

Vertical distribution of sub-micron aerosol chemical composition from North-Western Europe and the North-East Atlantic

W.T. Morgan¹, J.D. Allan^{1,2}, K.N. Bower¹, G. Capes¹, J. Crosier^{1,2},
P.I. Williams^{1,2} and H. Coe¹

1. Centre for Atmospheric Science, University of Manchester, Manchester, UK

2. National Centre for Atmospheric Science, University of Manchester, UK

Correspondance to: W. T. Morgan (william.morgan@postgrad.manchester.ac.uk)

Supplementary material for the discussion paper to be published in ACPD.

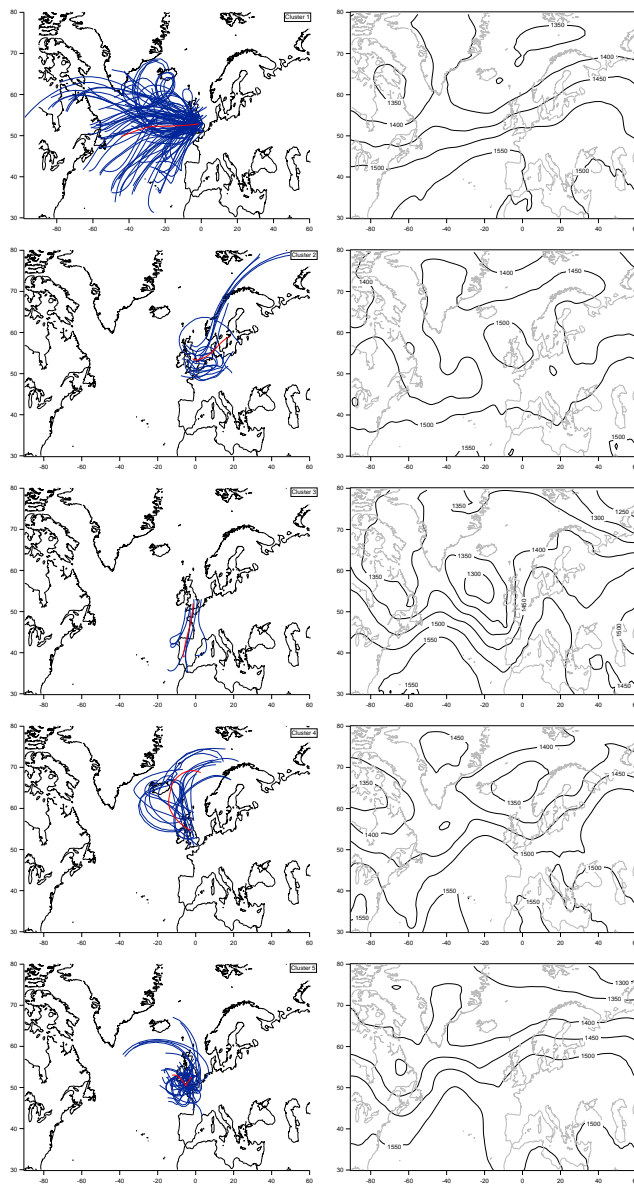


Figure S1: Maps of all back trajectories for each cluster along with the mean trajectory (red line). Also shown are average ECMWF* 850hPa geopotential height fields based on a 2.5 by 2.5 horizontal grid. *European Centre for Medium-Range Weather Forecasts. ECMWF Operational Analysis data, [Internet]. BADC, .2006-2008.

