**Supporting materials for "Modeling diurnal variation of surface $PM_{2.5}$ concentration over East China with WRF-Chem: Impacts from boundary layer mixing and anthropogenic emission"**

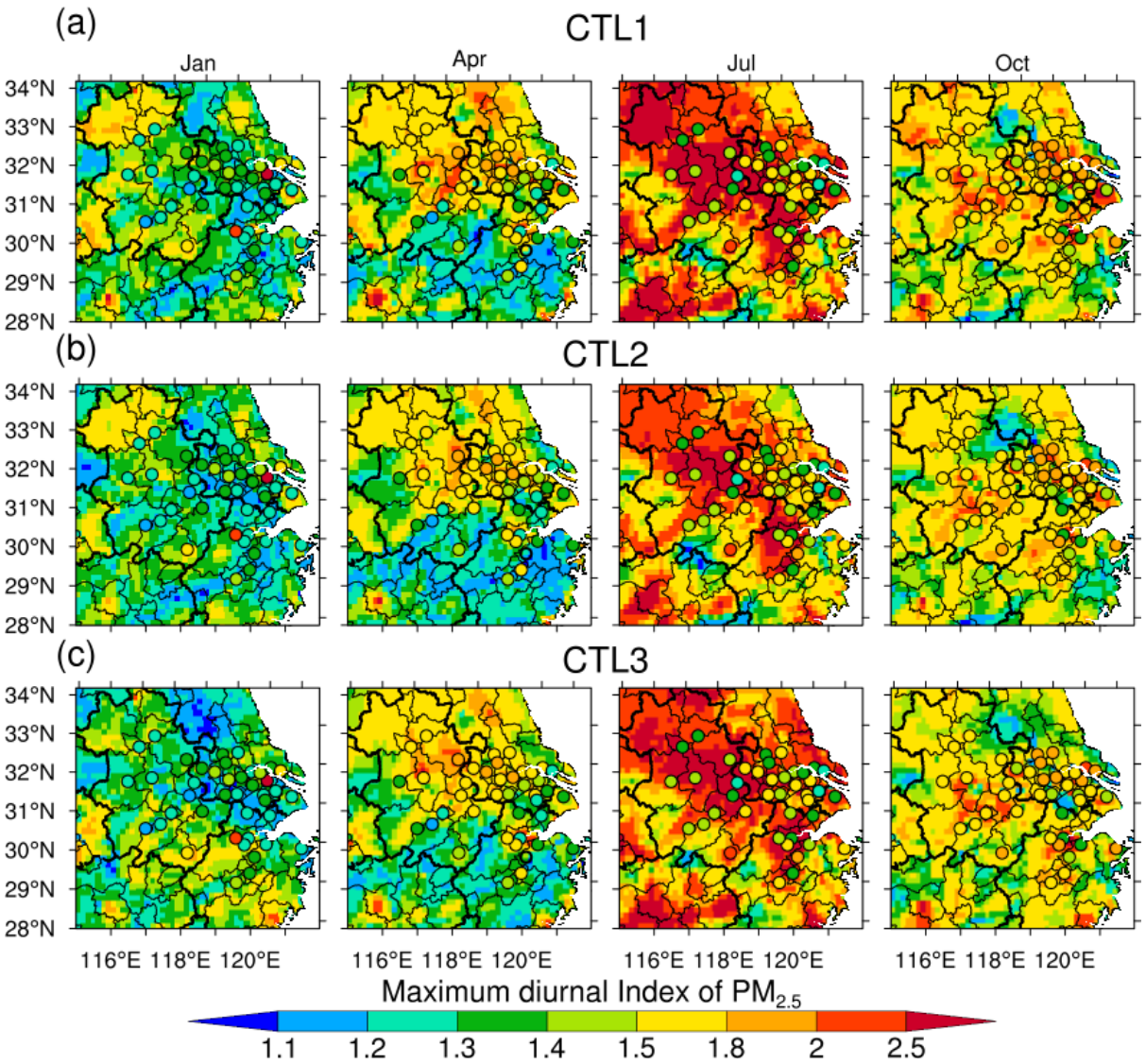


**Figure S1.** Spatial distribution of peak diurnal index of surface $PM_{2.5}$ in the four months from the experiments CTL1, CTL2, and CTL3. The observations are shown as the color filled circles. The observations at the stations within one city are averaged and shown as one circle as they are too close to be shown distinctly.

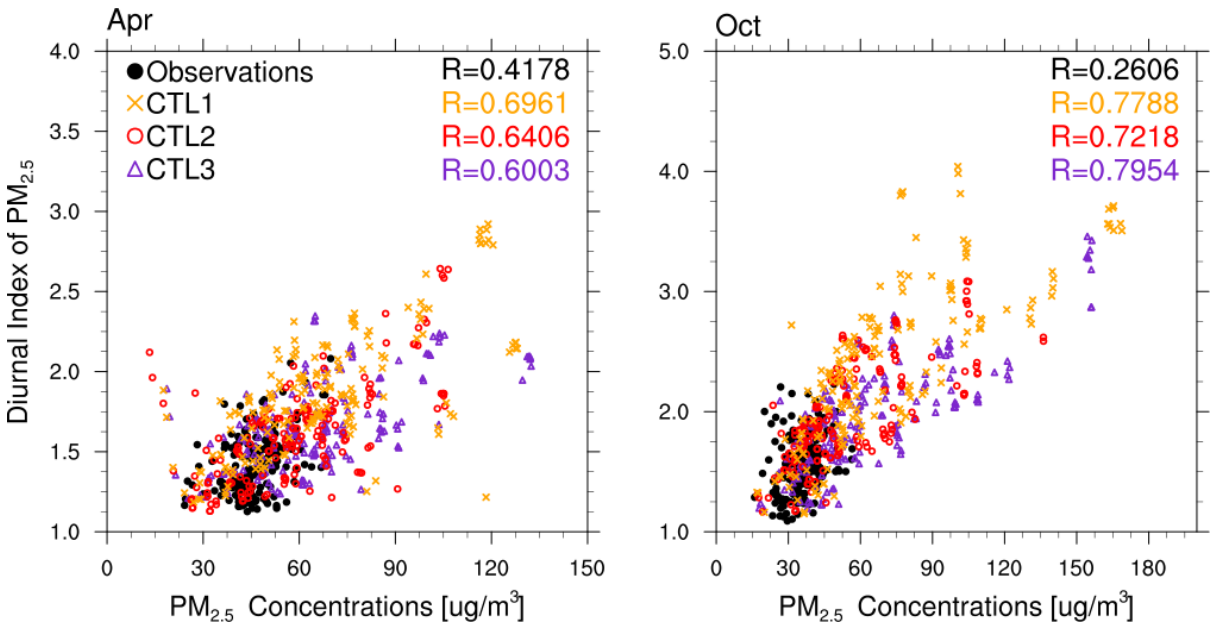


**Figure S2.** Comparison between monthly mean surface $PM_{2.5}$ concentration and diurnal index of surface $PM_{2.5}$ at each observational site over the YRD region of East China (within black box of Fig. 1a) for April and October from observations and the experiments CTL1, CTL2, and CTL3.

