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*Supplement of*

# Radiation fog properties in two consecutive events under polluted and clean conditions in the Yangtze River Delta, China: a simulation study

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The root-mean-square error (RMSE), mean bias (MB), the normalized mean bias (NMB), normalized mean error (NME), mean fractional bias (MFB), and mean fractional error (MFE) are calculated as follows (Eq. S1-S6):

$$\mathrm{RMSE} = \sqrt{\sum_{i=1}^{n} \frac{(M_i - O_i)^2}{n}} \tag{S1}$$

$$\mathrm{MB} = \frac{1}{n} \sum_{i=1}^{n} (M_i - O_i) \tag{S2}$$

$$\mathrm{NMB} = \frac{\sum_{i=1}^{n} (M_i - O_i)}{\sum_{i=1}^{n} O_i} \tag{S3}$$

$$\mathrm{NME} = \frac{\sum_{i=1}^{n} |M_i - O_i|}{\sum_{i=1}^{n} O_i} \tag{S4}$$

$$\mathrm{MFB} = \frac{1}{n} \sum_{i=1}^{n} \frac{(M_i - O_i)}{(O_i + M_i / 2)} \tag{S5}$$

$$\mathrm{MFE} = \frac{1}{n} \sum_{i=1}^{n} \frac{|M_i - O_i|}{(O_i + M_i / 2)} \tag{S6}$$

where $M$ and $O$ represent the results from simulation and observation; $n$ is the total number of observation stations.

The following equations S7-S10 are the calculations about contributions to turbulent kinetic energy (TKE) including wind shear ($TKE_{\mathrm{shear}}$), buoyancy ($TKE_{\mathrm{buoy}}$), dissipation ($TKE_{\mathrm{diss}}$), and vertical mixing ($TKE_{\mathrm{mixing}}$).

$$TKE_{\mathrm{shear}} = -\overline{u'w'} \frac{\partial u}{\partial z} - \overline{v'w'} \frac{\partial v}{\partial z} \tag{S7}$$

$$TKE_{\mathrm{buoy}} = \frac{g}{\theta} \overline{\theta_v' w'} \tag{S8}$$

$$TKE_{\mathrm{diss}} = \frac{q^3}{B_1 L} \tag{S9}$$

$$TKE_{\mathrm{mixing}} = -\frac{1}{2} \frac{\partial}{\partial z} \overline{q'w'} \tag{S10}$$

where $\overline{u'w'}$ and $\overline{v'w'}$ are the Reynolds stress of the turbulent zonal pulsation $u'$ and meridional pulsation $v'$ in the vertical direction respectively, $u$ and $v$ are the zonal and meridional components of the horizontal wind, g is the acceleration of gravity, $\theta$ is potential temperature, $\overline{\theta_v' w'}$ is virtual potential temperature turbulent flux, $\varphi$ is the

dynamic physical quantity (e.g. $u$ and $v$) or thermal quantity (e.g. $\theta$), $\overline{\varphi'w'}$ is the turbulent flux of dynamic or thermal quantity, $q$ is related with TKE and its calculation is $q = \sqrt{2TKE}$, $B_1$ is closing constant, $L$ is the master length scale, $z$ is the height above ground.
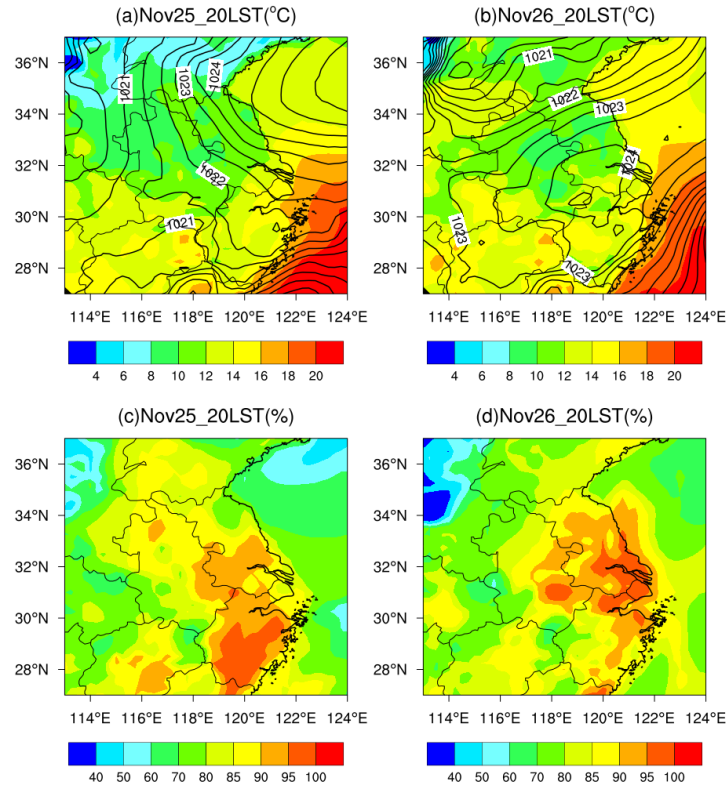


