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Supplement of

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

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

Elements (ICP)	LOD (ppt)	Inorganic ions (IC)	LOD (ppm)
Ag	0.74	Ammonium (NH ₄ ⁺)	0.0424
Al	29.47	Bromide (Br ⁻)	0.0251
As	7.95	Calcium (Ca ²⁺)	0.0452
B	361.83	Chloride (Cl ⁻)	0.0021
Ba	3.70	Fluoride (F ⁻)	^a
Br	^a	Lithium (Li ⁺)	0.0349
C	^a	Magnesium (Mg ²⁺)	0.0369
Ca	543.10	Methanesulfonic acid (MSA)	0.0123
Cd	4.19	Nitrate (NO ₃ ⁻)	0.0089
Cl	^a	Nitrite (NO ₂ ⁻)	0.0262
Co	0.72	Potassium (K ⁺)	0.0262
Cr	1.15	Sodium (Na ⁺)	0.0435
Cs	0.73	Sulfate (SO ₄ ²⁻)	0.0120
Cu	1.13		
Fe	1.19		
Ga	^a	<u>Organic ions (IC)</u>	<u>LOD (ppm)</u>
Hf	0.96	Acetate	0.0027
I	^a	Adipate	0.0227
K	10.48	Butyrate	^a
Li	103.65	Formate	0.0742
Mg	14.38	Glutarate	0.0063
Mn	1.62	Glycolate	0.0536
Mo	2.26	Glyoxylate	0.9448
Na	7.74	Lactate	^a
Nb	0.52	Maleate	0.0070
Ni	2.84	Malonate	0.3915
P	770.73	Oxalate	0.0123
Pb	0.50	Propionate	^a
Pd	1.68	Pyruvate	0.0638
Rb	1.57	<u>Succinate</u>	<u>0.0110</u>
Rh	^a		
Ru	1.44		
S	5823.00	<u>Amines (IC)</u>	<u>LOD (ppm)</u>
Sb	^a	Diethylamine (DEA) ^b	0.3152
Se	82.39	Dimethylamine (DMA)	0.0527
Si	126.47		
Sn	1.77		
Sr	1.10		
Ta	0.20		
Te	65.46		
Ti	39.05		
V	1.35		
W	^a		
Y	0.5230		
Zn	5.8800		
Zr	1.0080		

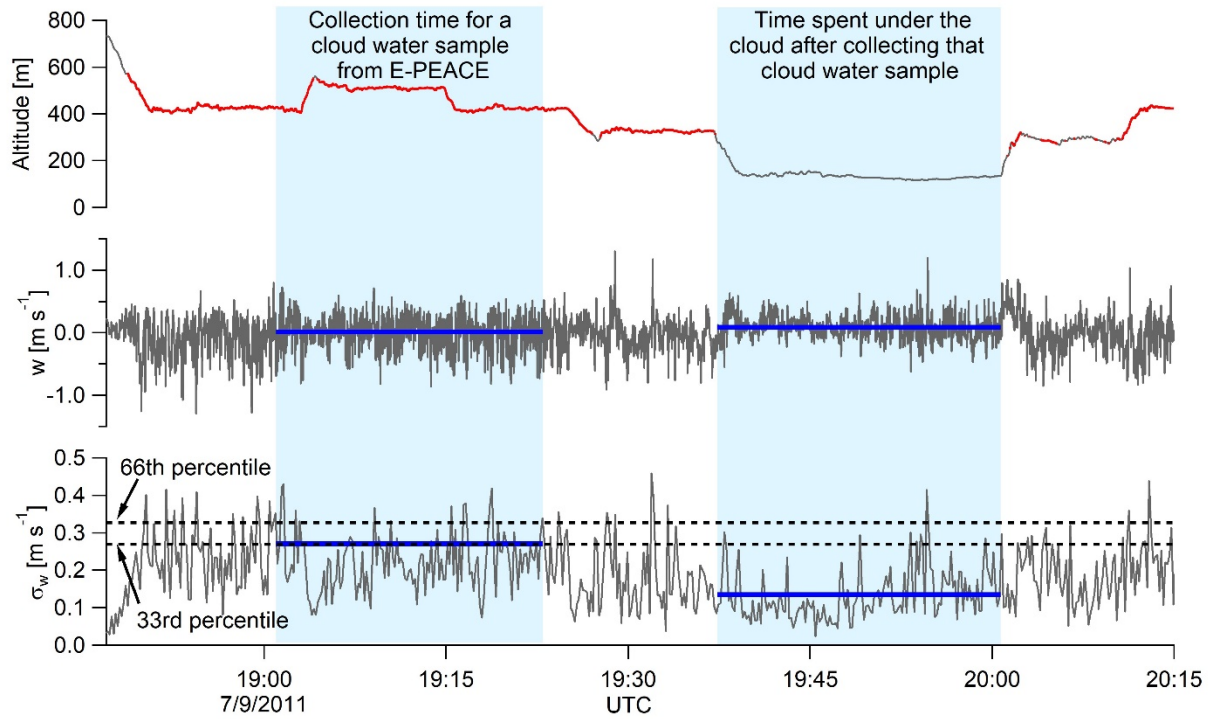
^a LODs were not available for these species.

