



Supplement of

Assessing the formation and evolution mechanisms of severe haze pollution in the Beijing–Tianjin–Hebei region using process analysis

Lei Chen et al.

Correspondence to: Hong Liao (hongliao@nuist.edu.cn)

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Figure S1. Hourly variations in aerosol concentrations (shown in black dot lines) and the sum of hourly IPRs of the nine processes (shown in red dot lines) averaged over the analyzed domain during 16-29 December 2015. The mean biases (MBs) are also shown.



Figure S2. Surface weather charts over East Asia at (a) 0600UTC 20, (b) 0600UTC 21, (c) 0600UTC 22, (d) 0600UTC 23, (e) 0600UTC 25, and (f) 0600UTC 29 December 2015.



Figure S3. Weighted contributions of each physical/chemical process to hourly PM_{2.5} changes in Stage_1 and Stage_2. The weighted contributions are calculated using the equation $%PC_i = \frac{PC_i}{\sum_{i=1}^{n} |PC_i|}$ (Goncalves et al., 2009), where PC_i is the absolute contribution

5 (μg m⁻³) (i.e., the change in PM_{2.5} concentration induced by process *i*), and %PC_i is the weighted contribution (%) of process *i*.
Note that the sum of %PC_i for all processes may not be 100%, but the sum of abs(%PC_i) is exactly 100%. The net variations of hourly PM_{2.5} concentrations (μg m⁻³) from all the processes in Stage_1 and Stage_2 are also listed at the top of each panel.



Figure S4. The differences in simulated surface-layer PM_{2.5} concentrations (shaded, µg m⁻³) and wind vectors (arrows, m s⁻¹) between CTL and NoABS cases during December 23-24. Same as CTL, but the direct radiative effects of absorbing aerosols (black carbon) are not considered in NoABS. The direct radiative effect is turned off by removing the mass of black carbon from the calculation of aerosol optical properties, following Qiu et al. (2017).



Figure S5. (a) Differences in contributions (µg m⁻³) of VMIX process to PM_{2.5} changes between CTL and NoARE cases (CTL minus NoARE) averaged over the Beijing-Tianjin-Hebei region in Stage_1. The purple and green lines denote the simulated PBLH in CTL and NoARE cases, respectively. (b) Differences in contributions (µg m⁻³) of AERC process to PM_{2.5} changes between CTL and NoARE cases (CTL minus NoARE) during the daytime (11:00-17:00LST) in Stage_1. Also shown at the lower right corner are the differences in contributions (µg m⁻³) of AERC to changes in PM_{2.5} components between CTL and NoARE cases (CTL minus NoARE) averaged over Beijing-Tianjin-Hebei during the daytime.

Reference

- Gon çalves, M., Jim énez-Guerrero, P., and Baldasano, J. M.: Contribution of atmospheric processes affecting the dynamics of air pollution in South-Western Europe during a typical summertime photochemical episode, Atmos. Chem. Phys., 9, 849-864, 10.5194/acp-9-849-2009, 2009.
- 5 Qiu, Y., Liao, H., Zhang, R., and Hu, J.: Simulated impacts of direct radiative effects of scattering and absorbing aerosols on surface layer aerosol concentrations in China during a heavily polluted event in February 2014, Journal of Geophysical Research: Atmospheres, 122, 5955-5975, 10.1002/2016jd026309, 2017.