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Supplement of

Development of an aerosol microphysical module: Aerosol Two-dimensional bin module for foRmation and Aging Simulation (ATRAS)

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In this supplement, figures for model validation (Figures S1 – S3), simulated horizontal distributions (Figure S4), simulated size distributions (Figure S5), and concentration ratios between simulations (Figure S6) are shown.

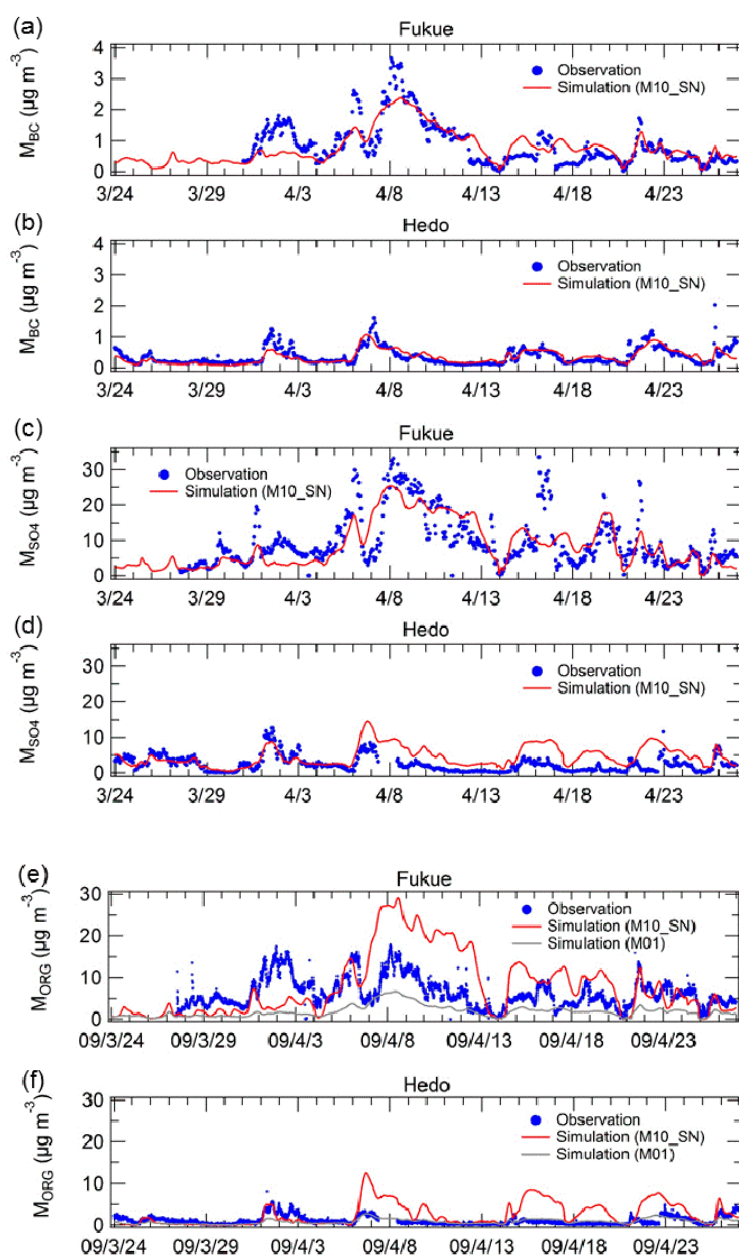


Figure S1: Time series of (a, b) black carbon mass concentrations, (c, d) sulfate mass concentrations, and (e, f) organic aerosol mass concentrations at the Fukue (32.75°N, 128.68°E) and Hedo (26.87°N, 128.25°E) sites, respectively, during the A-FORCE campaign (24 March – 26 April, 2009).

