Supplementary Materials for

New particle formation contribution to aerosol mass: regimes and implications for future urban environments

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Supplementary Figures and Tables

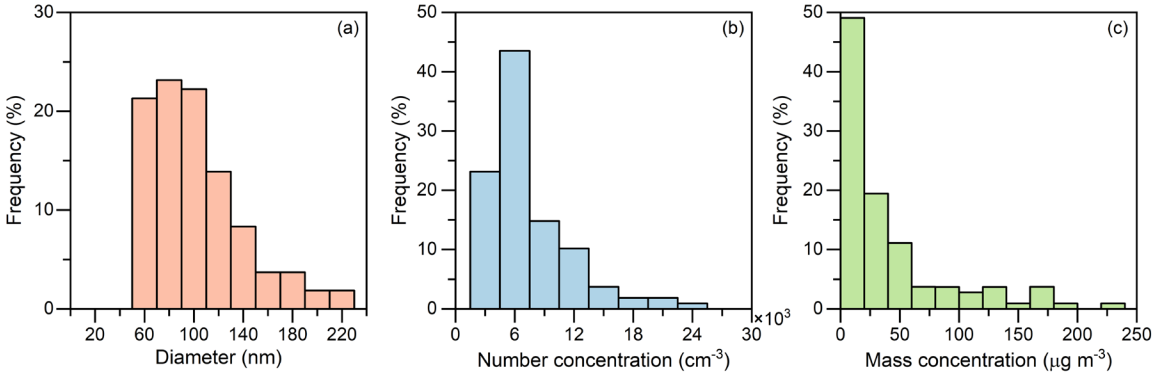

Figure S1. Statistical results of the growing new particle mode at the end of measured growth events in Beijing. a) Count median diameter; b) number concentration and c) mass concentration.

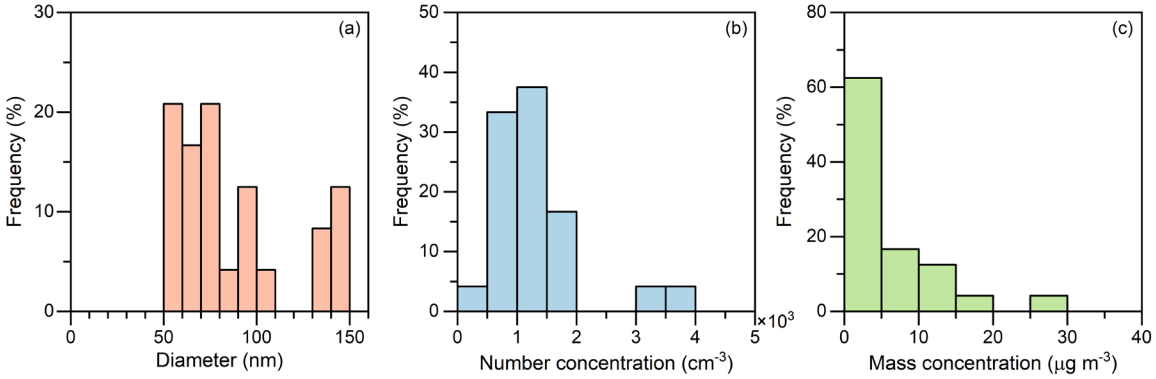

Figure S2. Statistical results of the growing new particle mode at the end of measured growth events at Hyytiälä. a) Count median diameter; b) number concentration and c) mass concentration.

