Supplementary Material

Supplementary Material-1

Procedure for EC, OC and WSOC analyses.

The EC-OC analyzing procedure is a two-stage process. In the first stage, OC fraction is volatilized by heating the sample step-wise in an inert condition (100% He) and later volatilizing EC fraction by step-wise heating the sample in an oxidizing medium (10% O_2 + 90% He, vol/vol). The evolved carbon fraction is oxidized to CO_2, reduced to methane (CH_4), and measured using a flame ionization detector. The transmittance of the laser source is continuously monitored. The split between EC and OC is demarcated by the return of transmittance value to its initial value. OC is defined as the fraction which evolved before the split and EC as the fraction that evolved after the split. OC and EC fractions are corrected for pyrolysis after the analysis. In addition to the samples collected onboard, blanks were also analyzed, and a correction was applied. The detection limits were found to be 0.31 μg m^{-3} (using 3σ values of procedural blanks) for OC and 0.01 μg m^{-3} (using 0.2 μg cm^{-2} as instrument signal) for EC measurements. The repeated measurements yielded the uncertainty of 0.73 μg cm^{-2} in the detection of OC and 0.17 μg cm^{-2} in the detection of EC. The precision of these measurements were found within 5%. Consistency of instrument performance was evaluated by periodic analysis of laboratory made sucrose/potassium hydrogen phthalate solution.

In order to measure the water-soluble organic carbon (WSOC), a quarter of the filter was cut and transferred to a savillex vial under a clean laminar flow bench. The filters were soaked in 50ml of Milli-Q water (specific resistivity = 18.2 MΩ cm) for 3-4 hours following the initial ultrasonic treatment for 15 minutes. Subsequently, water extract was centrifuged, and the supernatant fraction was filtered using PVDF filters (0.45 um pore size) and transferred

to a glass vial. An aliquot of this water extract was stored in pre-cleaned polypropylene bottles at -19 ºC and later used for analyses of cations and anions using Ion Chromatography. A Shimadzu TOC-LCPH analyzer was used to determine TOC concentrations (Dickson et al., 2007). Standardization was achieved using potassium hydrogen phthalate. A 5-point calibration curve was generated before each batch. WSOC was analyzed at 680°C following combustion catalytic oxidation method. Triplicate analysis was done for each sample. CRM (Deep Sea TOC standard; 41−44 μM) procured from the University of Miami was run in each batch, and the accuracy of the analysis was ±1 μM. 25 μL of water-extract was injected into the furnace packed with Pt catalyst at a temperature of 680 °C. The evolved CO2 was measured using a non-dispersive infrared (NDIR) detector to assess total carbon (TC) content. Another aliquot of the solution (100 μL) was acidified with 25% phosphoric acid (25% H3PO4, vol/vol), and the evolved CO2 was considered as inorganic carbon (IC). WSOC concentration was obtained by subtracting IC values from TC.

