Towards GFED5 emissions

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the equation:

$$M = A \times B \times \alpha \times \beta \quad [\text{g dry matter per year (g dm/yr)}]$$

where A = total land area burned annually $[\text{m}^2/\text{yr}]$, B = the average organic matter per unit area in the individual biomes $[\text{g dm/m}^2]$, α = fraction of the average above-ground biomass relative to the total average biomass B, and where β = the burning efficiency of the above-ground biomass.

The most uncertain parameters in the equation are the total land area burned annually and the burning efficiencies of the biomass in the individual ecosystems. The average phytomass per unit area and the fraction of the above-ground biomass in the individual

Authors	Year	Region	Burned area (Mha / year)	Associated GFED
Seiler and Crutzen	1980	Global	660	
Giglio et al.	2006	Global	330	GFED2
Randerson et al.	2012	Global	464	GFED4s
Giglio et al.	2018	Global	423	
Roteta et al.	2019	Africa	490	
Chen et al.; Hall et al.	2022	Global	±750 (?)	GFED5
???? et al.	202?	Global	±750 (??)	GFED6 (?)

Fuel consumption: difficult to get from space!

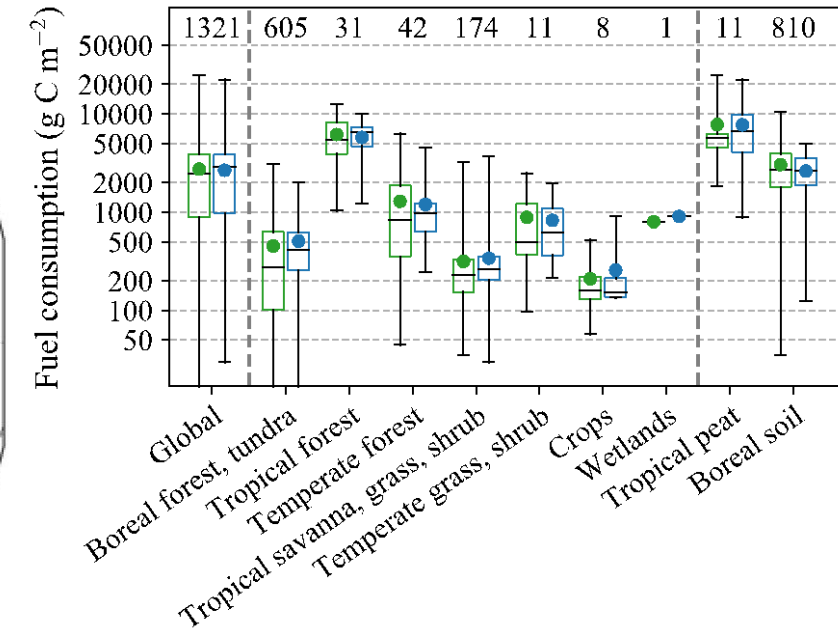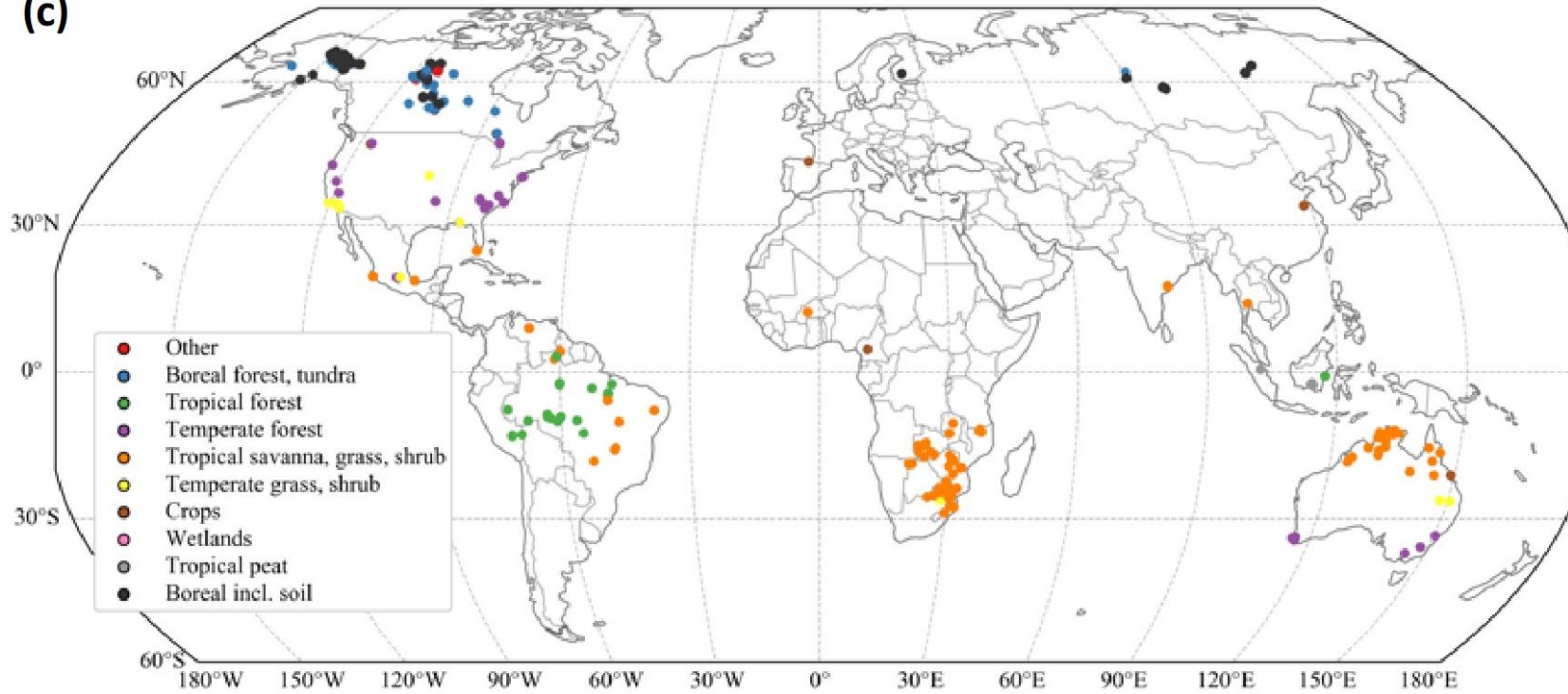
Photo credit: Roland Vernooij
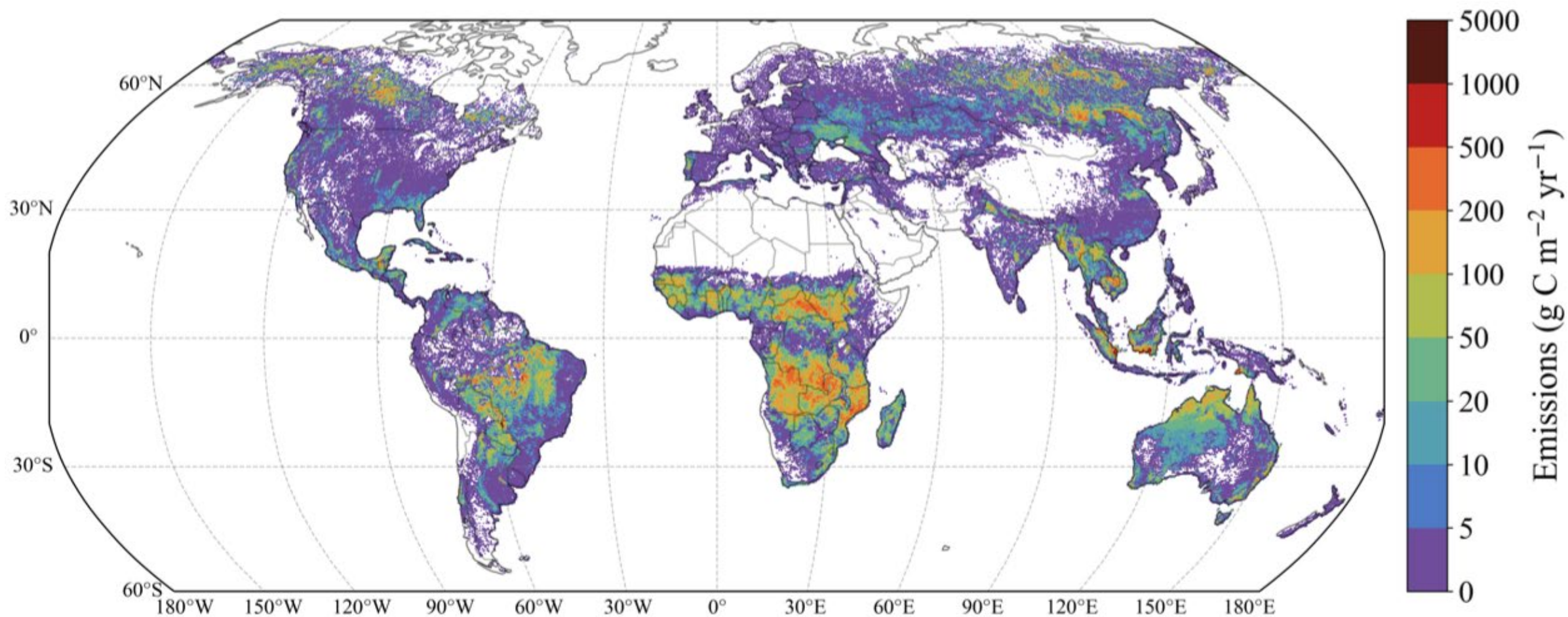
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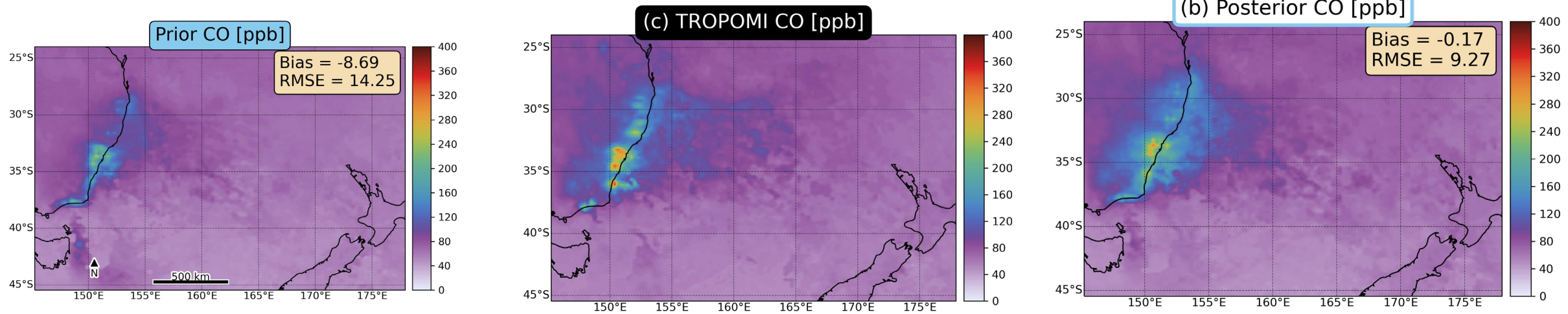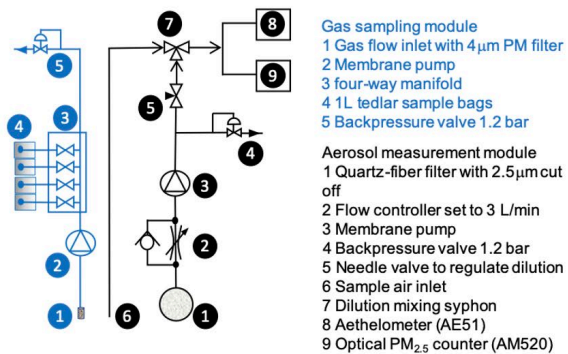
Fuel consumption for GFED5