^b DEA co-elutes with Trimethylamine (TMA), so this LOD is an overestimate.

12 **Table S2.** Summary of the number of regressions that were statistically significant in Figure 4. A
 13 regression was considered statistical significance if all the p-values for a regression were < 0.05 .
 14 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

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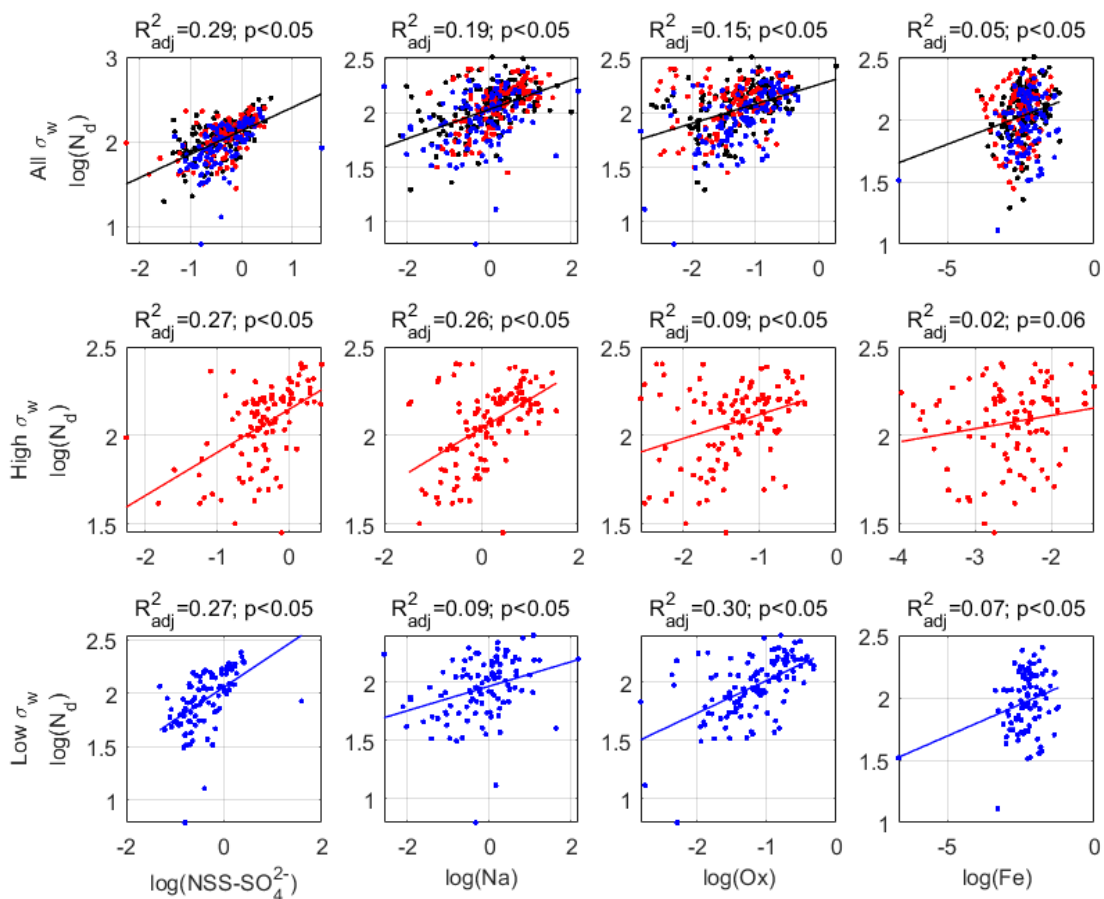