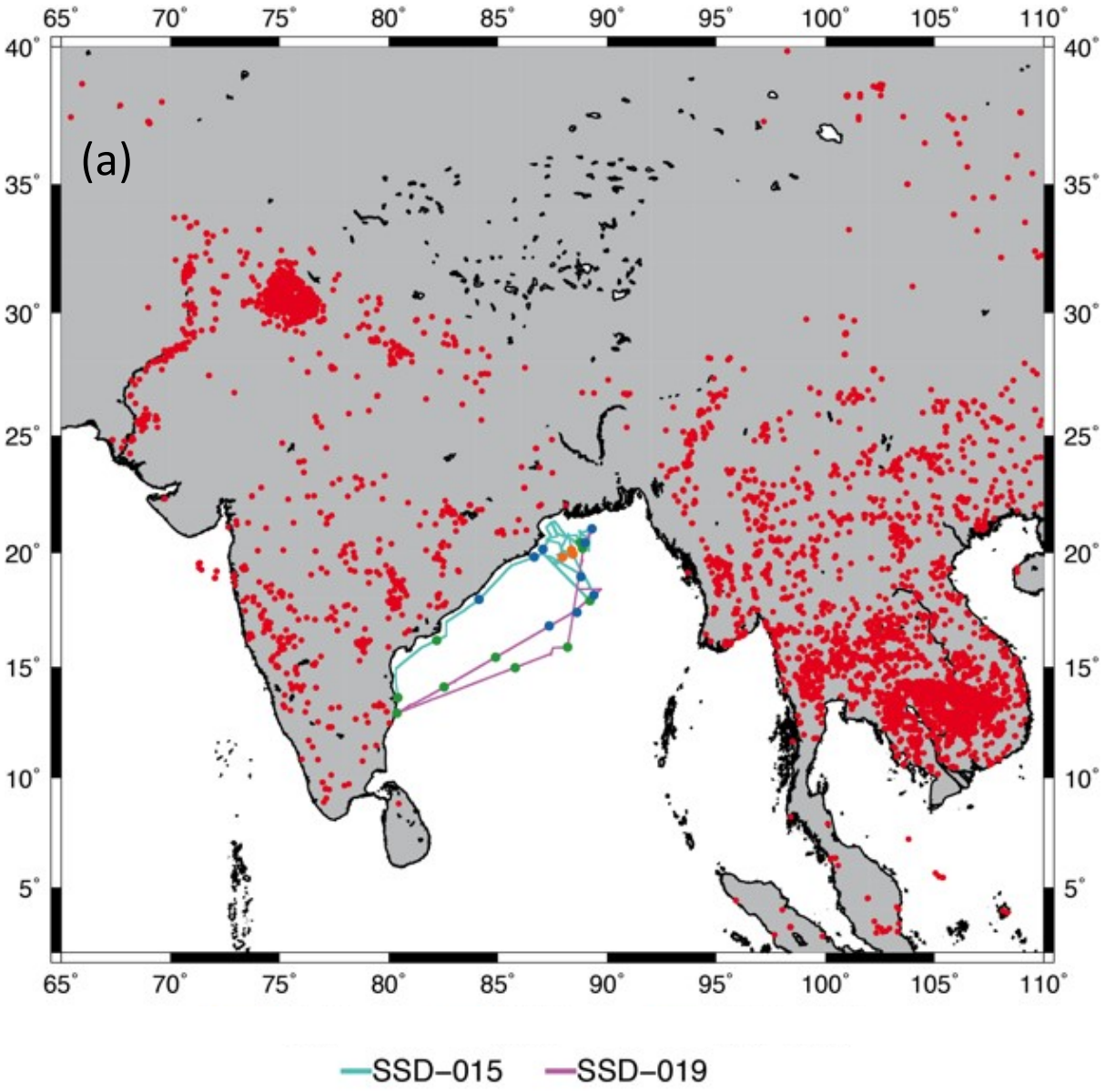
Supplementary Material-2

