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*Supplement of*

## **Size-segregated compositional analysis of aerosol particles collected in the European Arctic during the ACCACIA campaign**

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Table S1: Classification scheme adopted in this study. Similarly to Kandler et al. (2011), “All” stands for the sum of Na+Mg+Al+Si+P+S+Cl+K+Ca+Ti+Cr+Fe+Ni+Cu+Zn and square brackets indicate an interval of values. “All elements” represents each weight percentage unweighted. Kr2005: Krejci et al. (2005), K2007: Kandler et al. (2007), B2008: Behrenfeldt et al. (2008), G2010: Geng et al. (2010), H2010: Hand et al. (2010), K2011: Kandler et al. (2011). Source in bold: Direct copy of their criteria. Source in italics: Based upon their criteria.

Particle Class	Classification Criteria	Source
Carbonaceous	All elements/All<0.2, C+O>0.92 <b>OR</b> C+O>0.9, All elements/All<0.2 <b>AND</b> Mg/All≥0.1 <b>OR</b> Na/All≥0.1 <b>OR</b> S/All≥0.1 Criteria for secondary Na-rich and Ammonium Sulphate	<i>G2010</i> <b>K2011</b>
Biogenic	Criteria for biogenic C+O>0.9, Si/Cl>0.2, Na/Cl<0.3, Na/S<0.3 <b>AND</b> K/All≥0.2 <b>OR</b> P/All≥0.2 <b>OR</b> Cl/All≥0.2 <b>OR</b> (Ca+K)/All≥0.3 <b>OR</b> (Na+P+K)/All ≥ <b>OR</b> (Na+Mg+Zn)/All≥0.3	<i>Kr2005, G2010</i> <b>K2011</b>
Sulphates	Criteria for NaS sulphates (Ca+S)/All>0.5, Ca/S=[0.25;4], Si/Ca<0.5	<b>K2011</b> <b>K2007</b>
Gypsum	Criteria for Ca sulphates S/All>0.4, Si/S<0.5, S>All elements	<i>K2007, H2010</i> <b>K2011</b>
Ca-Rich	Criteria for CaNaS Ca/All>0.5, Si/Ca<0.5, Al/Ca<0.5, Ca>All elements Criteria for Ca- and CaMg-carbonates (Ca+Mg)/All>0.5, Mg/Ca=[0.33;3], Si/Ca<0.5, S/Ca<0.25, P/Ca<0.15	<i>H2010</i> <b>K2011</b> <b>K2007</b>
Phosphates	Criteria for phosphates (Na+Cl)/All>0.5, S/Na<0.375, S/Cl<0.5, Si/Cl<0.2, Fe/Cl<0.5	<b>K2011</b> <b>K2007</b>
Fresh Chlorides	<b>OR</b> Na/Cl=[0.5;1.5], S/Cl<0.5, Si/Cl<0.2, S/Na<0.375, Fe/Cl<0.5 Criteria for NaCl, KCl and other chlorides	<i>Kr2005, G2010</i> <b>K2011</b>
Aged Chlorides	(Na+Cl)>0.4, S/Cl<0.5, S/Na<0.5, Si/Cl<0.5 <b>OR</b> Cl/All=[0.1;1.1], Si/All<0.0699, Al/All<0.0099, Na/Cl<2, Mg/Cl<2, P/Cl<0.2, K/Cl<2, Ca/Cl<2, Ti/Cl<0.1, Cr/Cl<0.1, Fe/Cl<0.1 Criteria for mixClS	<i>Kr2005, B2008</i> <i>K2011</i> <b>K2011</b>
Sulphates	Cl/S<0.5, Si/S<0.5, Ti/S<0.2, Cr/S<0.2, Fe/S<0.5, Ni/S<0.2, Cu/S<0.2, Zn/S<0.2 Criteria for other sulphates	<i>K2007</i> <b>K2011</b>
Metallic	Criteria for Fe, Ti, Fe-Ti and Al oxides <b>OR</b> Fe/All>0.3, Si/Fe<0.2, Al/Fe<0.2, Cl/Fe<0.2, Ti/Fe<1.33, Mg/Fe<0.2 <b>OR</b> Ti/All>0.3, Na/Ti<1, Mg/Ti<1, Al/Ti<0.2, Si/Ti<0.2, S/Ti<1, Fe/Ti<1	<b>K2007, H2010</b> <b>K2007, H2010</b>
