Supporting Information for

Measurement Report: Seasonal and Vertical Variations in $PM_{2.5}$ Water-Soluble Matter Hygroscopicity at Mt. Hua, Central China: Insights from Inorganic and Organic Fractions

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Contents of this file

Figures S1 to S6

Tables S1 to S3

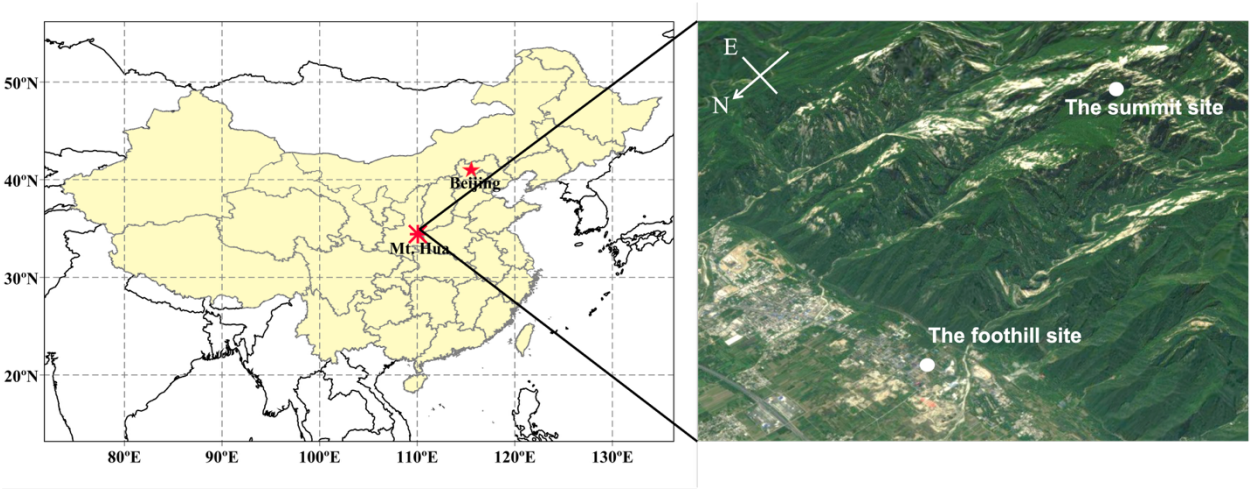


Figure S1. Location of Mt. Hua and the summit and foothill sampling sites.

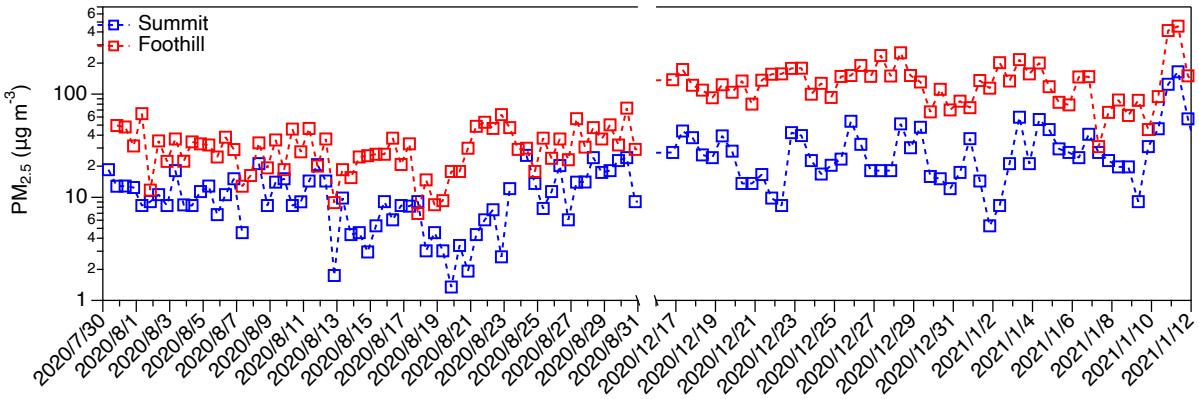


Figure S2. Temporal variations in $PM_{2.5}$ concentrations at the summit and foothill sites of Mt. Hua during summer and winter.

