*Supplemental material to:*

# "Comparison of aerosol properties from the Indian Himalayas and the Indo-Gangetic plains''

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## 1 Planetary boundary layer height

Planetary boundary layer (PBL) heights, given as metres above ground level, are from the European Centre for Medium-Range Weather Forecasts (ECMWF) model for every 3 hours. Station PBL heights are calculated as a distance weighted averages from those at the four closest integer coordinate points. In addition, the coordinate point SW from the Mukteshwar station (29° N, 79° E) is interesting as it is already located at the Indo-Gangetic plains. The original data as well as calculated daily, monthly and seasonal averages are shown in Fig. S1. In addition, daily maximum PBL heights and corresponding monthly and seasonal averages are also shown. Because the PBL heights are strongly correlated (Pearson's correlation coefficients are all above 0.9), only the Gual Pahari and Mukteshwar PBL heights are shown in the main text.

PBL heights have very strong diurnal cycles; the daily maximum PBL height is often a few thousands of meters and minimum can be only tens of meters. Therefore, we have additionally calculated daily maximum PBL heights, which most often mean PBL height at 14:30 local time (note the three hour time resolution). In general, daily average and maximum PBL heights are strongly correlated (Pearson's correlation coefficients over 0.9) so that the averages are about 30 % of the maximum PBL heights.

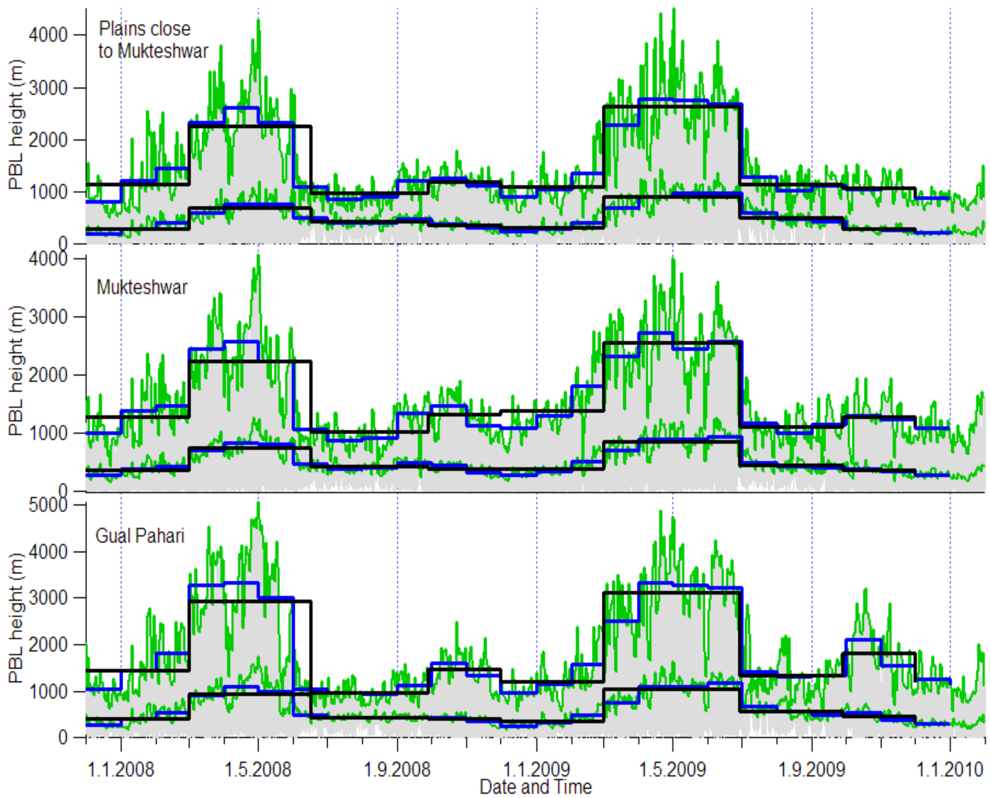


Figure S1: Planetary Boundary Layer (PBL) heights at the stations as well as plains close to Mukteshwar. The original 3 h data is shown with the gray color. The solid lines are daily (green), monthly (blue) and seasonal (black) averages of both original and daily maximum PBL heights.

# 2 Meteorological data

Time series of Gual Pahari and Mukteshwar wind directions and speeds are shown Figs S2 and S3, respectively. Because wind directions are distributed between two dominant sectors (roughly from NE to S and from W to N), monthly averages are not describing wind directions well. Therefore, probability distributions of monthly wind directions are shown in Fig. S4. The sum of probabilities, which are described by different colors, is one for each month. Also note that the probability color scale is the same for Gual Pahari and Mukteshwar. Wind direction is defined as a clockwise angle from north.