Available from <http://badc.nerc.ac.uk/data/ecmwf-op/>

Species	Statistic	Altitude (km)											
		0.0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0	5.0-5.5	
Organics	25 th percentile	0.066	-0.121	-0.201	-0.280	-0.218	-0.348	-0.378	-0.609	-1.067	-0.846	-1.420	
	50 th percentile	0.768	0.558	0.535	0.415	0.441	0.333	0.228	0.033	-0.013	-0.070	-0.309	
	75 th percentile	1.632	1.470	1.445	1.323	1.383	0.904	1.081	1.037	1.048	1.075	0.731	
Sulphate	Mean	1.052	0.801	0.799	0.716	0.610	0.446	0.382	0.264	0.206	0.199	-0.188	
	MAE/\sqrt{n}	0.049	0.047	0.054	0.060	0.083	0.084	0.067	0.146	0.175	0.191	0.208	
	25 th percentile	0.302	0.200	0.203	0.142	0.107	0.075	0.053	0.030	-0.042	-0.030	-0.041	
Nitrate	50 th percentile	0.800	0.678	0.663	0.482	0.450	0.254	0.311	0.189	0.117	0.185	0.148	
	75 th percentile	1.504	1.365	1.358	1.103	0.925	0.687	0.532	0.512	0.412	0.374	0.524	
	Mean	1.093	1.029	0.964	0.782	0.642	0.409	0.341	0.330	0.176	0.182	0.254	
Ammonium	MAE/\sqrt{n}	0.032	0.031	0.032	0.028	0.035	0.030	0.026	0.049	0.035	0.049	0.047	
	25 th percentile	0.027	0.014	0.017	-0.004	-0.009	-0.015	-0.017	-0.030	-0.032	-0.082	-0.030	
	50 th percentile	0.140	0.099	0.079	0.045	0.049	0.027	0.033	0.017	0.020	0.005	0.028	
Ammonium	75 th percentile	0.619	0.516	0.623	0.170	0.178	0.119	0.090	0.076	0.136	0.115	0.151	
	Mean	0.911	0.696	0.657	0.328	0.310	0.099	0.052	0.022	0.038	0.017	0.052	
	MAE/\sqrt{n}	0.033	0.025	0.026	0.015	0.019	0.012	0.007	0.012	0.016	0.019	0.019	
Ammonium	25 th percentile	-0.028	-0.072	-0.110	-0.176	-0.220	-0.186	-0.348	-0.470	-0.464	-0.402	-0.418	
	50 th percentile	0.375	0.306	0.352	0.274	0.262	0.157	0.045	0.106	0.092	0.197	0.180	
	75 th percentile	0.910	0.879	0.935	0.782	0.729	0.593	0.564	0.548	0.725	0.596	0.640	
Ammonium	Mean	0.646	0.550	0.514	0.384	0.303	0.234	0.062	0.001	0.100	0.137	0.156	
	MAE/\sqrt{n}	0.030	0.028	0.033	0.034	0.051	0.046	0.043	0.115	0.101	0.127	0.119	

Table S1a: Profile statistics summary for the full dataset from 0.0-5.5km. MAE refers to the Mean Absolute Error and n refers to the number of points.

Species	Statistic	Altitude (km)										
		5.5-6.0	6.0-6.5	6.5-7.0	7.0-7.5	7.5-8.0	8.0-8.5	8.5-9.0	9.0-9.5	9.5-10.0	10.0-10.5	10.5-11.0
Organics	25 th percentile	-1.400	-1.392	-1.118	-0.931	-1.629	-1.262	-1.568	-1.322	-2.032	-2.160	-1.857
	50 th percentile	0.275	0.139	0.535	0.661	-0.031	0.563	-0.109	0.958	0.026	-0.351	0.079
	75 th percentile	1.514	1.130	1.878	2.059	1.542	2.307	2.532	3.458	2.246	2.349	2.012
Sulphate	Mean	0.227	-0.039	0.566	0.812	0.181	0.762	0.666	1.687	0.062	-0.301	0.498
	MAE/\sqrt{n}	0.327	0.301	0.342	0.261	0.320	0.338	0.301	0.381	0.514	0.458	0.561
	25 th percentile	-0.063	-0.130	-0.168	-0.081	-0.212	-0.175	-0.060	-0.106	-0.424	-0.057	0.184
Nitrate	50 th percentile	0.222	0.177	0.242	0.228	0.206	0.227	0.263	0.348	0.460	0.271	0.715
	75 th percentile	0.542	0.552	0.523	0.665	0.659	0.850	0.693	0.834	0.891	0.778	1.023
	Mean	0.2123	0.162	0.188	0.264	0.216	0.321	0.315	0.301	0.409	0.423	0.603
Nitrate	MAE/\sqrt{n}	0.0589	0.075	0.083	0.063	0.080	0.100	0.072	0.090	0.165	0.089	0.146
	25 th percentile	-0.096	-0.112	-0.169	-0.063	-0.124	-0.067	-0.093	-0.195	-0.186	-0.252	-0.198
	50 th percentile	0.003	0.007	0.024	0.033	0.011	0.014	0.023	-0.007	0.100	0.048	0.031
Ammonium	75 th percentile	0.173	0.099	0.121	0.217	0.160	0.168	0.192	0.130	0.324	0.229	0.281
	Mean	0.031	-0.020	-0.0312	0.042	0.024	0.012	0.020	-0.035	0.094	0.048	0.101
	MAE/\sqrt{n}	0.026	0.048	0.080	0.031	0.030	0.034	0.036	0.046	0.070	0.060	0.056
Ammonium	25 th percentile	-0.595	-0.499	-0.612	-0.832	-0.726	-0.724	-1.023	-1.338	-1.294	-0.706	-0.860
	50 th percentile	0.146	0.176	0.148	0.204	0.364	0.008	0.253	0.016	0.334	0.159	-0.042
	75 th percentile	0.902	1.012	0.832	0.883	0.972	0.947	1.247	1.334	1.384	1.288	0.735
Ammonium	Mean	0.093	0.185	0.090	0.011	0.332	0.135	0.068	-0.083	-0.050	0.194	0.056
	MAE/\sqrt{n}	0.145	0.150	0.179	0.187	0.166	0.161	0.225	0.217	0.403	0.206	0.269