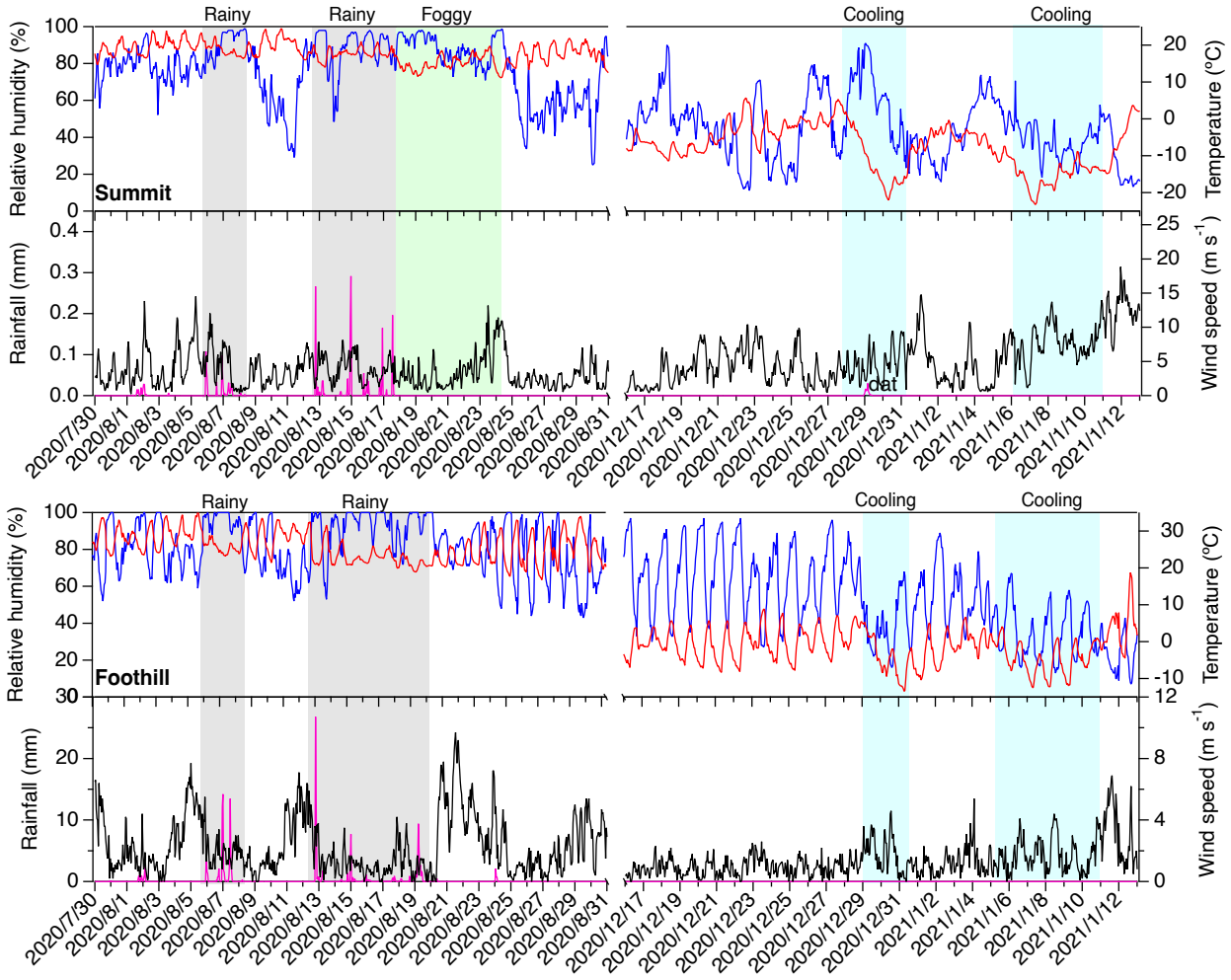


Figure S3. Temporal variations in relative humidity (RH), temperature, rainfall, and wind speed at the summit and foothill sites during the summer and winter sampling periods.

