Supplement of

Air mass physiochemical characteristics over New Delhi: impacts on aerosol hygroscopicity and cloud condensation nuclei (CCN) formation

Zainab Arub et al.

Correspondence to: Zainab Arub (jyotika.mmmec@gmail.com)

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Text S1

The following checks were carried out for all clusters: (a) If $R_{HOA} < R_{Ref,HOA}$, then aerosols are HOA, else if $R_{BBOA} < R_{Ref,BBOA}$, then aerosols are BBOA else if $R_{OOA} < R_{Ref,OOA}$, then aerosols are OOA else mixed, (b) If $R_{BBOA} < R_{Ref,BBOA}$, then aerosols are BBOA, else if $R_{HOA} < R_{Ref,HOA}$, then aerosols are HOA else if $R_{OOA} < R_{Ref,OOA}$, then aerosols are OOA else mixed, (c) If $R_{OOA} < R_{Ref,OOA}$, then aerosols are OOA, else if $R_{BBOA} < R_{Ref,BBOA}$, then aerosols are BBOA else if $R_{HOA} < R_{Ref,HOA}$, then aerosols are HOA else mixed, (d) If $R_{OOA} < R_{Ref,OOA}$, then aerosols are OOA, else if $R_{HOA} < R_{Ref,HOA}$, then aerosols are HOA else mixed, (e) If $R_{OOA} < R_{Ref,OOA}$, then aerosols are OOA else if $R_{BBOA} < R_{Ref,BBOA}$, then aerosols are BBOA else if $R_{HOA} < R_{Ref,HOA}$, then aerosols are HOA else mixed, (f) If $R_{BBOA} < R_{Ref,BBOA}$, then aerosols are BBOA, else if $R_{OOA} < R_{Ref,OOA}$, then aerosols are OOA else if $R_{HOA} < R_{Ref,HOA}$, then aerosols are HOA else mixed. If all 6 conditions were evaluated as the same specific category (i.e. HOA or BBOA or OOA), then that category was considered as the aerosol type for a cluster else they were considered as mixed.
Figure S1: HYSPLIT 5-day back trajectory cluster analysis for all seasons
**Figure S2:** Diurnal variations of volume fractions of (NH$_4$)$_2$SO$_4$, NH$_4$NO$_3$, NH$_4$Cl (representing the dominant contributors to hygroscopicity of air masses) and organics.
Figure S3: Variation of CCN number concentration and activated fraction with SS for BB branches (B and B.reg) and SA branches (L, R1, R2, and R3).
Figure S4: Diurnal variation of (a) $N_{\text{CCN}}$ at 0.1%, 0.4% and 0.8% SS, (b) activated fraction at 0.1%, 0.4% and 0.8% SS, (c) $N_{\text{CN}}, N_{\text{Aitken}}, N_{\text{Accumulation}}$, (d) $D_c$ at 0.1%, 0.4% and 0.8% SS, (e) Chemical Dispersion, and (f) GMD for BB (B and B.reg) air masses.
Figure S5: Diurnal variation of (a) $N_{CCN}$ at 0.1%, 0.4% and 0.8% SS, (b) activated fraction at 0.1%, 0.4% and 0.8% SS, (c) $N_{CCN}$, $N_{Aitken}$, $N_{Accum}$, (d) $D_c$ at 0.1%, 0.4% and 0.8% SS, (e) Chemical dispersion, and (f) GMD for SA (L, R1, R2 and R3) air masses.
Figure S6: Scatter plots between ns-NH$_4^+$ vs. NO$_3^-$ for B (left) and B.reg (right) branches.
Table S1: ANR and $r^2$ values between (a) [$\text{NH}_4^+$] and [$\text{O}_2^-$], (b) [ns-$\text{NH}_4^+$] and [$\text{Cl}$], (c) [ns-$\text{NH}_4^+$] and [$\text{NO}_3^-$], and (d) [ns-$\text{NH}_4^+$] and [$\text{Cl}^+$ + $\text{NO}_3^-$] for all air masses.