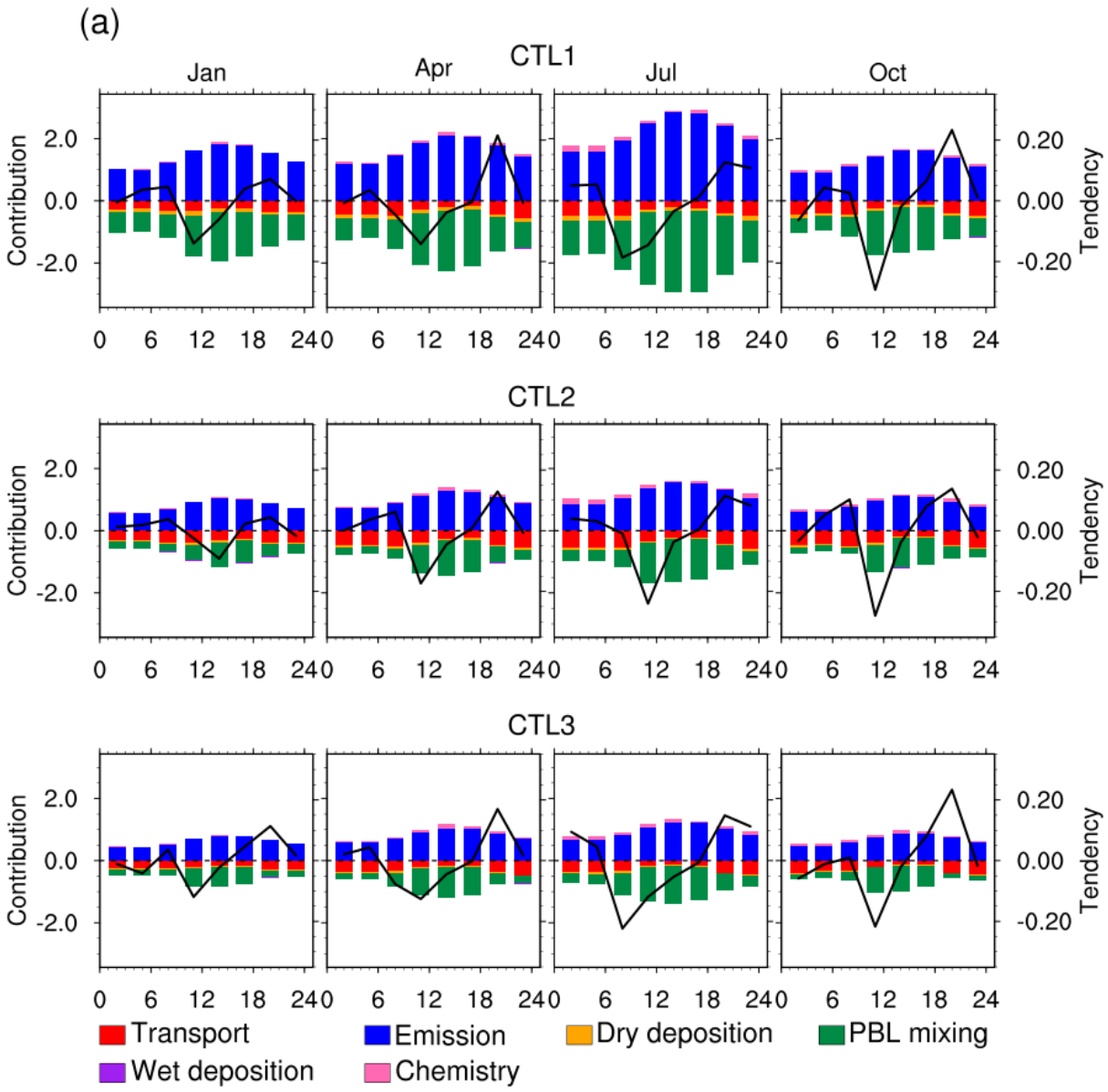


**Figure S3a.** Contribution to surface $PM_{2.5}$ concentration every 3-hour from individual process (transport, emission, dry and wet deposition, PBL mixing, settling, and chemical production/loss) averaged over Nanjing(a) for January, April, July, and October of 2018 from the experiments CTL1, CTL2, and CTL3.