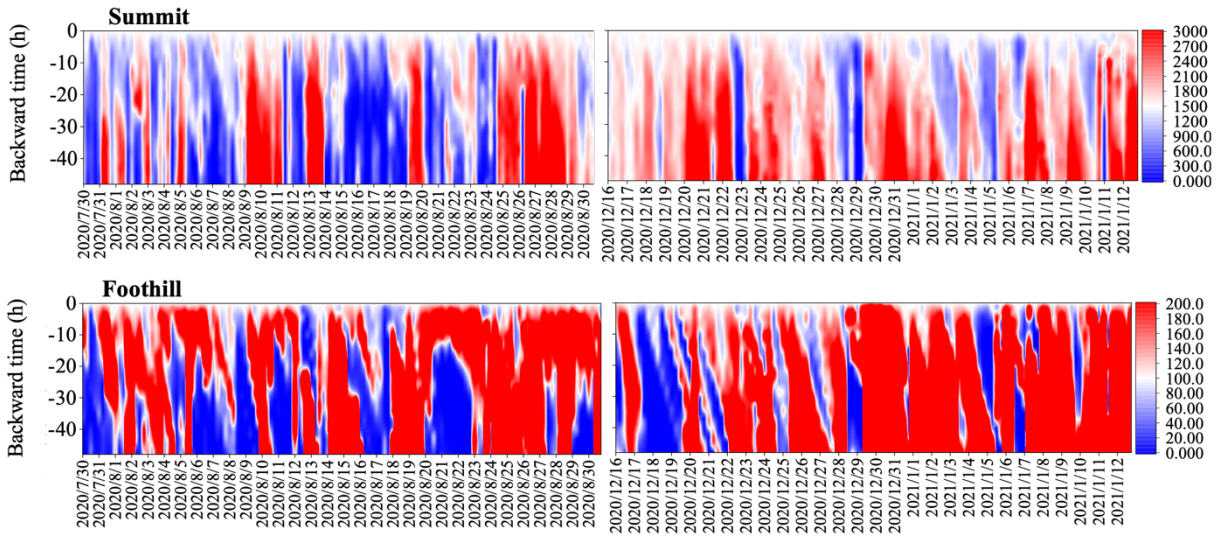


Figure S4. Variations in air mass height along the 48-h backward trajectories arriving at the summit and foothill sites of Mt. Hua during summer and winter.

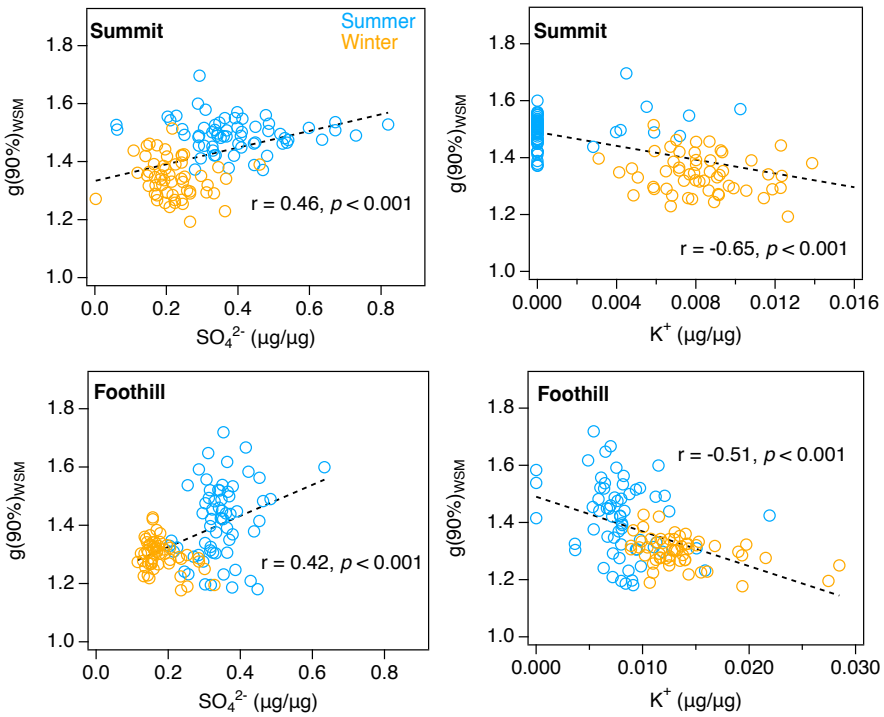


Figure S5. Correlations between $g(90\%)_{WSM}$ and relative contributions of SO_4^{2-} and K^+ at the summit and foothill. Summer and winter samples are shown in different colors.