Silicates	Criteria for quartz, SiAl, SiAlK, SiAlNa, SiAlNaCa, SiAlNaK, SiAlCaFeMg, SiAlKFeMg, SiAlFeMg, SiMgFe, SiMg, SiCaTi <b>OR</b> Si/All>0.2, Na/Si<0.7, Mg/Si<1.33, Al/Si<1.33, K/Si<0.5, Ca/Si<0.5, Ti/Si<0.5, Fe/Si<0.5, (P+S+Cl)/All<0.2 <b>OR</b> Si/All≥0.6, S/Si<0.2, Cl/Si<0.2 <b>OR</b> Si/All≥0.2, S/Si<0.2, Cl/Si<0.2 <b>AND</b> (Al+Si)/All≥0.6 <b>OR</b> (Si+Fe)/All≥0.6 <b>OR</b> (Al+Si+Fe)/All≥0.5 <b>OR</b> (Al+Si+Na)/All≥0.5 <b>OR</b> (Al+Si+Mg)/All≥0.5 <b>OR</b> (Al+Si+K)/All≥0.5 <b>OR</b> (Al+Si+Ca)/All≥0.5 <b>OR</b> (Al+Si+Ti)/All≥0.5 <b>OR</b> Si/All≥0.5, S/Si<0.2, Cl/Si<0.2 <b>AND</b> Mg/All≥0.1 <b>OR</b> K/All≥0.1 <b>OR</b> Ca/All≥0.1 <b>OR</b> (Si+Al)/All≥0.5, S/Si<0.2, Cl/Si<0.2 <b>AND</b> Mg/All≥0.1 <b>OR</b> K/All≥0.1 <b>OR</b> Ca/All≥0.1 <b>OR</b> (Si+Fe)/All≥0.5, S/Si<0.2, Cl/Si<0.2 <b>AND</b> Mg/All≥0.1 <b>OR</b> K/All≥0.1 <b>OR</b> Ca/All≥0.1 <b>OR</b> (Si+Al+Fe)/All≥0.5, S/Si<0.2, Cl/Si<0.2 <b>AND</b> Mg/All≥0.1 <b>OR</b> K/All≥0.1 <b>OR</b> Ca/All≥0.1	<b>K2011</b> <b>K2007</b> <i>H2010</i>
Mixed Silicates	(Na+S+Mg+Al+Si+K+Ca)/All>0.7, S/Si=[0.6;2] <b>OR</b> (Al+Si)/All≥0.6, S/Si>0.2 <b>OR</b> Si/All>0.2, Na/Si<0.7, Mg/Si<1.33, Al/Si<1.33, K/Si<0.5, Ca/Si<0.5, Ti/Si<0.5, Fe/Si<0.5, (P+Cl)/All<0.2, S/All>0.2 <b>OR</b> Si/All≥0.1, S/Si>0.2 <b>AND</b> (S+Si)/All≥0.5 <b>OR</b> (S+Si+Al)/All≥0.5 <b>OR</b> (Si+S+Fe)/All≥0.5 <b>OR</b> (Si+S+Al+Fe)/All≥0.5 <b>OR</b> Si/All≥0.1, (Si+S)/All≥0.4, S/Si>0.2 <b>AND</b> Mg/All≥0.1 <b>OR</b> K/All≥0.1 <b>OR</b> Ca/All≥0.1 <b>OR</b> Si/All≥0.1, (Si+S+Al)/All≥0.4, S/Si>0.2 <b>AND</b> Mg/All≥0.1 <b>OR</b> K/All≥0.1 <b>OR</b> Ca/All≥0.1 <b>OR</b> Si/All≥0.1, (Si+S+Fe)/All≥0.4, S/Si>0.2 <b>AND</b> Mg/All≥0.1 <b>OR</b> K/All≥0.1 <b>OR</b> Ca/All≥0.1 <b>OR</b> Si/All≥0.1, (Si+S+Fe+Al)/All≥0.4, S/Si>0.2 <b>AND</b> Mg/All≥0.1 <b>OR</b> K/All≥0.1 <b>OR</b> Ca/All≥0.1 <b>OR</b> Fe/All>0.15, Si/Fe<1, Ti/Fe<1.33, (Fe+S)/All>0.4 <b>OR</b> Ti/All>0.3, Na/Ti<1, Mg/Ti<1, Al/Ti<1, Si/Ti<1, Fe/Si<1, (Ti+S)/All>0.4 <b>OR</b> (Ti+S)/All>0.5	<b>K2007, H2010</b> <i>K2007</i>
Fresh Chlorides	Criteria for mixSiS, mixAlSiS, mixNaClSi, mixNaClSiAl, mixCaSi, mixCaAlSi (Na+Cl+Ca)/All≥0.5, Na/Cl=[0.2;1.1], Si/Cl<0.2, S/Cl<0.2	<i>K2007</i> <b>K2011</b>
Aged Chlorides	(Na+Cl+Ca+S)/All≥0.5, Na/Cl=[0.1;1.1], Si/Cl<0.2, S/Cl>0.2 <b>OR</b> Cl/All=[0.1;1.1], Si/Cl<0.1, S/Cl>0.2, Cr/Cl<1	<i>K2007</i> <b>K2011</b>
Metallic	(Fe+Ni+Cr+Cu+Zn)/All>0.5, Si/(Fe+Ni+Cu+Zn)<0.05 <b>OR</b> Zn/All=[0.2;1.1] <b>OR</b> Cu/All=[0.2;1.1] <b>OR</b> Cr/All=[0.2;1.1] <b>OR</b> Ni/All=[0.2;1.1] <b>OR</b> Cu; All elements	<i>K2011</i>
Silicates	Mg/All=[0.35;1.1], Si≥0.1	<i>K2011</i>
Phosphates	P/All=[0.1;1.1], P>All elements	<b>K2011</b>
Silicates	Si/All=[0.1;1.1]	<b>K2011</b>
Metallic	Al/All=[0.1;1.1]	<b>K2011</b>
Silicates	(Al+Si)/All=[0.2;1.1], Si≥0.1	<b>K2011</b>
Fresh Chlorides	Cl/All=[0.1;1.1]	<b>K2011</b>
Biomass Tracers	K/All=[0.25;1.1]	<b>K2011</b>
Ca-Rich	Ca/All=[0.2;1.1]	<i>K2011</i>
Other	Particles not classified by these criteria	