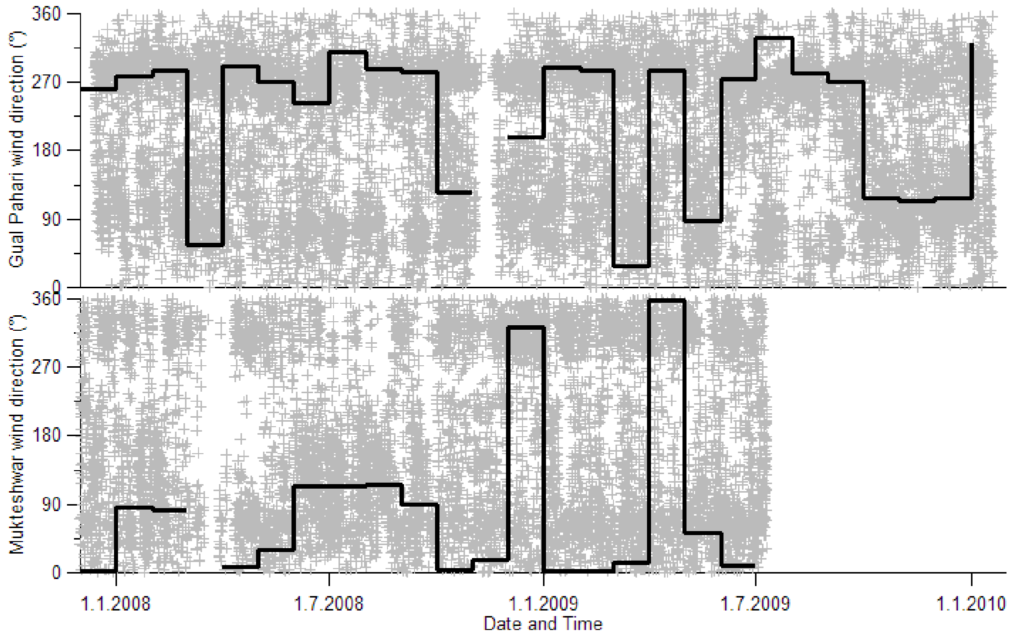


Figure S2: Hourly (markers) and monthly (lines) wind directions in Gual Pahari and Mukteshwar.

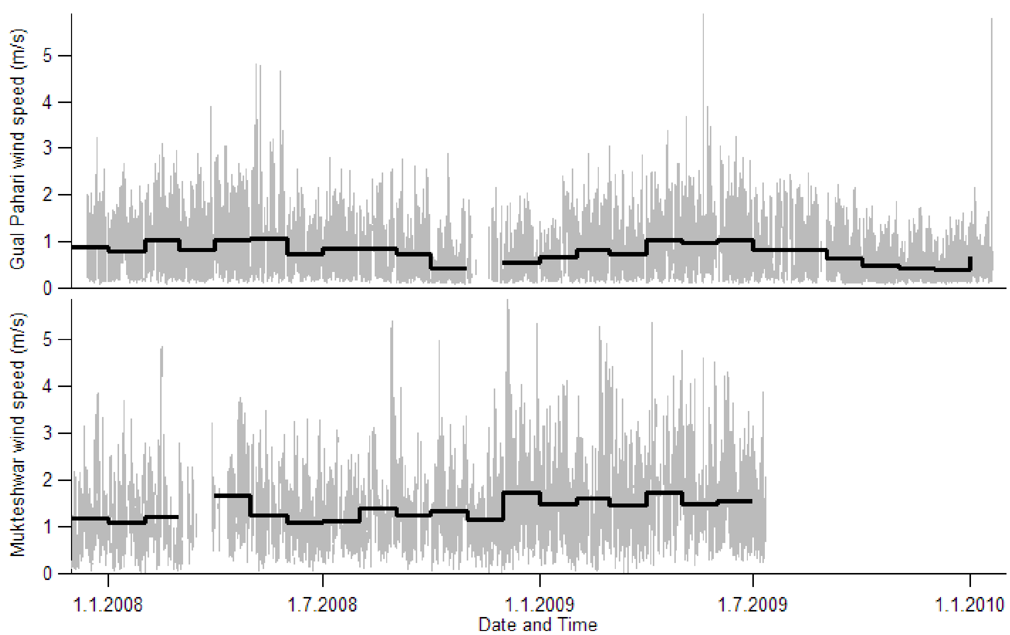


Figure S3: Hourly (thin lines) and monthly (thick lines) wind speeds in Gual Pahari and Mukteshwar.

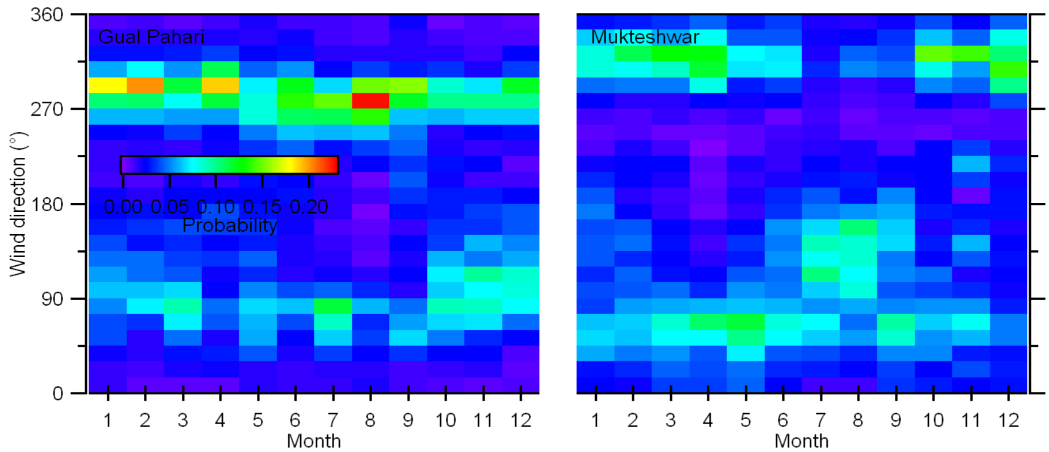


Figure S4: Probability distributions of monthly wind directions for Gual Pahari (left) and Mukteshwar (right).