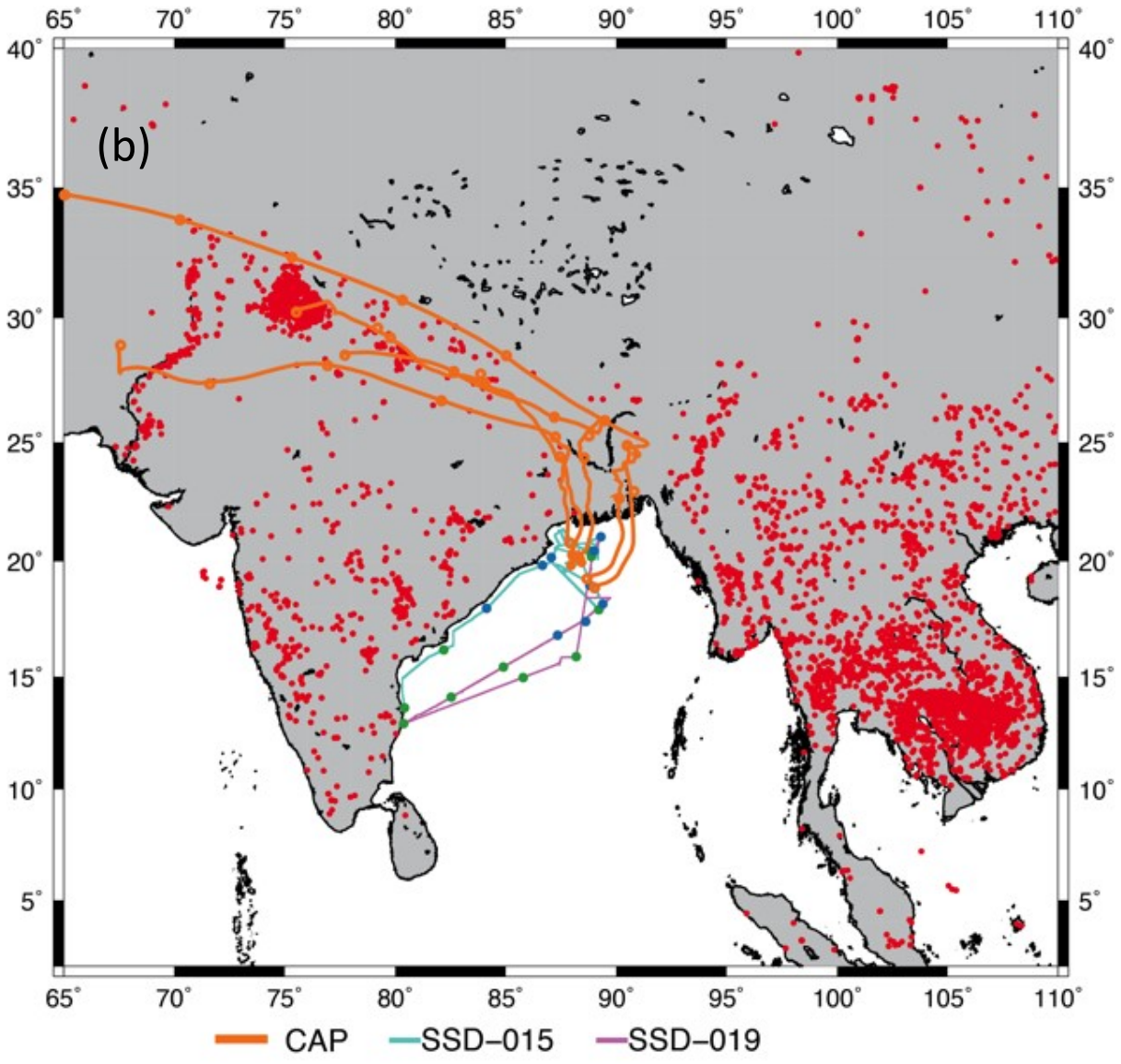
Table listing all acronyms/symbols used in the manuscript

