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Microphysical properties and light absorption enhancement of refractory black carbon aerosols in the central Arctic marine boundary layer: role of warm airmass intrusions on mixing state

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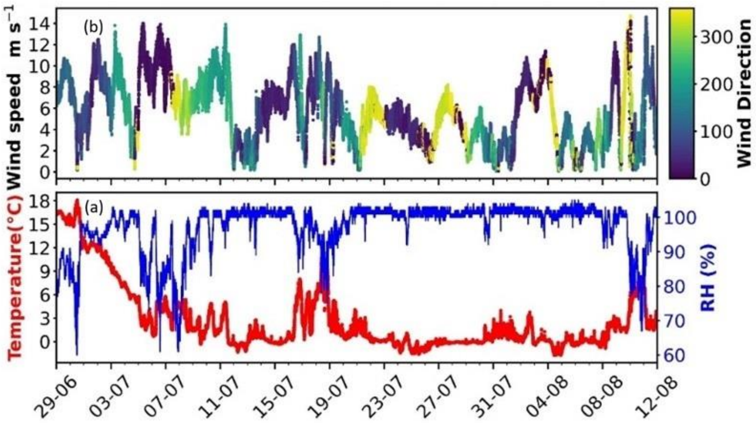

Figure S1: (a) Ambient temperature (red) and relative humidity (blue), (b) wind speed and wind direction measured during ATWAICE.

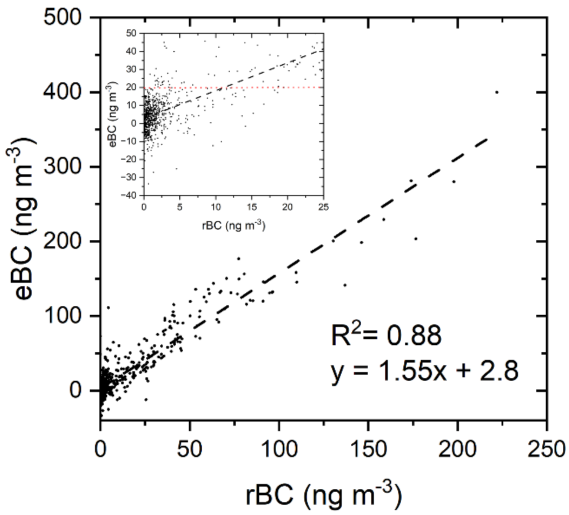

Figure S2: correlation between eBC measured by MAAP and rBC measured by SP2. Red dotted lines in the inset represents the value below which eBC becomes unreliable.

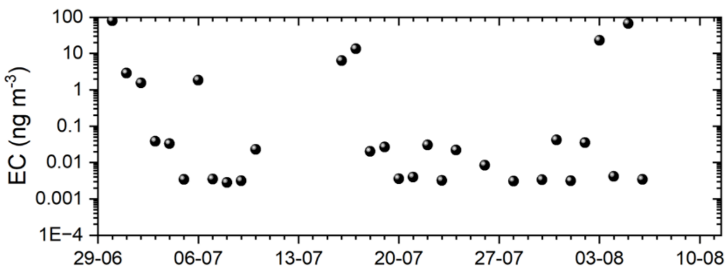

Figure S3: Temporal variabilities in elemental carbon concentrations measured using the thermo-optical transmission method (Birch and Cary, 1996). 0.002 ng m^{-3} represents the detection limit of the instrument.

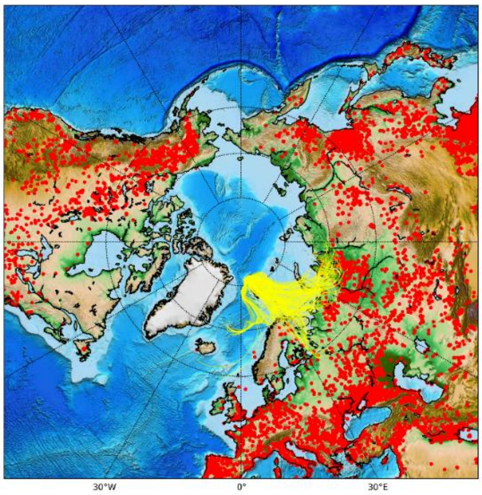

Figure S4: VIIRS fire pixel counts along with the hysplit airmass back trajectories during the first warm airmass intrusion period (WA1).

