Supplement of

Severe winter haze days in the Beijing–Tianjin–Hebei region from 1985 to 2017 and the roles of anthropogenic emissions and meteorology

Ruijun Dang and Hong Liao

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

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Figure S1. Approach for obtaining the visibility threshold ($V_t$, km) at the Beijing site for defining SWHD based on atmospheric visibility. 1) Select the period with observations of both PM$_{2.5}$ (from U.S. embassy) and atmospheric visibility (from NCDC database) available at the Beijing site: 2009-2016; 2) scatterplot the daily atmospheric visibility vs. daily mean PM$_{2.5}$ for all samples over the manual period of 2009-2012 (yellow) and the automatic period of 2013-2016 (green); 3) for each period, perform an exponential fit as $Vis = C_1 + C_2 \exp(C_3*PM_{2.5_{\text{obs}}})$, where $C_1$, $C_2$ and $C_3$ are all parameters, and obtain the $V_t$ that corresponds to the observed PM$_{2.5}$ concentration of 150 μg m$^{-3}$. Also presented here are the $V_t$ values. The $V_t$ values obtained from the 2009-2012 period were used to obtain the SWHDs for the entire manually observed period of 1985-2012, and the $V_t$ values obtained from the 2013-2016 period were used for the automatically observed period of 2013-2017.
**Figure S2.** Obtained threshold concentrations ($C_t$, $\mu$g m$^{-3}$) for simulated PM$_{2.5}$ at 161 grids in China. Red/green circles indicate grids with high/low biases in simulated PM$_{2.5}$. The $C_t$ values are used to obtain the SWHDs at each of the grids from 1985-2017.
Figure S3. Time series of simulated seasonal mean concentrations of PM$_{2.5}$ ($\mu$g m$^{-3}$, CTRL: black line, EMIS: red line, MET: green line) and its components ($\mu$g m$^{-3}$, CTRL: bars) in BTH from 1985-2017. Also shown are the linear trends (dashed lines) calculated for the results of the CTRL and EMIS simulations, which are statistically significant above the 95 % confidence level. The MET simulation results do not pass the significance test.