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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Trace gas emissions from combustion of peat, crop residue, biofuels, grasses, and other fuels: configuration and FTIR component of the fourth Fire Lab at Missoula Experiment (FLAME-4)" *by* C. E. Stockwell et al.

Anonymous Referee #2

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The FLAME-4 has been conducted to investigate the emission characterization of gases and particle from the burning of a variety of fuels including peat, crop straw, wood, grass, tire, and trash. Giving a brief review of the FLAME-4 configurations, the present study reported emission factors of about 20 trace gases measured by OP-FITR, and compared the results with previous studies. These results are valuable and important for emission regulation and for future inventory development and modeling inputs. So this referee would like to recommend the publication of this paper on Atmos. Chem. Phys. if the following points are addressed appropriately.

Main comments:

1) It's no doubt that OP-FTIR is a good instrument to provide an opportunity to measure a large number of gases in a high time resolution. Since optical measurements are usually associated with relatively high variations and uncertainties compared to the methods like traditional chemical analysis and GC separation with ECD, FID or MS detectors, is there any previous calibration work in the data obtained from OP-FTIR?

2) The carbon mass balance method is used to calculate EFs. The method has been widely used in emission measurements by using CO2 as a reference species, although CO is also sometimes used as a refer compound. In the cited reference, Burling et al., used CO2 as the refer target to calculate pollutant EFs. Therefore, it may be interesting to compare some representative results calculated from CMB using CO and CO2 as refer compounds, respectively. In addition, is it possible to calculate the total mass of pollutants with the data of chamber volume and compare the results from the CMB method? The difference may be expected. This may be one important reason for the difference between the present study and those in the literatures.

3) It would be interesting to look into the relationship between fuel element content and pollutant emission factors, and the relationship among measured 20 gases using statistical analysis, for example using CO as the main incomplete pollutant to investigate its correlation with other air pollutants.

4) In data comparison part, different chemical analytical methods and EF calculation methods between the present study and others should be taken into account, and these factors can hardly be reflected by the parameter, MCE, which is mainly related to the different fuel properties and burning performance.

Technical comments:

1) Title: crop residue and grasses are typical types of "Biofuels". Please consider to revise the word here.

2) Abstract line 16-17, “cooking fires” are not fuel types. In this study, indoor cookstove burning using different wood fuels were done. It may be “different fuel burning activities”, instead of “fuel types”, in my opinion.

3) Abstract line 22, and throughout the text, does “crop residue fires” mean “simulated open crop straw burning”? Please clarify.

4) Abstract line 29, what are “other reactive oxygenate organics” emitted from the burning of sugar cane?

5) Method, for each fuel type, the burning duration in stack and room burnings should be added, maybe into the table 1.

6) Page 8 line 23, “the entire space” here means the sealed combustion chamber or the adjacent room with analytical instruments? Also, in the room burning, where are the emissions “stored”, sealed chamber or adjacent room? Line 30, where is “greater detailed elsewhere”? A reference should be added, and it is may be necessary to describe a little more why the room burning is needed here to allow the analysis of optical and ice-nucleating properties of smoke, more samples required or simulated short aging process?

7) Page 11, 2.2.3. Was the Water Boiling Test (WBT) used in the simulated burning in cooking stoves? If so, or not, please describe more about the burning procedure, as this may be also one important reason behind the differences in EFs among different studies.

8) Page 19, line 13-15, it is very good to see the re-calculation of EFs in the case of higher missing carbon. It is strongly recommended to analyze all data available in the experiment and confirm the amount of missing carbon. This is also a way of evaluation of EF calculation method.

9) Page 21, results and discussion, did the fuel moisture measured in the experiment? And is there any relationship found between fuel moisture and MCE, for different fuel

types or all 157 burning experiments?

10) Page 22-23, did you measure CH3Cl in addition to HCl? And in the cited reference, did inorganic HCl measured together with CH3Cl? If not, the comparison between HCl/CO in the present study and CH3Cl/CO in other studies may be difficult to address the question that organic or inorganic Cl is the major form in biomass burning exhaust.

11) Page 23 line 24, Is there any relationship found between Cl content and Cl EF.

12) Page 28, line 5-10, it is suggested to check and confirm the data from ToFMS, and revise the EFs here, instead of in a later publication, if you had already found 28% of carbon in NMOC.

13) Page 31, did the EF of NH3 statistically correlate with N contents of crop residues? what is in HCl EF-Cl content?

14) Table 2-3, what is the data shown in parentheses?

15) Fig.1, how did the MCE, or CO/CO2 ratio change over time?

16) Fig.3, does “the maximum value” here mean the maximum concentration of each species?

17) Fig.8. There is a very large difference found in CO EF from the burning in Philips HD4012. Is there any explanation?

18) Fig.9, how did the CO/CO2 ratio change over time, and what is the difference in the temporal change of the ratio between the 3-stone and rocket stove?

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 10061, 2014.