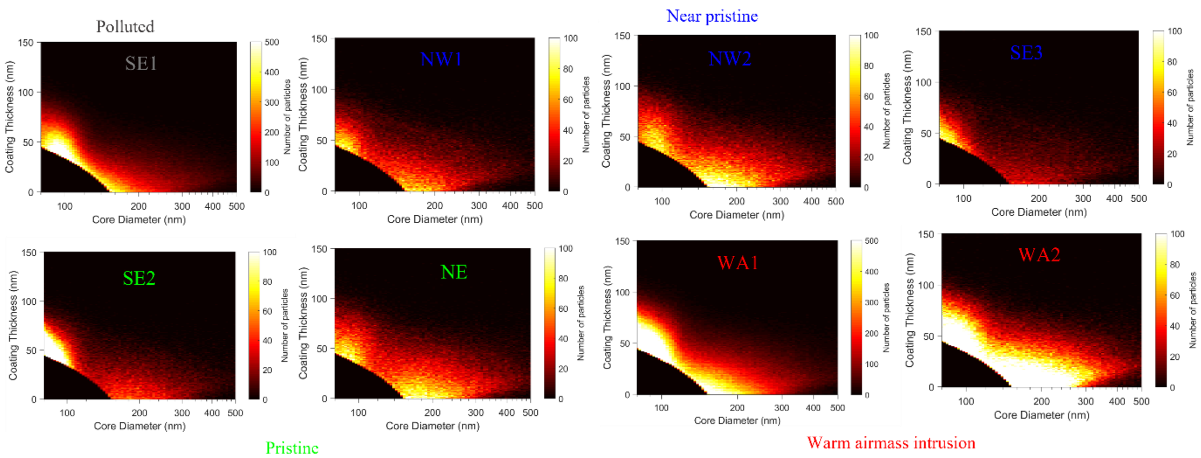

Figure S5: Size segregated coating thickness of rBC particles during the campaign. The colour bar indicates the number of particles in each of the size bins.

