Supplement of Atmos. Chem. Phys., 14, 7941–7951, 2014
http://www.atmos-chem-phys.net/14/7941/2014/
doi:10.5194/acp-14-7941-2014-supplement

Atmospheric Chemistry and Physics Open Access

Supplement of

Production and growth of new particles during two cruise campaigns in the marginal seas of China

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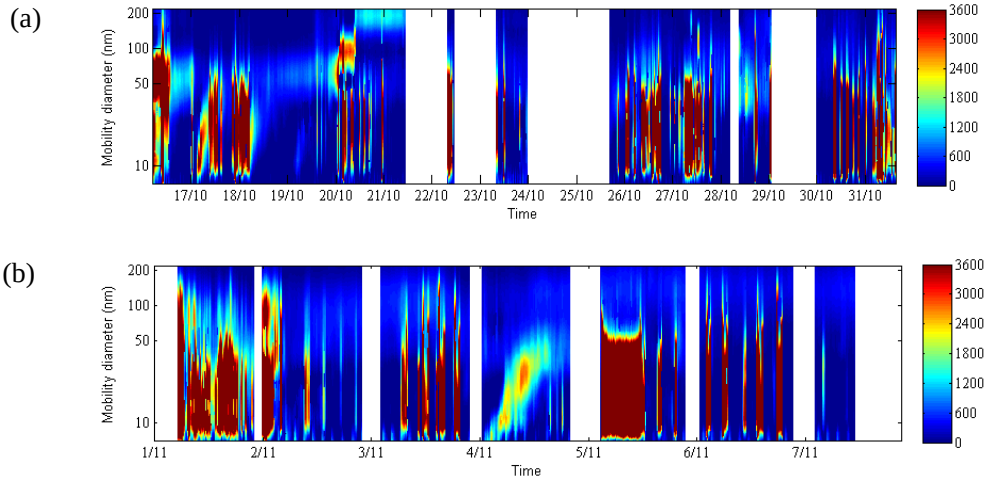
Table S1 Acronym and definition of each SOA species in CMAQ 4.7.1



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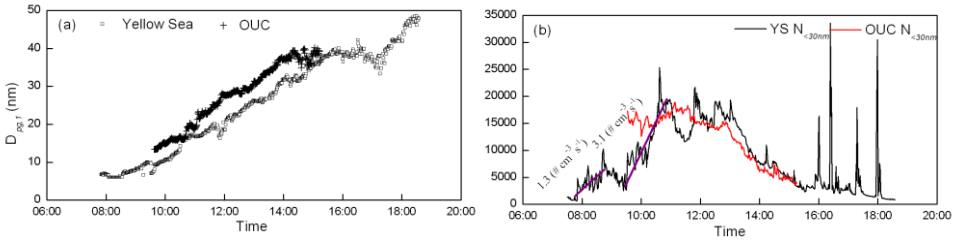

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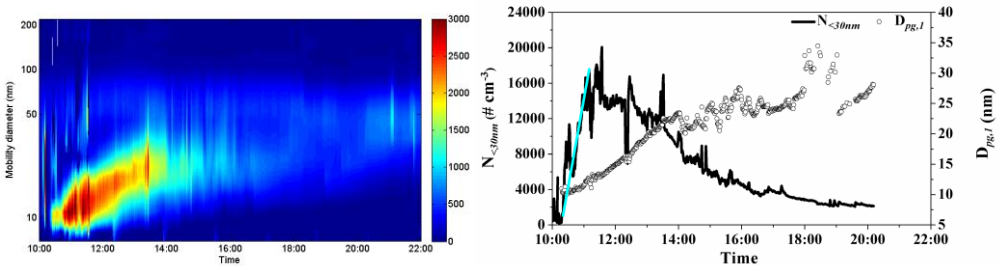

Figure S3 New particle formation on 18 October 2011 deducted of the ship plumes.

