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Supplement of

On the relationship between cloud water composition and cloud droplet number concentration

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Table S1. Limits of detection (LOD) for the species that were measured in this study. IC = Ion Chromatography, ICP = ICP-MS or ICP-QQQ.

| Elements (ICP) | LOD (ppt) | Inorganic ions (IC) | LOD (ppm) |
|---------------|-----------|---------------------|-----------|
| Ag            | 0.74      | Ammonium (NH₄⁺)     | 0.0424    |
| Al            | 29.47     | Bromide (Br⁻)       | 0.0251    |
| As            | 7.95      | Calcium (Ca²⁺)      | 0.0452    |
| B             | 361.83    | Chloride (Cl⁻)      | 0.0021    |
| Ba            | 3.70      | Fluoride (F⁻)       | a         |
| Br            | a         | Lithium (Li⁺)       | 0.0349    |
| C             | a         | Magnesium (Mg²⁺)    | 0.0369    |
| Ca            | 543.10    | Methanesulfonic acid (MSA) | 0.0123 |
| Cd            | 4.19      | Nitrate (NO₃⁻)      | 0.0089    |
| Cl            | a         | Nitrite (NO₂⁻)      | 0.0262    |
| Co            | 0.72      | Potassium (K⁺)      | 0.0262    |
| Cr            | 1.15      | Sodium (Na⁺)        | 0.0435    |
| Cs            | 0.73      | Sulfate (SO₄²⁻)     | 0.0120    |
| Cu            | 1.13      | Ammonium (NH₄⁺)     | 0.0424    |
| Fe            | 1.19      | Acetate             | a         |
| Ga            | a         | Adipate             | 0.0227    |
| Hf            | 0.96      | Butyrate            | a         |
| K             | 10.48     | Formate             | 0.0742    |
| Li            | 103.65    | Glutarate           | 0.0063    |
| Mg            | 14.38     | Glycolate           | 0.0536    |
| Mn            | 1.62      | Glyoxylate          | 0.9448    |
| Mo            | 2.26      | Lactate             | a         |
| Na            | 7.74      | Maleate             | 0.0070    |
| Nb            | 0.52      | Malonate            | 0.3915    |
| Ni            | 2.84      | Oxalate             | 0.0123    |
| Pb            | 0.50      | Propionate          | a         |
| Pd            | 1.68      | Pyruvate            | 0.0638    |
| Rb            | 1.57      | Succinate           | 0.0110    |
| Rh            | a         | Amines (IC)         | LOD (ppm) |
| S             | 5823.00   | Diethylamine (DEA)b | 0.3152    |
| Si            | 126.47    | Dimethylamine (DMA) | 0.0527    |
| Sn            | 1.77      | Diethylamine (BM)   | a         |
| Sr            | 1.10      | Dimethylamine (DMA) | 0.0527    |
| Ta            | 0.20      | Lactate             | a         |
| Te            | 65.46     | Maleate             | 0.0070    |
| Ti            | 39.05     | Malonate            | 0.3915    |
| V             | 1.35      | Oxalate             | 0.0123    |
| W             | a         | Propionate          | a         |
| Y             | 0.5230    | Succinate           | 0.0110    |
| Zn            | 5.8800    | Amines (IC)         | LOD (ppm) |
| Zr            | 1.0080    | Diethylamine (DEA)b | 0.3152    |

*a LODs were not available for these species.

b DEA co-elutes with Trimethylamine (TMA), so this LOD is an overestimate.
Table S2. Summary of the number of regressions that were statistically significant in Figure 4. A regression was considered statistical significance if all the p-values for a regression were < 0.05. There is a p-value associated to the overall regression, to each predictor, and to the intercept.

| # of predictors | # of regressions | % of regressions that are statistically significant |
|-----------------|------------------|--------------------------------------------------|
| 1               | 9                | 100                                              |
| 2               | 35               | 66                                               |
| 3               | 77               | 22                                               |
| 4               | 105              | 10                                               |
| 5               | 91               | 8                                                |
| 6               | 49               | 0                                                |
| 7               | 15               | 0                                                |
| 8               | 2                | 0                                                |
Figure S1. Time series of altitude (top), vertical wind speed ($w$) (middle), and the standard deviation of vertical wind speed ($\sigma_w$) (below) for a representative flight on 9 July 2011. The red trace in the top panel indicates when the aircraft was inside the cloud (i.e., LWC $\geq 0.02$ g m$^{-3}$). The bold blue lines in the middle and bottom panels are the averages of $w$ and $\sigma_w$, over the duration of the shaded blue boxes, respectively. The dashed lines in the bottom panel represent the 33rd percentile and 66th percentile of the data in this study.
**Figure S2.** Correlation matrix of $R^2_{adj}$ for the nine filtered species used to predict cloud droplet number concentration ($N_d$). All values are statistically significant (p-value < 0.05). The cells are color coded to highlight low values (red) and high values (green).
Figure S3. Scatterplots of four selected species when binning by $\sigma_w$. These four species were selected owing to their ability to represent distinct aerosol sources in the study region. Red: top 33rd percentile ($\sigma_w \geq 0.33 \text{ m s}^{-1}$); Blue: bottom 33rd percentile ($\sigma_w \leq 0.27 \text{ m s}^{-1}$); Black: between bottom and top percentiles ($0.27 \text{ m s}^{-1} \leq \sigma_w \leq 0.33 \text{ m s}^{-1}$).
Figure S4. Scatterplots of four selected species when binning by smoke influence. (a) The NiCE (2015) and FASE (2016) campaigns are considered together. Black: Smoke-influence and no-
smoke influence combined; Red: smoke influence; Blue: no smoke influence. (b) The NiCE and FASE campaigns are considered separately. Green: NiCE; Orange: FASE.
Figure S5. Scatterplots of four selected species when binning by normalized in-cloud height. Red: top third; Green: mid third; Blue: bottom third.