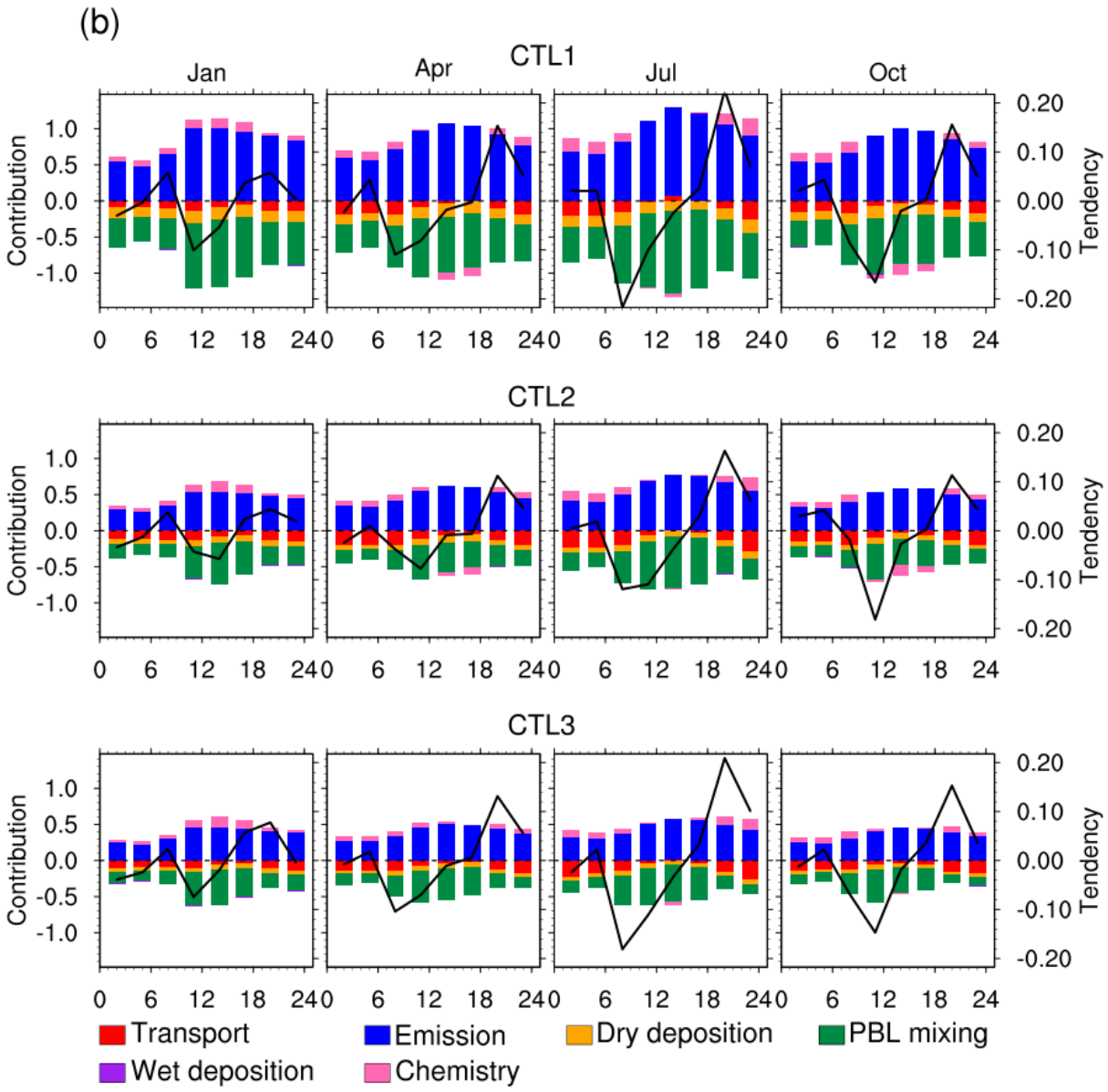


**Figure S3b.** Same as Fig. S3a but for Hangzhou.

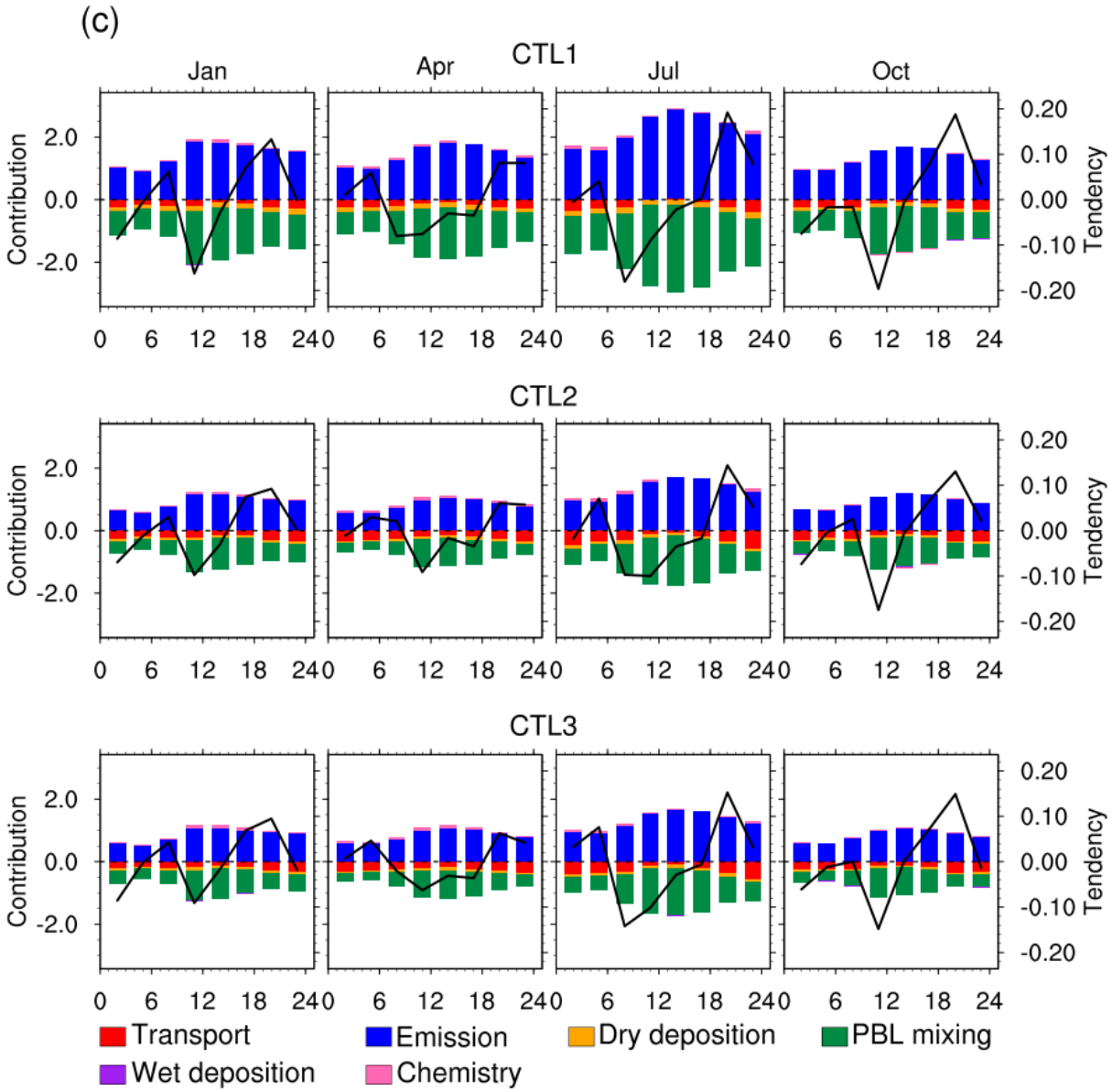


**Figure S3c.** Same as Fig. S3a but for Shanghai.

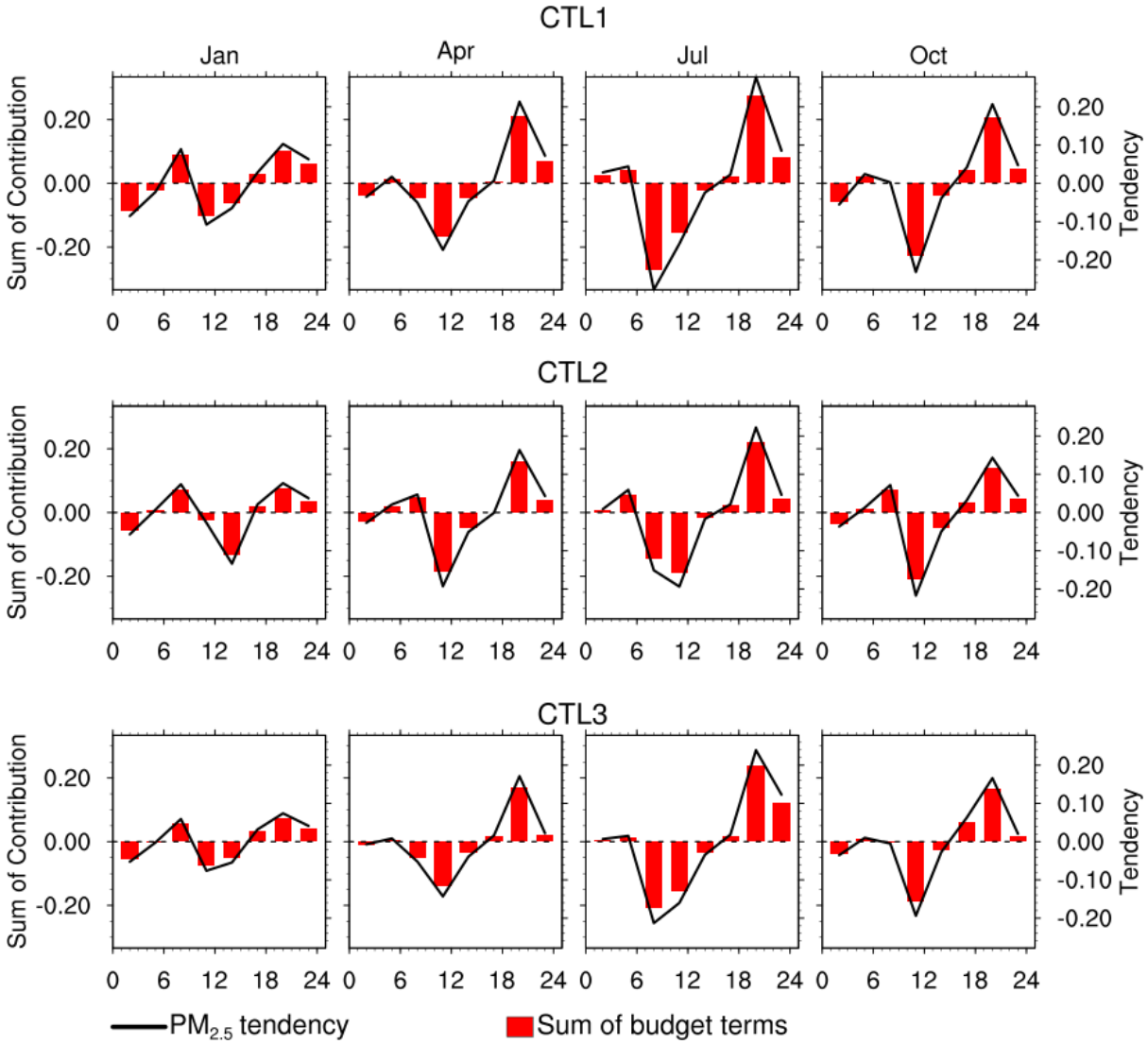


**Figure S4.** Validation of the consistency between summation of contributions from processes and the tendency of surface $PM_{2.5}$ concentration averaged over Hefei for