Diurnal temperature (T) and RH cycles in Gual Pahari (left) and Mukteshwar (right) are shown in Fig. S5. Due to the very clear month-to-month variations, diurnal cycles are calculated for each month. Seasonally averaged diurnal cycles of wind directions and speeds are shown in Fig. S6.

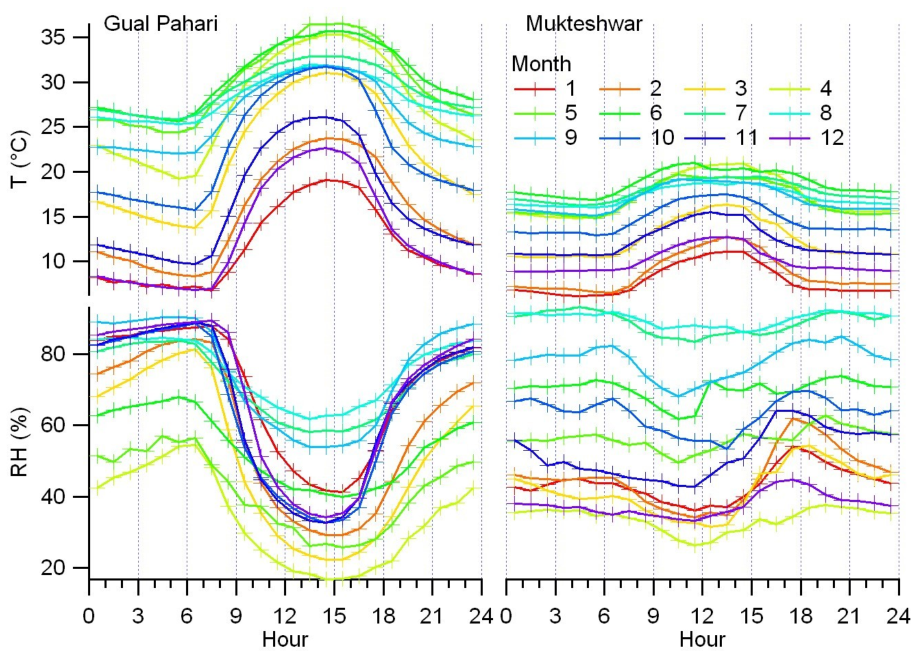


Figure S5: Monthly averaged diurnal cycles of temperature and RH for Gual Pahari (left) and Mukteshwar (right).

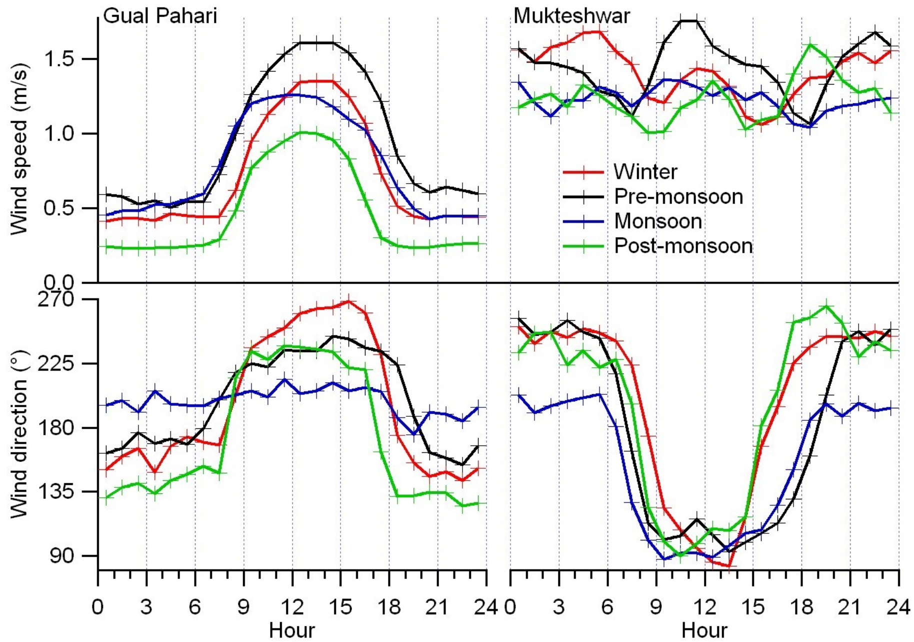


Figure S6: Seasonally averaged diurnal cycles of wind speeds and directions for Gual Pahari (left) and Mukteshwar (right).

