Supplement of
Air Quality and Climate Change, Topic 3 of the Model Inter-Comparison Study for Asia Phase III (MICS-Asia III), Part I: overview and model evaluation

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Equations of model evaluation metrics:

The following equations show how they are calculated, where $M_i$ is the individual model result at time $i$ (total time is $n$), and $O_i$ is the individual observation data at time $i$. $\bar{M}$ and $\bar{O}$ are the mean values of model and observation over time from 1 to $n$.

$$r = \frac{\sum_{i=1}^{n} (M_i - \bar{M})(O_i - \bar{O})}{\sqrt{\sum_{i=1}^{n} (M_i - \bar{M})^2 \sum_{i=1}^{n} (O_i - \bar{O})^2}}$$  \hspace{1cm} (1)$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} (M_i - O_i)^2}{n}}$$  \hspace{1cm} (2)$$

$$MBE = \frac{\sum_{i=1}^{n} (M_i - O_i)}{n}$$  \hspace{1cm} (3)$$

$$NMB = \frac{\sum_{i=1}^{n} (M_i - O_i)}{\sum_{i=1}^{n} O_i} \times 100\%$$  \hspace{1cm} (4)$$

$$MFB = \frac{1}{n} \sum_{i=1}^{n} \frac{(M_i - O_i)}{\frac{M_i + O_i}{2}}$$  \hspace{1cm} (5)$$
\[ MFE = \frac{1}{n} \sum_{i=1}^{n} \frac{|M_i - O_i|}{(M_i + O_i)/2} \] (6)

Table S1. Physics configurations of WRF-Chem and NU-WRF applications

<table>
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Figure S1. MEGAN biogenic emission inventory for January 2010 (moles/s/grid)
Figure S2. Re-gridded GFED biomass burning emissions (kg/s/grid)

Figure S3. Air and ship emissions of SO$_2$, NO and BC (mole/grid/year for gas and g/grid/year for aerosol)
Figure S4. Locations of used meteorology measurements sites

Figure S5. Locations of used radiation sites in North China (blue), radiation sites in South China (red), used CARE-China AOD measurements sites (green), and used AERONET AOD measurements sites (magneta)
Figure S6. Locations of used CARE-China air quality measurements sites (red) and EANET sites (blue).

Figure S7. Comparisons of observed and predicted temperature, water vapor and wind speed at near surface, 1km and 3km (near surface observation is at 55m and model predictions are at 2m).
Figure S8. Comparisons between simulated and observed daily air pollutants (SO$_2$, NO$_x$, CO, O$_3$, PM$_{2.5}$ and PM$_{10}$) at the Tianjin CARE-China site.
Figure S9. Comparisons between simulated and observed daily air pollutants (SO₂, NOₓ, CO, O₃, PM$_{2.5}$ and PM$_{10}$) at the Shijiazhuang CARE-China site

Figure S10. Comparisons between simulated and observed daily air pollutants (SO₂, NOₓ, CO, O₃, PM$_{2.5}$ and PM$_{10}$) at the Xianghe CARE-China site
Figure S11. Comparisons between simulated and observed daily air pollutants (SO$_2$, NO$_x$, O$_3$, and PM$_{10}$) at the Barnryu EANET sites
Figure S12. Comparisons between simulated and observed daily air pollutants (SO$_2$, NO$_x$, O$_3$, and PM$_{10}$) at the Hedo EANET sites.
Figure S13. Comparisons between simulated and observed daily air pollutants (SO$_2$, NO$_x$, O$_3$, and PM$_{10}$) at the Oki EANET sites.
Figure S14. Comparisons between simulated and observed daily air pollutants (SO$_2$, NO$_x$, O$_3$, and PM$_{10}$) at the Yusuhara EANET sites.
Figure S15. Inter-comparisons of simulated daily mean RH at the Beijing (a), Baoding (b), Xianghe (c) and Xinglong (d) AOD site