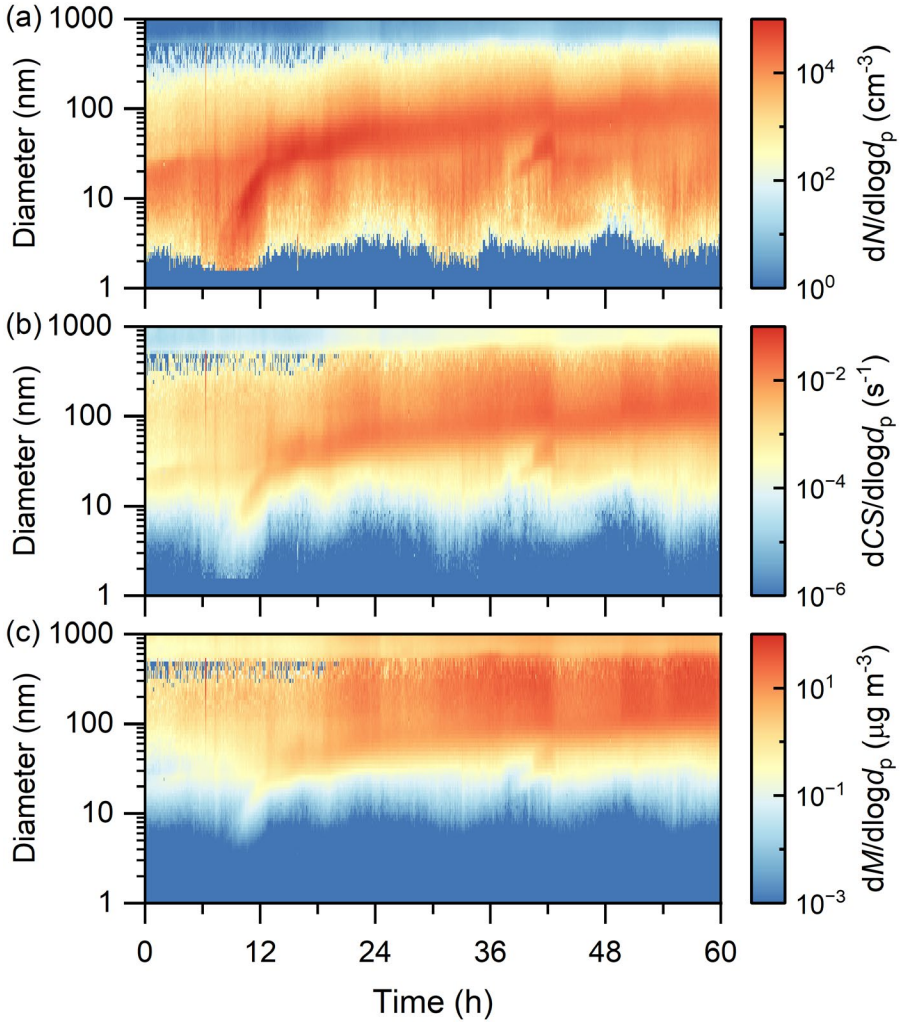

Figure S3. Measured evolution of atmospheric particles at on Sep. 8-10, 2019 from urban Beijing. a) Particle number–size distribution (dN/dlogd_p); b) Condensation sink–size distribution (dCS/dlogd_p); c) Particle mass-size distribution (dM/dlogd_p). The horizontal axis is the elapsed time since 0:00 Sep. 8, 2019 (local time).