A_{365}	Absorption at 365nm
A_{700}	Absorption at 700nm
AAE	Absorption Angstrom Exponent
AAE_{BrC}	Absorption Angstrom Exponent of Brown Carbon
AMBT	Air Mass Back Trajectories
ATN	Attenuation
ATN_{EC-678}	Attenuation of Elemental Carbon at 678nm
$b_{abs-365}$	Absorption Coefficient at 365nm
$b_{abs-EC-678}$	Absorption Coefficientof Elemental Carbon at 678nm
$b_{ATN-EC-678}$	Attenuation Coefficient of Elemental Carbon at 678nm
BC	Black Carbon
BLH	Atmospheric Boundary Layer Height
BoB	Bay of Bengal
BrC	Brown Carbon
CAP	Continental Air Parcel
CAP+MAP	Continental and Marine Air Parcel
EC	Elemental Carbon
HVS	High Volume Sampler
HYSPLIT	Hybrid Single-Particle Lagrangian Integrated Trajectory
IGP	Ind0-Gangetic Plain
MABL	Marine Atmospheric Boundary Layer
MAE	Mass Absorption Efficiency
MAE_{BrC}	Mass Absorption Efficiency of Brown Carbon
$MAE_{BrC-365}$	Mass Absorption Efficiency of Brown Carbon at 365nm
MAE_{EC-678}	Mass Absorption Efficiency of Elemental Carbon at 678nm
MAP	Marine Air Parcel
MODIS	Moderate Resolution Imaging Spectroradiometer
NEM	North East Monsoon
NOAA	National Oceanic and Atmospheric Administration
nss K^+	Non Sea Salt Potassium
nss SO_4^{2-}	Non Sea Salt Sulphate
OC	Organic Carbon
ORV	Ocean Research Vessel
PM_{10}	Particulate Matter 10mm
POM	Particulate Organic Matter
RRF	Relative Radiative Forcing
RRF_{BrC}	Relative Radiative Forcing of Brown Carbon
SOA	Secondary Organic Aeresols
SOC	Secondary Organic Carbon

SSD	Sindhu Sadhana
SVOC	Semi Volatile Organic Compounds
TCA	Total Carbonaceous Aerosol
TOC	Total Organic Carbon
TOT	Total Optical Transmission
V_{aero}	Volume of the air filtered during sampling
V_{ext}	Volume of Milli-Q used to extract WSOC
VOC	Volatile Organic Compounds
WS_{BrC}	Water Soluble Brown Carbon
WSOC	Water Soluble Organic Carbon