January, April, July, and October of 2018 from the experiments CTL1, CTL2, and CTL3.

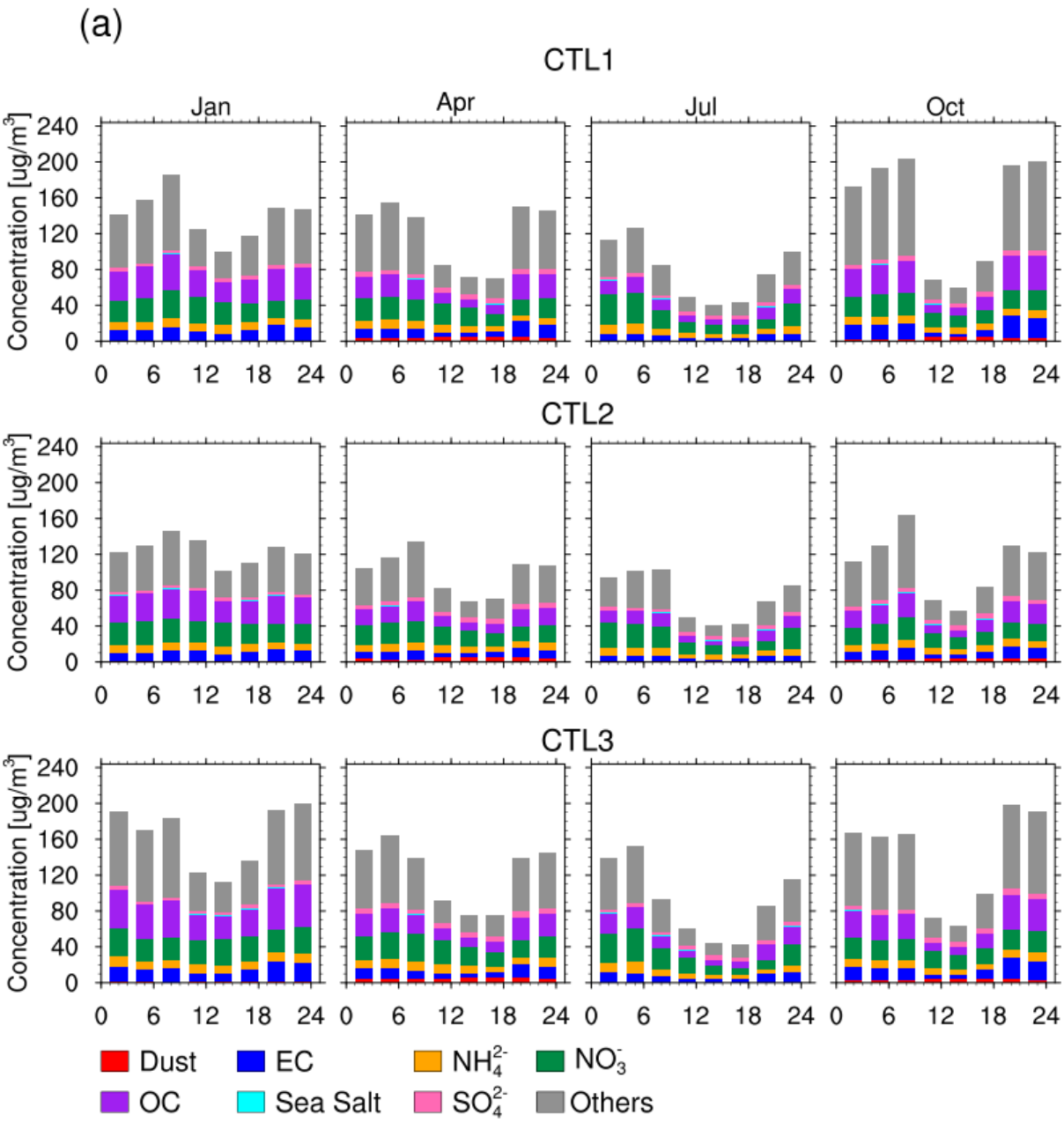


**Figure S5a.** Diurnal variation of surface concentration of each $PM_{2.5}$ composition (Dust, OC, EC, Sea Salt, $NH_4^{2-}$, $SO_4^{2-}$, $NO_3^-$, and other inorganics) averaged over Nanjing(a) for January, April, July, and October of 2018 from the experiments CTL1, CTL2, and CTL3.

