

***Interactive comment on “A two year’s source apportionment study of wood burning and traffic aerosols for urban and rural sites in Switzerland” by H. Herich et al.***

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We thank the referee very much for the review and will consider the comments in the revised version of the paper.

Please note: In the revised manuscript, the BC data from the three sites was extended until October 2010. The longer time series provide improved information about the temporal variation of considered measures (e.g. Angstrom exponent  $\alpha$ ) and even more robust results. In the revised version, the figures and the numbers in

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tables have thus slightly changed. This has, however, no impact on the results and the conclusions.

- Authors claim that the Aethalometer model proposed by Sandradewi et al. (EST, 2008a) is not applicable to long-term datasets as it is only valid for situations where non-combustion carbonaceous aerosol sources may be neglected (e.g., in winter). It is surely true, but not a new finding! Sandradewi et al. (ACPD, 2008b) and Favez et al. (ACP, 2010) further proposed improved versions of the “Aethalometer model” allowing for the apportionment of non-combustion carbonaceous aerosol sources. To apply this improved methodology to long-term datasets it would be worthy to scrutinize short-time periods (e.g., month, season) separately. In this respect, paragraph 3.2.1 (and related discussions within the introduction and conclusion) should be eliminated, or at least rewritten.

The referee is right that the “improved Aethalometer model” needs to be considered. We assume that the reviewer is referring to the initially manuscript submitted to ACPD. In the discussion paper at hand we have already added sentences to section “3.2.1 “ considering Sandradewi et al. (ACPD, 2008b) and Favez et al. (ACP, 2010). This was done to underline that we did investigate different time periods (only winter data) and that we used the “improved Aethalometer model” (adding an intercept, e.g. C3). But including an intercept in Equation 4 as proposed by Sandradewi et al 2008b and Favez et al 2010 did not lead to a satisfactory model for our data. We discuss this in detail in p.10-p.11.

- Authors suggest a rather simple methodology to assess the wood burning contribution to BC (equation 5). This methodology seems to be valuable since obtained results are in good agreement with independent datasets used as indicators of wood burning and traffic emissions. However, the robustness and uncertainties of the proposed

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methodology might be further investigated. In particular, the uncertainty evaluation should take into account the impact of the following hypotheses:

1) In equation 5,  $\sigma_{absFF}(880nm)$  and  $\sigma_{absWB}(470nm)$  are replaced by  $\sigma_{abs}(880nm)$  and  $\sigma_{abs}(470nm)$ . These simplifications are only valid when BCFF has negligible impacts on  $\sigma_{abs}(470nm)$ , BCWB has negligible impacts on  $\sigma_{abs}(880nm)$ , and OMWB has negligible impacts on  $\sigma_{abs}(470nm)$ . I am not sure if it is the case here. The impacts of these simplifications on the uncertainty budget should be discussed. 2)  $\sigma_{abs}(\lambda)$  is considered to be constant all along the studied period at a given site. Does it mean that no seasonal variation was observed for this parameter? How good are the correlations between EC and  $\sigma_{abs}$  at each site?

1 and 2: The referee is correct, the above described assumptions/simplifications are made in equation 5. In the revised manuscript we will briefly mention these assumptions. With the extended dataset we have parallel measurements of the aerosol absorption and EC at PAY and MAG for about 2 years (less at ZUE). From the linear dependence between aerosol absorption coefficients and EC the  $\sigma_{abs}$  at different wavelength are calculated. From our data, we have no indications of a seasonal dependence of  $\sigma_{abs}$ . The measured aerosol absorption coefficients are highly correlated to EC (exemplarily Fig.1), the uncertainties of the determined average  $\sigma_{abs}$  are therefore rather small (see Table 2). Consequently, varying impacts of sources and processes (WB, FF, SOA, ...) seem to have a small or negligible influence on  $\sigma_{abs}$ . The simplifications made in equation 5 therefore seem not to introduce significant uncertainty or bias.

In the revised manuscript we will describe that the linear dependence between aerosol absorption coefficients and EC was independent of season, the coefficients of determination will be given. For  $\lambda=880nm$ , the obtained values for R2 are 0.94, 0.68 and 0.90 for PAY, ZUE and MAG, respectively.

3)  $\alpha_{FF}$  and  $\alpha_{WB}$  are considered to be the same at each site. However, Fig.2 indicates for instance different values for  $\alpha$  during morning rush-hours in summer, which could

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be considered as representative of  $\alpha_{FF}$  at each site. 4) The variation of  $\pm 0.05$  used for sensitivity tests seems to me rather tiny. What would be the impacts of varying  $\alpha_{FF}$  by 0.1 and  $\alpha_{WB}$  by 0.5?

3 and 4: The Angstrom exponent  $\alpha_{FF}$  should be very similar at all sites as emissions from FF combustion should not be site specific. We use an  $\alpha_{FF}$  that is compatible with the observations at all sites. Small site specific variations (likely in the range  $\pm 0.05$ ) will be covered by the sensitivity tests (see below).

In the revised manuscript the range for the variation of the Angstrom exponents for testing the sensitivity of the results will be increased.  $\alpha_{FF}$  will be varied by  $\pm 0.1$  and  $\alpha_{WB}$  will be varied by  $\pm 0.2$ . However, the variation of  $\alpha_{WB}$  by  $\pm 0.5$  is too large. In order to find a reasonable range, the fraction of WB and FF to BC was determined for varying  $\alpha_{WB}$  as well as  $\alpha_{FF}$ . Changing the assumed values for  $\alpha_{WB}$  by  $\pm 0.5$  leads to unrealistic high or low (or even negative)  $BC_{WB}$  and  $BC_{FF}$  fractions.

In addition, we compared how the coefficients of determination between  $BC_{WB}$  as well as  $BC_{FF}$  and tracers (e.g. levoglucosan) changed with  $\alpha_{WB}$  and  $\alpha_{FF}$ , respectively. If the selected ranges are too large, decreasing correlations between  $BC_{FF}$  and wood burning tracers and/or increasing correlations between  $BC_{FF}$  and wood burning tracers are observed. By this procedure, the ranges of plausible values for  $\alpha_{WB}$  and  $\alpha_{FF}$  were identified. Variation  $\alpha_{WB}$  by  $\pm 0.2$  and  $\alpha_{FF}$  by  $\pm 0.1$  was found to lead to reasonable results. The uncertainty of  $BC_{WB}$  and  $BC_{FF}$  will in the revised manuscript be expressed as the range of results obtained when varying the  $\alpha_{WB}$  and  $\alpha_{FF}$  between  $\pm 0.2$  and  $\pm 0.1$  respectively (Table 3 will be updated accordingly). The uncertainty in the choice of  $\alpha_{WB}$  and  $\alpha_{FF}$  must be considered as the dominating source of uncertainty in the proposed approach.

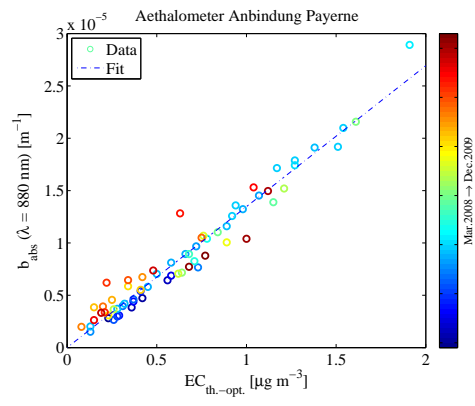


Fig. 1.

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