Table S1b: Profile statistics summary for the full dataset from 5.5-11.0km.

Species	Statistic	Altitude (km)											
		0.0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0	5.0-5.5	
Organics	25 th percentile	-0.009	-0.150	-0.239	-0.379	-0.433	-0.360	-0.429	-0.257	-0.660	-1.063	-0.852	
	50 th percentile	0.624	0.442	0.243	0.210	0.233	0.258	0.107	0.909	0.420	0.116	0.007	
	75 th percentile	1.264	1.145	0.934	0.861	0.837	0.730	0.832	1.862	2.018	1.777	1.905	
	Mean	0.673	0.479	0.336	0.287	0.281	0.3067	0.314	0.830	0.963	0.748	0.633	
Sulphate	MAE/\sqrt{n}	0.058	0.054	0.053	0.072	0.108	0.119	0.088	0.381	0.371	0.323	0.313	
	25 th percentile	0.299	0.243	0.193	0.189	0.105	0.087	0.095	-0.088	-0.117	-0.173	-0.011	
	50 th percentile	0.764	0.583	0.485	0.434	0.3547	0.241	0.366	0.184	0.107	0.266	0.120	
	75 th percentile	1.282	1.112	1.164	0.864	0.731	0.617	0.583	0.772	0.329	0.471	0.499	
Nitrate	Mean	0.933	0.782	0.775	0.642	0.527	0.338	0.385	0.384	0.119	0.189	0.276	
	MAE/\sqrt{n}	0.035	0.031	0.035	0.033	0.043	0.034	0.042	0.118	0.060	0.112	0.067	
	25 th percentile	0.030	0.013	0.016	-0.002	-0.005	-0.021	-0.010	-0.032	-0.071	-0.059	-0.170	
	50 th percentile	0.150	0.089	0.060	0.036	0.025	0.0054	0.032	0.022	0.035	0.098	0.017	
Ammonium	75 th percentile	0.495	0.392	0.329	0.091	0.086	0.043	0.090	0.079	0.167	0.196	0.161	
	Mean	0.489	0.375	0.278	0.127	0.142	-0.014	0.055	0.018	0.030	0.043	0.010	
	MAE/\sqrt{n}	0.024	0.019	0.016	0.009	0.014	0.038	0.010	0.022	0.035	0.071	0.052	
	25 th percentile	0.012	-0.118	-0.186	-0.119	-0.301	-0.336	-0.346	-0.733	-0.521	-0.920	-0.408	
Ammonium	50 th percentile	0.379	0.282	0.296	0.239	0.202	0.086	0.082	0.122	0.021	-0.003	0.062	
	75 th percentile	0.802	0.696	0.743	0.686	0.651	0.449	0.564	0.449	0.305	0.410	0.389	
	Mean	0.452	0.344	0.347	0.333	0.199	0.112	0.066	-0.098	-0.052	-0.209	0.095	
	MAE/\sqrt{n}	0.034	0.033	0.043	0.041	0.079	0.068	0.070	0.192	0.167	0.327	0.109	

Table S2a: Profile statistics summary for the Atlantic cluster from 0.0-5.5km.