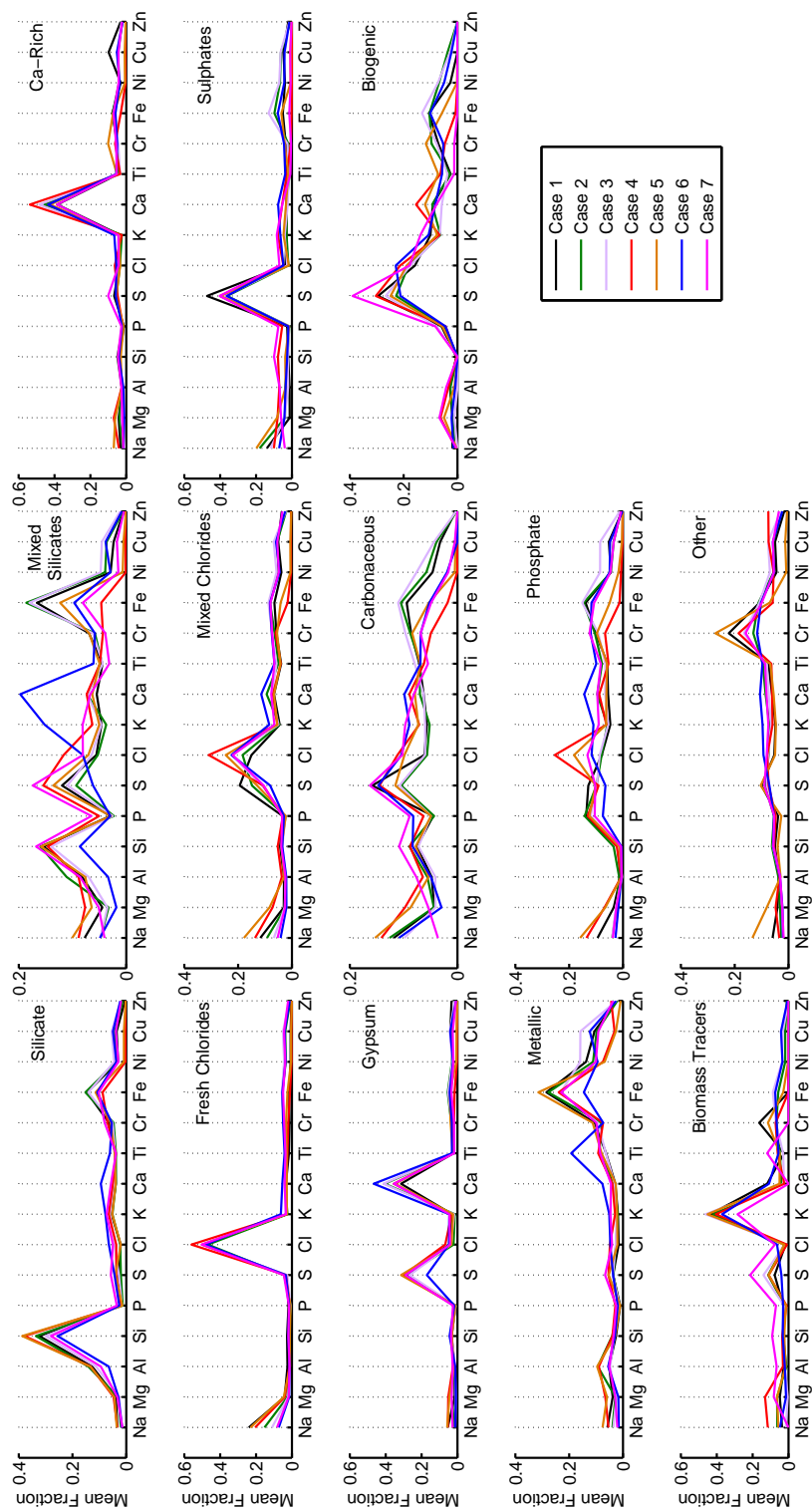


Figure S2: Mean elemental fractions of each particle category, normalised by the summed contributions from all elements except C and O. Variability is seen most clearly in the mixed categories, with consistency amongst the well-defined categories (e.g. Ca-rich)