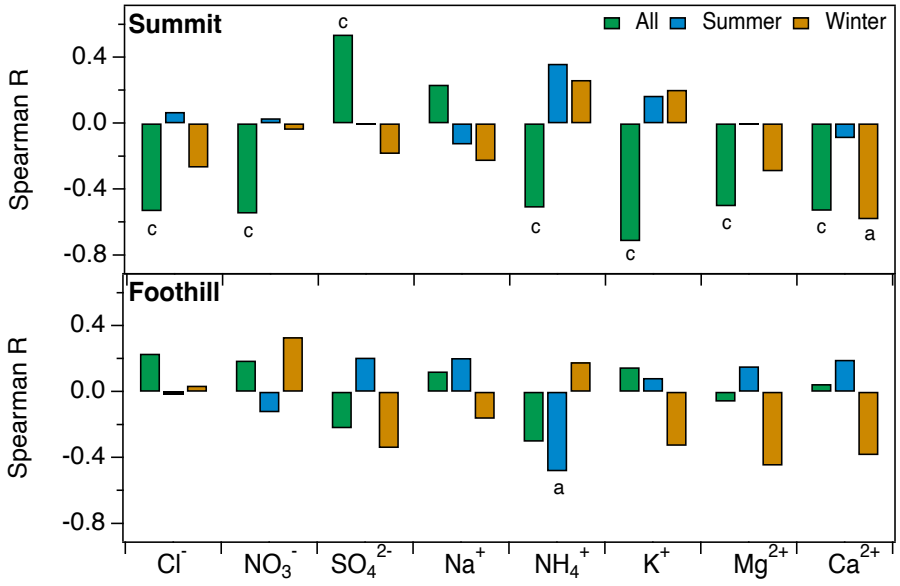


Figure S6. Spearman correlation coefficients between g(90%)$_{WSIM}$ and the relative contributions of individual water-soluble ions at the summit and foothill for all samples and separately for summer and winter. a and c indicate statistical significance at $p < 0.05$ and $p < 0.001$, respectively.

Table S1. Recovery of nitrate and sulfate in the inorganic fractions after SPE separation.

Sampling Date	Sampling site	Before SPE (μg m^{-3})		Separated inorganic fraction (μg m^{-3})		Separated organic fraction (μg m^{-3})		Recovery	
		NO_3^-	SO_4^{2-}	NO_3^-	SO_4^{2-}	NO_3^-	SO_4^{2-}	NO_3^-	SO_4^{2-}
2020/12/30 daytime	Foothill	5.06	5.43	4.69	4.99	<LOD	<LOD	92.6%	92.0%
2020/08/05 daytime	Foothill	2.41	5.93	2.20	5.74	<LOD	<LOD	91.0%	96.8%
2020/08/12 nighttime	Summit	0.61	1.98	0.54	1.88	<LOD	<LOD	87.3%	94.7%

Table S2. Relative contributions of major water-soluble species to WSM at the summit and foothill sites during different meteorological conditions in summer and winter.

	Summer foothill		Winter foothill		Summer summit		Winter summit	
	Rainy/foggy	Clear	Cooling	Non-cooling	Rainy/foggy	Clear	Cooling	Non-cooling
Cl^-	0.74%	0.40%	8.57%	5.84%	0.92%	0.49%	4.22%	1.72%
NO_3^-	23.20%	12.98%	19.38%	33.04%	8.01%	6.99%	22.37%	27.84%
SO_4^{2-}	33.84%	33.77%	20.57%	15.11%	39.86%	35.87%	23.04%	18.72%
Na^+	0.37%	1.17%	2.45%	0.79%	8.11%	6.12%	3.68%	1.38%
NH_4^+	11.12%	6.85%	4.05%	3.97%	1.00%	1.55%	3.71%	4.87%
K^+	0.79%	0.76%	1.49%	1.25%	0.19%	0.13%	0.88%	0.83%
Mg^{2+}	0.34%	0.59%	0.53%	0.22%	0.64%	0.23%	0.71%	0.44%
Ca^{2+}	2.09%	4.22%	9.22%	3.64%	2.25%	2.65%	11.30%	4.61%
WSOM	27.52%	39.27%	33.75%	36.15%	39.00%	45.97%	30.10%	39.60%

Table S3. Numbers and relative frequencies of backward trajectory clusters at the summit and foothill sites of Mt. Hua under different meteorological conditions during summer and winter.

(a) summer

Site	Cluster	Number (relative frequency)		
		Total	Clear	Rainy/foggy
Summit	1	42 (32.81%)	29 (22.65%)	13 (10.16%)
	2	23 (17.97%)	22 (17.19%)	1 (0.78%)
	3	63 (49.22%)	37 (28.91%)	26 (20.31%)
Foothill	1	73 (57.03%)	53 (41.40%)	20 (15.63%)
	2	39 (30.47%)	21 (16.41%)	18 (14.06%)
	3	16 (12.50%)	2 (1.56%)	14 (10.94%)

(b) winter

Site	Cluster	Number (relative frequency)		
		Total	Clear	Rainy/foggy
Summit	1	54 (48.21%)	40 (35.71%)	14 (12.50%)
	2	24 (21.43%)	23 (20.54%)	1 (0.89%)
	3	34 (30.36%)	9 (8.04%)	25 (22.32%)
Foothill	1	66 (58.93%)	33 (29.46%)	33 (29.46%)
	2	21 (18.75%)	21 (18.75%)	0 (0%)
	3	25 (22.32%)	22 (19.64%)	3 (2.68%)