Species	Statistic	Altitude (km)											
		5.5-6.0	6.0-6.5	6.5-7.0	7.0-7.5	7.5-8.0	8.0-8.5	8.5-9.0	9.0-9.5	9.5-10.0	10.0-10.5	10.5-11.0	
Organics	25 th percentile	-1.218	-1.056	-1.439	-0.876	-1.813	-1.197	-0.909	0.006	-1.249	-1.880	-1.754	
	50 th percentile	0.055	0.519	0.299	0.725	-0.116	0.538	0.630	1.654	0.026	-0.293	0.206	
	75 th percentile	1.335	1.430	1.778	1.964	1.376	1.818	3.711	4.336	2.062	2.349	2.207	
Sulphate	Mean	0.115	0.243	0.344	1.086	-0.010	0.837	1.621	2.229	0.478	-0.118	0.856	
	MAE/\sqrt{n}	0.316	0.419	0.381	0.292	0.377	0.364	0.430	0.408	0.5118	0.441	0.915	
	25 th percentile	-0.129	-0.147	-0.038	0.069	-0.260	-0.346	-0.191	-0.143	-0.433	-0.158	-0.065	
Nitrate	50 th percentile	0.129	0.111	0.279	0.293	0.251	0.184	0.217	0.235	0.505	0.2267	0.587	
	75 th percentile	0.368	0.461	0.526	0.683	0.659	0.794	0.636	0.6591	1.095	0.750	0.887	
	Mean	0.115	0.093	0.240	0.338	0.166	0.308	0.253	0.270	0.492	0.394	0.3989	
Nitrate	MAE/\sqrt{n}	0.075	0.093	0.096	0.078	0.120	0.145	0.090	0.108	0.235	0.097	0.213	
	25 th percentile	-0.091	-0.074	-0.020	-0.040	-0.057	-0.047	-0.059	-0.080	-0.207	-0.102	-0.211	
	50 th percentile	-0.015	0.021	0.066	0.027	0.003	0.014	0.021	0.014	0.077	0.071	0.002	
Ammonium	75 th percentile	0.154	0.107	0.189	0.121	0.101	0.117	0.123	0.114	0.240	0.222	0.101	
	Mean	0.011	-0.005	0.060	0.048	0.035	0.036	0.037	0.023	0.037	0.106	0.029	
	MAE/\sqrt{n}	0.033	0.060	0.038	0.029	0.027	0.019	0.024	0.031	0.084	0.040	0.050	
Ammonium	25 th percentile	-0.706	-0.572	-0.623	-0.911	-0.418	-0.717	-1.027	-1.021	-1.267	-0.7056	-1.172	
	50 th percentile	0.0923	0.176	-0.099	0.204	0.384	-0.001	0.0256	-0.043	0.177	0.159	-0.091	
	75 th percentile	0.672	0.928	0.812	0.883	0.981	0.7489	0.739	1.260	1.748	1.288	0.626	
Ammonium	Mean	-0.018	0.075	-0.032	-0.025	0.439	0.082	-0.177	-0.055	0.231	0.165	-0.101	
	MAE/\sqrt{n}	0.198	0.269	0.179	0.249	0.204	0.194	0.235	0.240	0.393	0.239	0.438	

Table S2b: Profile statistics summary for the Atlantic cluster from 5.5-11.0km.

Species	Statistic	Altitude (km)											
		0.0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0	5.0-5.5	
Organics	25 th percentile	0.632	0.275	0.593	0.029	0.538	-0.033	-0.036	-2.268	-0.617	-1.000	-3.025	
	50 th percentile	1.171	1.135	1.591	0.796	1.358	0.843	0.296	-1.125	0.404	-0.437	-1.464	
	75 th percentile	2.228	2.497	2.793	2.038	1.994	1.612	1.206	-0.152	0.589	1.771	0.341	
	Mean	1.481	1.480	1.758	1.068	1.399	0.933	0.473	-1.245	0.061	0.067	-1.481	
Sulphate	MAE/\sqrt{n}	0.112	0.121	0.153	0.121	0.171	0.194	0.180	0.690	0.654	0.461	0.853	
	25 th percentile	0.570	0.179	0.588	0.331	0.619	0.294	0.157	0.314	0.243	-0.347	-0.354	
	50 th percentile	1.037	0.985	1.074	0.801	1.030	0.713	0.319	0.417	0.743	-0.035	0.272	
	75 th percentile	1.724	2.297	1.783	1.299	1.509	1.277	0.752	0.781	1.001	0.154	0.492	
Nitrate	Mean	1.308	1.429	1.315	0.975	1.100	0.960	0.485	0.663	0.656	-0.081	0.139	
	MAE/\sqrt{n}	0.077	0.108	0.068	0.072	0.099	0.124	0.073	0.139	0.180	0.118	0.355	
	25 th percentile	0.079	0.029	0.077	0.0467	0.091	0.064	0.033	-0.027	-0.007	-0.072	0.002	
	50 th percentile	0.440	0.354	0.737	0.125	0.256	0.261	0.061	0.017	0.010	-0.045	0.026	
Ammonium	75 th percentile	1.255	2.323	2.708	0.815	1.194	0.560	0.141	0.038	0.027	-0.005	0.096	
	Mean	1.898	1.588	1.827	0.753	1.006	0.508	0.105	0.004	0.013	-0.044	0.042	
	MAE/\sqrt{n}	0.166	0.137	0.143	0.072	0.135	0.066	0.014	0.021	0.010	0.019	0.014	
	25 th percentile	0.096	0.052	0.213	-0.030	0.090	-0.006	-0.479	-0.198	-0.789	-0.847	-0.949	
Ammonium	50 th percentile	0.677	0.482	0.891	0.378	0.669	0.248	-0.007	0.266	1.245	0.093	0.277	
	75 th percentile	1.713	1.611	1.328	1.239	1.444	0.992	0.760	0.923	1.917	1.106	1.386	
	Mean	1.294	1.044	1.034	0.633	0.896	0.436	-0.013	0.233	0.761	0.156	0.226	
	MAE/\sqrt{n}	0.112	0.090	0.094	0.082	0.152	0.143	0.160	0.495	1.202	0.622	0.476	