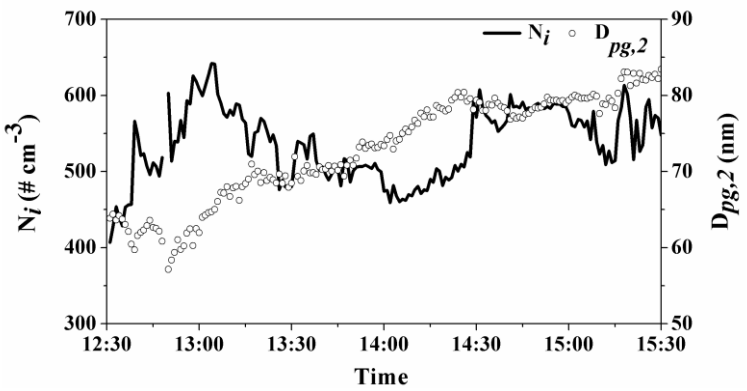

Figure S4 Variations of median diameter of preexisting particle mode ($D_{pg,2}$) and number concentrations of median diameter particles (N_i) of particle growth event over China Seas on 26 October 2011.

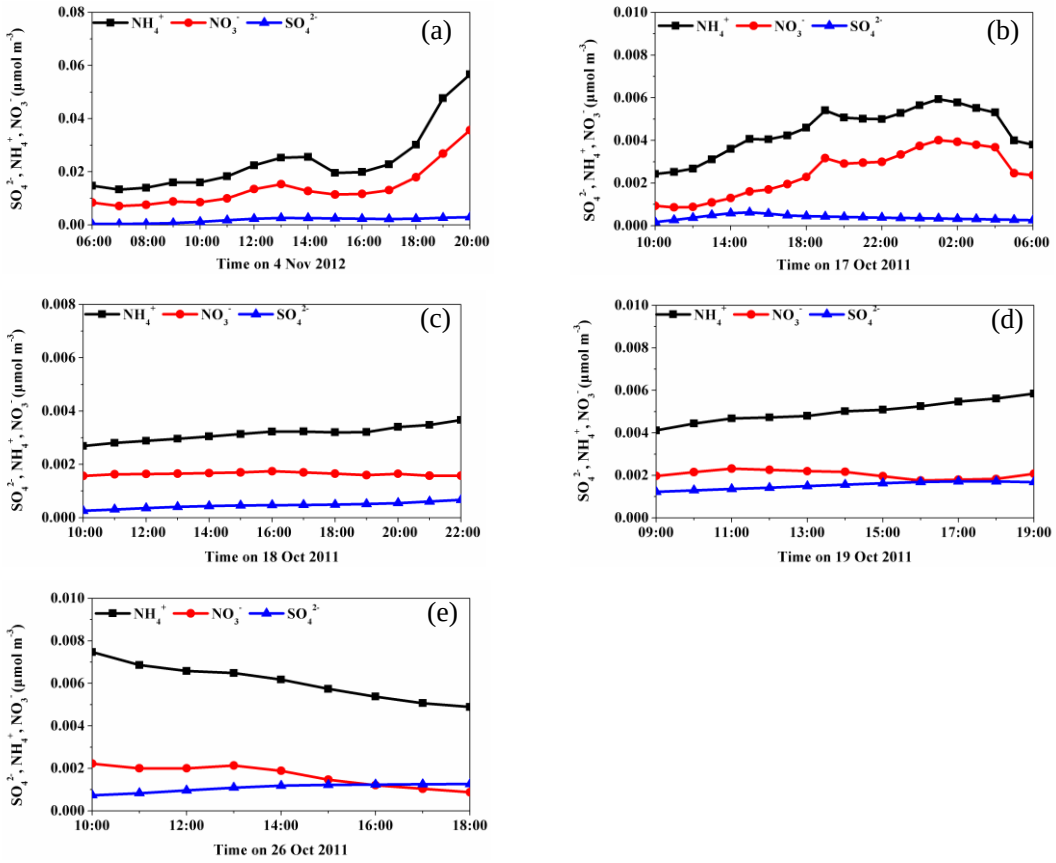

Figure S5 Variations of $PM_{0.1}$ NH_4^+, NO_3^- and SO_4^{2-} concentrations during 5 new particle formation events (Due to the lack of evaluation about the simulated $PM_{0.1}$ species with observations and SOA only distributed in $PM_{0.1\text{-}2.5}$ in modeling results, we chose $PM_{2.5}$ NH_4^+, NO_3^- and SO_4^{2-} in the text but not $PM_{0.1}$ NH_4^+, NO_3^- and SO_4^{2-}. However, simulated species in $PM_{0.1}$ could also support our analysis).