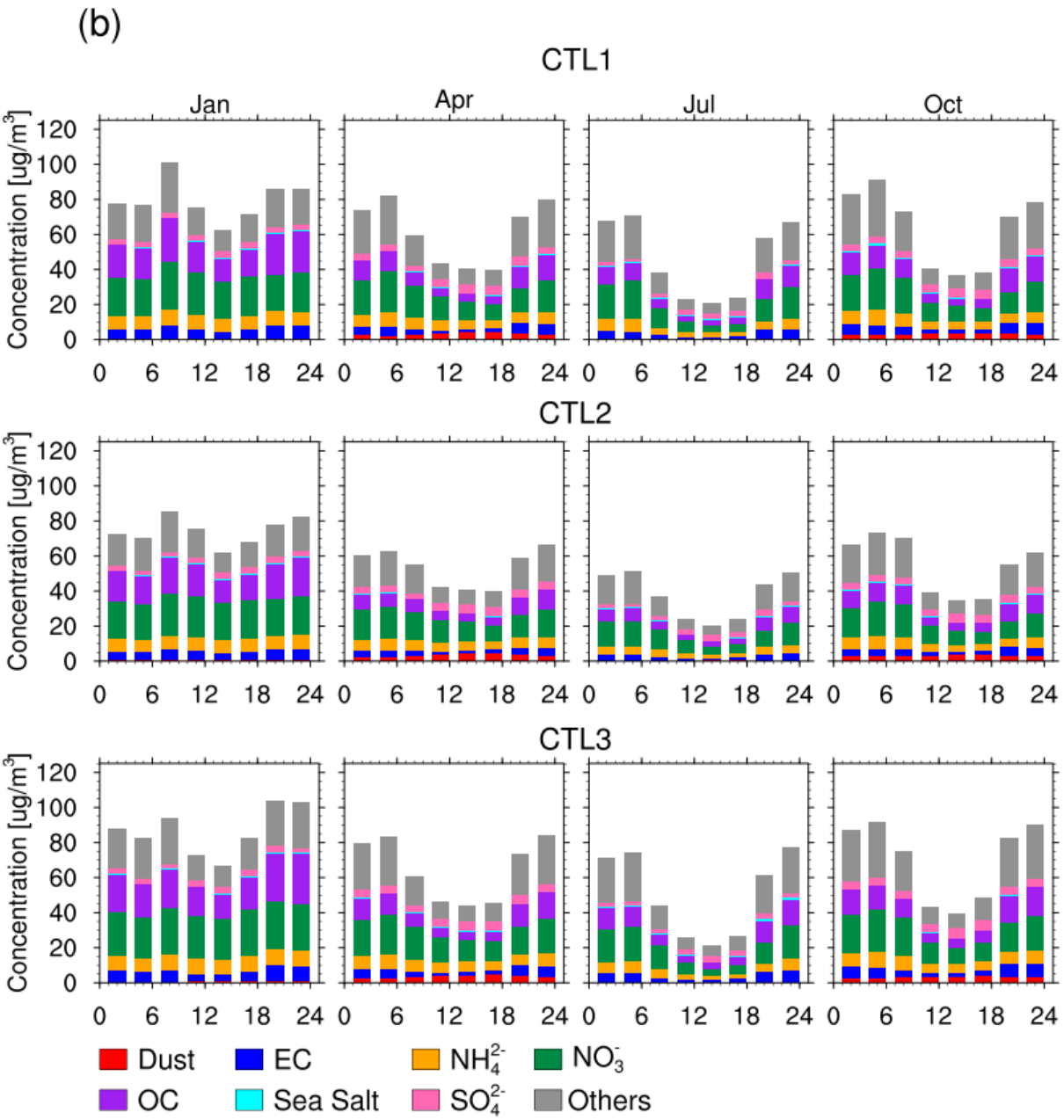


**Figure S5b.** Same as Fig. S5a but for Hangzhou.

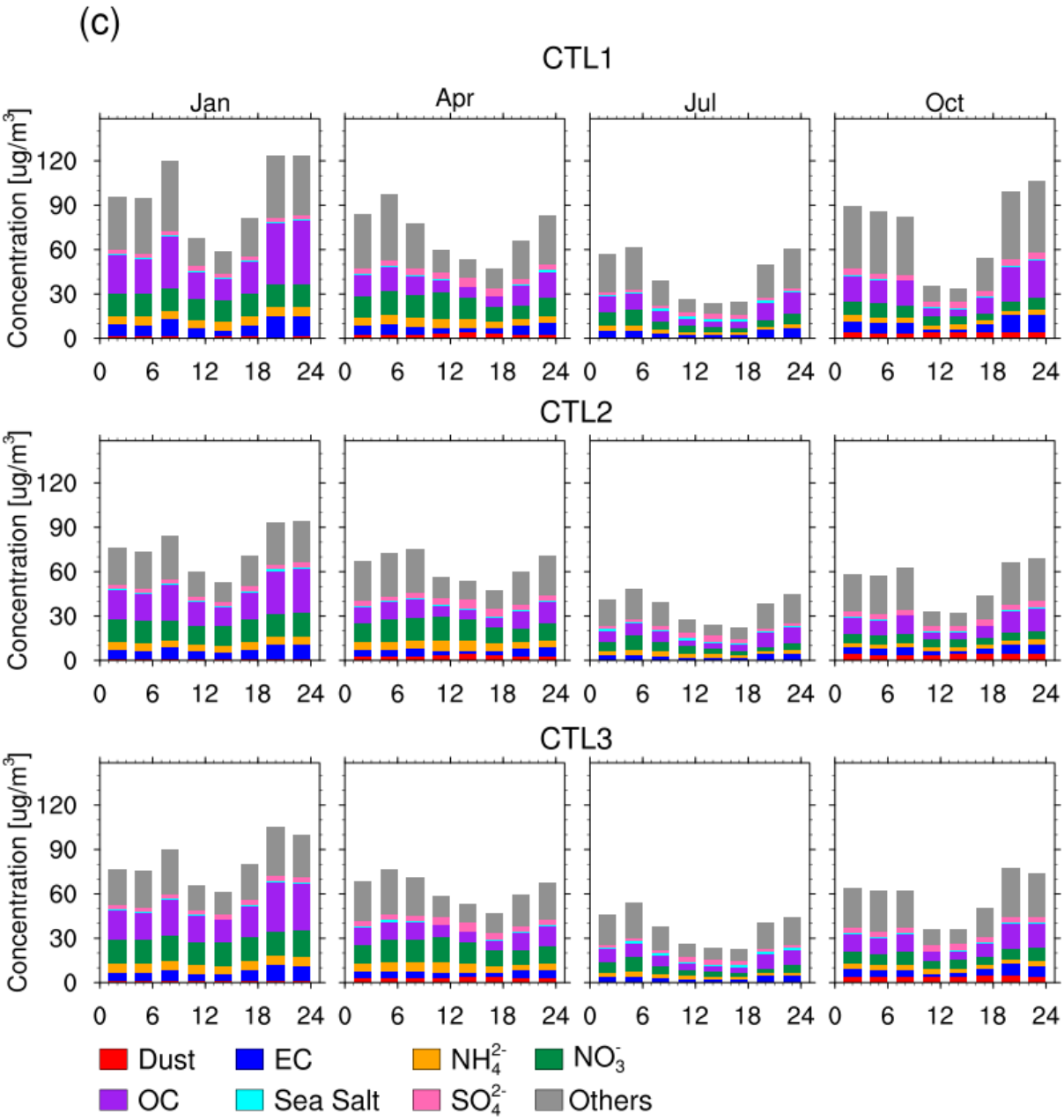


**Figure S5c.** Same as Fig. S5a but for Shanghai.

