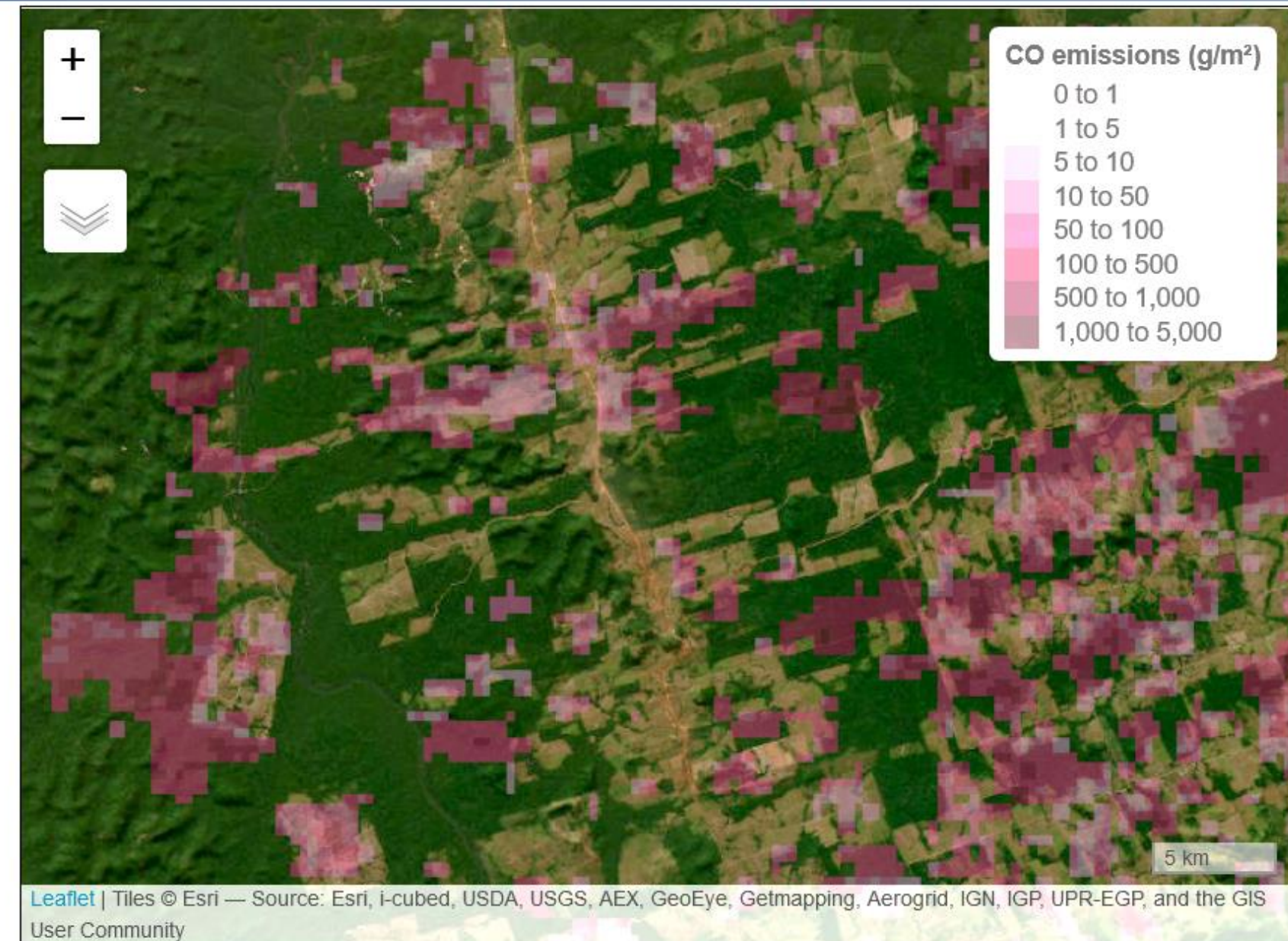
TUD-S4F dry matter burnt 2020



Sense⁴ Fire

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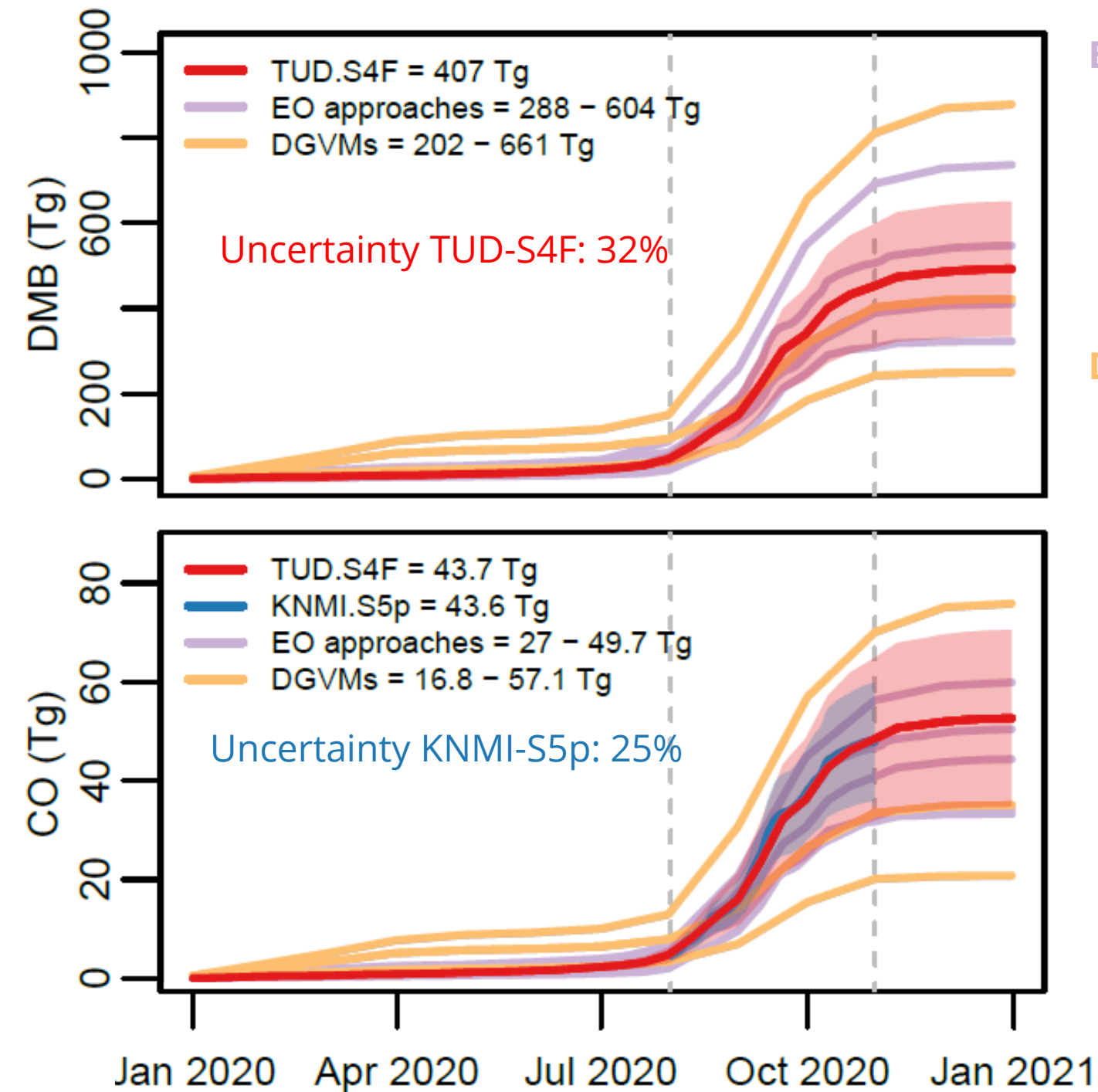
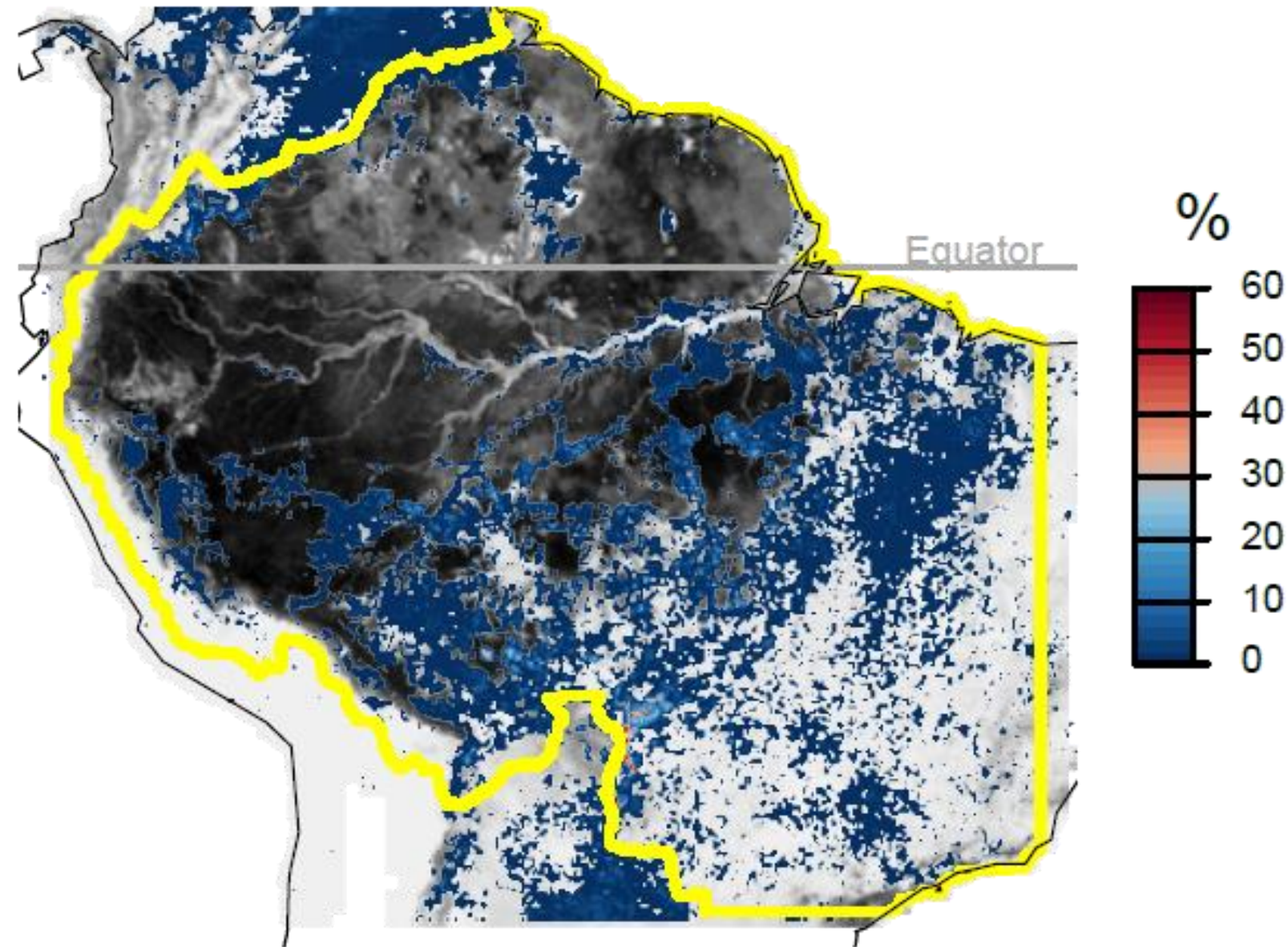
Data available at <https://sense4fire.eu/>