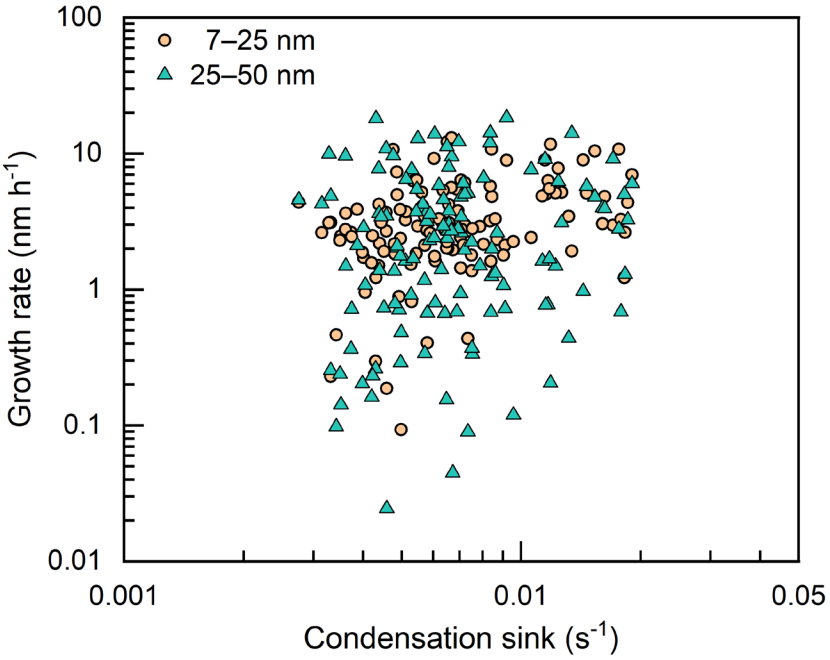

Figure S4. Correlation between new particle growth rate and the condensation sink during NPF events in urban Beijing. The condensation sink is calculated for the nucleation period, during which the new particles have not grown to sufficiently large sizes. This figure shows that the rate of mass accumulation by new particles does not have a strong negative correlation with background particle concentrations.

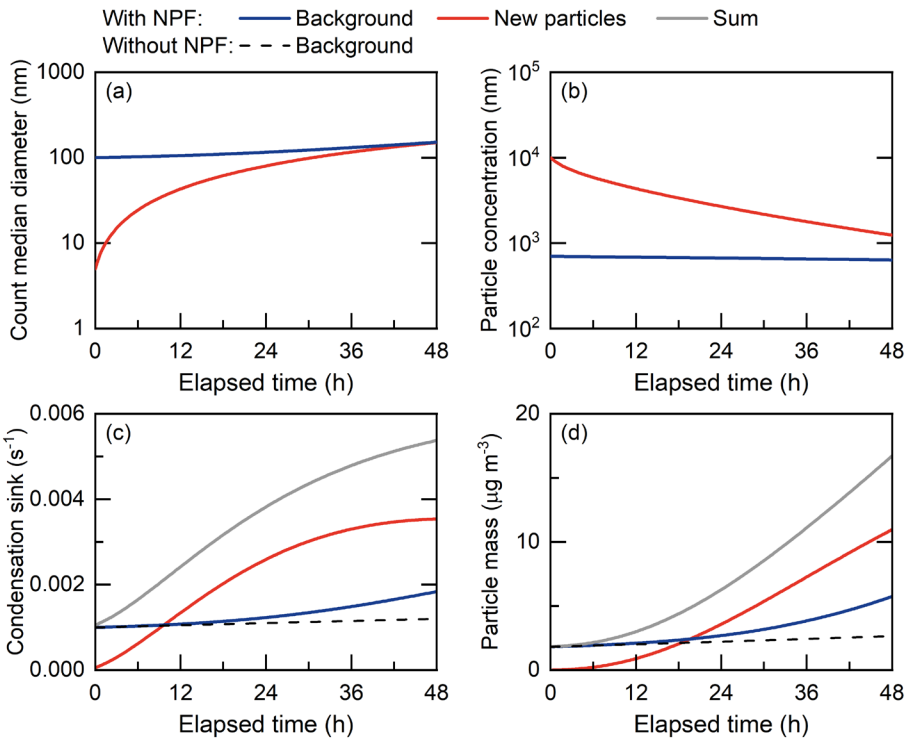

Figure S5. Simulated evolution of the new particle mode and the background mode with a constant vapor concentration. a) particle diameter; b) particle number concentration; c) condensation sink; and d) mass concentration. Dashed lines represent simulation results under a separate scenario without the new particle mode. The model inputs are: constant $N_v = 2\times10^7$ cm^{-3} s^{-1}, $CS_{bg0} = 0.001$ s^{-1}, $N_{np0} = 10^4$ cm^{-3}, and $\alpha_{bg} = 0.1$. The condensation sink of background particles in panel c is reported at $\alpha_{bg} = 1.0$ to better reflect its contribution to the surface area and the coagulation sink.