**Figure S1.** Surface weather map at 20:00 local standard time (LST = Universal Time Coordinated + 8 h) on 25 and 26 November 2018. (a-b) the shaded color is 2 m temperature (°C), the contour line is surface pressure (hPa), (c-d) the 2 m relative humidity (%). The time "Nov25_20LST" means 20:00 LST on 25 November 2018. The other time expressions follow the same notation.
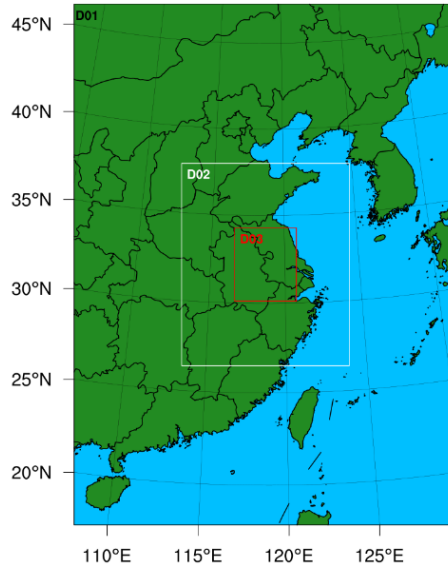
**Figure S2.** The model domain configuration with 3 nested domains and D01-D03 stand for domain 01-03, respectively.
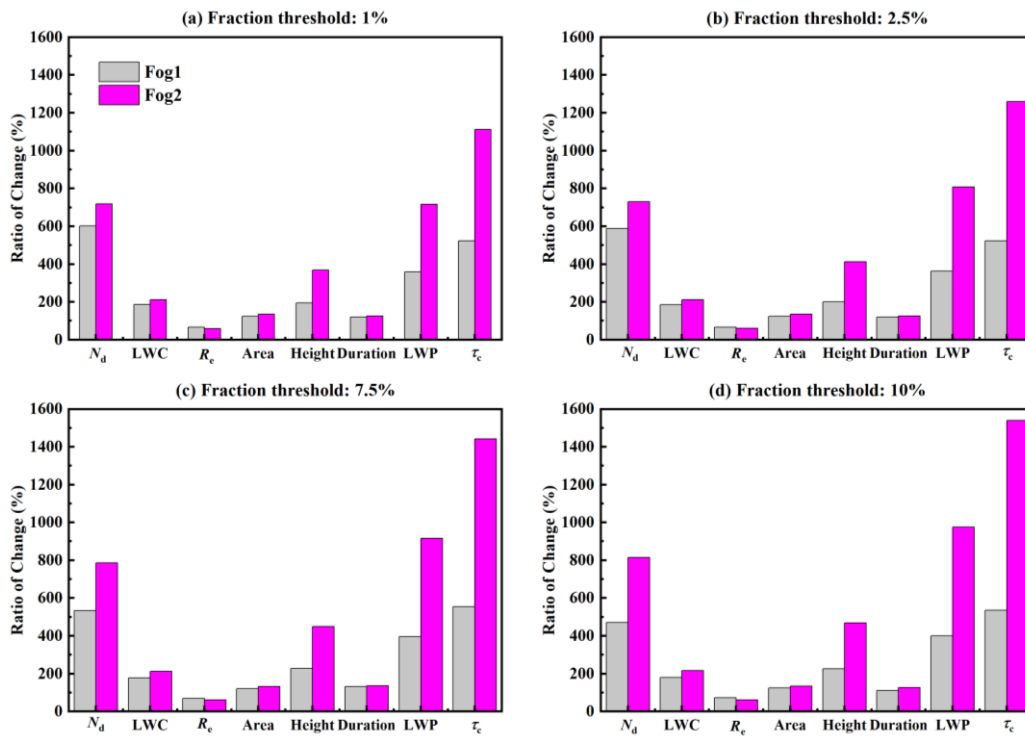