Fire emissions 2020: Uncertainties



TUD-S4F uncertainty in dry matter burnt

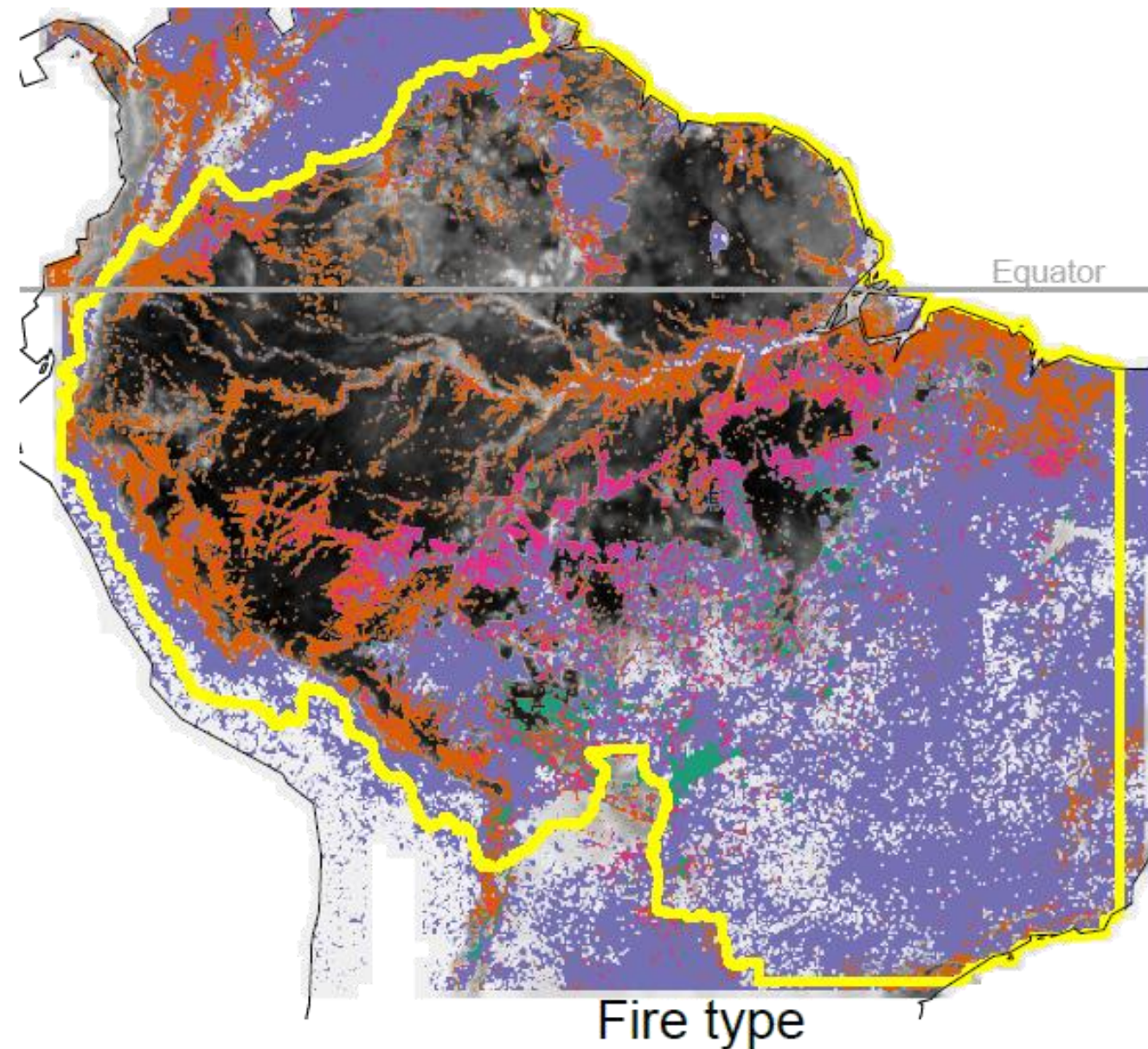


- EO approaches:**
- TUD-S4F
 - KNMI-S5p
 - GFA-S4F
 - GFAS
 - GFED500m
 - REFIT-AC
- DGVMs:**
- JULES
 - OCN
 - ORCHIDEE

Fire emissions 2020: Uncertainty per fire type

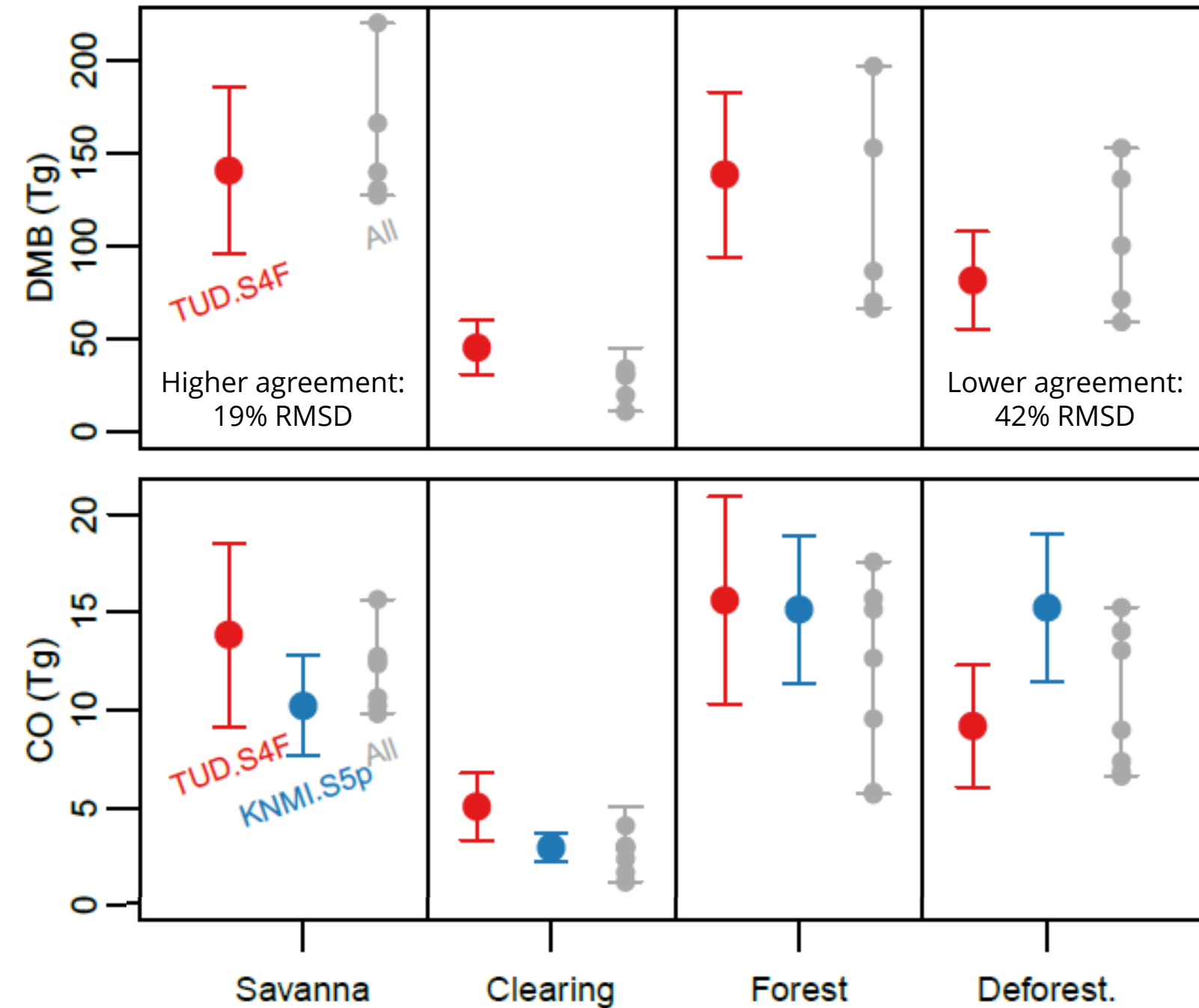


GFA-S4F fire types 2020



65% Savanna 3% Forest
 24% Clearing 7% Deforest.