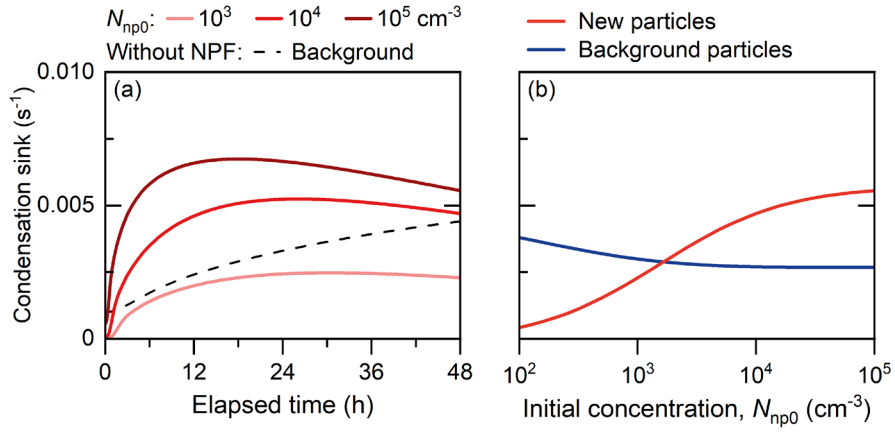

Figure S6. Influence of initial new particle concentration on the condensation sink the new particle mode. a) Temporal evolution of the condensation sink; b) condensation sink after 48 h as a function of initial new particle concentration (N_{np0}). The model inputs are: $Q_v = 1\times10^5$ cm^{-3} s^{-1}, $CS_{bg0} = 0.001$ s^{-1}, and $\alpha_{bg} = 0.1$.

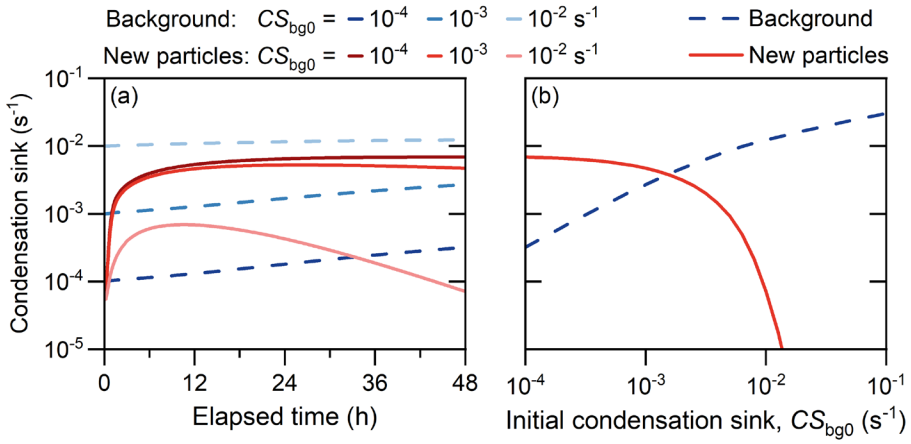

Figure S7. Influence of initial background condensation sink. a) Temporal evolution of the condensation sink; b) condensation sink after 48 h as a function of initial background condensation sink (CS_{bg0}); The model inputs are: Qv = 1×10^5 cm^{-3} s^{-1}, N_{np0} = 10^5 cm^{-3}, and $\alpha_{bg} = 0.1$.