Table S3a: Profile statistics summary for the easterly cluster from 0.0-5.5km.

Species	Statistic	Altitude (km)													
		5.5-6.0	6.0-6.5	6.5-7.0	7.0-7.5	7.5-8.0	8.0-8.5	8.5-9.0	9.0-9.5	9.5-10.0	10.0-10.5	10.5-11.0			
Organics	25 th percentile	-3.329	-1.816	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	0.100	-0.282	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	2.060	0.454	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean <i>MAE</i> / \sqrt{n}	-0.670 1.545	-0.601 0.859	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Sulphate	25 th percentile	-0.114	0.123	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	0.202	0.521	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	0.609	0.786	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean <i>MAE</i> / \sqrt{n}	0.225 0.164	0.468 0.244	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Nitrate	25 th percentile	-0.067	-0.084	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	-0.014	-0.007	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	0.059	0.018	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean <i>MAE</i> / \sqrt{n}	0.006 0.038	-0.028 0.040	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A
Ammonium	25 th percentile	-0.190	-0.640	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	0.499	-0.156	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	1.737	1.529	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean <i>MAE</i> / \sqrt{n}	0.580 0.483	0.324 0.464	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A	N/A N/A

Table S3b: Profile statistics summary for the easterly cluster from 5.5-11.0km.

Species	Statistic	Altitude (km)											
		0.0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0	5.0-5.5	
Organics	25 th percentile	0.470	0.063	0.108	-0.242	-0.036	0.0109	-0.380	-1.026	-1.427	-0.673	-2.011	
	50 th percentile	1.555	0.678	1.255	0.681	0.959	0.424	0.424	-0.100	-0.145	0.465	-0.567	
	75 th percentile	2.312	2.280	2.337	1.861	1.883	1.568	1.285	0.306	0.803	1.527	0.741	
	Mean	1.927	1.419	1.385	1.253	1.035	0.689	0.505	-0.2156	-0.289	0.220	-0.519	
Sulphate	MAE/\sqrt{n}	0.208	0.174	0.248	0.204	0.282	0.218	0.180	0.376	0.451	0.538	0.349	
	25 th percentile	0.314	0.342	0.302	0.031	0.250	0.030	-0.111	0.058	-0.098	-0.054	-0.174	
	50 th percentile	1.251	1.035	0.894	0.399	0.637	0.418	0.139	0.253	0.031	0.104	0.082	
	75 th percentile	2.454	1.748	1.548	1.482	1.071	0.810	0.386	0.374	0.406	0.375	0.528	
Nitrate	Mean	1.740	1.431	1.089	1.052	0.860	0.440	0.156	0.227	0.089	0.150	0.216	
	MAE/\sqrt{n}	0.165	0.125	0.114	0.135	0.100	0.105	0.045	0.065	0.073	0.079	0.109	
	25 th percentile	0.019	0.022	0.019	-0.008	-0.005	-0.016	-0.029	-0.027	0.009	-0.116	-0.058	
	50 th percentile	0.108	0.115	0.086	0.026	0.061	0.072	0.019	0.060	0.057	-0.007	0.026	
Ammonium	75 th percentile	0.910	1.036	0.642	0.323	0.416	0.227	0.053	0.118	0.172	0.022	0.180	
	Mean	2.124	1.394	0.855	0.848	0.423	0.164	0.032	0.053	0.086	-0.021	0.065	
	MAE/\sqrt{n}	0.283	0.156	0.101	0.115	0.074	0.032	0.010	0.047	0.038	0.050	0.037	
	25 th percentile	-0.070	-0.034	-0.135	-0.342	-0.419	-0.187	-0.279	-0.778	-0.897	-0.402	-0.697	
Ammonium	50 th percentile	0.241	0.334	0.320	0.198	0.281	0.237	0.011	0.144	0.104	0.409	-0.054	
	75 th percentile	1.117	1.031	1.015	1.029	0.737	0.705	0.521	0.745	0.778	1.040	1.046	
	Mean	1.034	0.876	0.513	0.541	0.239	0.258	0.104	-0.044	-0.035	0.451	0.001	
	MAE/\sqrt{n}	0.134	0.116	0.102	0.110	0.184	0.108	0.069	0.370	0.335	0.157	0.240	