# 3 Trajectories

Again, simple averages are not good in describing trajectory directions distributed between two dominant sectors, so these are shown as monthly probability distributions in Fig. S7. Trajectory direction is defined as a clockwise angle from north.

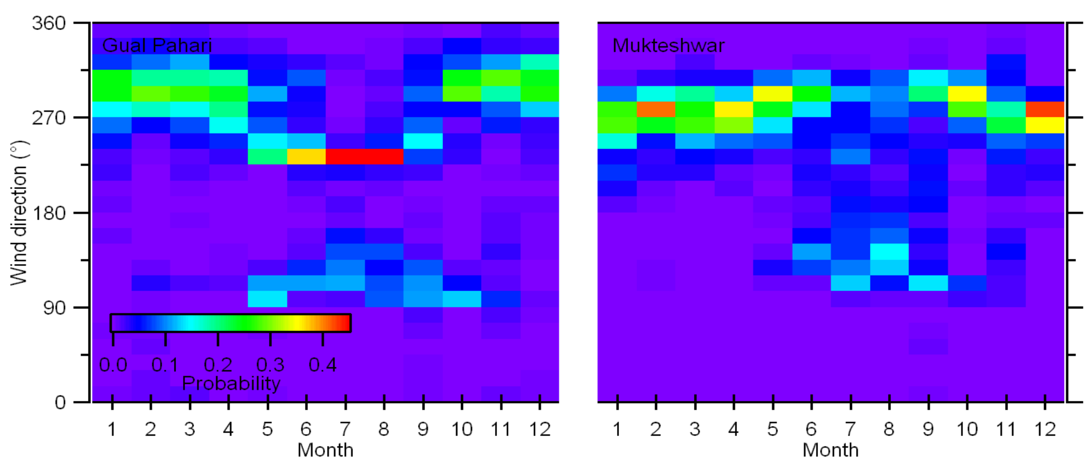


Figure S7: Probability distributions of monthly trajectory directions for Gual Pahari (left) and Mukteshwar (right).

# 4 Aerosol measurements

## 4.1 Number size distributions

Particle number size distributions were measured by a twin DMPS system in Gual Pahari and a single DMPS system capable of detecting 10–800 nm particles in Mukteshwar. One Gual Pahari DMPS unit was detecting particles from size range 4 nm to 58 nm and the other from 31 to 850 nm. The time series of integrated total particle number concentrations are shown in Fig. S8. The Gual Pahari data coverage is low, only about 16 %, so these results are not very reliable. This is also the reason why this DMPS data is not shown in the main text.

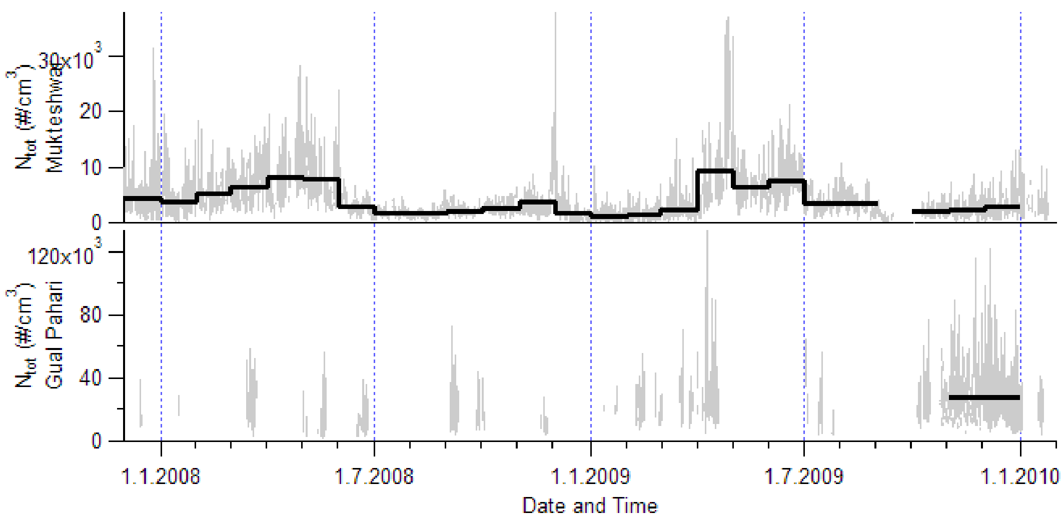


Figure S8: Total particle number concentrations integrated from the number size distributions. Monthly averages are shown with the thick black line.

Figure S9 shows number size distributions averaged for the four seasons. Nucleation events have a clear effect on the sub-40 nm size range especially in Gual Pahari. Therefore, annual and diurnal cycles (Figs S10 and S11) are calculated for two additional size fractions; below and above 40 nm. The minimum particle size for the sub-40 nm size range and the maximum particle size for the above 40 nm size range depend on instrument detection limits being 10–800 nm and 4–850 nm in Mukteshwar and Gual Pahari, respectively. Also the integrated total particle volumes are shown. The unit of the total particle volume (µcm$^3$/m$^3$) is chosen as it is directly comparable to mass concentration (µg/m$^3$) when expecting unit density (1 g/cm$^3$).