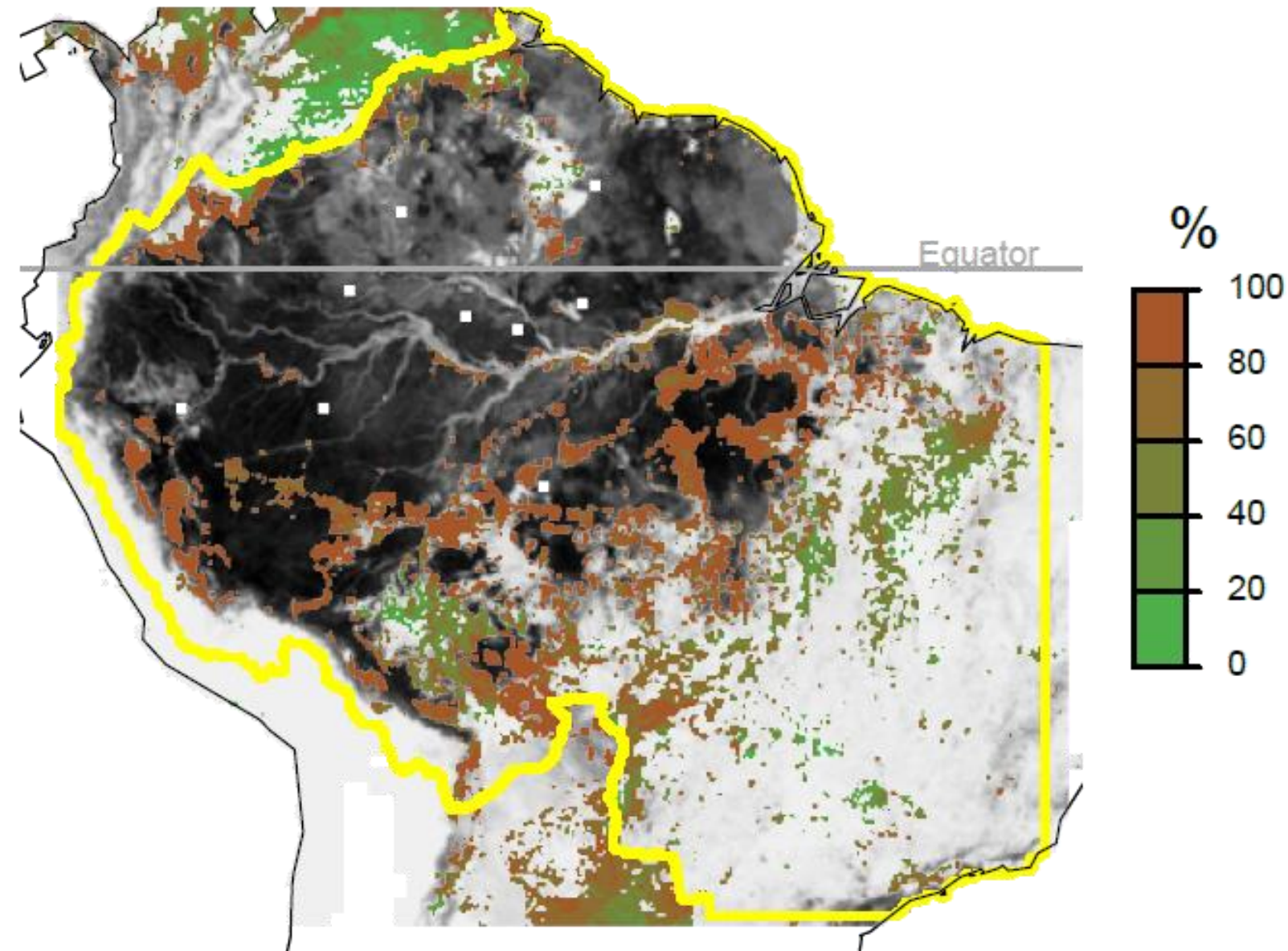
(b) Emissions per fire type



Fire emissions 2020: role of woody debris



TUD-S4F contribution of woody debris