Uncertainty in biomass burning emission factors:
Assessing the impact of new emission fields on atmospheric CO concentrations

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1. Background

- Fires are a major source of trace gases and aerosols to the atmosphere
- Partitioning of burned biomass into emitted trace gases (through use of emission factors (EFs)) is one of the weakest links in emissions estimates
- An EF can be defined as the amount of trace gas emitted per kg of dry matter emitted, and varies substantially in time and space even within a single biome
- However, most modeling studies do not take this variability into account and use EFs based on the arithmetic mean of field measurement outcomes, stratified by biome and taken from the EF compilation of Andreae and Merlet (2001)

2. Objectives

- We present global CO emissions estimates based on 6 newly developed EF scenarios using different spatial and temporal variabilities, implemented in the Global Fire Emissions Database (GFED; van der Werf et al., 2011) modeling framework
- The TM5 atmospheric model was used to transport these different bottom-up emission fields and investigate which scenario was in closest agreement with results from recent inverse modeling studies

3. Results

- 6 bottom-up biomass burning emission fields, based on the different EF scenarios described in Table 1, were transported in the TM5 model on a 3°x2° resolution. Figure 1 and Figure 2 show monthly mean mole fractions of CO for the lowest vertical layer in the troposphere. Plots are based on the mean of the 2002-2007 period.
- In Table 2 a qualitative comparison was made of recent inversion studies and the EF scenario emissions estimates for different regions. The ‘+’ and ‘−’ signs indicate that respectively higher and lower CO concentrations than GFEDv3 were found. The ‘=’ sign indicates that results from inversion studies were in close agreement with GFEDv3
- Figure 3 shows the time series of 6 different EF scenarios for important regions from a biomass burning perspective for the 2002-2007 period

4. Conclusions

- Including spatial and temporal variability in EFs impacted CO emissions on a global scale, and altered regional emission estimates
- Most of the EF scenarios suggested GFEDv3 to be biased high for CO in Africa for the year 2004, while recent studies indicated the opposite
- The overestimation compared to GFEDv3 biomass burning CO in Boreal North America is consistent with results found in recent studies
- Our results indicate that improving emission factors may reconcile part of the differences between bottom-up and top-down estimates, but improvements in burned area and fuel consumption are likely to be equally important

5. References

- Pison, I., et al. (2009). Time series for important regions from a biomass burning perspective