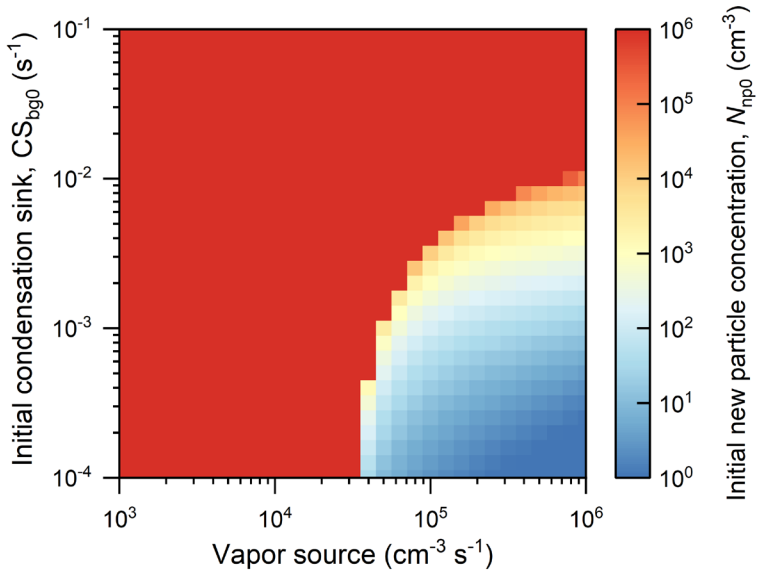

Figure S8. Initial new particle number concentration required to reach a certain mass. The color map indicates the minimum initial number concentration of new particles to reach 10 μg m^{-3} after 48 h growth. The value of α_{bg} is set to 0.1. For vapor source lower than 3×10^4 cm^{-3} s^{-1}, the new particle mode cannot reach 10 μg m^{-3} as a result of the limited total mass produced.

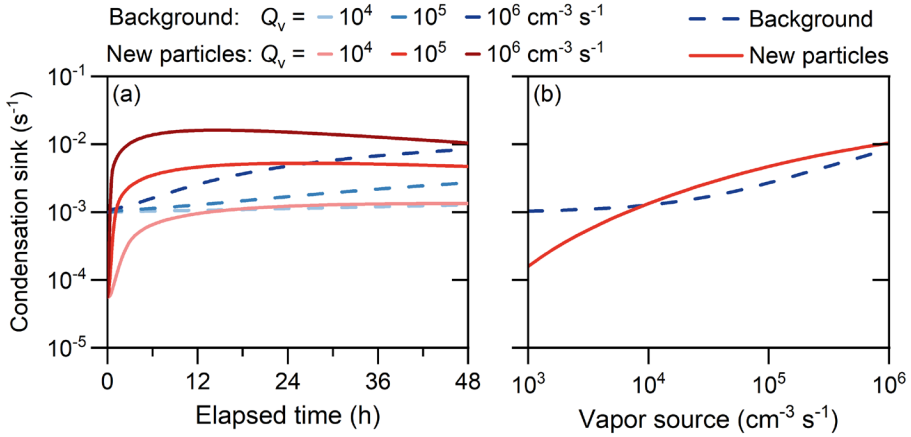

Figure S9. Influence of condensable vapor source. a) Temporal evolution of the condensation sink; b) condensation sink after 48 h as a function of vapor source (Q_v); The model inputs are: N_{np0} = 10^5 cm^{-3}, CS_{bg0} = 0.001 s^{-1}, and α_{bg} = 0.1. Q_v is kept constant in each simulation.

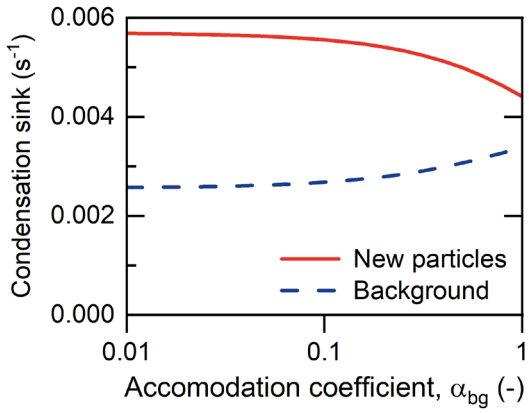

Figure S10. Influence of mass accommodation coefficient of background particles. a) condensation sink and b) particle mass concentration after 48 h as a function of the mass accommodation coefficient (α_{bg}). The model inputs are: $Q_v = 1\times10^5$ cm^{-3} s^{-1}, $N_{np0} = 10^5$ cm^{-3}, and $CS_{bg0} = 0.001$ s^{-1}.