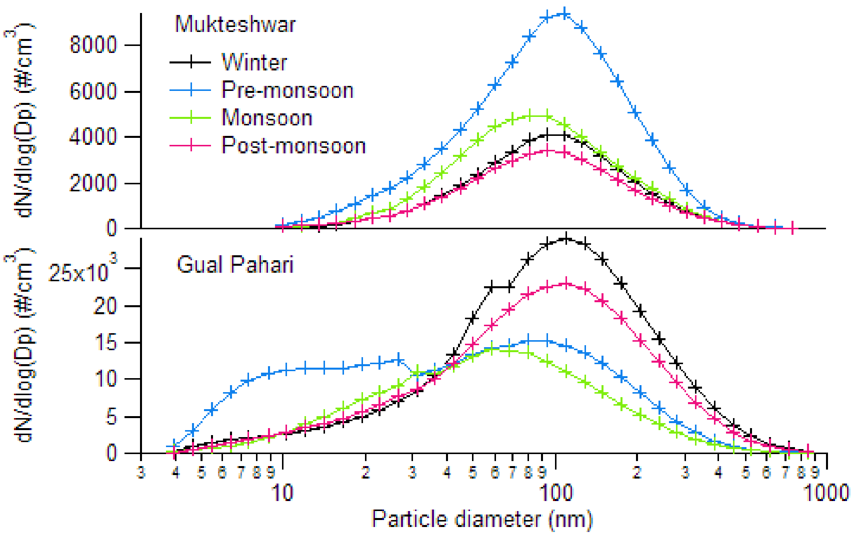


Figure S9: Seasonal averages of the number size distributions.

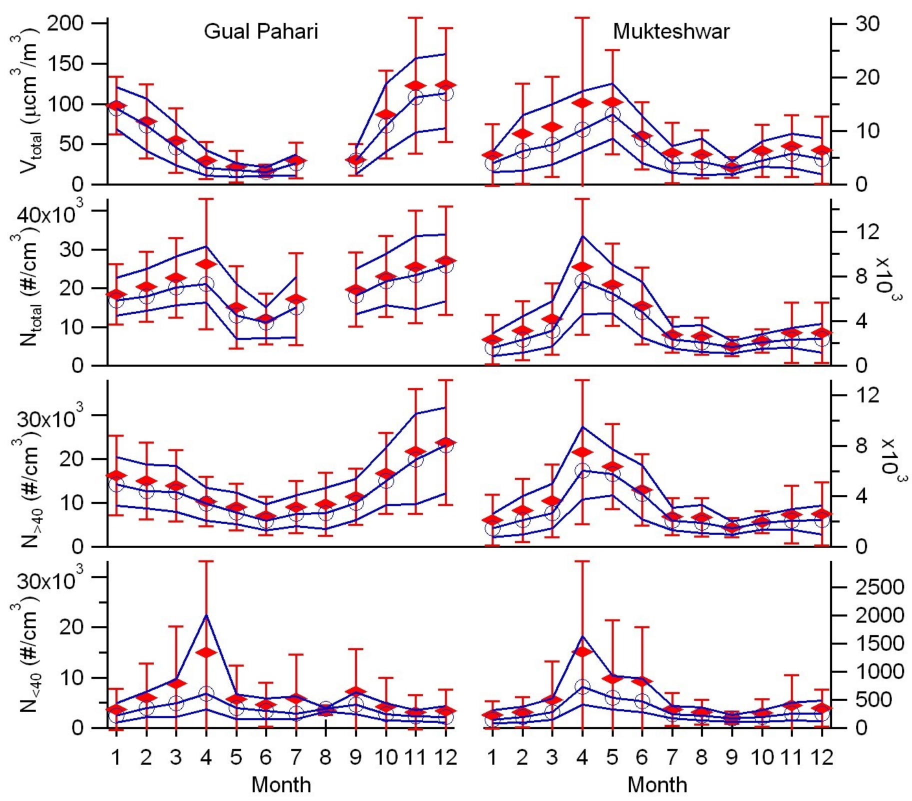


Figure S10: Annual cycles of particle number and volume concentrations. Monthly averages and one standard deviation error bars are shown with the red color, and the blue markers and lines are 25, 50 and 75 percentiles.