Figure S3. Aerosol effect on relative changes in macro- and microphysical properties during the first fog (Fog1) and the second fog (Fog2). Figure S3 a–d are the results with fog fraction area thresholds 1%, 2.5%,7.5%, and 10% respectively. $N_d$, LWC, $R_e$, Area, Height, Duration, LWP, and $\tau_c$ indicate fog number droplet concentration, liquid water content, effective radius, fog area fraction, fog-top height, liquid water path, and fog optical depth, respectively. The ratio of changes is calculated as Polluted/Clean.
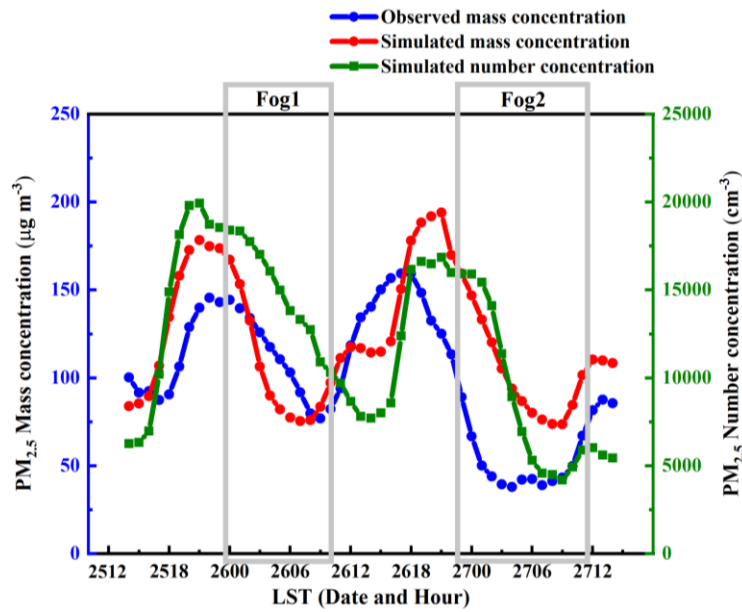
**Figure S4.** The timeseries of PM$_{2.5}$ mass concentration and aerosol number concentration in Nanjing (the blue line: observed PM$_{2.5}$ mass concentration, the red line: simulated PM$_{2.5}$ mass concentration and the green line: simulated PM$_{2.5}$ number concentration). Fog1 and Fog2 in the light grey box are the two fog events. Time '2512' indicates 12:00 local standard time (LST) (LST = Universal Time Coordinated + 8 h) on 25 November 2018. The other time expressions follow the same notation.
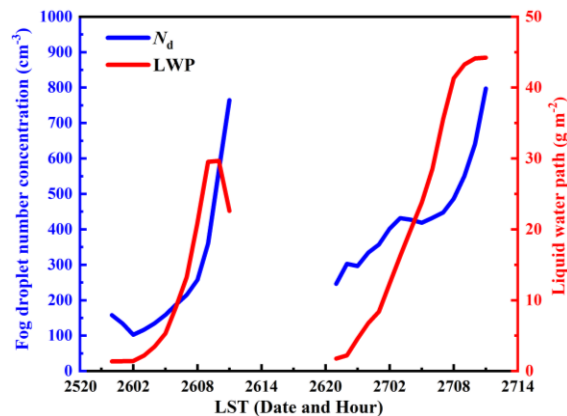


**Figure S5.** The timeseries of average liquid water path (LWP) in domain 03 under polluted and clean conditions (the red line: polluted conditions, the blue line: clean conditions). Time '2520' indicates 20:00 local standard time (LST) (LST = Universal Time Coordinated + 8 h) on 25 November 2018. The other time expressions follow the same notation.