Table S4a: Profile statistics summary for the stagnant air mass cluster from 0.0-5.5km.

Species	Statistic	Altitude (km)										
		5.5-6.0	6.0-6.5	6.5-7.0	7.0-7.5	7.5-8.0	8.0-8.5	8.5-9.0	9.0-9.5	9.5-10.0	10.0-10.5	10.5-11.0
Organics	25 th percentile	-1.351	-1.701	-1.172	-1.702	-1.045	-1.644	-1.945	-2.274	-3.905	-2.822	-2.215
	50 th percentile	0.826	0.003	0.525	0.320	0.119	0.969	-0.639	-0.148	-0.476	-0.651	-0.850
	75 th percentile	2.894	0.675	2.715	2.338	2.551	2.874	1.237	2.573	2.444	3.081	1.585
	Mean	0.874	-0.321	0.792	0.306	0.386	0.624	-0.420	1.076	-0.622	-0.745	-0.025
Sulphate	MAE/\sqrt{n}	0.716	0.608	0.626	0.510	0.633	0.705	0.398	0.605	1.020	1.365	0.743
	25 th percentile	0.169	-0.320	-0.289	-0.318	-0.216	-0.151	-0.047	-0.105	-0.426	-0.025	0.5156
	50 th percentile	0.388	0.182	-0.049	0.082	0.203	0.260	0.424	0.454	0.429	0.462	0.865
	75 th percentile	0.651	0.612	0.488	0.660	0.598	1.039	0.715	0.909	0.832	0.991	1.255
Nitrate	Mean	0.373	0.188	0.067	0.130	0.236	0.346	0.386	0.337	0.273	0.495	0.901
	MAE/\sqrt{n}	0.132	0.136	0.130	0.121	0.096	0.138	0.115	0.144	0.279	0.206	0.145
	25 th percentile	-0.173	-0.275	-0.516	-0.310	-0.239	-0.275	-0.346	-0.445	-0.174	-0.474	-0.194
	50 th percentile	0.141	-0.005	-0.241	0.167	-0.006	0.051	0.094	-0.150	0.206	-0.264	0.239
Ammonium	75 th percentile	0.305	0.262	0.107	0.287	0.231	0.318	0.322	0.163	0.471	0.336	0.551
	Mean	0.105	-0.038	-0.210	0.032	-0.008	-0.031	0.001	-0.010	0.188	-0.095	0.205
	MAE/\sqrt{n}	0.082	0.087	0.117	0.086	0.075	0.109	0.087	0.073	0.122	0.108	0.152
	25 th percentile	-0.576	-0.350	-0.748	-0.656	-0.862	-0.733	-1.032	-1.596	-2.976	-0.697	-0.790
Ammonium	50 th percentile	0.364	0.502	0.448	0.169	0.364	0.227	0.519	0.186	0.404	0.147	0.129
	75 th percentile	1.051	1.216	1.124	0.955	0.972	1.280	1.547	1.512	1.090	1.637	0.7856
	Mean	0.231	0.417	0.305	0.047	0.224	0.231	0.347	-0.114	-0.510	0.267	0.286
	MAE/\sqrt{n}	0.254	0.276	0.599	0.319	0.315	0.287	0.331	0.393	1.127	0.340	0.375

Table S4b: Profile statistics summary for the stagnant air mass cluster from 5.5-11.0km.