to dry matter emissions

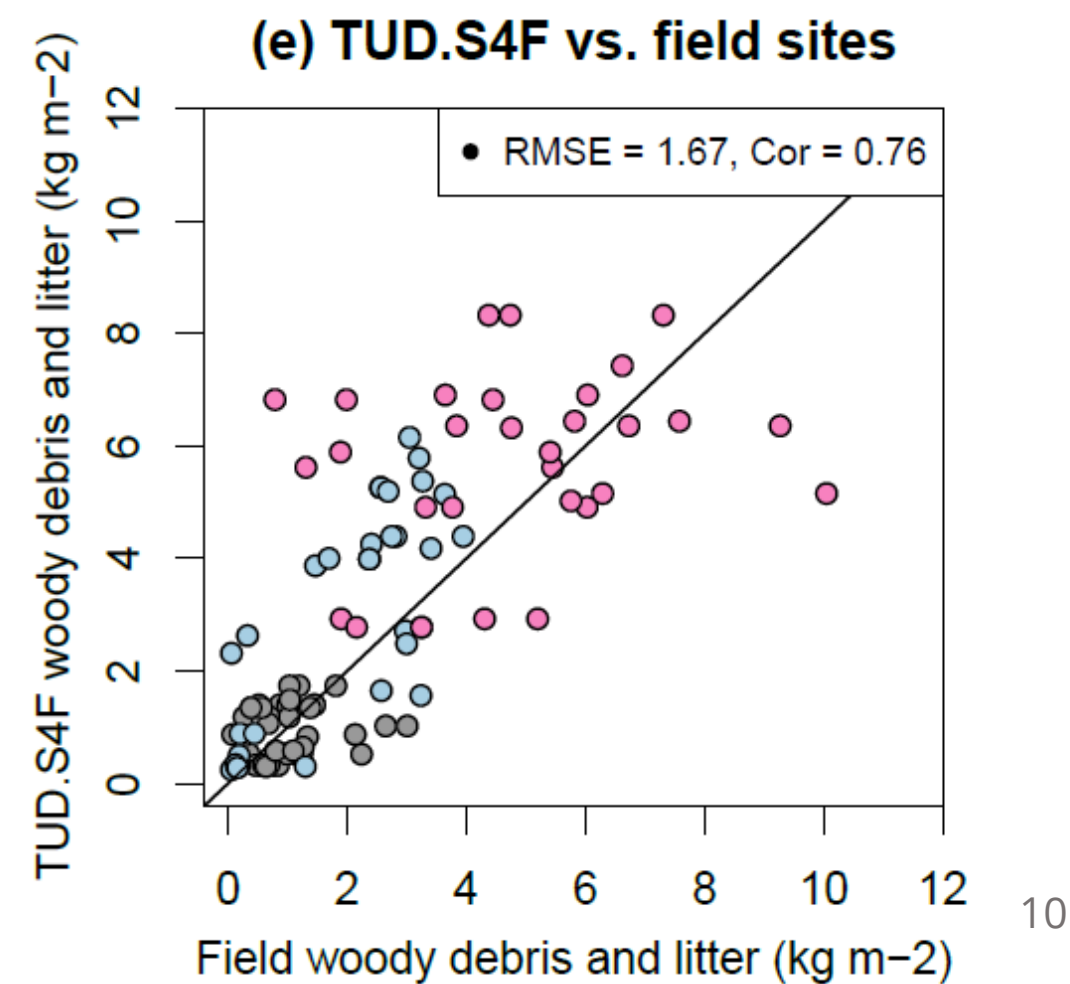
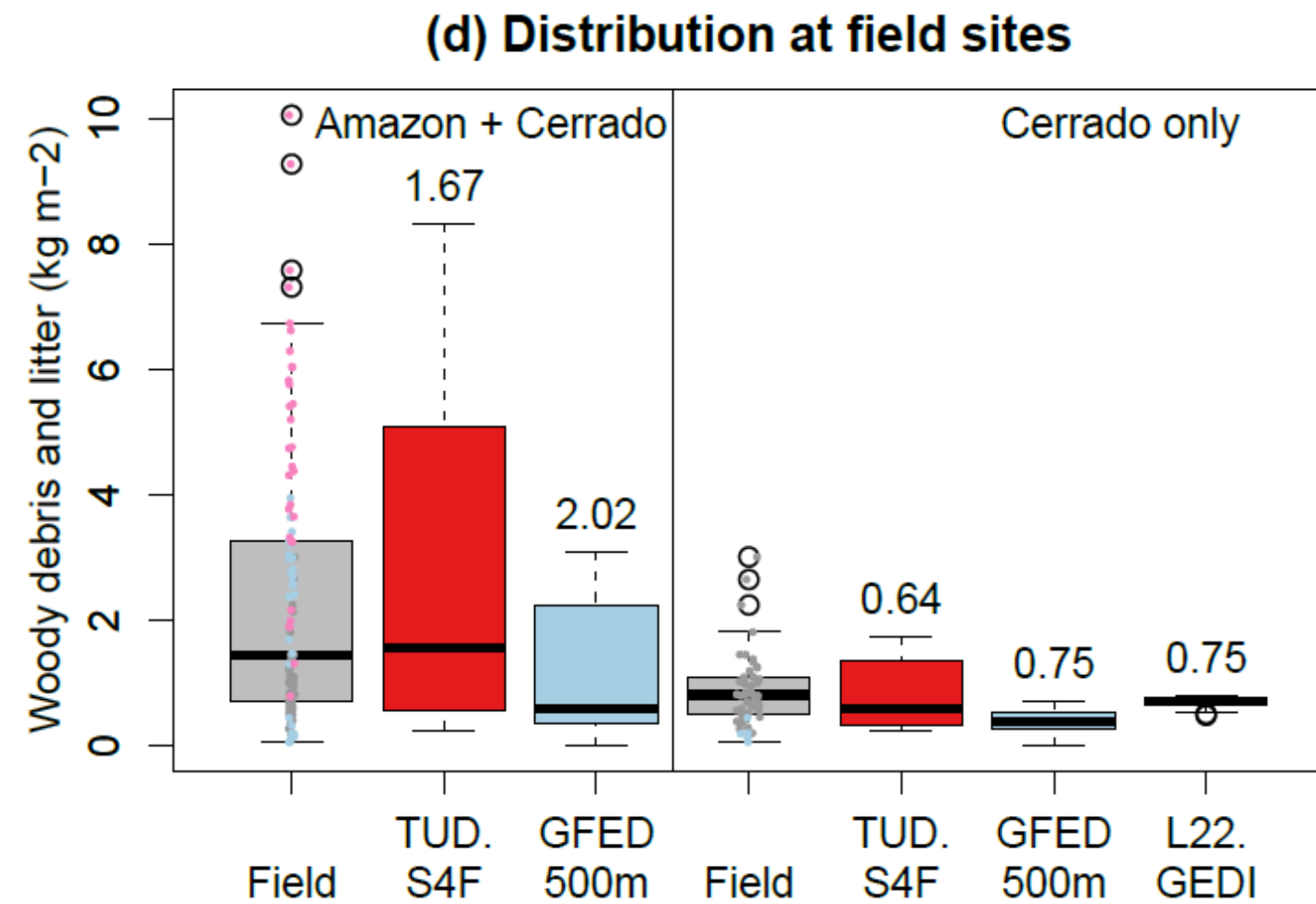
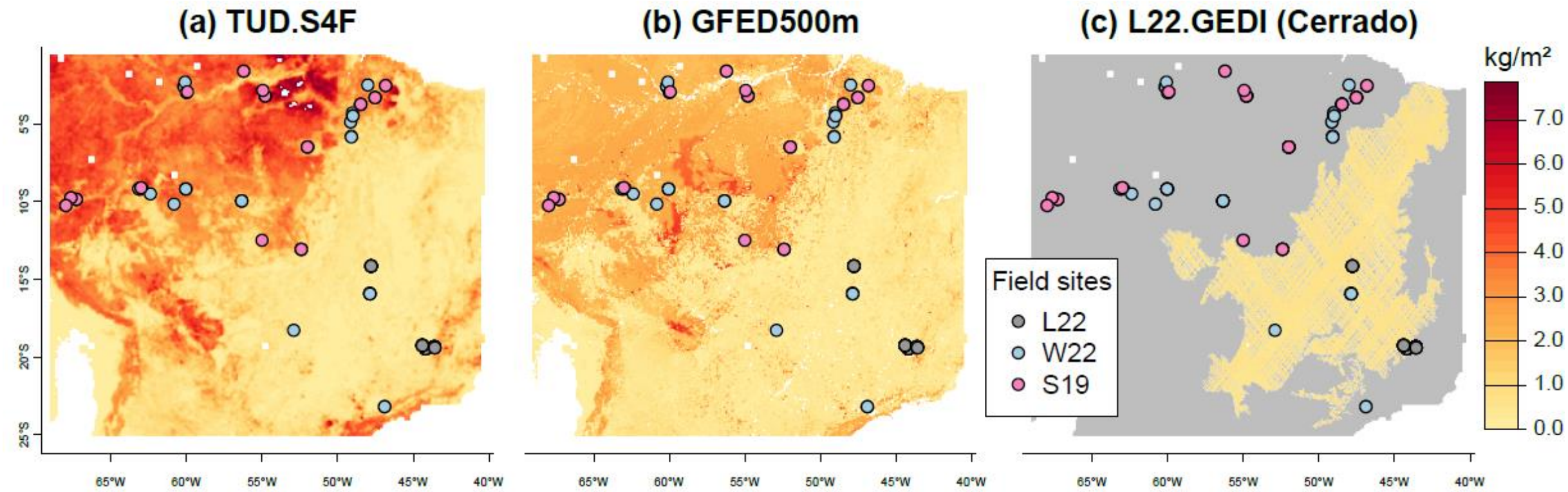


