Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-1019-RC4, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Near-field emission profiling of Rainforest and Cerrado fires in Brazil during SAMBBA 2012" *by* Amy K. Hodgson et al.

C. Paton-Walsh (Referee)

clarem@uow.edu.au

Received and published: 20 February 2017

This comment is prepared jointly by Clare Paton-Walsh and Bob Yokelson and addresses the first comment made in the original review by Clare Paton-Walsh, recommending a generalised least squares regression (that takes into consideration the uncertainties in both x and y) as a more accurate mathematical method for determining the emission ratios than the method actually used in the study. In particular the use of forcing the intercept through zero (after subtracting background values) was questioned.

This comment initiated a detailed discussion of the analysis of aircraft data like those in the study by Hodgson et al., between us both (Bob Yokelson and Clare Paton-Walsh). At the end of these discussions, we have come to agreement that in fact the real over-

Printer-friendly version

Discussion paper

all uncertainty in fire emission factors due to the small fraction of global fires sampled, weaknesses of any sampling procedure, lack of data on the exact fuel that burned, unmeasured species in the carbon mass balance, etc., is much larger than the relatively insignificant differences that occur due to the method used in this study (and similar ones) versus a full generalised least squares regression weighted by the individual uncertainties of each point in the regression.

Some aspects of these measurements that make this conclusion particularly valid for aircraft-based source characterization studies are:

1. There are typically a vastly greater number of measurements made in background conditions, than through the smoke plume. This means that, whilst the background values are not known with zero uncertainty, the background is very well-characterized compared to the other points in the regression. This makes forcing the zero intercept a reasonable approach.

2. Similarly, the uncertainty in the measurements of CO and CO2, (the reference species plotted on the x-axis) is usually very small compared to the uncertainty for the species plotted on the y axis. This means that a simple linear regression (that only minimises the sum of the square of the deviations in the y-axis), will yield very similar results to a full regression that minimises the sum of the square of the deviations in both x and y weighted by the uncertainty in each for each individual point.

3. Indeed in Yokelson et al., (1999) it was found that close to fires at high concentrations several approaches to retrieve emission ratios (ER) usually gave similar answers and within the uncertainties of each approach. Those authors chose to force the intercept in their data pair plots partly because of the following scenario that occurs on occasion. One can fly through the plume at low concentrations of “x” and measure a high “y/x” ratio (e.g, smoldering) and fly through the plume at high concentrations of “x” and get low “y/x” ratio (e.g. flaming). Using regression in this case without forcing the intercept gives a negative gradient. Using regression with the intercept forced still

gives a reasonable estimate of the ER.

Given these aspects of the aircraft data, the analysis undertaken should yield a reasonable result. We suggest that the authors may choose to ignore the first comment in the review by Clare Paton-Walsh when preparing their final manuscript.

Finally, it's worth briefly clarifying the main point of Yokelson et al., (2013). Changing the dilution air composition as mixing proceeds can have very large effects on the "apparent ER" that would be measured downwind. This is especially problematic when changes in the background approach the magnitude of the plume enhancement. Cases exist in the literature where an aircraft enters an aged, very dilute plume, CO and acetonitrile rise, and CO2 decreases. In this case (or in the less extreme case shown in Figure 1 of Yokelson et al (2013) the true original ER for CO/CO2 cannot be retrieved regardless of whether the intercept is forced or not, or what type of regression is used. One would likely need a detailed history of all the air masses involved.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1019, 2017.