Supplementary Figures:

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CAP
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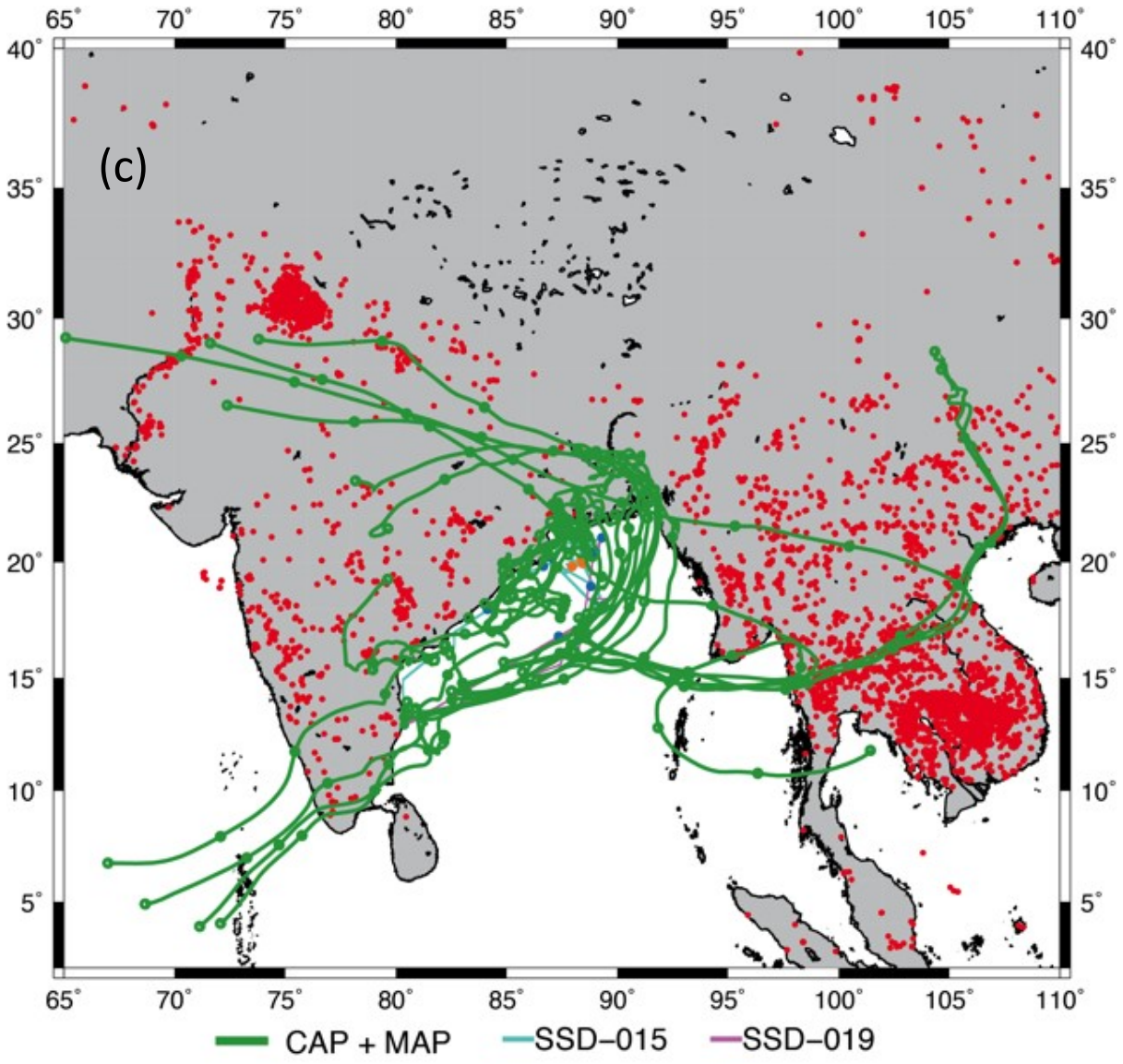
SSD–019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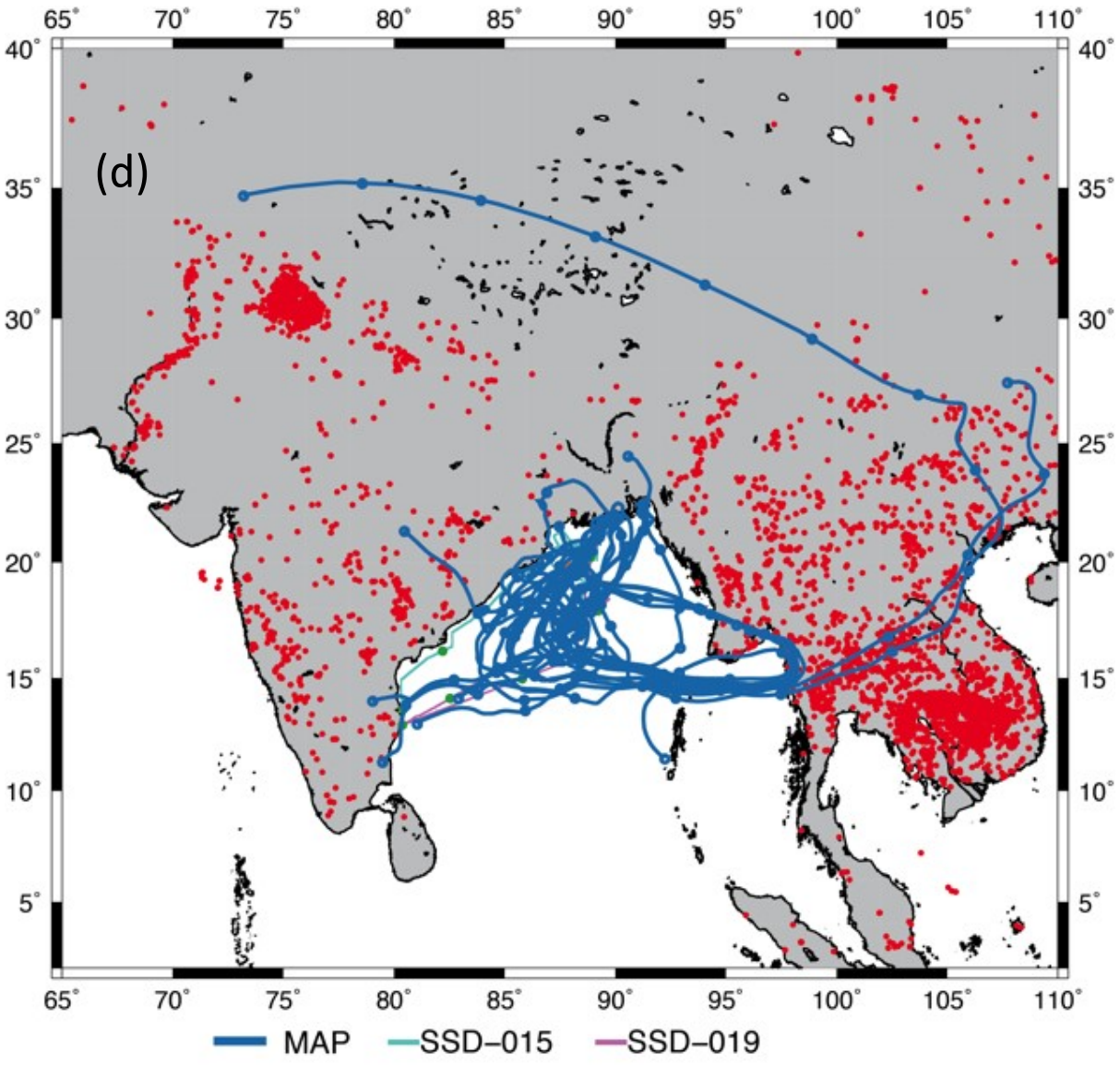