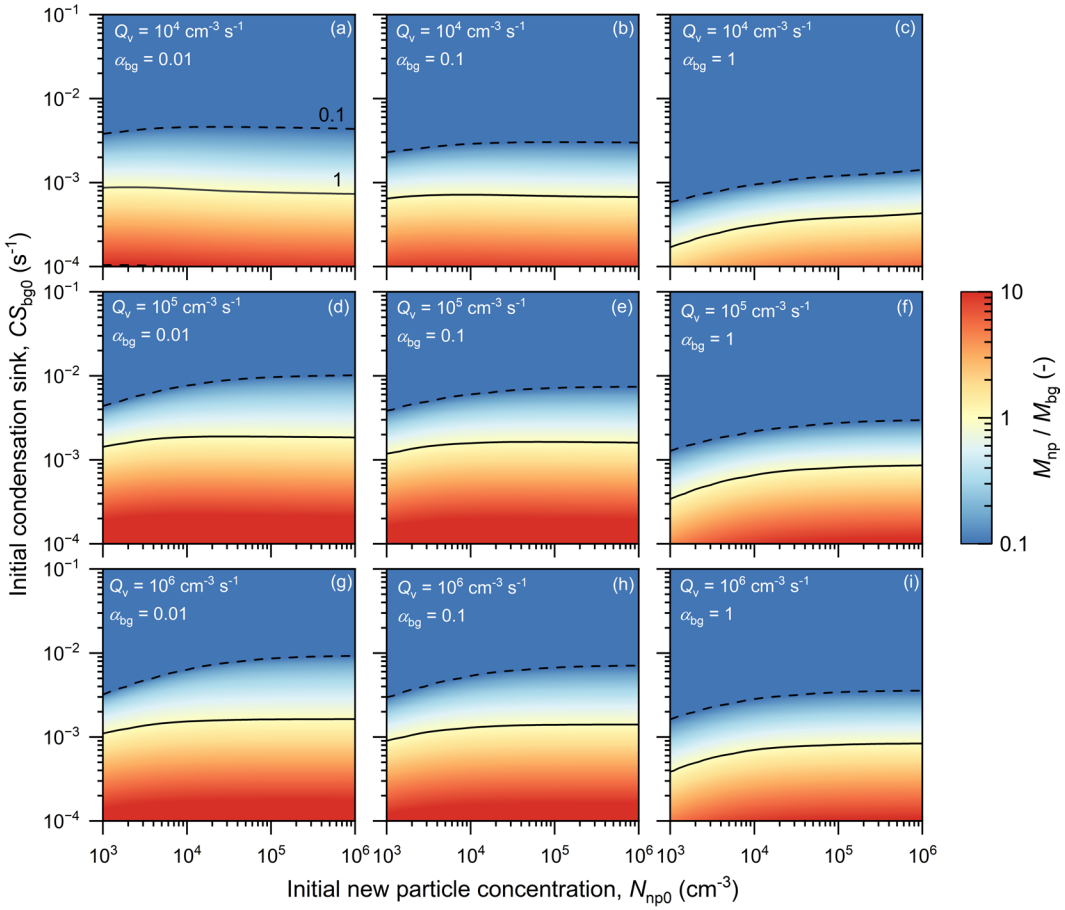

Figure S11. Contribution of the new particle mode to particle mass concentration after 48 h at different simulation conditions. The model inputs of panel e are identical to those in Fig. 3.