(d) Contribution of fuels to DM emissions



75% of emissions comes from burning of woody debris

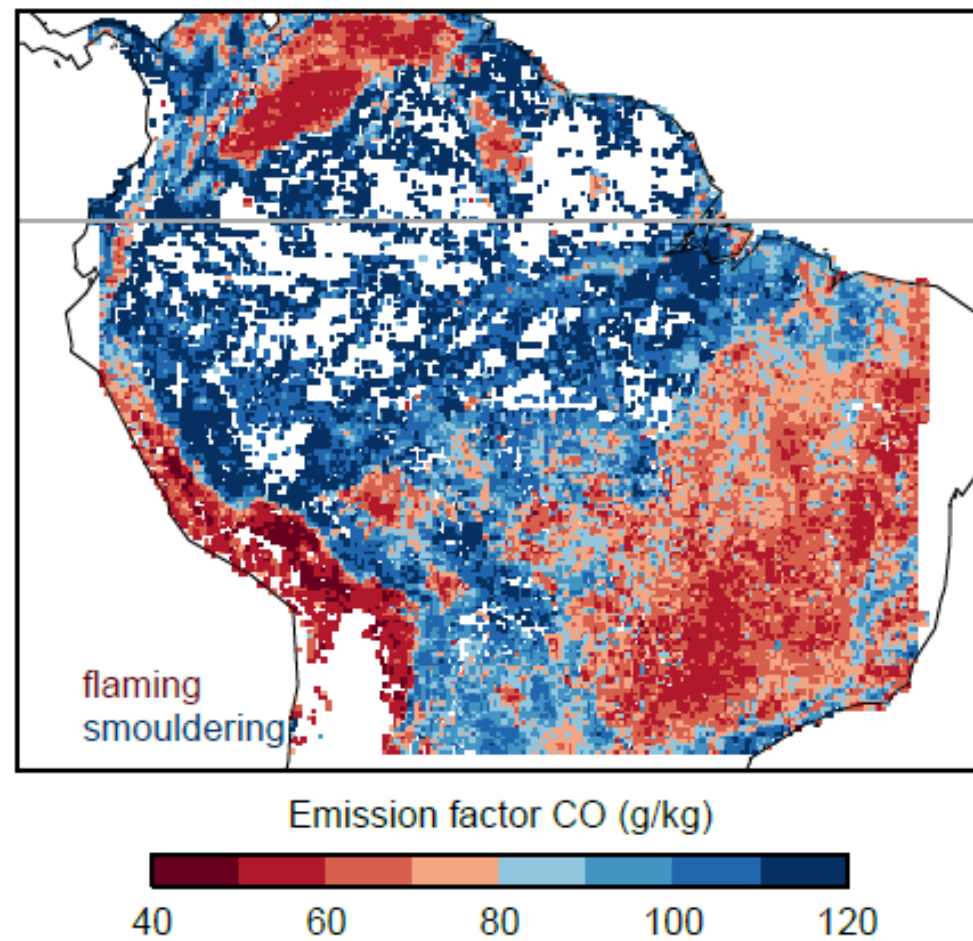
Validation of woody debris



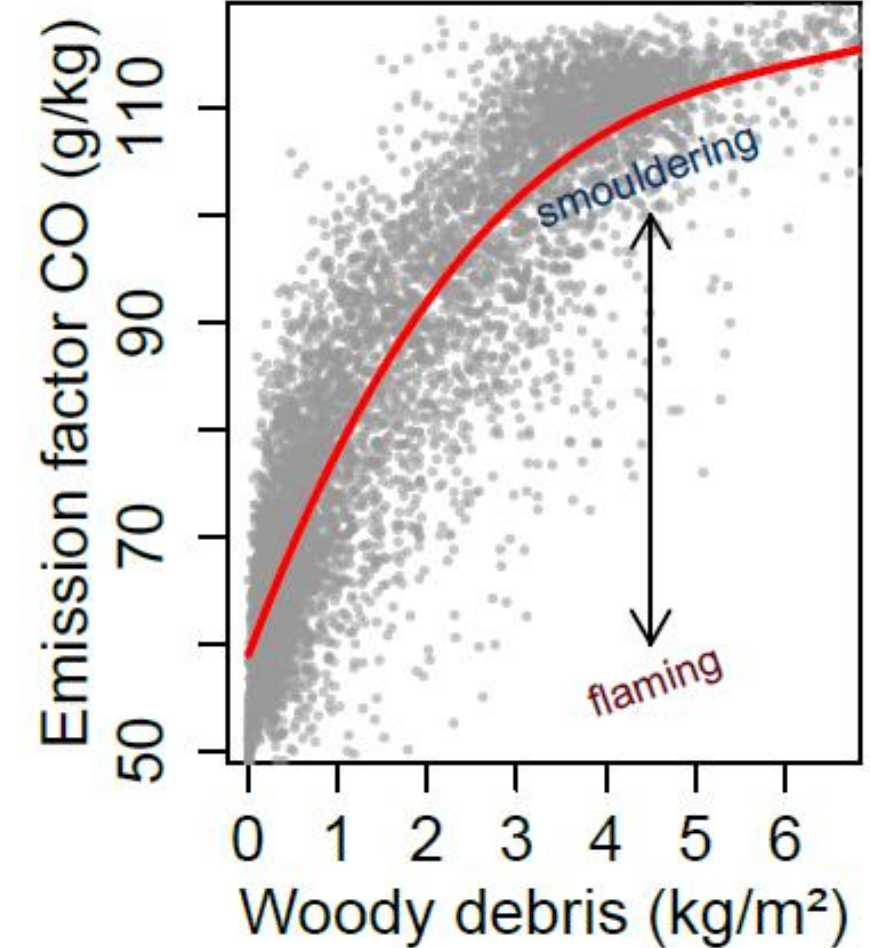
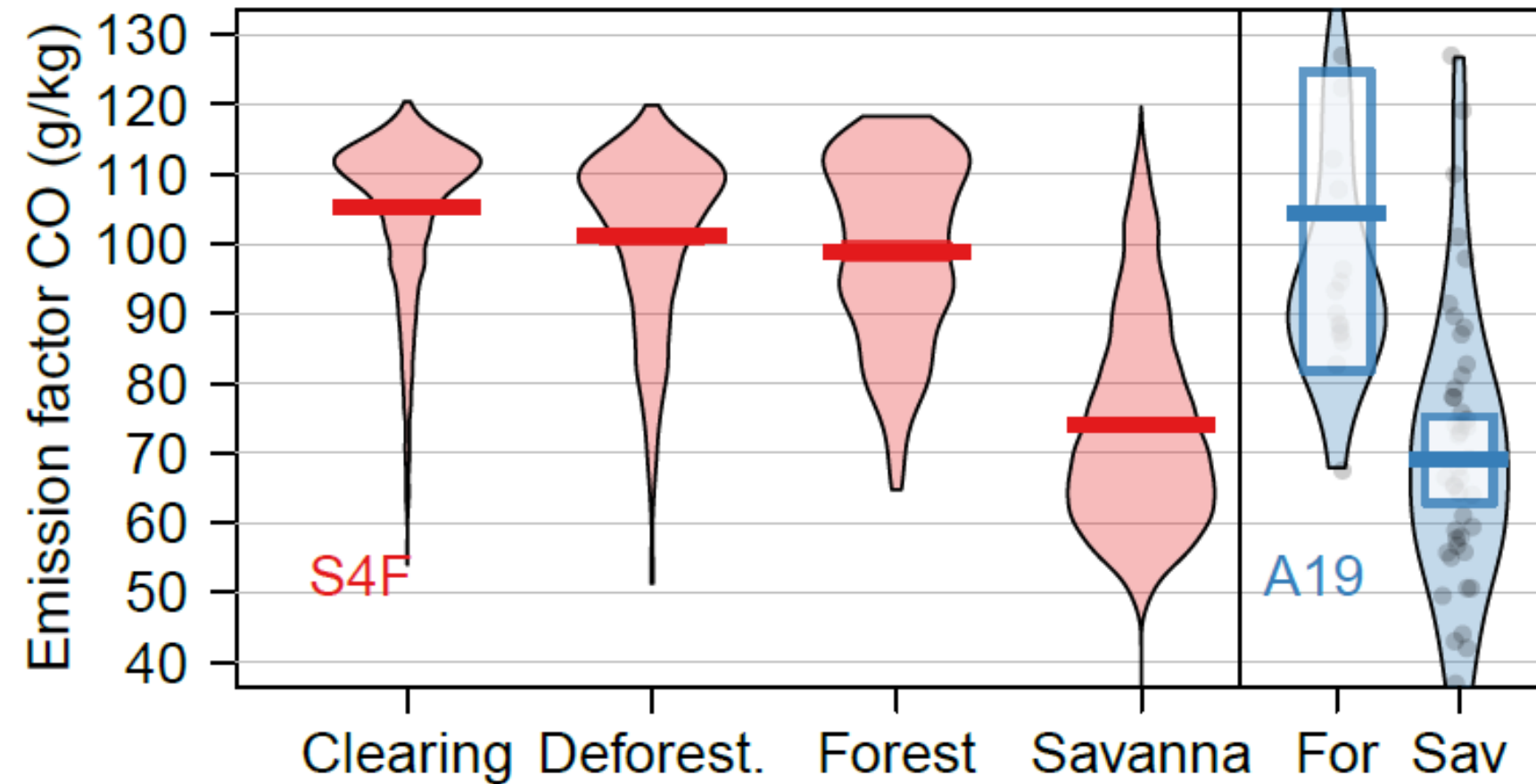
Dynamic emission factors in TUD-S4F