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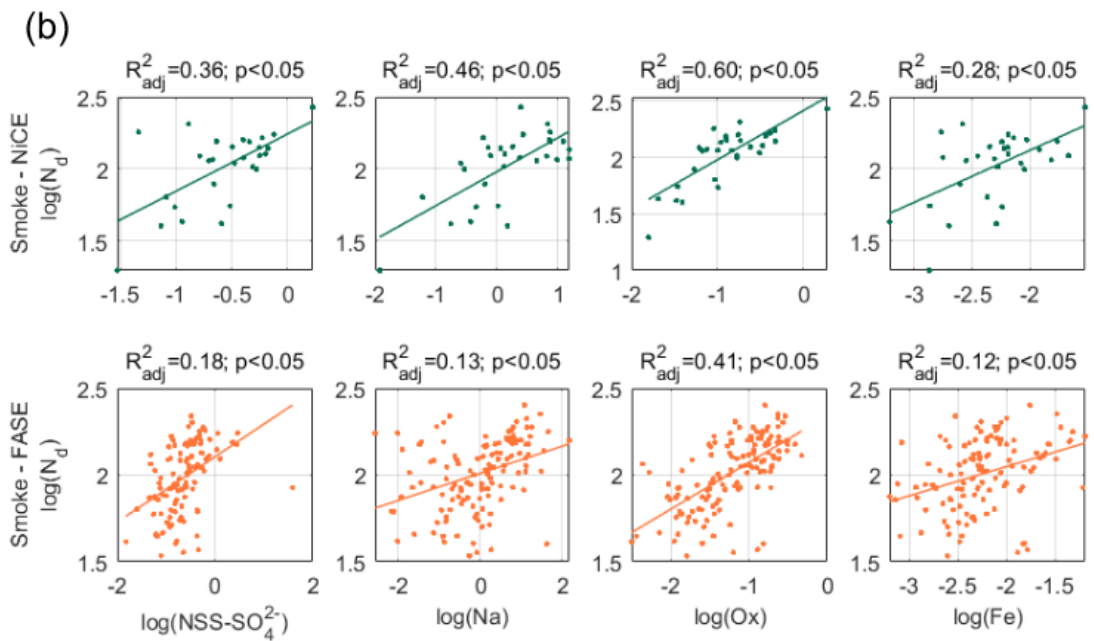
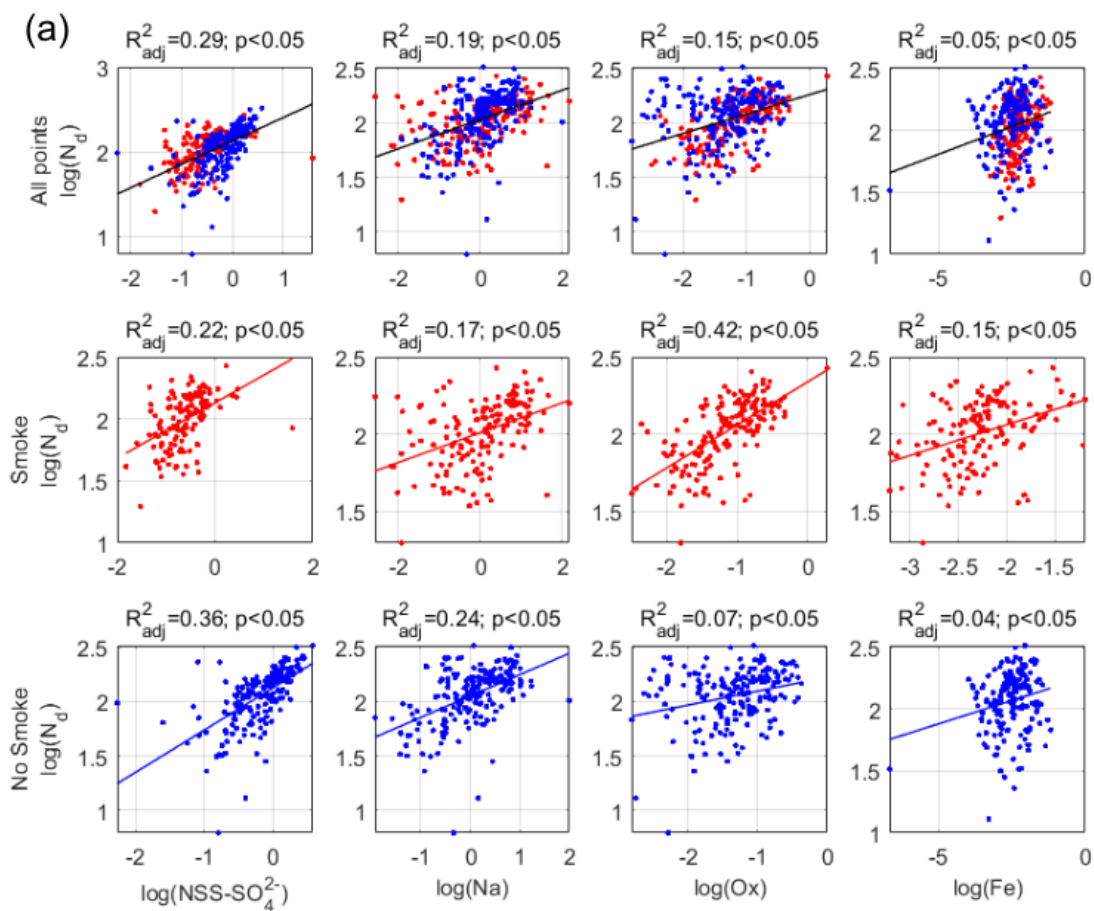
Figure S1. Time series of altitude (top), vertical wind speed (w) (middle), and the standard deviation of vertical wind speed (σ_w) (below) for a representative flight on 9 July 2011. The red trace in the top panel indicates when the aircraft was inside the cloud (i.e., $LWC \geq 0.02 \text{ g m}^{-3}$). The bold blue lines in the middle and bottom panels are the averages of w and σ_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.