Van Wees et al., 2022

Emissions (based on MCD64A1 C6)

Van Wees et al., 2022

Prior CO [ppb]
Bias = -8.69
RMSE = 14.25

(c) TROPOMI CO [ppb]

(b) Posterior CO [ppb]
Bias = -0.17
RMSE = 9.27

Van der Velde et al. (2021)

Gas sampling module
1 Gas flow inlet with 4 μm PM filter
2 Membrane pump
3 four-way manifold
4 1L tedlar sample bags
5 Backpressure valve 1.2 bar

Aerosol measurement module
1 Quartz-fiber filter with 2.5 μm cut off
2 Flow controller set to 3 L/min
3 Membrane pump
4 Backpressure valve 1.2 bar
5 Needle valve to regulate dilution
6 Sample air inlet
7 Dilution mixing syphon
8 Aethelometer (AE51)
9 Optical PM₂.₅ counter (AM520)

Current status

- GFED5 burned area nearing completion
- GFED5 fuel consumption done
- GFED5 emission factors under construction (based on compilations of Andreae, Yokelson). Spatial and temporal variability in savannas

- Putting it all together during fall and winter
- Use top-down constraints to check whether the atmosphere agrees with a large boost in emissions!

- And then hopefully work towards GFED6 with wall-to-wall global medium resolution burned area …… ?