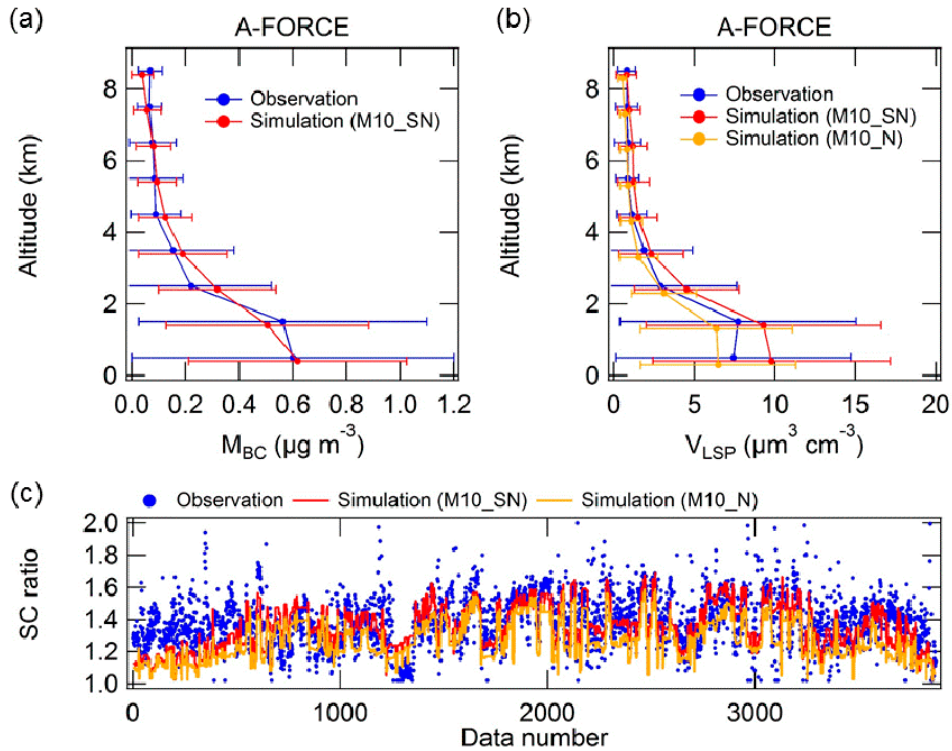


Figure S2: (a, b) Mean vertical profiles of BC mass and LSP (light scattering particles) volume concentrations over all flights during the A-FORCE campaign. Horizontal bars denote standard deviations at individual altitude levels. (c) Time series plot of observed (blue) and simulated (red, orange) mean shell-to-core diameter ratio at a BC core diameter of 200 nm along the flight tracks during the A-FORCE campaign. One-minute average concentrations are plotted in order of sampling for all the flights during A-FORCE.

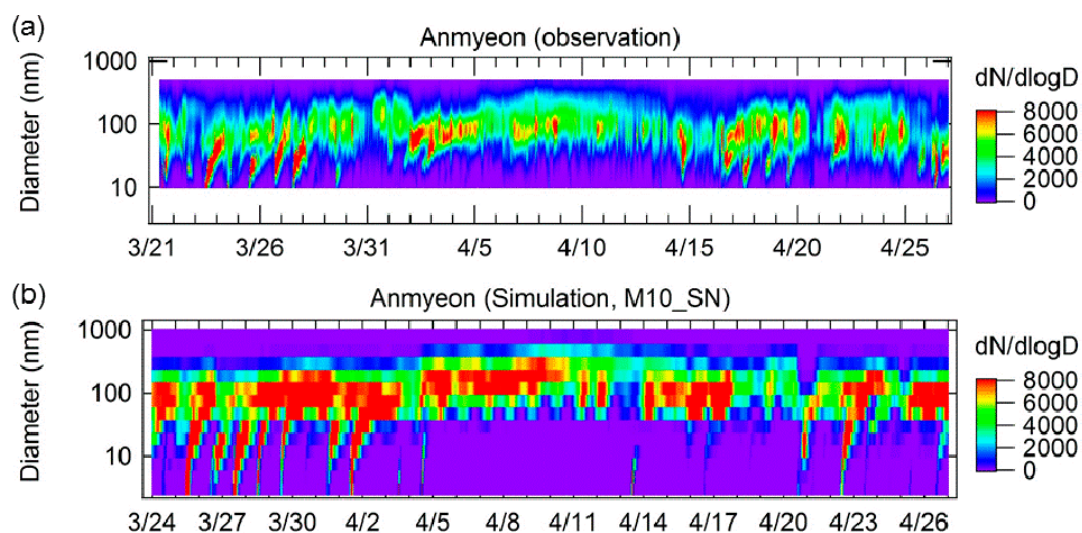


Figure S3: Time series of aerosol number size distribution (3–1000 nm) for (a) measurements and (b) model simulations at Anmyeon site (36.53°N, 126.32°E) during the A-FORCE campaign (24 March – 26 April, 2009).