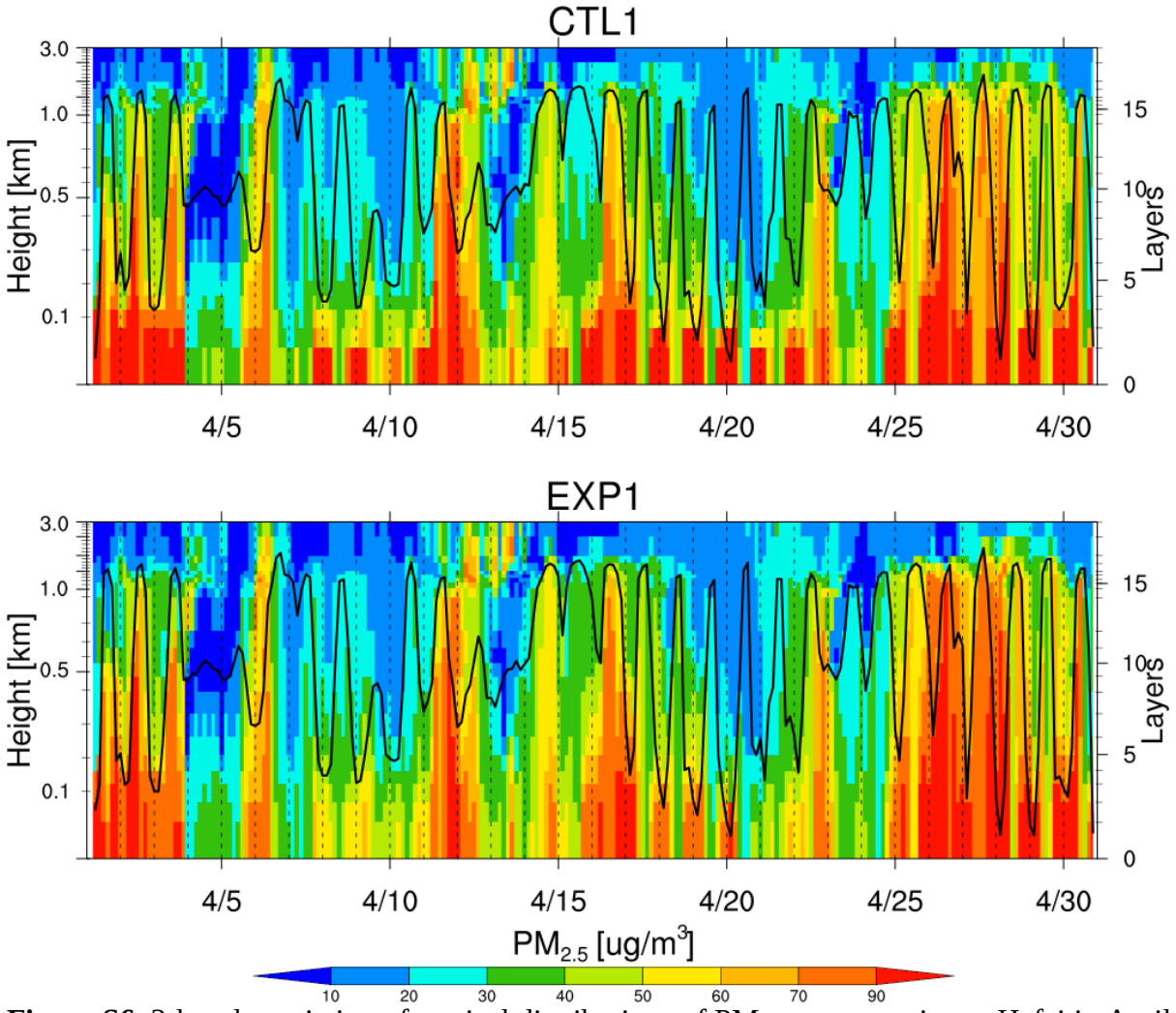


**Figure S6**. 3-hourly variation of vertical distributions of $PM_{2.5}$ concentration at Hefei in April of 2018 from the experiments CTL1 and EXP1.