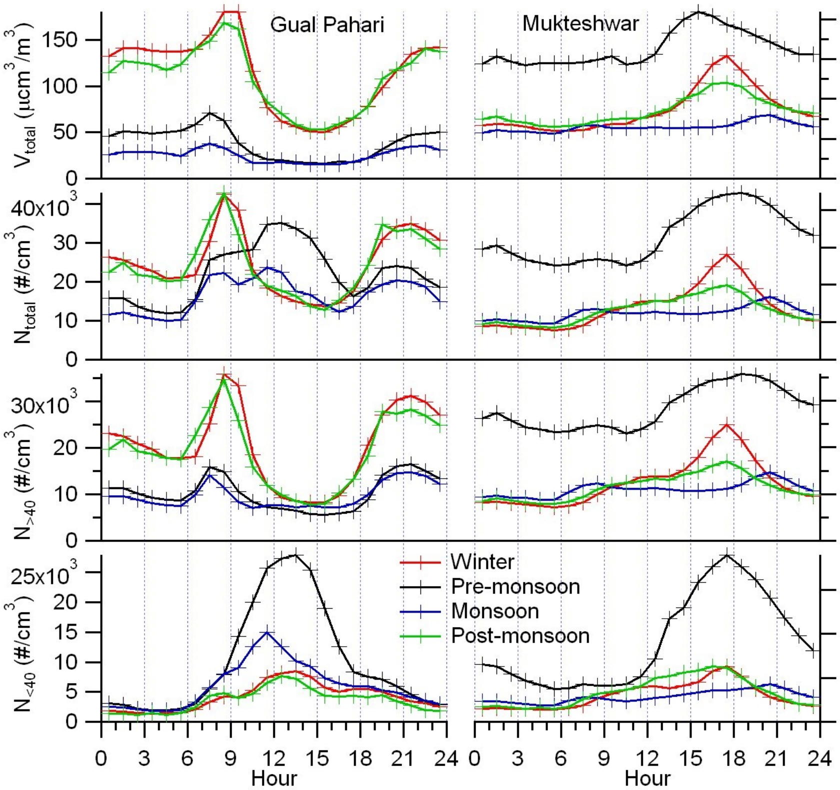


Figure S11: Seasonally averaged diurnal cycles of particle number and volume concentrations for Gual Pahari (left) and Mukteshwar (right).

## 4.2 Optical properties

Annual and monthly diurnal cycles of Single Scattering Albedo (SSA) and absorption ($\sigma_{abs}$) and scattering ($\sigma_{scat}$) coefficients are shown in Figs S12 and S13, respectively. In the comparison it must be kept in mind that the aethalometer was connected to $PM_{2.5}$ inlet and the MAAP was connected to $PM_{10}$ inlet.

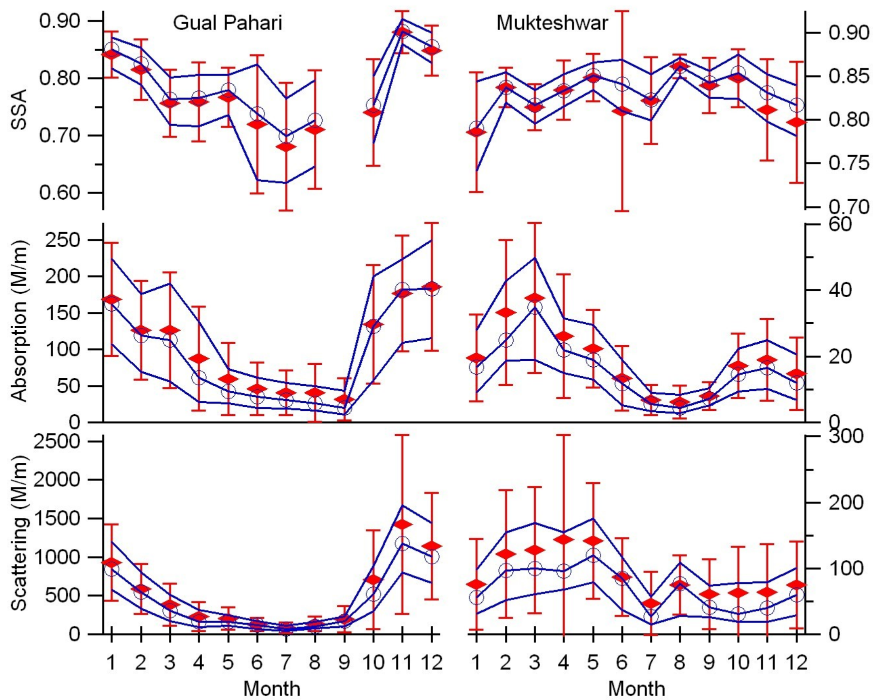


Figure S12: Annual cycles of SSA and scattering and absorption coefficients. Monthly averages and one standard deviation error bars are shown with the red color, and the blue markers and lines are 25, 50 and 75 percentiles.