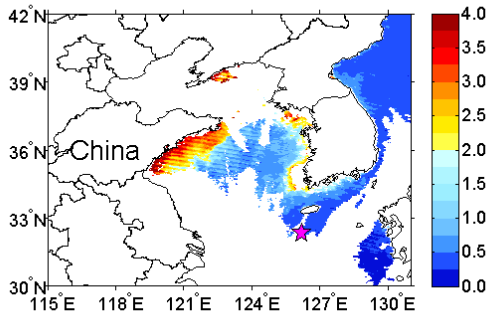

Figure S6 MODIS derived chlorophyll a oceanic concentrations on 26 October 2011 over China Seas (pentacle represents the location of new particle burst event).

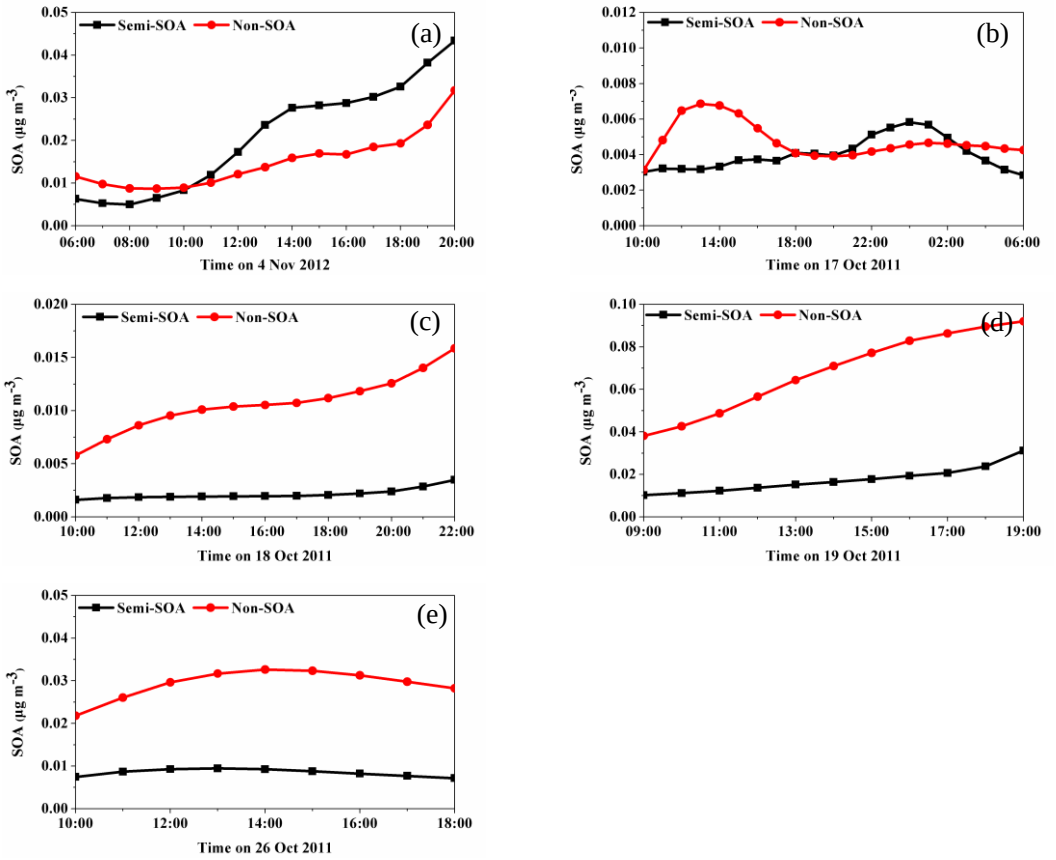

Figure S7 Variations of semi-volatile and non-volatile SOA concentrations during 5 new particle formation events (Non-SOA includes ABNZ3, ATOL3, AXYL3, AOLGA, AISO3, AOLGB and AORGC, while Semi-SOA includes AALK,ABNZ1, ABNZ2, ATOL1, ATOL2, AXYL1, AXYL2, AISO1, AISO2, ATRP1, ATRP2 and ASQT. Due to the temperature-related characteristics, SOA volatility always varies with different conditions, therefore we chose total SOA concentrations in the text, however, different volatility SOA could also support our analysis).

Supporting information

1. SOA simulation in CMAQ

The U.S. EPA Community Multi-scale Air Quality Model (CMAQ v4.7.1; Byun and Ching, 1999) with the AE5 SOA module was used to simulate the processes of secondary organic aerosol formation during new particle burst events.