(a) TUD.S4F emission factor CO

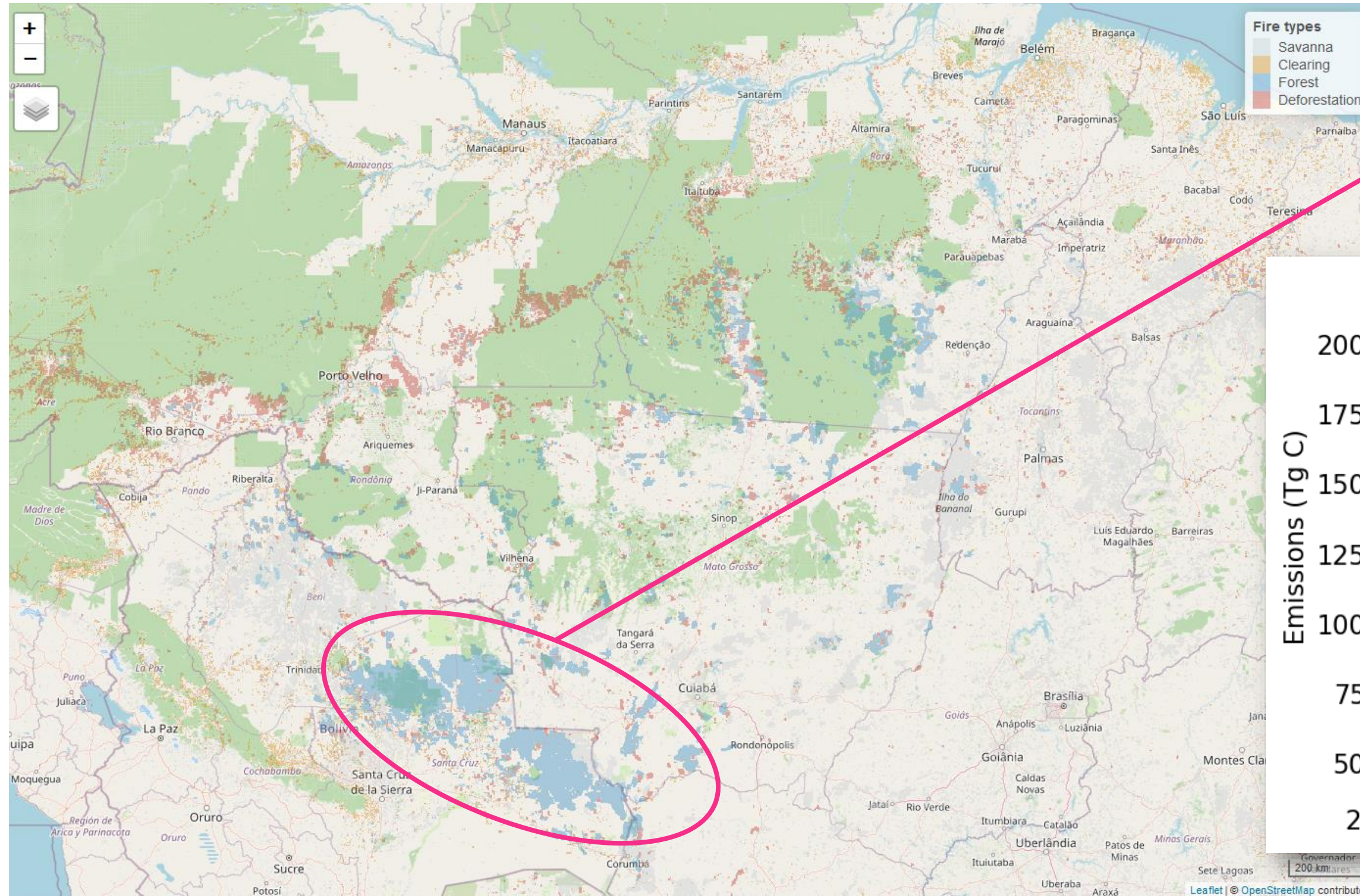


(b) CO emission factor per fire type

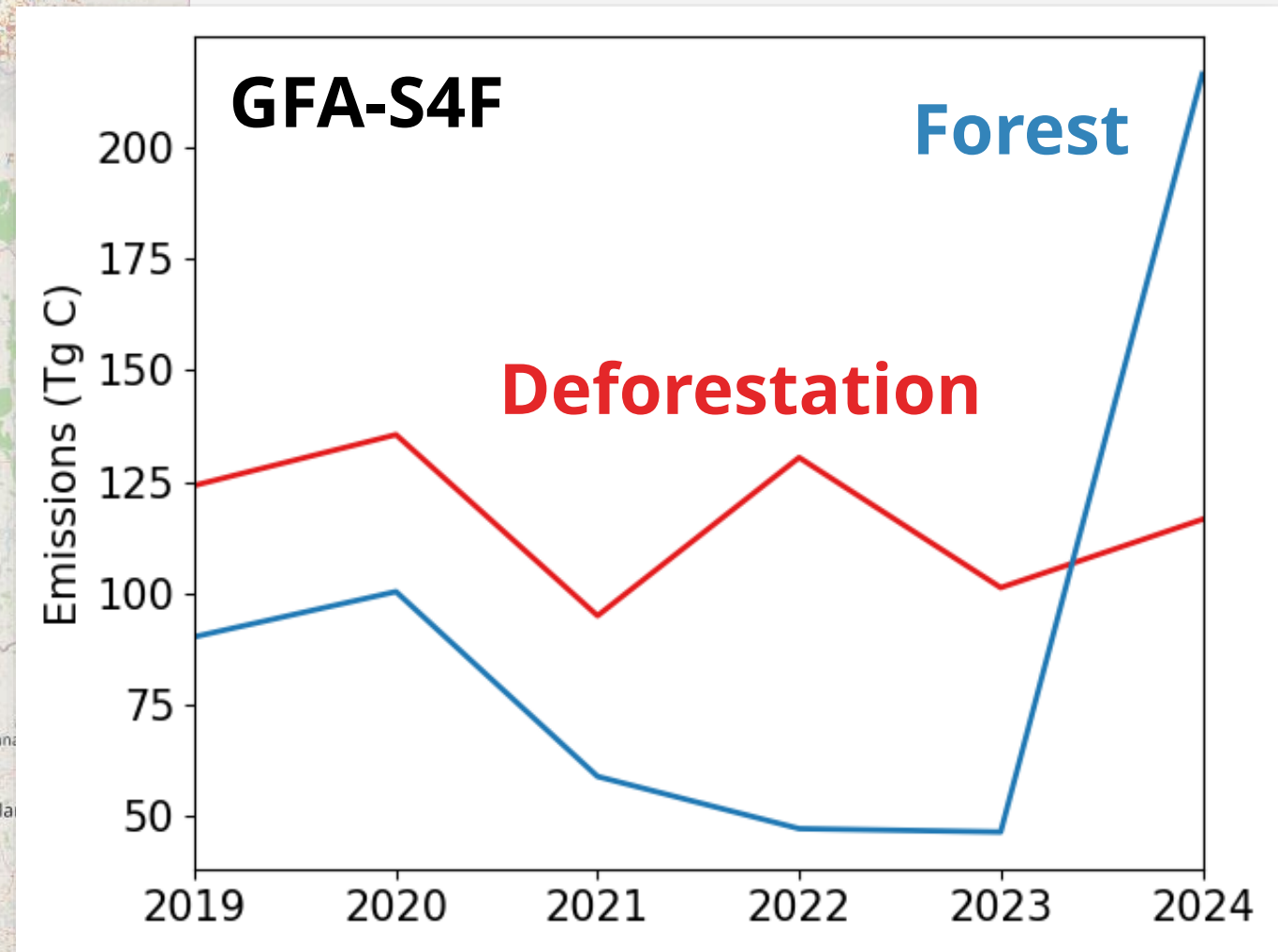


Fire season 2024

https://sense4fire.eu/database/2024_nrt/



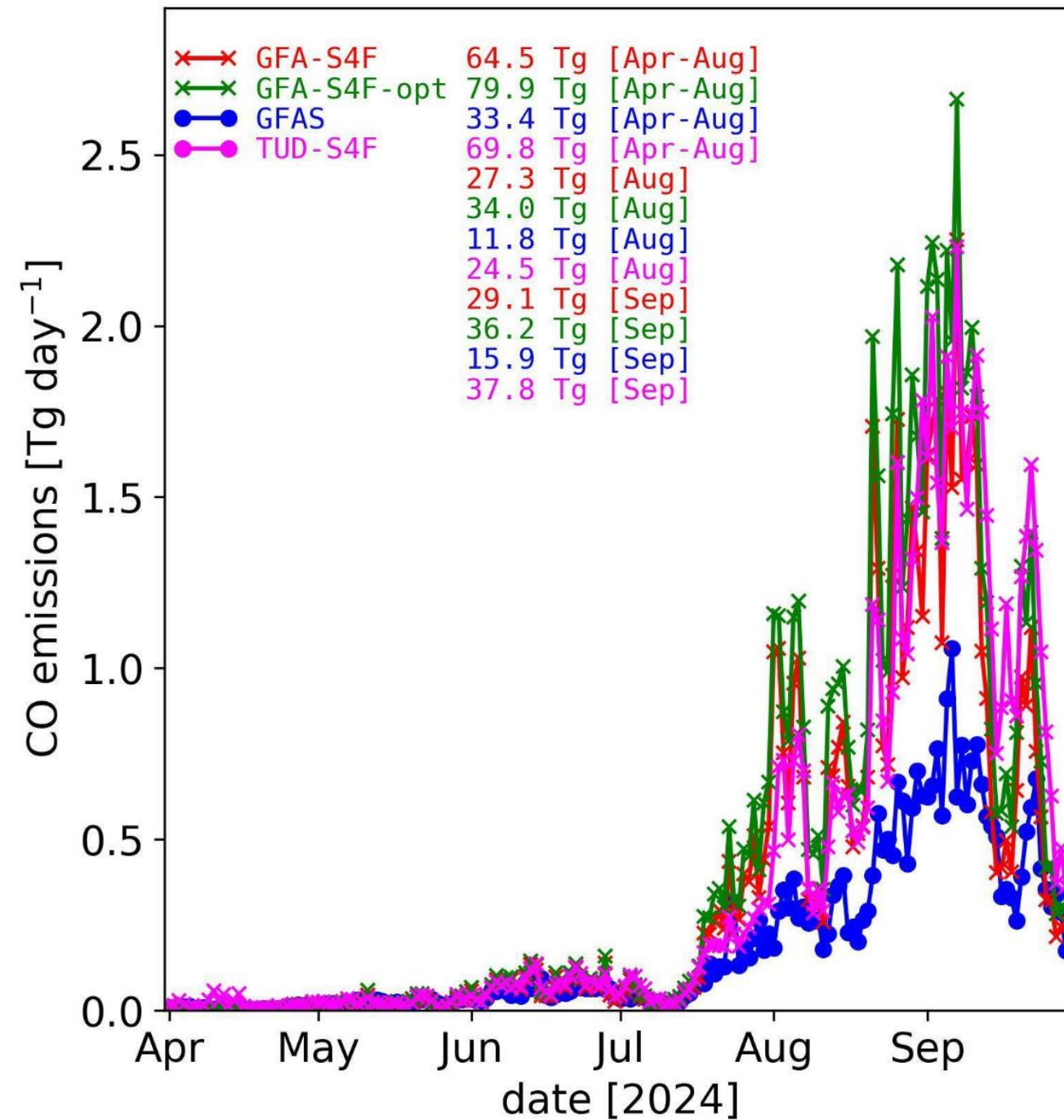
2024
Forest fires >>
deforestation fires