Species	Statistic	Altitude (km)											
		0.0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0	5.0-5.5	
Organics	25 th percentile	1.274	-1.415	-1.214	0.032	-0.468	-1.238	-0.782	-0.180	-1.400	-2.032	-1.919	
	50 th percentile	2.588	0.915	0.401	1.100	0.620	0.465	-0.277	0.291	-0.228	-0.669	-0.344	
	75 th percentile	5.263	2.101	2.231	2.268	1.276	2.133	1.080	1.448	1.089	0.275	0.999	
	Mean	3.290	0.884	0.810	1.153	0.722	0.713	0.734	0.438	-0.231	-1.018	-0.555	
Sulphate	MAE/\sqrt{n}	0.420	0.459	0.395	0.313	0.415	0.745	0.530	0.246	0.426	0.693	0.993	
	25 th percentile	1.393	0.847	0.491	0.652	0.124	-0.285	0.164	-0.044	0.012	0.159	0.044	
	50 th percentile	1.740	1.740	1.133	1.225	0.620	0.323	0.315	0.527	0.090	0.317	0.455	
	75 th percentile	2.643	2.418	2.440	1.982	1.105	0.488	0.459	0.583	0.396	0.448	0.798	
Nitrate	Mean	2.068	2.176	1.903	1.443	0.681	0.060	0.302	0.383	0.156	0.289	0.379	
	MAE/\sqrt{n}	0.145	0.181	0.220	0.138	0.131	0.284	0.059	0.226	0.055	0.092	0.188	
	25 th percentile	0.167	-0.155	-0.145	-0.073	-0.083	-0.056	0.020	-0.027	-0.112	-0.013	-0.049	
	50 th percentile	0.575	0.047	0.032	0.088	0.037	0.109	0.089	0.027	0.001	0.073	0.058	
Ammonium	75 th percentile	2.947	0.204	0.174	0.342	0.209	0.394	0.135	0.100	0.061	0.171	0.245	
	Mean	1.867	0.361	0.150	0.185	0.210	0.121	0.092	0.031	-0.013	0.072	0.113	
	MAE/\sqrt{n}	0.281	0.064	0.046	0.041	0.045	0.110	0.026	0.025	0.048	0.042	0.067	
	25 th percentile	0.290	0.069	-0.110	0.091	-0.217	-0.159	-0.429	-0.429	0.027	-0.322	0.342	
Ammonium	50 th percentile	1.051	0.490	0.444	0.637	0.262	0.300	0.373	0.414	0.462	0.167	0.543	
	75 th percentile	2.177	1.160	1.064	1.244	0.832	1.229	0.637	0.623	0.985	0.699	1.270	
	Mean	1.237	0.760	0.635	0.635	0.215	0.673	0.166	0.212	0.455	0.092	0.797	
	MAE/\sqrt{n}	0.155	0.164	0.162	0.126	0.151	0.312	0.258	0.353	0.235	0.241	0.177	

Table S5a: Profile statistics summary for the southerly air mass cluster from 0.0-5.5km.

Species	Statistic	Altitude (km)													
		5.5-6.0	6.0-6.5	6.5-7.0	7.0-7.5	7.5-8.0	8.0-8.5	8.5-9.0	9.0-9.5	9.5-10.0	10.0-10.5	10.5-11.0			
Organics	25 th percentile	-3.059	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	-0.344	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	-1.489	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean	-2.274	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sulphate	MAE/\sqrt{n}	0.785	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	25 th percentile	-0.006	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	0.455	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	1.403	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrate	Mean	0.698	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	MAE/\sqrt{n}	0.704	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	25 th percentile	-0.009	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	0.058	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ammonium	75 th percentile	0.117	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean	0.054	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	MAE/\sqrt{n}	0.063	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	25 th percentile	-0.535	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ammonium	50 th percentile	0.543	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	0.146	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean	-0.194	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	MAE/\sqrt{n}	0.341	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table S5b: Profile statistics summary for the southerley air mass cluster from 5.5-11.0km.