| Cluster | ANR | $r^2_{\text{NH}_4^+/\text{SO}_4}$ | $r^2_{\text{ns-NH}_4^+/\text{Cl}^+}$ | $r^2_{\text{ns-NH}_4^+/\text{NO}_3^-}$ | $r^2_{\text{ns-NH}_4^+/\text{Cl}^+ \text{NO}_3^-}$ |
|---------|-----|-------------------------------|---------------------------------|---------------------------------|---------------------------------|
| A       | 0.95| 0.78                          | 0.71                            | 0.45                            | 0.84                            |
| BB      | 0.91| 0.75                          | 0.43                            | 0.69                            | 0.59                            |
| SA      | 0.85| 0.34                          | 0.90                            | 0.54                            | 0.95                            |
| B       | 0.96| 0.78                          | 0.56                            | 0.70                            | 0.83                            |
| B.reg   | 0.83| 0.73                          | 0.27                            | 0.63                            | 0.31                            |
| L       | 0.92| 0.56                          | 0.87                            | 0.62                            | 0.94                            |
| R1      | 0.84| 0.53                          | 0.88                            | 0.59                            | 0.94                            |
| R2      | 0.81| 0.39                          | 0.93                            | 0.54                            | 0.96                            |
| R3      | 0.79| 0.36                          | 0.95                            | 0.60                            | 0.97                            |
Table S2: Mean total CN concentrations (cm$^{-3}$), CN in Aitken and Accumulation modes of all clusters.

| Cluster | CN Mean | CN Std | Aitken CN Mean | Aitken CN Std | Accumulation CN Mean | Accumulation CN Std |
|---------|---------|--------|----------------|---------------|----------------------|---------------------|
| A       | 20558   | 9654   | 15860          | 8083          | 4446                 | 3203                |
| BB      | 20864   | 9731   | 14964          | 8758          | 5595                 | 2536                |
| SA      | 31406   | 15168  | 19266          | 9615          | 11602                | 7392                |
| B       | 19025   | 7704   | 13344          | 6969          | 5392                 | 2323                |
| B.reg   | 24333   | 11956  | 18020          | 10745         | 5979                 | 2856                |
| L       | 27009   | 11651  | 16979          | 7933          | 9584                 | 5382                |
| R1      | 32772   | 16475  | 19792          | 10252         | 12395                | 8097                |
| R2      | 33371   | 14989  | 20243          | 9612          | 12552                | 7290                |
| R3      | 30974   | 12223  | 20245          | 8375          | 10289                | 5949                |
Table S3: Summary of $r^2$ values between GMD and $a_f$ for all clusters at SS=0.1%, 0.4% and 0.8%.

| Cluster | $r^2_{a_f, 0.1/%GMD}$ | $r^2_{a_f, 0.4/%GMD}$ | $r^2_{a_f, 0.8/%GMD}$ |
|---------|------------------------|------------------------|------------------------|
| A       | 0.873721               | 0.954904               | 0.787067               |
| BB      | 0.867738               | 0.985957               | 0.924469               |
| SA      | 0.665737               | 0.955936               | 0.850547               |
| B       | 0.887764               | 0.9867                 | 0.933447               |
| B.reg   | 0.793281               | 0.97207                | 0.891727               |
| L       | 0.77255                | 0.952054               | 0.881572               |
| R1      | 0.661235               | 0.941952               | 0.836889               |
| R2      | 0.609523               | 0.952322               | 0.870326               |
| R3      | 0.684657               | 0.954688               | 0.886271               |
Table S4: Contribution of BCwb and BCff for the various air masses

| Cluster | BCwb  | BCff  |
|---------|-------|-------|
| A       | 21%   | 79%   |
| BB      | 21.60%| 78.40%|
| SA      | 24.70%| 75.30%|
| B       | 26.80%| 73.20%|
| B.reg   | 21.60%| 78.40%|
| L       | 13.90%| 86.10%|
| R1      | 25.20%| 74.80%|
| R2      | 29%   | 71%   |
| R3      | 29.20%| 70.80%|