Estimating emissions of Amazonian biomass burning using in situ and satellite measurements of atmospheric carbon monoxide

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Fire is a significant mechanism by which carbon leaves the forest and savanna biomes of the Amazon Basin. Most often, these carbon emissions are quantified using "bottom-up" inventory approaches that are partly constrained by satellite detection of fire hot spots or burned area, but also rely on highly uncertain parameters such as fuel loading and combustion completeness. As a complement to bottom-up emissions estimates, here we will present, independent, "top-down" estimates of carbon emissions from fires based on measurements of atmospheric carbon monoxide (CO). CO is emitted from fires, which allows its use, within an atmospheric inverse model, to determine total carbon emissions given knowledge of emission ratios for different vegetation types. In order to isolate the impact of Amazonian fires on atmospheric CO concentrations, a global CO modeling framework has been developed that describes all the sources and sinks of atmospheric CO. Most importantly for the Amazonian atmosphere, we have included a description of the production of CO resulting from oxidation of non-methane volatile organic compounds (NMVOCs) constrained by satellite observations of formaldehyde. We have conducted three separate inversions spanning 2010-2017 using different types of atmospheric CO data as constraints on fire emissions: a) in situ CO data from the NOAA Global Greenhouse Gas Reference Network and especially from INPE bi-weekly aircraft vertical profiles from the surface to 4.5 km above sea level; b) satellite CO data from the IASI instrument aboard the MetOp A satellite; and c) satellite CO data from the MOPITT sensor flying aboard NASA's Terra. We will also use the highly accurate (but sparse in time and space) INPE in situ vertical profiles to assess the potentially biased (but spatially and temporally dense) satellite CO data streams. Preliminary comparisons of in situ CO data with those from MOPITT show low bias, suggesting that the emissions derived from (at least) the MOPITT-based inversions

should be robust. For all of our inversely-derived C emissions, we will consider the impact of emissions ratio uncertainties, and with that perspective, we will compare our top-down C emissions with those from inventories such as GFED and GFAS.

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