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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Impact of black carbon aerosol over Italian basin valleys: high resolution measurements along vertical profiles, radiative forcing and heating rate" *by* L. Ferrero et al.

Anonymous Referee #2

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The authors present measurements of BC and aerosol concentrations over three Italian sites, with particular emphasis on the vertical profiles of BC. As well pointed out in the paper, this is highly relevant data, both for understanding the local climate conditions, and for validating both regional and global climate models. The authors then proceed to calculate the atmospheric absorption at various heights due to BC, and the corresponding heating rates.

I enjoyed the first part of the paper, and believe the data are of high relevance. The second part, however, I feel is trying to go a bit too far, a bit too fast. I recommend that this paper advance to publication in ACP only if the authors either significantly extend,

or greatly tone down, the discussion on what they label BC-DRE. Generally the paper is in need of language revision. I will not attempt to point out all grammatical errors.

The authors place their measurements of BC vertical profiles in the context of recent publications – both model comparisons and experiments – that show that the uncertainty in the profiles is a major contributor to the current uncertainty in total BC forcing. This is true. However, most of that uncertainty comes from the region from 5km and upwards. It is also true that the community needs better measurements of near-ground profiles to validate regional modelling, but the vertical profile up to 600-800 meters above ground level, as measured here, is unlikely to greatly impact the total uncertainty. Hence, I believe that this part of the discussion is a bit misguided. A better comparison would be e.g. against AEROCOM model profiles for the region, to see if they reproduce the observed behavior w.r.t. the mixing height. (Which I doubt, as they will be much too coarse in both spatial and temporal resolution.)

This leads me to the discussion of radiative transfer calculations in sections 2.4 and 3.3. It is unclear to me how the authors have defined and quantified their DRE. The definition is on page 557, line 25, and then further on page 570, line 3, but how was this used in practice? As I understand the description of the model, all measurements are within the first layer (1 km resolution from 0 to 25 km a.s.l.). The authors then say that dF is the difference of the aerosol DRE at the top and bottom of each atmospheric layer. How does this yield the profiles shown in Figure 8? Do they e.g. quantify the amount of radiation reaching the surface without any BC added, then add each individual measured point separately? Isn't the case then simply that they have a forcing per gram calculated from one model, and then scale the concentration in each measured layer by this factor? Comparing figure 8 with figure 4, this appears to be approximately the case for TR and MI, but not for HR where e.g. an extra feature appears just above the mixing height and the slope is changed. What is the difference between these cases? Also, how does the forcing strength of the model used compare to other models in the literature (e.g. Myhre et al. 2013, ACP, which shows the AeroCom models, albeit on global mean?) In general, a more thorough presentation of the sensitivities of the RTM used to the various parameters given as input – either measured or assumed – is needed to add weight to this part of the paper.

Given the issues above, I'm not sure how to interpret the resulting heating rate calculations. My advice to the authors would be to put emphasis on the measurements themselves, up to and including the extraction of optical properties (though I note that Reviewer 1 has made comments here, which should also be looked closely at), but not proceed to radiative forcing and/or heating rates for profiles. Conversely, if they still wish to do so, I recommend a much more detailed description and sensitivity check of the RTM calculations and subsequent results.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 541, 2014.