Related SOA formation reactions and SOA composition in CMAQ4.7.1 are shown in Figure S8 (Carlton et al., 2010). Table S1 provides the acronym and definition of each SOA species. The concentration of SOA in this study represents the sum of 19 species listed in Table S1. Four types (7 species) of were non-volatile SOA (Fig. S7 and S8), while other SOA species was treated as semi-volatile (Carlton et al., 2010).

Table S1 Acronym and definition of each SOA species in CMAQ 4.7.1.

Acronym	Definition
AALK	Semi-volatile SOA from alkanes
ABNZ1,ABNZ2	Semi-volatile SOA from benzene
ABNZ3	Non-volatile SOA from benzene (low-NO_x)
ATOL1,ATOL2	Semi-volatile SOA from high-yield aromatics
ATOL3	Non-volatile SOA from high-yield aromatics (low-NO_x)
AXYL1,AXYL2	Semi-volatile SOA from low-yield aromatics
AXYL3	Non-volatile SOA from low-yield aromatics (low-NO_x)
AOLGA	Oligomers from anthropogenic SOA precursors
AISO1,AISO2	Semi-volatile SOA from isoprene
AISO3	Acid-enhanced SOA from isoprene
ATRP1, ATRP2	Semi-volatile SOA from monoterpenes
ASQT	Semi-volatile SOA from sesquiterpenes
AOLGB	Oligomers from biogenic SOA precursors
AORGC	Non-volatile from aqueous-phase oxidation of glyoxal and methylglyoxal

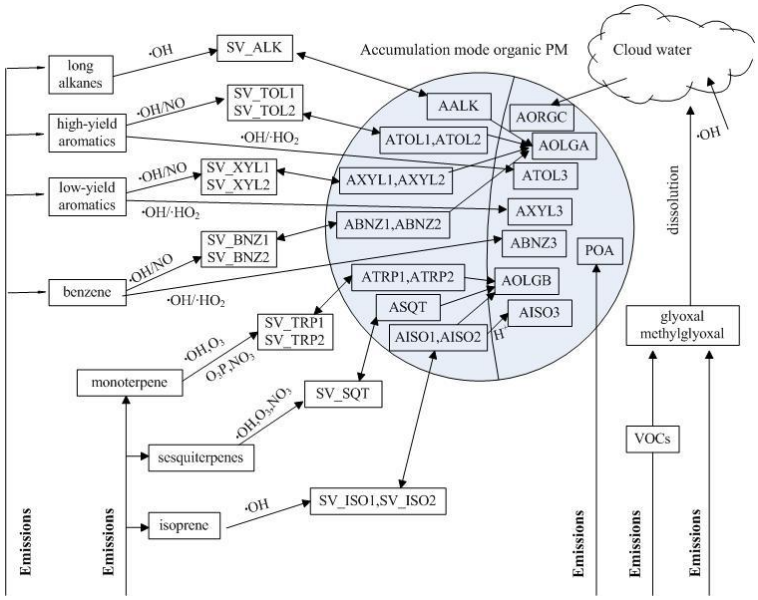

Figure S8 Schematic of CMAQv4.7 SOA module (Carlton et al., 2010)

2. An approach used to deduct the contribution of ship-emitted primary particles

The ship-emitted primary particles exhibited a uni-modal size distribution of their number concentrations in our two cruise campaign. The mode was distributed at 25-29 nm. However, there was a small difference between these number concentration size distribution spectra, depending on the concentration. Thus, the measurements in low background number concentration days were used to establish a library of number concentration size distribution spectra of ship-emitted particles in various concentration levels.

In the cruise campaign, the observed concentration some times reflects a combination of the contributions from new particle formation, ship-emitted particles and background particles. To deduct the contribution from ship emissions, the number concentration size distribution spectrum of ship-emitted particles with the concentration at 25-29 nm same as the observed particles at the size were selected. The observed number concentrations minus the values in the selected size distribution spectrum generated the concentrations of particles from new particle formation and background particles.

References:

Carlton, A.G., Bhave, P.V., Napelenok, S.L., Edney, E.O., Sarwar, G., Pinder, R.W., Pouliot, G.A. and Houyoux, M.: Model representation of secondary organic aerosol in CMAQ v4.7, Environ. Sci. Technol., 24, 8553-8560, 2010.

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