

SUPPLEMENTAL INFORMATION

Table S1: LCMS Setup for analysis for carbonyl compounds.

Instrument	
LCMS System	Varian 1200L LCMS (Varian, Palo Alto, CA)
Pumps	Varian Prostar 210
Autoinjector	Varian Prostar 410 Variable Volume
Column	Supelcosil-LC-18, 25cm x 3mm x 5µm
Absorbance Spectrophotometer	Varian 335 Diode Array
Mass Spectrometer	Varian 1200 Triple Quadrupole MS

Solvents	
A	Water (>18MΩ, Millipore, Billerica, MA)
B	Acetonitrile (Fisher Scientific, Optima grade, Waltham, MA)

Solvent Program	
Time (min)	Composition (A:B)
0:00	50:50
23:00	50:50
27:00	25:75
36:00	25:75
Nine minute post-run equilibration	

Instrumental Parameters	
Injection volume (µL)	50
Solvent Flow (mLmin ⁻¹)	0.6
Diode Array Wavelengths (nm)	360, 430

Mass Spectrometer Parameters	
Ion Source	Electrospray Ionization (ESI)
Ionization Mode	Negative
Detection Mode	Multiple Ion Monitoring (MIM)
Detector Voltage (V)	- 1440
Needle Voltage (V)	- 4500
Shield Voltage (V)	- 600
ESI Housing Temperature (°C)	60
Drying Gas Temperature (°C)	375
Drying Gas Pressure (psi)	20
Nebulizing Gas Pressure (psi)	60

Table S2: Pseudo-molecular ions of 2,4-dinitrophenylhydrazine (DNPH) derivatized carbonyls in ESI negative mode. Compounds with the same m/z were resolved and identified by spiking with pure standards.

Compound	Selected mass-to-charge ratios (m/z)
formaldehyde-2,4-DNPH	208, 209
acetaldehyde-2,4-DNPH	223
acrolein-2,4-DNPH	235
propionaldehyde-2,4-DNPH	237
acetone-2,4-DNPH	237
crotonaldehyde-2,4-DNPH	249
methacrolein-2,4-DNPH	249
butyraldehyde-2,4-DNPH	251
2-butanone-2,4-DNPH	251
isovaleraldehyde-2,4-DNPH	265
valeraldehyde-2,4-DNPH	265
hexaldehyde-2,4-DNPH	279
benzaldehyde-2,4-DNPH	285
p-tolualdehyde-2,4-DNPH	299
glyoxal-2,4-DNPH	417
methylglyoxal-2,4-DNPH	430

Calculation of K_H^{*DOC}

In order to compare the overall partitioning of DOC between gas and aqueous phases, we define the ratio as used in Henry's Law constants, i.e.

$$K_H = \frac{c_{aq}}{p_g} \left[\frac{\text{mol/l}_{aq}}{\text{atm}} \right] \quad [\text{Eq-S1}]$$

Since strictly, K_H is only defined for the physical solubility of individual species in ideal solution, we use K_H^{*DOC} instead in order to account for the deviation from this original definition.

$$K_H^{*DOC} = \frac{c_{aq}(DOC)}{p_g(\text{gasOC})} \left[\frac{\text{mol/l}_{aq}}{\text{atm}} \right] \quad [\text{Eq-S2}]$$

whereas gasC is defined here as the fraction of TOOC that is not present in the aqueous phase, i.e. the difference between TOOC and DOC. This assumption neglects the amount of carbon that is not dissolved in clouds but associated with particles.

 1) DOC aqueous phase concentrations in fog/clouds are listed in Table 1 [mg L_{aq}^{-1}]

Conversion of DOC [mg L_{aq}^{-1}] to c_{aq} [mol l_{aq}^{-1}]

$$1 \text{ mg l}^{-1} = 10^{-3} \text{ g/L} / (12 \text{ gC/molC}) = 8.3 \cdot 10^{-5} \text{ mol/L} \quad [\text{Eq-S3}]$$

 2) DOC [mg m^{-3}] and estimated TOOC [$\mu\text{g m}^{-3}$] concentrations are listed in Table 1.

$$OC_{gas} [\mu\text{g m}^{-3}] = TOOC [\mu\text{g m}^{-3}] - DOC [\mu\text{g m}^{-3}] \quad [\text{Eq-S4}]$$

Convert mass loading of OC_{gas} [$\mu\text{g m}^{-3}$] to partial pressure of $p(OC_{gas})$ [atm]

$$10^{-6} \text{ g m}^{-3} \cdot (12 \text{ g/mol})^{-1} = 8.33 \cdot 10^{-8} \text{ moles m}^{-3} \quad [\text{Eq-S5}]$$

Conversion of gas concentration [moles m^{-3}] to partial pressure [atm] according to law for ideal gases

$$p[\text{atm}] = \frac{n}{V} [\text{moles m}^{-3}] \cdot R [\text{m}^3 \text{atm mol}^{-1} \text{K}^{-1}] \cdot T [\text{K}] \quad [\text{Eq-S6}]$$

with $R = 82.1 \text{ m}^3 \text{atm mol}^{-1} \text{K}^{-1}$ and $T \sim 290 \text{ K}$

$$8.33 \cdot 10^{-8} \text{ moles m}^{-3} / (1 \mu\text{g gasC m}^{-3}) \cdot 8.205 \cdot 10^{-5} \text{ m}^3 \text{atm mol}^{-1} \text{K}^{-1} \cdot 290 \text{ K} = 2 \cdot 10^{-9} \text{ atm} \quad [\text{Eq-S7}]$$

 3) Conversion of ratio of aqueous phase concentration DOC [mg l^{-1}] to gas phase concentration OC_{gas} [mg m^{-3}] to [$\text{mol l}^{-1} \text{atm}^{-1}$]:

$$K_H^{*DOC} [\text{mol L}^{-1} \text{atm}^{-1}] = \frac{DOC [\text{mg L}^{-1}] \cdot 8.3 \cdot 10^{-5} [\text{mol L}^{-1} / (\text{mg L}^{-1})]}{OC_{gas} [\mu\text{g m}^{-3}] \cdot 2 \cdot 10^{-9} [\text{atm} / (\mu\text{g m}^{-3})]} \quad [\text{Eq-S8}]$$