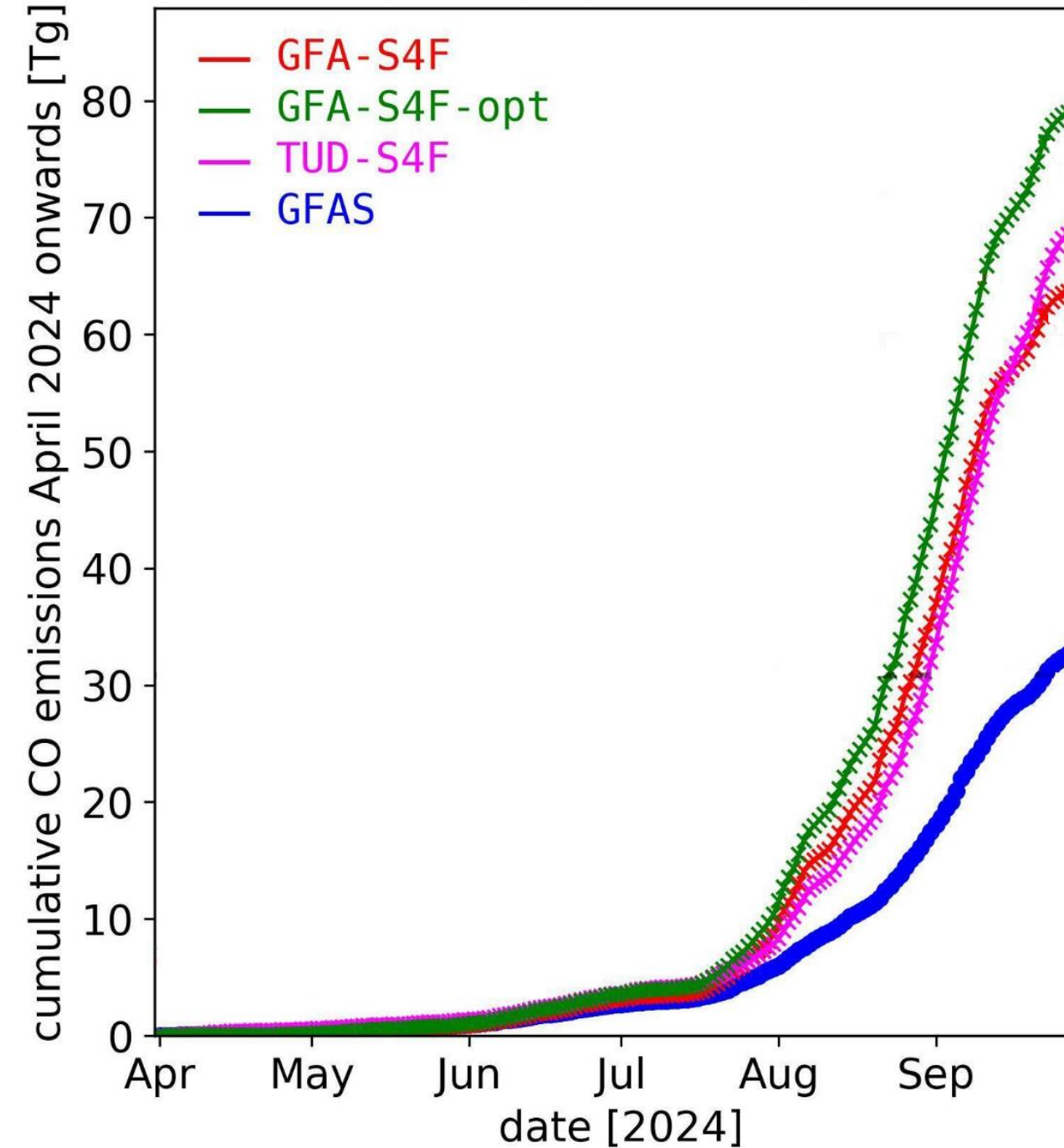
Fire season 2024



Amazon 2024 daily total fire CO emissions



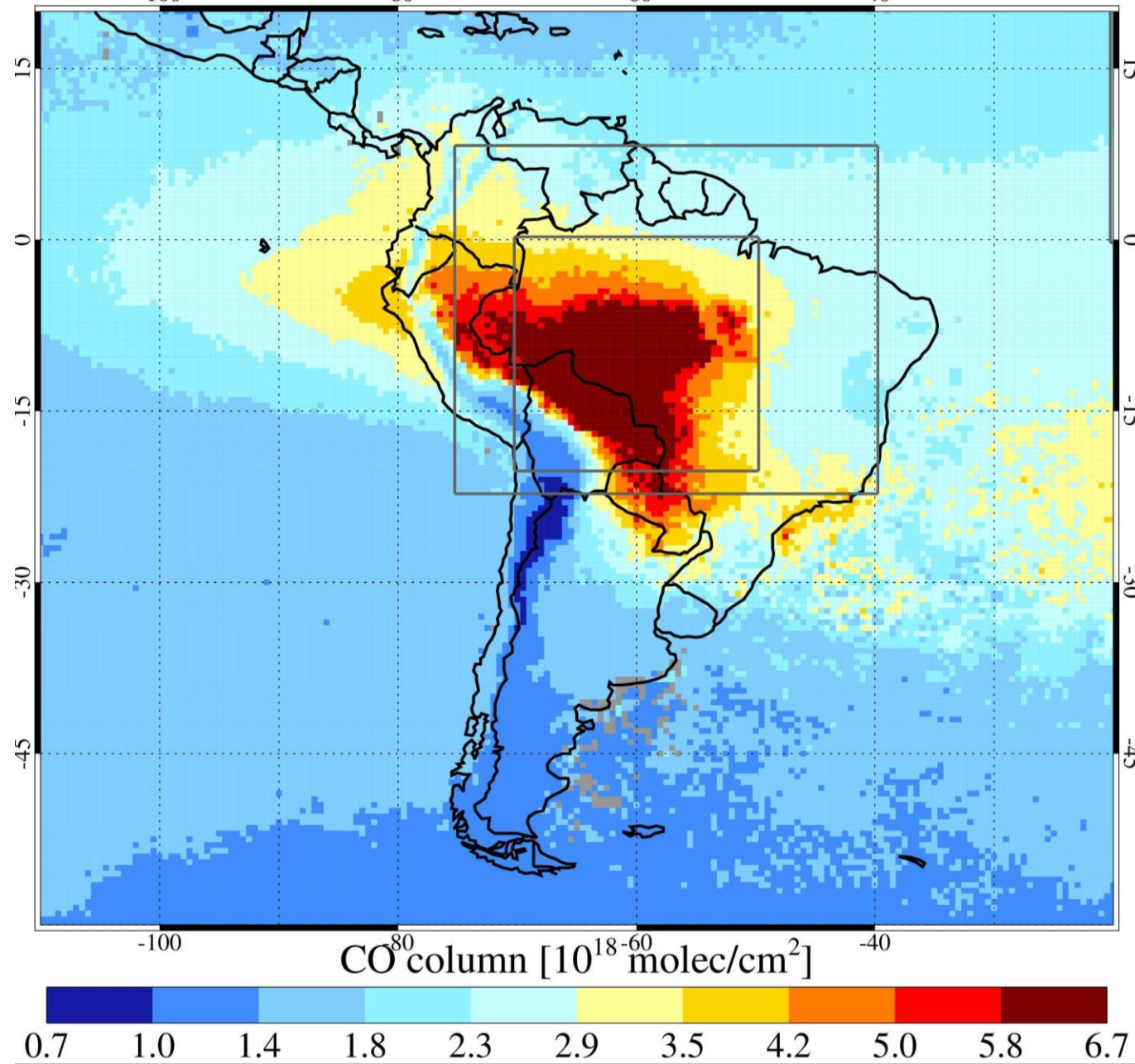
2024 cumulative emissions



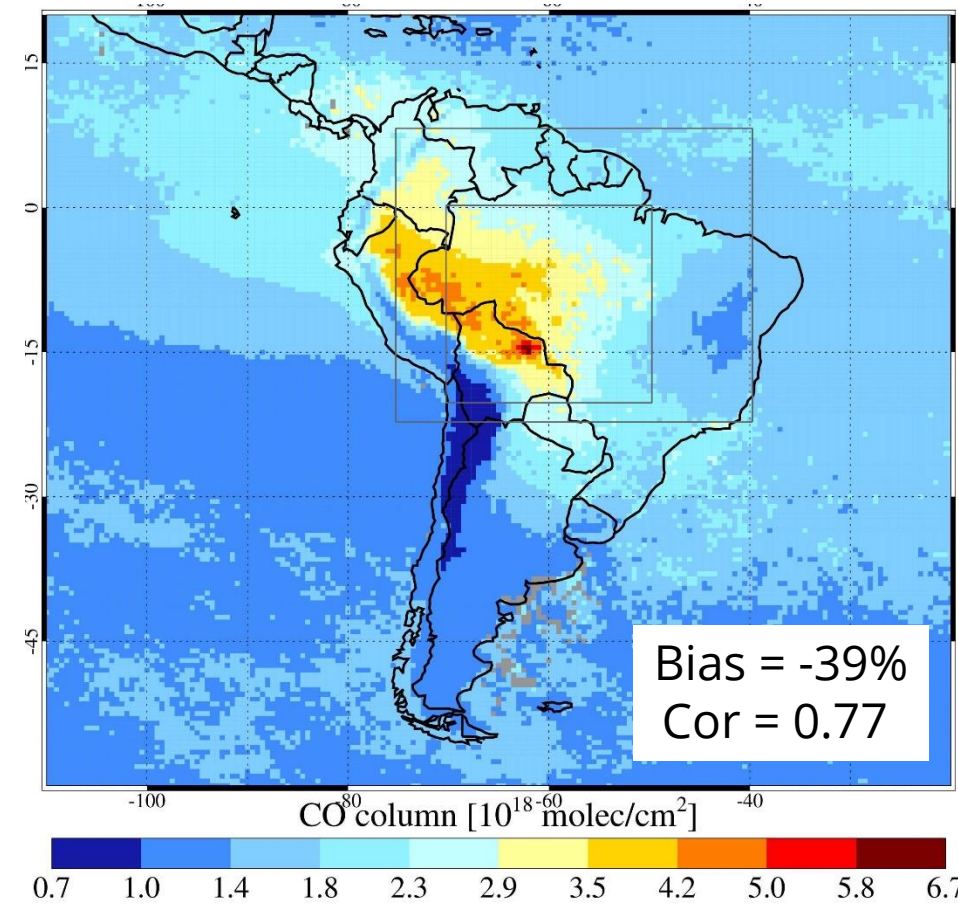
Emissions in GFA-S4F and TUD-S4F are 2 – 2.5 times higher than in GFAS
 → Large underestimation of carbon emissions by CAMS-GFAS