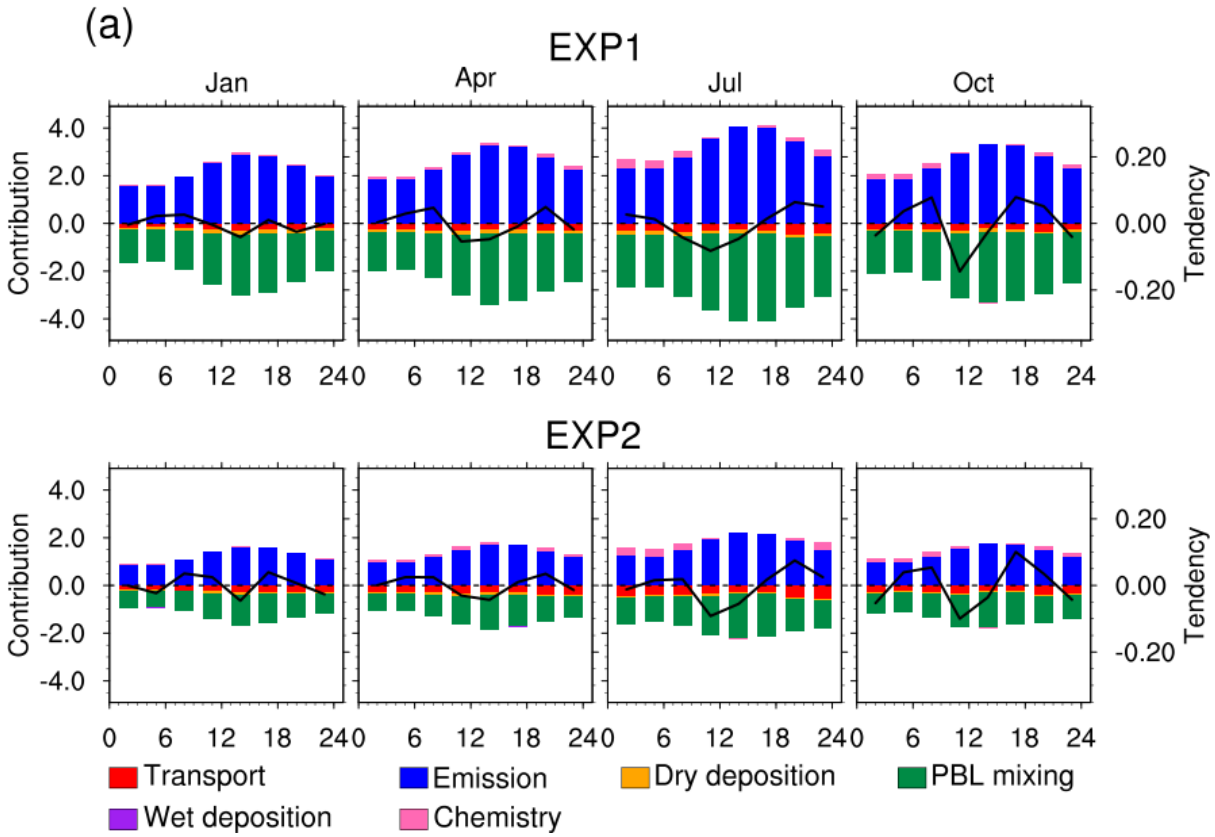


**Figure S7a**. Contribution to surface $PM_{2.5}$ concentration every 3-hour from individual process (transport, emission, dry and wet deposition, PBL mixing, and chemical production/loss) averaged over Nanjing(a) for January, April, July, and October of 2018 from the experiments EXP1 and EXP2.