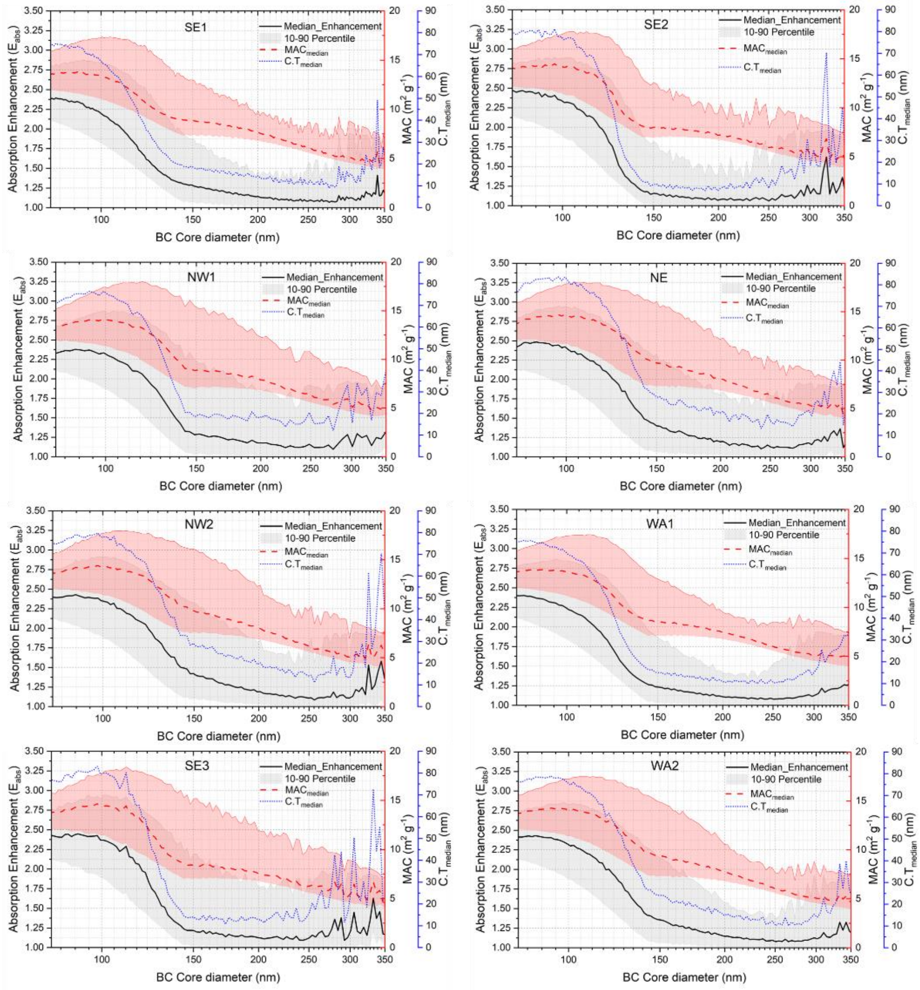

Figure S6: Size resolved absorption enhancement of rBC particles and Mass absorption cross section. The x-axis denotes the black carbon core diameter (nm); the y-axis (left) indicates the absorption enhancement factor, which quantifies the ratio of the absorption cross-section of coated BC particles to that of uncoated rBC cores of the same size. Median values are plotted as black solid lines, with the 10th to 90th percentile range shaded in grey to show variability.

Table S1: Summary of previously reported light absorption enhancement values (Eabs) for black carbon from different environments.

$\mathbf{E_{abs}}$	**Wavelength (nm)**	**Location**	**Method**	**Reference**
1.1-1.6	550	Arctic	Core-shell Mie theory	Present study
1.5	550	Pearl River Delta, China	Filter based with minimum R-squared method	Wu, C. et al. (2018)
1.36	550	Thumba	Core-shell Mie theory	Nithin et al. (2026)
1.3	550	Qinghai-Tibet Plateau	Core-shell Mie theory	Zeng et al. (2024)
1.06	532	California, USA	Thermodenuder + photoacoustic absorption method	Cappa et al. (2012)

1.06	532	Noto Peninsula, Japan	Thermodenuder + photoacoustic absorption method	Ueda et al. (2016)
1.38	532	Boulder, Colorado, USA	Thermodenuder + photoacoustic absorption method	Lack et al. (2012)
1.2	550	Xianghe, North China Plain, China	Core-shell Mie theory	Zhang et al. (2023)
1.42	532	Nanjing, China	Thermodenuder + photoacoustic absorption method	Ma et al. (2020)
1.15	550	Beijing, China	Core-shell Mie theory	Liu et al. (2020)
1.69	532	Shanghai, China	TD-CRDS/nephelometer	Zhai et al. (2022)
1.83	550	Biomass burning, multiple sites/global synthesis	Filter-photometer-based compilation	Asmi et al. (2025)
1.59	550	Remote, multiple sites/global synthesis	Filter-photometer-based compilation	Asmi et al. (2025)
1.38	550	Urban, multiple sites/global synthesis	Filter-photometer-based compilation	Asmi et al. (2025)

Table S2: Summary of previously reported mass absorption cross-section values of black carbon from different environments.

MAC	**Wavelength (nm)**	**Location**	**Method**	**Reference**
6.5-8.7	550	Arctic	Core-shell Mie theory	Present study
5	550	Alert, Canada	Particle soot absorption photometer with EC and SP2	Sharma et al. (2017)
13.3	530	Texas, USA	Particle soot absorption photometer with SP2	Schwarz et al. (2008)
10.38	522	Aspvreten, Sweden	Particle soot absorption photometer with EC	Zanatta et al. (2016)
9.54	525	Birkenes, Norway	Particle soot absorption photometer EC	Zanatta et al. (2016)
12.32	565	Jeju Island, Korea	Particle soot absorption photometer with EC	Kondo et al. (2009)
6.4	565	Gosan Climate Observatory	COSMOS with EC	Cho et al. (2019)

7	565	ACE-Asia, C-130 flights below 2km	Particle soot absorption photometer with EC	Clarke et al. (2004)
10.12	532	Cool, USA	Photoacoustic spectrometer with SP2	Gyawali et al. (2017)
3.1	532	Jeju Island, Korea	Photoacoustic spectrometer with EC	Flowers et al. (2010)
8.4	532	Karlsruhe, Germany	photoacoustic absorption + SP2	Linke et al. (2016)
7.5	532	California, USA	Photoacoustic absorption + SP2 rBC mass	Cappa et al. (2019)
6.5	532	South China	Photoacoustic absorption + SP2 rBC mass	Lan et al. (2013)
11.8	532	Nanjing, China	Photoacoustic soot spectrometer + SP-AMS	Ma et al. (2020)
14.7	550	Biomass burning, multiple sites/global synthesis	Filter-photometer-based compilation	Asmi et al. (2025)
12.8	550	Remote, multiple sites/global synthesis	Filter-photometer-based compilation	Asmi et al. (2025)
11	550	Urban, multiple sites/global synthesis	Filter-photometer-based compilation	Asmi et al. (2025)