

## Answer to referees

### Two-year intercomparison of three methods for measuring black carbon concentration at a high-altitude research station in Europe

Please find below reviewer comments in black and our responses in blue.

The authors have resolved most of the issues however, there are still some parts that need to be carefully revised:

1. L. 122 Please describe better  $Mr_{BC, fit}$  and  $Mr_{BC, meas}$ . For example, is  $Mr_{BC, fit}$  the total rBC mass derived by integrating the fitted size distributions over the diameter range 1-1000 nm?

2. L. 225 The reason of fitting a log-normal is to estimate accumulation-mode rBC mass that is outside the detection range of SP2. I would expect then, the total rBC mass derived from the fit to be always higher than the rBC mass that has been measured by SP2 and therefore the ratio  $Mr_{BC, fit}/Mr_{BC, meas}$  to be greater than 1. However, in l. 227 you state that “the unimodal fit tends to slightly underestimate  $Mr_{BC}$  by around 1.6% regardless of the selected averaging time”. Looking at Fig. 1 and taking into account that  $Mr_{BC, fit}$  is indeed the integral total mass of rBC from the fitted lognormal over the diameter range 1-1000 nm,  $Mr_{BC, fit}/Mr_{BC, meas}$  cannot be less than 1. There is a confusion here because of the given definitions and this part needs still to be corrected.

#### REPLY:

We understand the confusion of the reviewer. To clarify that, we changed the notation of the different terms implying the rBC mass concentration throughout the whole manuscript, equations, and figures according to the editor’s suggestion so that:

- $Mr_{BC, meas}$  refers to the mass of rBC as reported directly from the SP2 measurements
- $Mr_{BC, corr}$  refers to the mass of rBC corrected for the extrapolated mass using a time-dependent correction factor based on lognormal fits on the rBC size distributions
- $Mr_{BC, fit}$  refers to the mass of rBC calculated from the rBC size distribution lognormal fits by integrating the fits from 1 nm to 1000 nm.

Besides, we have read in depth the manuscript and addressed the minor edits raised by the editor. In particular, the color scale in Fig. 4 has been modified in line with the ACP’s Copernicus guidelines, and the legends of Fig.4 and Fig. 5 have been refined.