Supplement materials to the manuscript titled "**Mixing state, spatial distribution, sources and photochemical enhancement to sulfate formation of black carbon particles in the Arctic Ocean during summer**"

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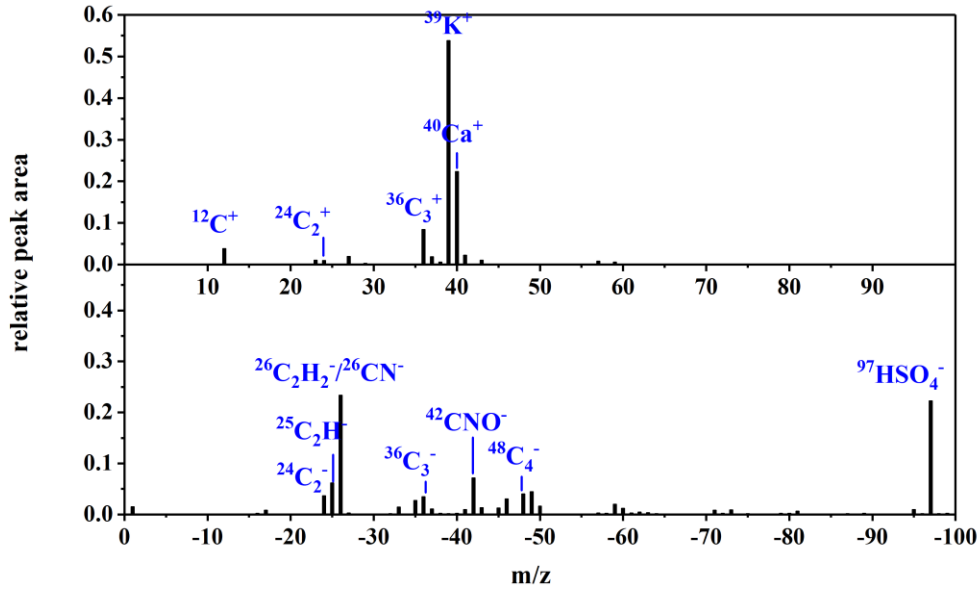

Figure S1. Average map of black carbon particles, with peaks showing strong signals marked in blue. The X-axis represents the mass-to-charge ratio (m/z), and the Y-axis indicates the relative peak area. The upper half of the map displays the cation spectrum, while the lower half shows the anion spectrum. In the cation spectrum, peaks for $^{39}K^+$ and $^{40}Ca^+$ are identified, excluding inorganic carbon peaks ($^{12}C^+$, $^{24}C_2^+$ and $^{36}C_3^+$). In the anion spectrum, peaks for inorganic carbon ($^{24}C_2^-$, $^{36}C_3^-$ and $^{48}C_4^-$), organic carbon ($^{25}C_2H^-/^{26}C_2H_2^-$, $^{26}CN^-/^{42}CNO^-$), and $^{97}HSO_4^-$ are identified.