Fig. S1: (a) Map showing cruise track during SSD-15 and 19 over the Bay of Bengal. Red spots in the map are total fire counts (obtained from the MODIS aboard Terra satellite with detection confidence higher than 80%) during sampling period October-2015 and February-2016 over Indo-Gangetic Plains and southeast Asia to possibly detect the influence of biomass burning over the BoB. 7-day HYSPLIT Back-trajectories (at 500 m agl) ending at midpoint of sampling track used for collection of one aerosol sample for (b) CAP, (c) CAP+MAP, (d) MAP (see text for detail).

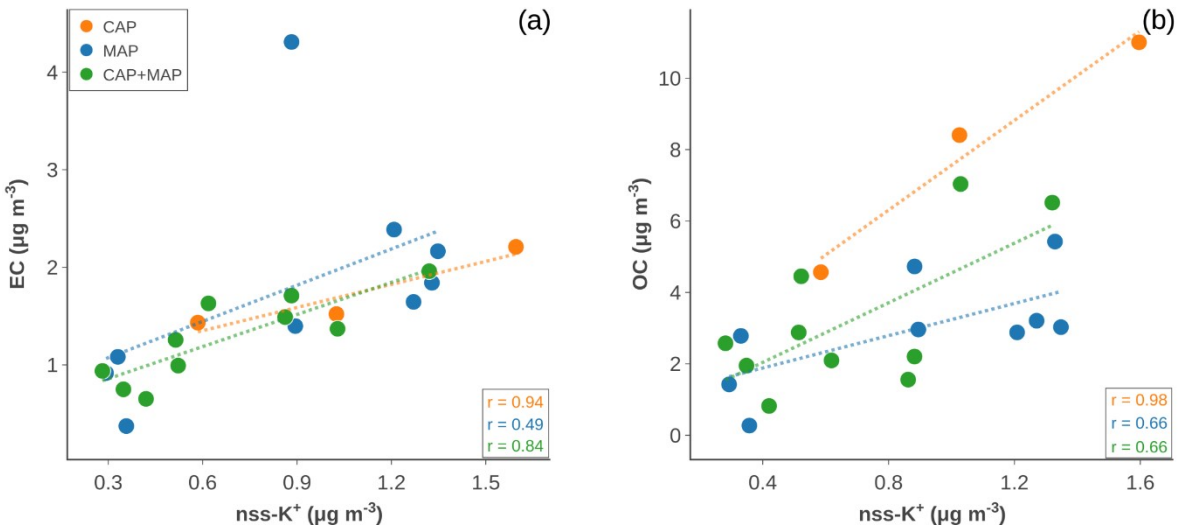

Fig. S2: Scatter plots between (a) EC and nss-K+ and (b) OC and nss-K^+ over the BoB during winter continental outflow.

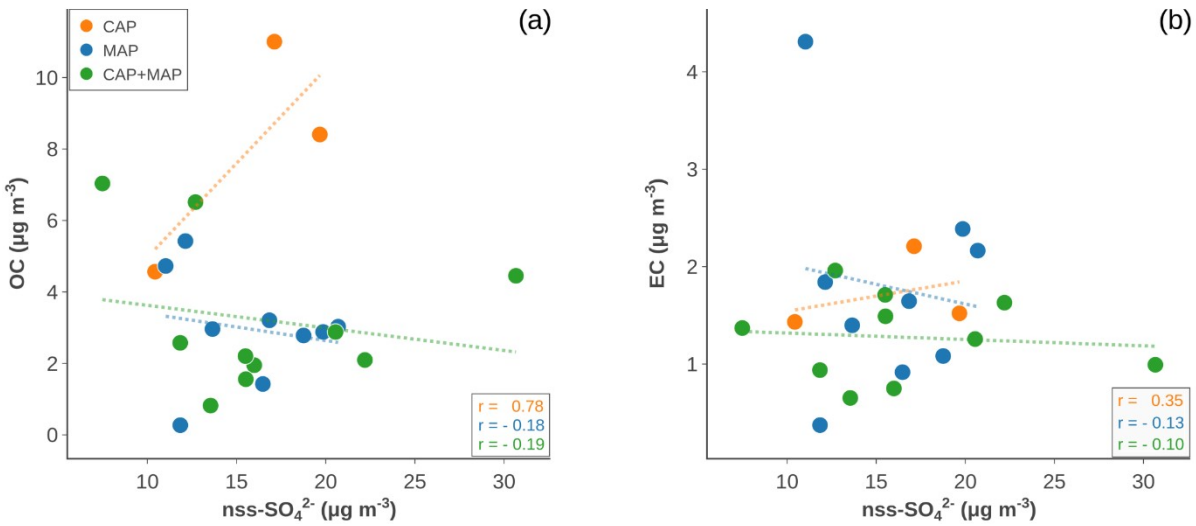

Fig. S3: Scatter plots between (a) OC and nss-SO_4^{2-} and (b) EC and nss-SO_4^{2-} over the BoB during winter continental outflow.

References:

Dickson, A.G., Andrew G., Sabine, C.L., Christian, J.R., North Pacific Marine Science Organization., 2007. Guide to best practices for ocean CO_2 measurements. North Pacific Marine Science Organization.