Supplement of Atmos. Chem. Phys., 14, 10383–10410, 2014
http://www.atmos-chem-phys.net/14/10383/2014/
doi:10.5194/acp-14-10383-2014-supplement
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Atmospheric Chemistry and Physics
Open Access

Supplement of

Constraining CO_2 emissions from open biomass burning by satellite observations of co-emitted species: a method and its application to wildfires in Siberia

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Here, we present the analysis of the relationships between different available estimates of carbon monoxide (CO) and total particulate matter (TPM) emission factors for fires in extratropical forests (see Figure S1) and in savannas and grasslands (see Figure S2). We used the emission factors from the dataset by M.O. Andreae (M.O. Andreae, pers. comm. 2013; Andreae and Merlet, 2001); the different values (which are unfortunately very scarce) represent average results of different measurement campaigns. The emission factors for TPM are considered here as a proxy for emission factors for OC and BC (since the data of simultaneous measurements of emission factors for CO and OC or BC are even scarcer). We interpret the differences between the emission factor values obtained in the different experimental campaigns as a manifestation of uncertainties in the region-average emission factor estimates used in our study (see Table1). The goal of our analysis is to examine if there is a strong covariance between the uncertainties in the emission factors for CO and aerosol; an estimate of such a covariance is needed for our Monte-Carlo experiment (see Section 2.3.3).

Figures S1and S2 indicate that the different measurements of the emission factors for CO and TPM covariate rather weakly both in the case of fires in extratropical forests and in the case of fires in savannas and grasslands. In the both cases, the correlation coefficient values are rather small (r=0.09 and r=-0.37) and are not statistically different from zero with the probability of a

Type 1 error of more than 32 percent. Note that one of the available data points (No. 9 in Fig. S1) was considered to be an outlier and thus was excluded from the analysis; if it were taken into account, there would be a negative correlation between the TPM and CO emission factors, which would be significant at the 68.3 confidence level but still not significant at the 90 percent confidence level. Unlike a positive correlation between the uncertainties in CO and aerosol emission factors (which is not present here but which could, in principle, be associated with variability of burning conditions), an apparent negative correlation between them can hardly be explained by any evident physical reason and is probably random in origin.

As a conclusion, the available measurement data show no evident indications that the regional average values of emission factors for CO and aerosol strongly covariate. Accordingly, the results of the analysis presented here do not contradict and (at least qualitatively) support the assumption that uncertainties in the CO and aerosol emission factor estimates involved in our CO_2 emission estimation procedure are statistically independent and their covariance can be neglected. The scarcity of data prevents us from making stricter statements about probable magnitude of the error covariance.

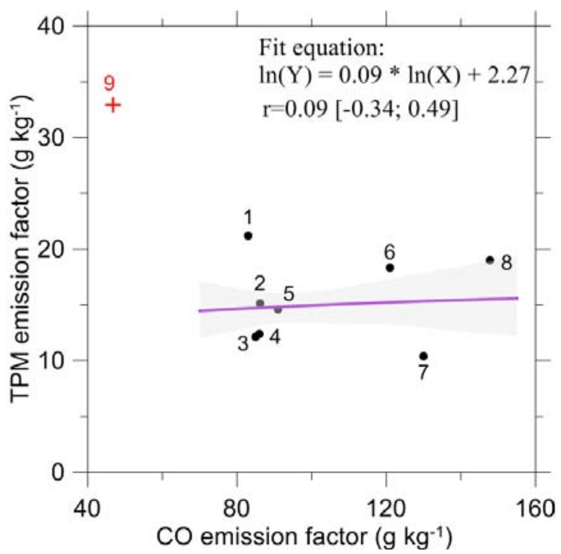

Fig. S1. Scatterplot of the CO and TPM emission factors for the case of fires in extratropical forest according to the several studies: 1- Radke et al. (1991); 2 -Vose et al. (1996); 3-Ward et al. (1990); 4-Susott et al. (1990); 5-Hegg et al. (1990); 6-Cofer et al. (1996); 7- Ward and Hardy, (1986); 8-Ward and Hardy (1991); 9-Vose et al. (1996). The point No. 9 is considered to be outlier and is excluded from the analysis. The coefficient of correlation (*r*) and its 68 % confidence interval (given in square brackets) are calculated for the emission factor logarithms. The grey shaded area indicates the 68 % confidence interval for the linear fit (see the purple line) to the emission factors logarithms.

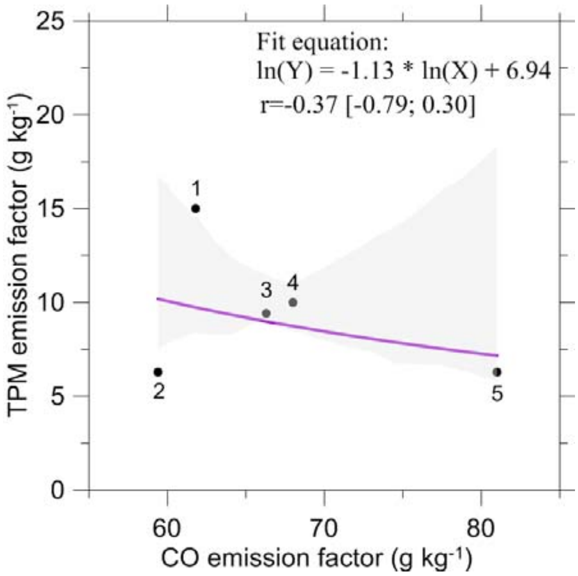

Fig. S2. The same as in Fig. S1 but for the case of fires in savannas and grasslands: 1- Ward and Hardy (1989); 2 –Ferek et al. (1998); 3 - Cachier et al. (1995); 4- Sinha et al. (2003); 5- Cachier et al. (1995).

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