Fire season 2024

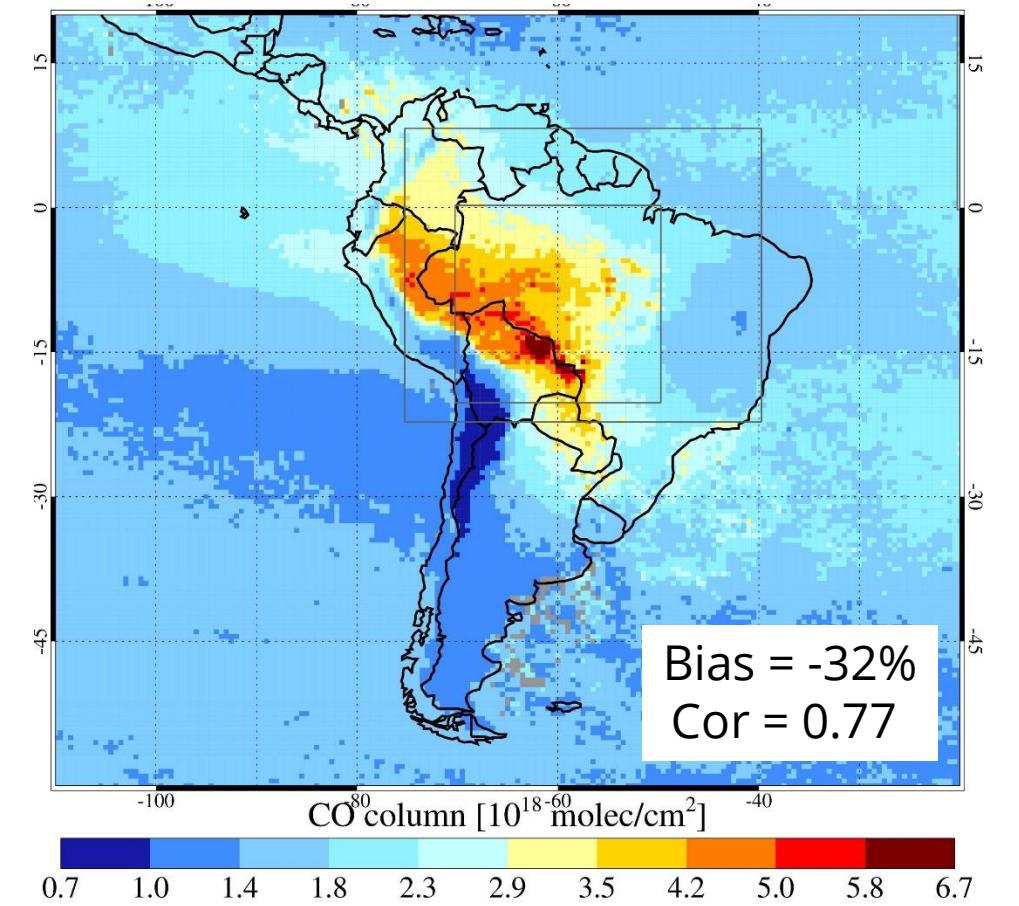
Sentinel-5p TROPOMI CO
Mean CO, 1st-30th September 2024



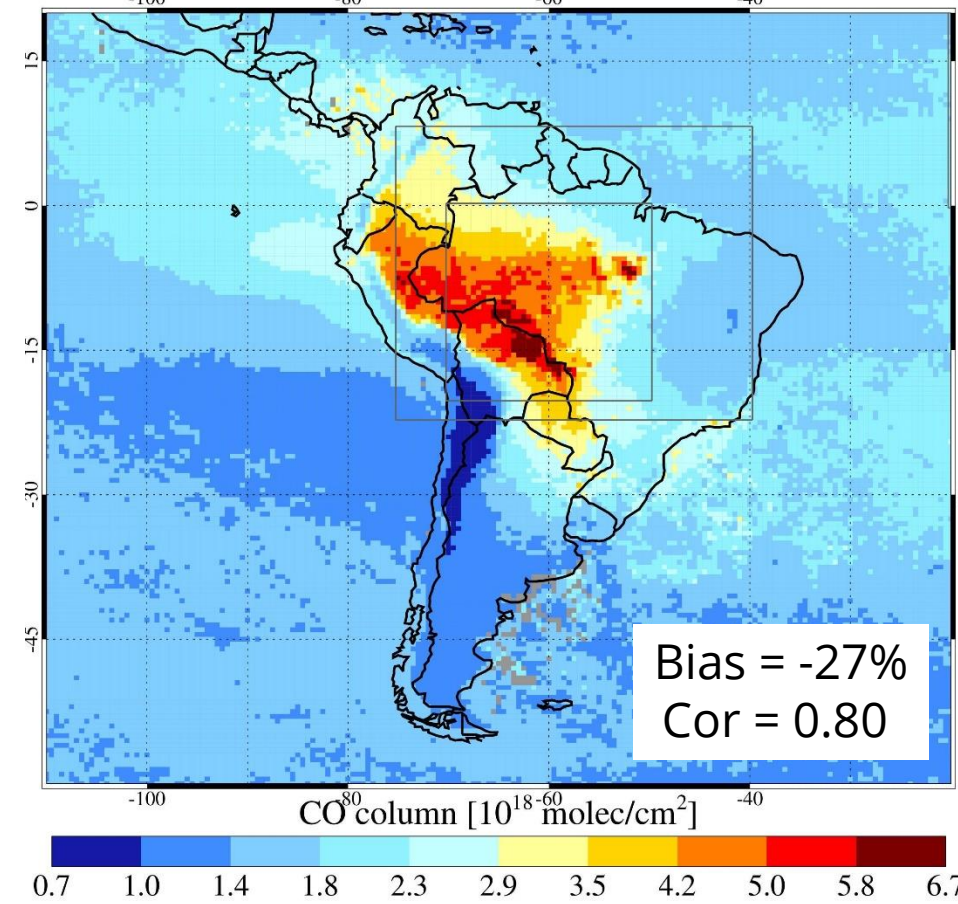
GFAS (CAMS v1.2)



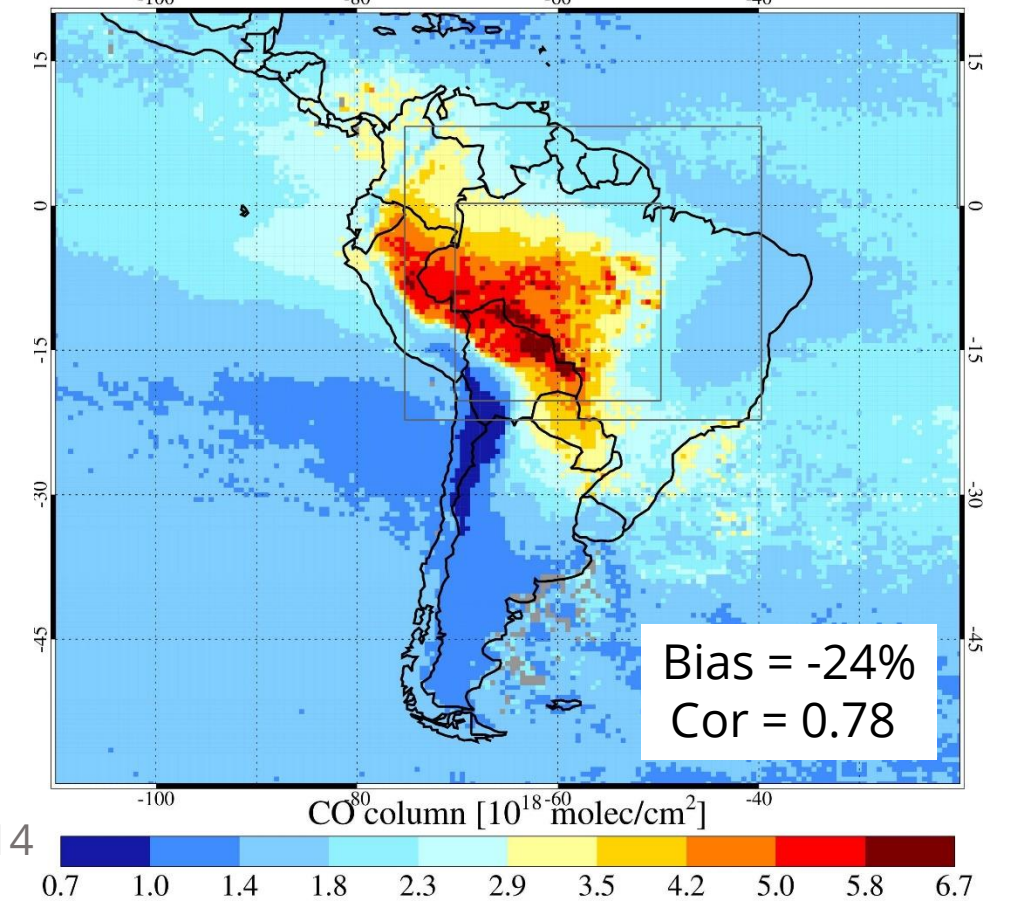
GFA-S4F (v0.2)



TUD-S4F (vNRT01)



GFA-S4F (optimised against S-5p)



Conclusions



- Burning of woody debris dominates fire emissions in the Amazon and Cerrado
- Sense4Fire provides a set of novel Earth observation-based fire emission approaches
- CO emissions in the Amazon and Cerrado:
 - 2020: $39.1^{49.7}_{27.0}$ Tg (8 approaches), CO emissions = 1.5 • GFAS
 - 2024: $67.2^{79.9}_{33.4}$ Tg (4 approaches), CO emissions = 2.0-2.5 • GFAS
- Representation of surface litter and woody debris drives uncertainty in Earth observation fire emission estimates and in global vegetation models
- Underestimation of atmospheric CO in September 2024 in comparison with TROPOMI
 - Hypothesis: caused by undetected smouldering combustion in forest fires after the initial flaming combustion, which is not captured by active fire observations
- Datasets available at <https://sense4fire.eu/database/>