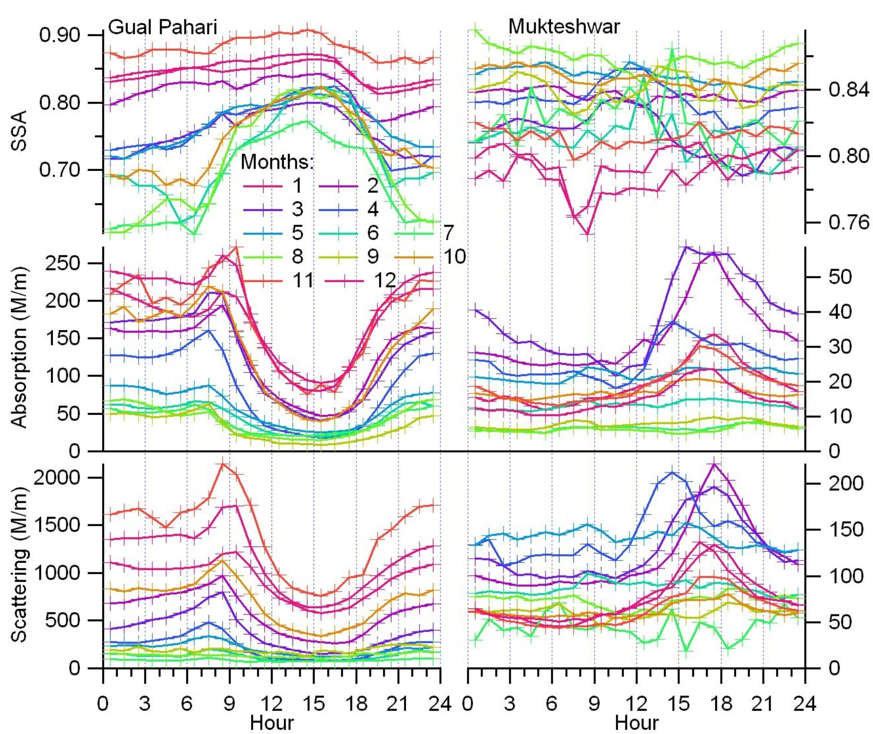


Figure S13: Monthly diurnal cycles for SSA and scattering and absorption coefficients.

## 4.3 Mass concentrations

$PM_{2.5}$, $PM_{10}$ and black carbon (BC) mass concentrations were measured in the both stations. Coarse particle mass concentration ($PM_{2.5-10}$) was calculated as a difference between $PM_{10}$ and $PM_{2.5}$ mass concentrations. In addition, BC and $PM_{2.5-10}$ mass fractions were calculated by dividing their mass concentration values by that of $PM_{10}$. Original mass fraction time series were quite spiky, so a filtering was applied. In the case of BC mass fraction, only those points were included where $PM_{10}$ mass concentration was higher than that of BC and also above 3 $\mu g/m^3$. Similarly, coarse particle mass fraction was calculated when $PM_{10}$ was greater than $PM_{2.5-10}$ and also above 3 $\mu g/m^3$.

Time series of these mass fractions and the coarse mode mass concentration are shown in Fig. S14. Annual cycles of these and the original mass concentrations are shown in Fig. S15. Finally, their diurnal cycles are shown in Fig. S16.

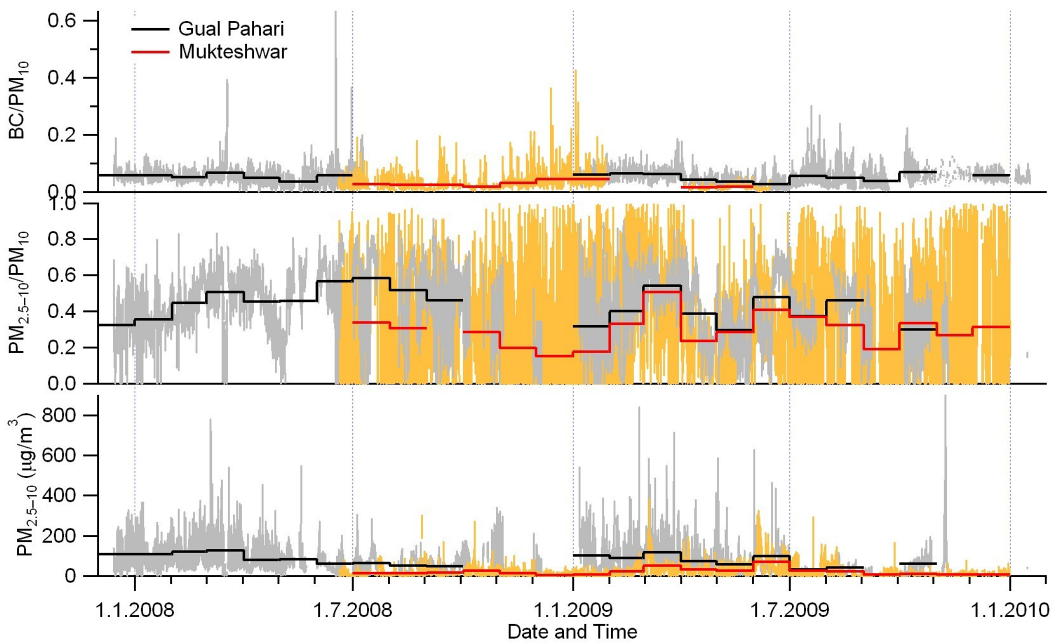


Figure S14: Hourly (thin lines) and monthly (thick lines) average BC and coarse particle mass fractions and coarse particle mass concentration.

