Evaluation of Background Black Carbon Concentration in India

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Supplementary Material

Local and Background BC

In the MMS method, local BC refers to the variability in the amount of BC caused due to short-term spikes in the BC time series. On the other hand, the background or baseline BC refers to the lowest amount of BC constantly present in a place after removing all the short-term variations in the BC data. If one needs to estimate the areal extent of influence within a city or a region, a simple description is provided below. Fig. S1 shows the rough estimate of the local BC domain and Background BC domain.
**Fig. S1:** Domain of influence (corresponding to 48 hours) and local BC (2 hour) in Monsoon (highest wind speed) and Winter (lowest wind speed) estimated using the mean wind speed for the whole Indian domain.

If we assume that the measured BC is a combination of local and regional sources, then the local sources can be identified using the short term fluctuations in the data. If suppose, there is a spike that corresponds to 1 hour (we will call this time base) and the wind speed is 1 m/s, then the distance around the measurement site that may have influenced it will be the time base multiplied by the wind speed. That will make the total distance covered as 1 m/s x 1 hour (60 min x 60 sec) = 3600 m (~3.6 km). If for the same case, the time base is 10 hours, then the distance would be 36 km or for 1-hour time base, but with a 10 m/s winds, the distance would be the same. Thus, one can determine a distance of influence depending on the time base and wind speed during the measurement period.

Based on the ground based measurement and the analysis discussed in Fig. 1, the best time base to determine the background BC is identified as 48 hours of travel distance. Fig. S1 shows four concentric circles in two colors. For example, the bold inner circles correspond to a 2-hour time base and the outer circle for 48 hours. If we use the actual mean wind speeds during winter (black) and monsoon (blue) periods, the corresponding distances for local BC would be ~ 23 km. On the other hand, the 48-hour time base corresponds to a distance of more than 500 km. Therefore, depending on the time base used, the distance of influence for measured BC within 2 hours and 48 hours can vary between 23 and 500 km. In our calculation, since we have utilized the time base as 48 hours (based on a stable estimate for background BC, Fig. 1), any BC influence from outside the 500 km domain is called the background. A similar calculation for the monsoon period returns 40 and 950 km for 2 and 48 time bases.
Therefore, a clear cut domain of influence determination is not possible. However, 48-hour criteria appear to be stable irrespective of season or months (see Fig. 1).

Comparison of MERRA-2 Background BC with Earlier Studies

Fig. S2: a) Background BC for Tehran, b) Background BC for Bhubaneswar, c) Background BC for Bangalore calculated from MERRA-2 in our study, d) comparison of MERRA-2 background BC with Aethalometer background BC in three different locations calculated in three different studies. Red dots in a, b, and c represent the locations of the three different studies.

References