MSA	1								
NH ₄ ⁺	0.36	1							
NO ₃ ⁻	0.42	0.48	1						
Ox	0.51	0.55	0.39	1					
Tot-SO ₄ ²⁻	0.50	0.42	0.43	0.20	1				
NSS-SO ₄ ²⁻	0.18	0.26	0.36	0.08	0.60	1			
Na	0.35	0.20	0.12	0.13	0.53	0.05	1		
Fe	0.20	0.14	0.22	0.23	0.07	0.02	0.03	1	
V	0.07	0.27	0.49	0.04	0.28	0.48	0.03	0.04	1
	MSA	NH ₄ ⁺	NO ₃ ⁻	Ox	Tot-SO ₄ ²⁻	NSS-SO ₄ ²⁻	Na	Fe	V

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 26 **Figure S2.** Correlation matrix of R^2_{adj} for the nine filtered species used to predict cloud droplet
 27 number concentration (N_d). All values are statistically significant (p-value < 0.05). The cells are
 28 color coded to highlight low values (red) and high values (green).
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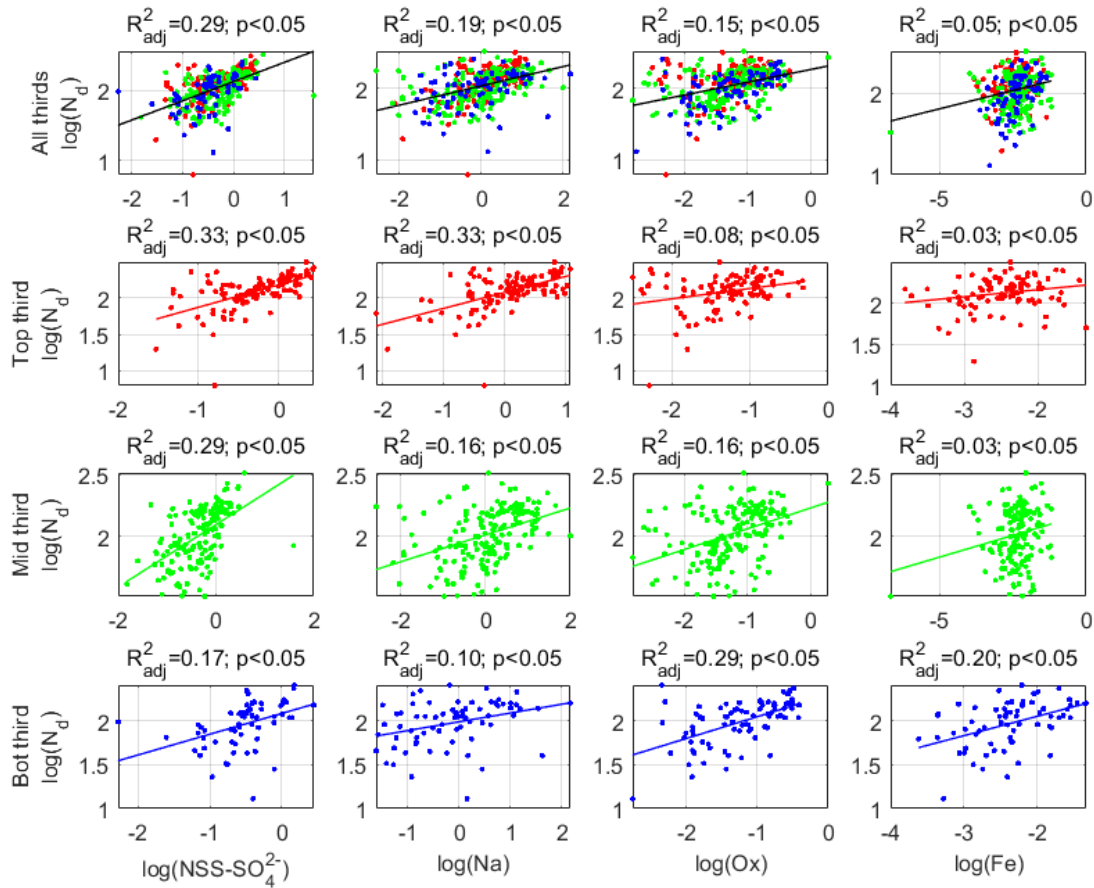


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 31 **Figure S3.** Scatterplots of four selected species when binning by σ_w . These four species were
 32 selected owing to their ability to represent distinct aerosol sources in the study region. Red: top
 33 33rd percentile ($\sigma_w \geq 0.33 \text{ m s}^{-1}$); Blue: bottom 33rd percentile ($\sigma_w \leq 0.27 \text{ m s}^{-1}$); Black: between
 34 bottom and top percentiles ($0.27 \text{ m s}^{-1} \leq \sigma_w \leq 0.33 \text{ m s}^{-1}$).



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 36 **Figure S4.** Scatterplots of four selected species when binning by smoke influence. (a) The NiCE
 37 (2015) and FASE (2016) campaigns are considered together. Black: Smoke-influence and no-

38 smoke influence combined; Red: smoke influence; Blue: no smoke influence. (b) The NiCE and
39 FASE campaigns are considered separately. Green: NiCE; Orange: FASE.
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 44 **Figure S5.** Scatterplots of four selected species when binning by normalized in-cloud height.
 45 Red: top third; Green: mid third; Blue: bottom third.