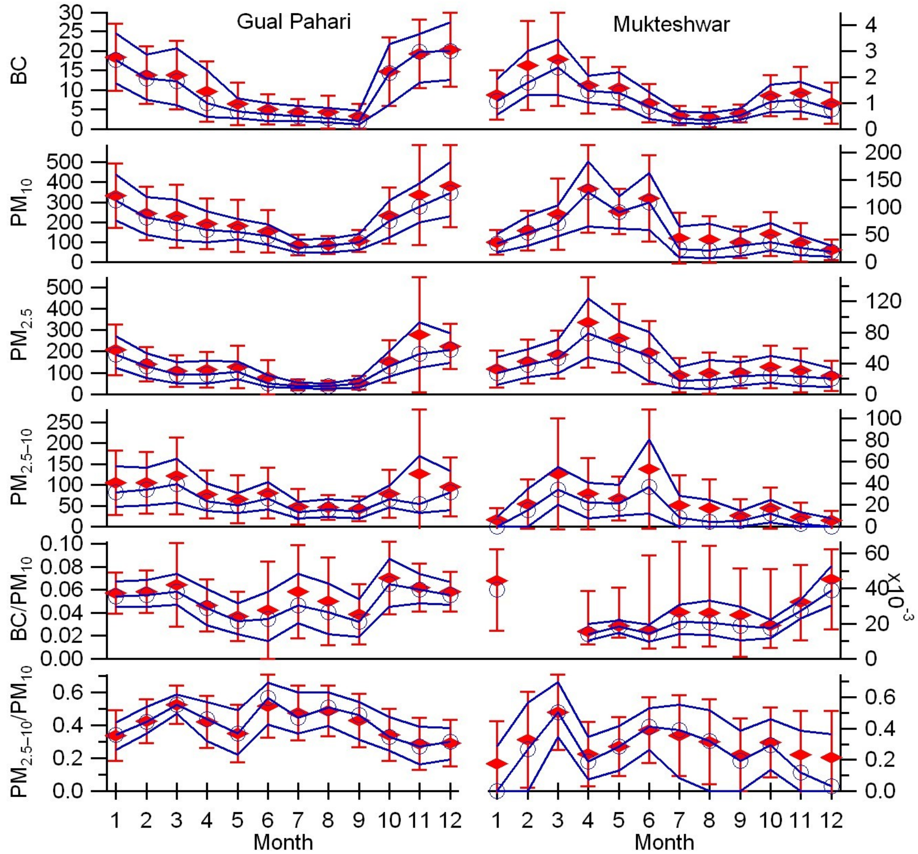


Figure S15: Annual cycles of the coarse mode ($PM_{2.5-10}$), $PM_{10}$, $PM_{2.5}$ and BC mass concentrations, and BC and coarse mode mass fractions. Monthly averages and one standard deviation error bars are shown with the red color, and the blue markers and lines are 25, 50 and 75 percentiles.

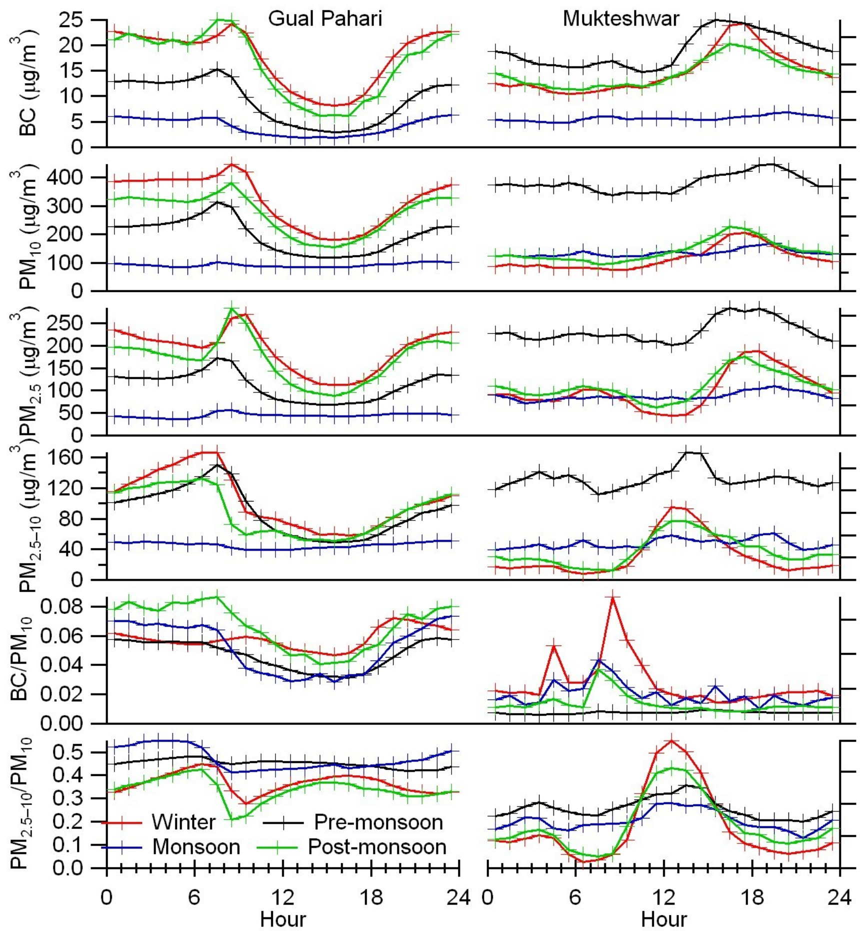


Figure S16: Seasonally averaged diurnal cycles of the different mass concentrations and mass fractions for Gual Pahari (left) and Mukteshwar (right).