Species	Statistic	Altitude (km)											
		0.0-0.5	0.5-1.0	1.0-1.5	1.5-2.0	2.0-2.5	2.5-3.0	3.0-3.5	3.5-4.0	4.0-4.5	4.5-5.0	5.0-5.5	
Organics	25 th percentile	-0.403	-0.498	-0.226	-0.547	-0.416	-0.531	-0.293	-0.565	-1.231	-0.472	-0.818	
	50 th percentile	0.034	0.078	0.308	0.278	0.037	-0.243	0.134	-0.251	-0.380	-0.227	-0.265	
	75 th percentile	0.706	0.860	1.198	1.692	0.456	0.311	1.179	1.037	0.513	0.832	0.420	
	Mean	0.253	0.483	0.652	0.761	0.166	0.082	0.235	0.253	-0.369	0.114	-0.271	
Sulphate	MAE/\sqrt{n}	0.102	0.125	0.162	0.149	0.165	0.154	0.193	0.218	0.296	0.248	0.321	
	25 th percentile	0.014	-0.019	-0.043	-0.106	0.009	-0.015	-0.025	0.041	0.051	0.123	0.001	
	50 th percentile	0.147	0.130	0.043	0.106	0.104	0.094	0.241	0.100	0.197	0.215	0.194	
	75 th percentile	0.538	0.597	0.378	0.361	0.324	0.236	0.522	0.257	0.489	0.303	0.380	
Nitrate	Mean	0.500	0.470	0.494	0.266	0.235	0.256	0.332	0.177	0.287	0.252	0.275	
	MAE/\sqrt{n}	0.054	0.065	0.075	0.039	0.044	0.040	0.064	0.034	0.081	0.052	0.065	
	25 th percentile	-0.016	-0.016	-0.046	-0.079	-0.077	-0.018	-0.105	-0.046	-0.059	-0.093	0.021	
	50 th percentile	0.020	0.036	0.051	0.018	-0.013	0.036	-0.011	0.002	0.020	0.003	0.053	
Ammonium	75 th percentile	0.070	0.153	0.153	0.099	0.060	0.079	0.084	0.047	0.111	0.111	0.106	
	Mean	0.064	0.203	0.383	0.106	-0.004	0.042	0.005	0.001	0.027	0.019	0.075	
	MAE/\sqrt{n}	0.010	0.026	0.058	0.018	0.017	0.021	0.029	0.022	0.036	0.033	0.017	
	25 th percentile	-0.230	-0.183	-0.201	-0.635	-0.244	-0.066	-0.241	-0.323	-0.165	0.003	-0.027	
Ammonium	50 th percentile	0.014	0.186	0.078	0.012	0.066	0.138	0.045	-0.121	0.029	0.519	0.238	
	75 th percentile	0.368	0.839	0.430	0.510	0.480	0.599	0.550	0.256	0.475	0.641	0.464	
	Mean	0.071	0.243	0.220	-0.070	0.070	0.266	0.013	0.051	0.133	0.276	0.199	
	MAE/\sqrt{n}	0.057	0.087	0.071	0.118	0.099	0.080	0.117	0.108	0.137	0.186	0.132	

Table S6a: Profile statistics summary for the northerly air mass cluster from 0.0-5.5km.

Species	Statistic	Altitude (km)													
		5.5-6.0	6.0-6.5	6.5-7.0	7.0-7.5	7.5-8.0	8.0-8.5	8.5-9.0	9.0-9.5	9.5-10.0	10.0-10.5	10.5-11.0			
Organics	25 th percentile	0.281	-1.212	0.759	0.014	-0.838	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	0.390	-0.047	1.835	1.094	1.069	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	1.270	0.935	2.596	1.862	1.445	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean	0.699	-0.108	1.730	0.990	0.559	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sulphate	MAE/\sqrt{n}	0.220	0.589	0.971	1.330	1.396	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	25 th percentile	0.028	0.079	0.018	0.223	0.102	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	0.133	0.261	0.161	0.302	0.721	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	0.456	0.390	0.831	0.333	1.058	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrate	Mean	0.220	0.243	0.336	0.286	0.627	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	MAE/\sqrt{n}	0.091	0.098	0.175	0.085	0.525	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	25 th percentile	-0.176	-0.103	-0.084	-0.040	0.066	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	50 th percentile	-0.125	-0.037	0.034	0.039	0.185	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ammonium	75 th percentile	0.071	0.027	0.061	0.092	0.355	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean	-0.067	-0.038	0.004	0.030	0.202	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	MAE/\sqrt{n}	0.053	0.044	0.088	0.033	0.054	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	25 th percentile	-0.449	-0.544	-0.162	-0.699	-1.036	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ammonium	50 th percentile	0.057	-0.464	0.192	0.349	-0.120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	75 th percentile	0.547	-0.366	0.508	0.942	1.301	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Mean	0.051	-0.458	0.179	0.198	0.048	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	MAE/\sqrt{n}	0.353	0.051	0.341	0.456	0.443	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table S6b: Profile statistics summary for the northerly air mass cluster from 5.5-11.0km.