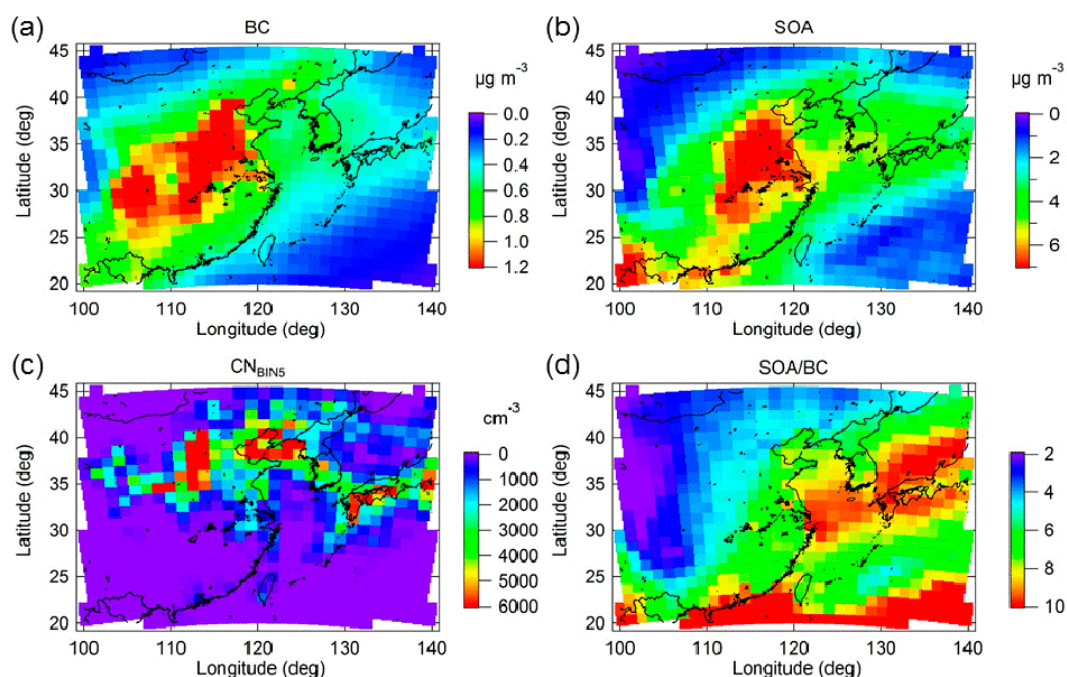


Figure S4: Period-averaged (a) BC mass concentrations, (b) SOA mass concentrations, (c) number concentrations in bin 5 (6.3 – 10 nm) (CN_{BIN5} , an indicator of new particle formation), and (d) SOA/BC mass concentration ratio at a σ level of 0.895 (~ 1 km).

Period-averaged values are calculated using the data at 12:00 local time (03:00 UTC) between 24 March and 26 April. BC and CN_{BINS} concentrations are calculated from the M10_SN simulations. SOA concentrations are calculated from the difference of OA mass between the M10_SN and M10_N simulations. SOA/BC ratio is the ratio of mean SOA mass to mean BC mass.

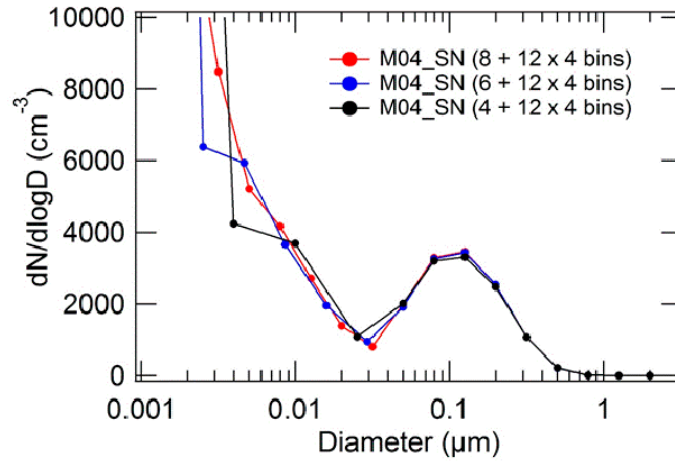


Figure S5: Period- and domain-averaged number size distributions at a sigma level of 0.895 (~1 km) in three simulations: the simulations with 8 (red), 6 (blue), and 4 (black) bins between 1 and 40 nm (12×4 bins between 40 nm and 10 μm).

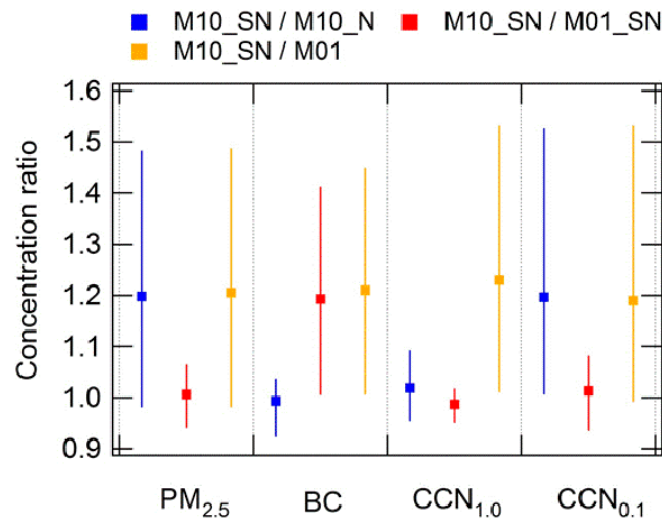


Figure S6: Concentration ratios of $PM_{2.5}$, BC, $CCN_{1.0}$, and $CCN_{0.1}$ for the simulations

between M10_SN and M10_N (blue), between M10_SN and M01_SN (red), and between M10_SN and M01 (orange). Concentration ratios are calculated for individual horizontal grids (39×24 grids) and times (34 days at noon) at 1 km, and their average (squares) and 10th – 90th percentiles (vertical bars) are shown.