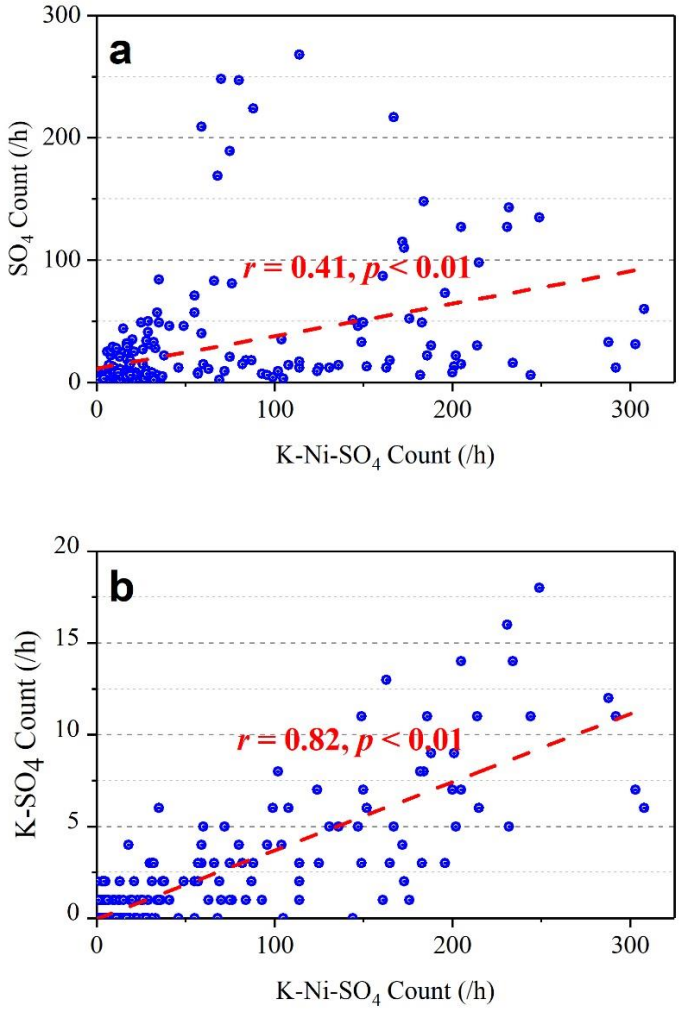

Figure S2. Relationship between K-Ni-SO_4 and SO_4, as well as K-SO_4 black carbon particles. The X-axis represents the hourly count of K-Ni-SO_4 black carbon particles. The Y-axis shows the hourly count of SO_4 black carbon particles in the upper graph and K-SO_4 black carbon particles in the lower graph, respectively. A red dashed line indicates the linear fit curve, with the correlation coefficient (r) and significance level (p) provided.

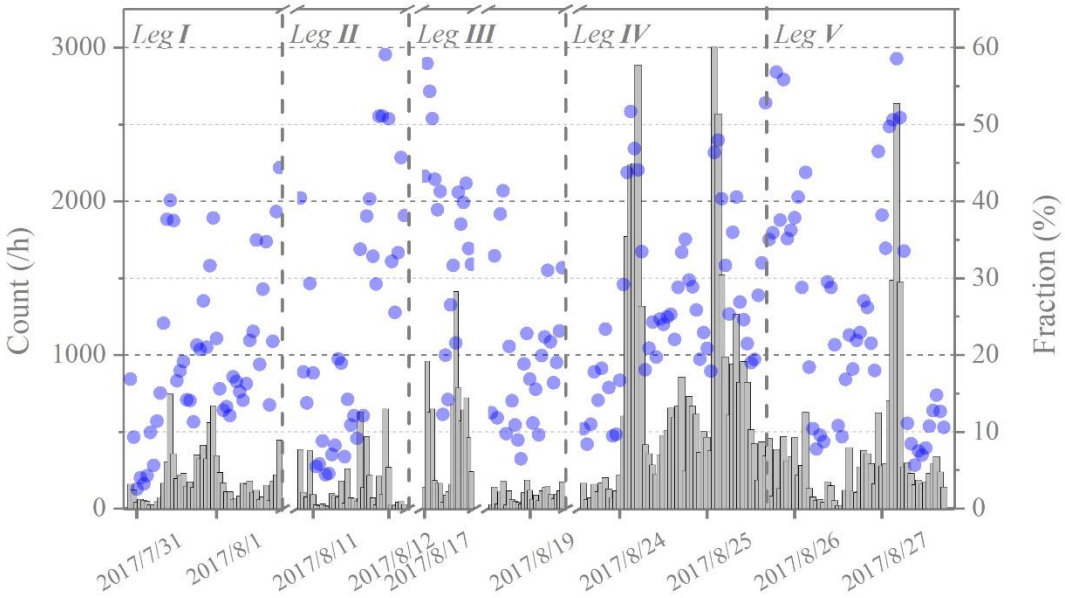

Figure S3. Hourly counts and fractions of black carbon particles from Leg I to Leg V. The X-axis displays the sampling time. Gray columns represent the hourly counts of black carbon particles, while blue dots indicate the hourly fractions of black carbon particles relative to all particles. Each segment of the cruise is delineated by a dotted line.

Table S1. Sampling time (in UTC) and locations during the cruise (Jul: July; Aug: August; lon: longitude; lat: latitude)

	Sampling Time		**Starting Location**		**Ending Location**	
	start	end	lon	lat	lon	lat
Leg I	22:00 30th Jul	19:00 1st Aug	169.4°W	66.0°N	159.2°W	74.8°N
Leg II	20:00 10th Aug	5:00 12th Aug	132.0°E	83.7°N	110.4°E	84.6°N
Leg III	2:00 17th Aug	11:00 19th Aug	25.4°E	82.6°N	2.1°E	74.3°N
Leg IV	14:00 23th Aug	14:00 25th Aug	2.1°W	67.0°N	25.8°W	61.2°N
Leg V	14:00 25th Aug	17:00 27th Aug	25.9°W	61.1°N	46.9°W	56.2°N