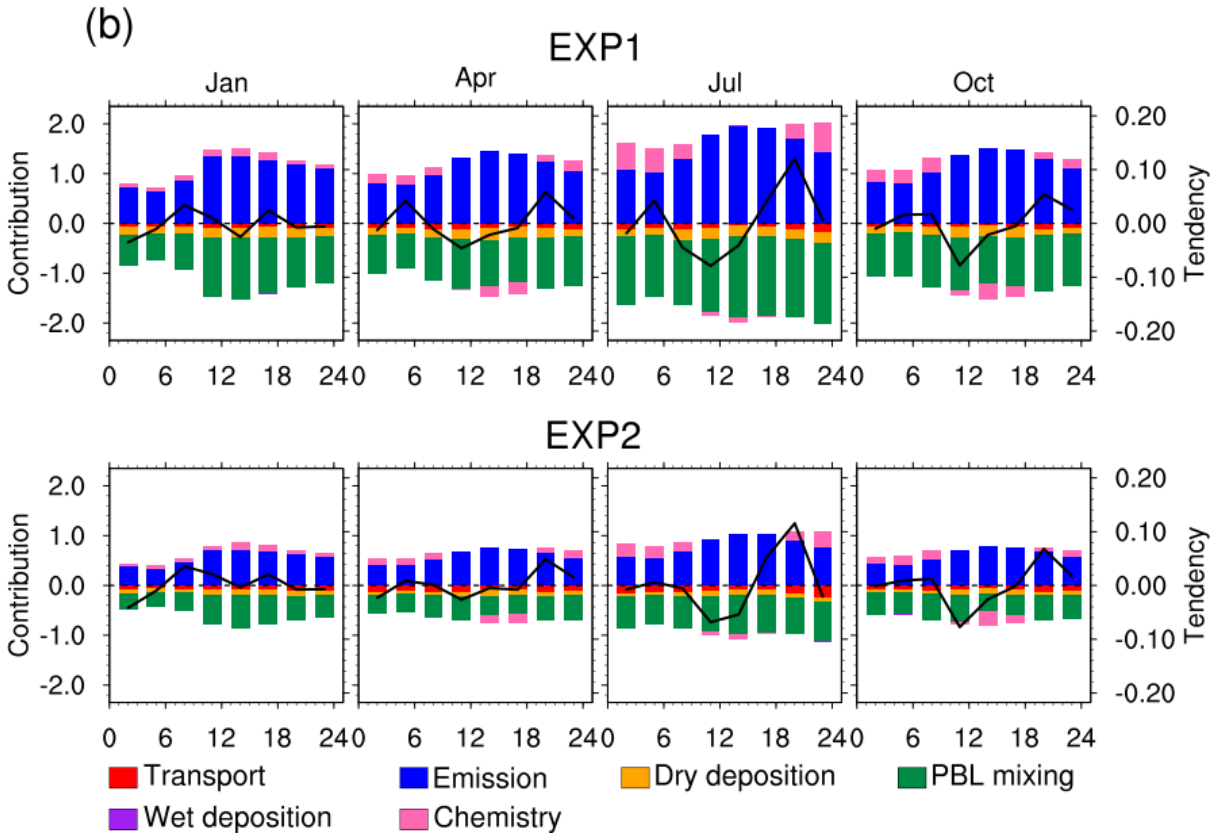


**Figure S7b**. Same as Fig. S7a but for Hangzhou.

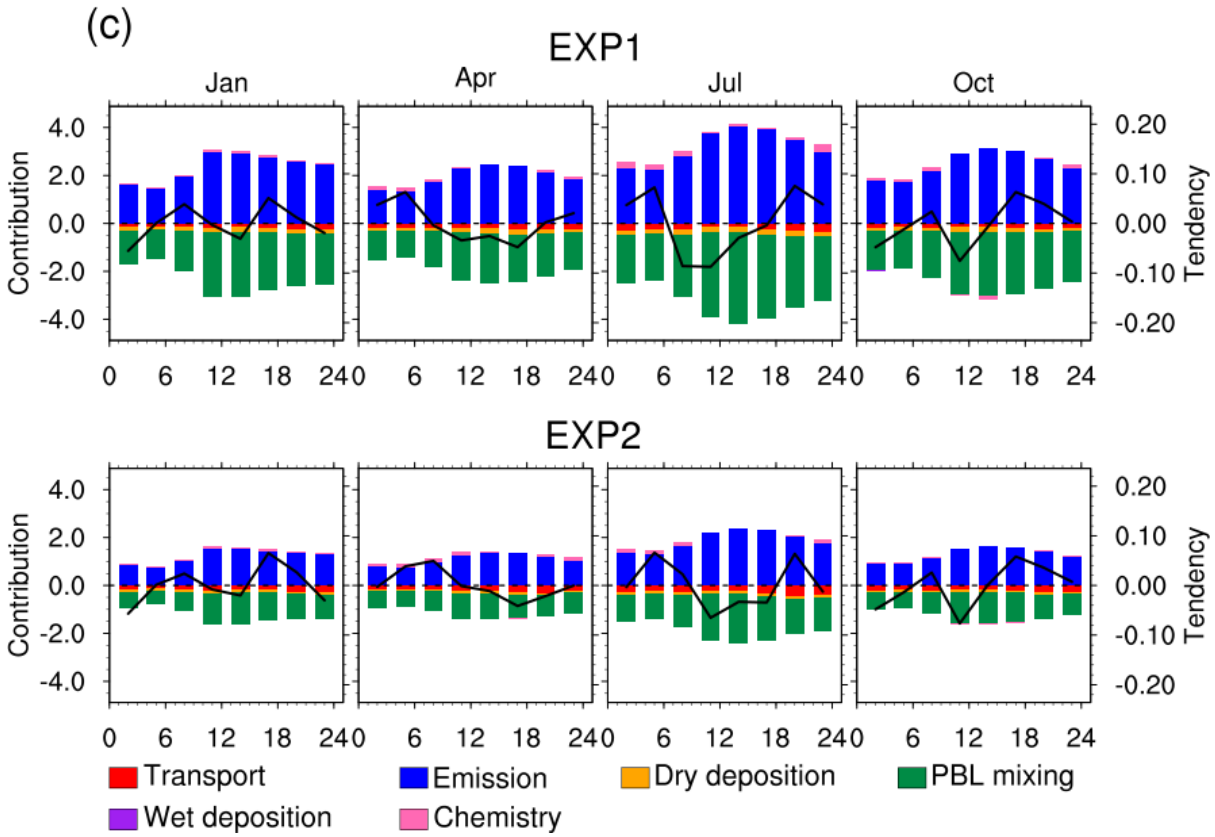


**Figure S7c**. Same as Fig. S7a but for Shanghai.

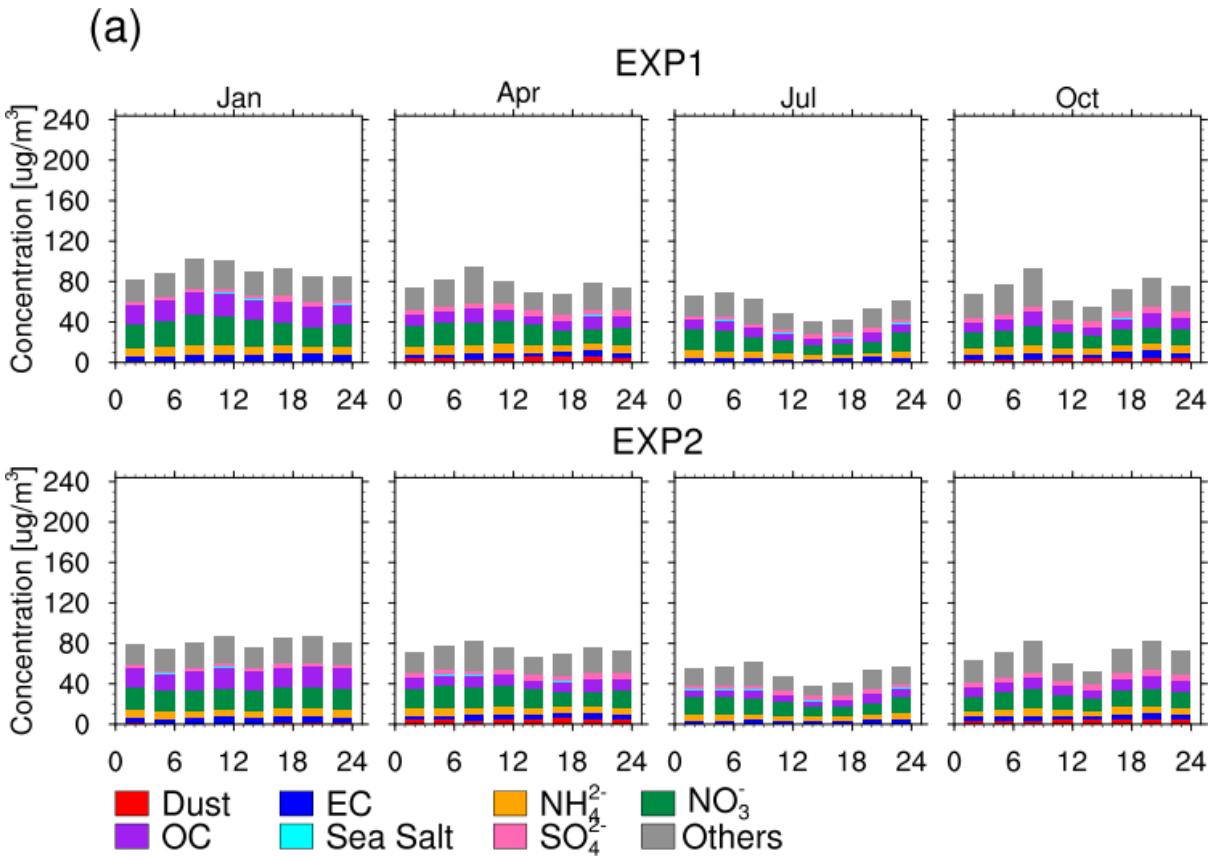


**Figure S8a.** Diurnal variation of surface concentration of each $PM_{2.5}$ composition (Dust, OC, EC, Sea Salt, $NH_4^{2-}$, $SO_4^{2-}$, $NO_3^-$, and other inorganics) averaged over Nanjing(a) for January, April, July, and October of 2018 from the experiments EXP1 and EXP2.

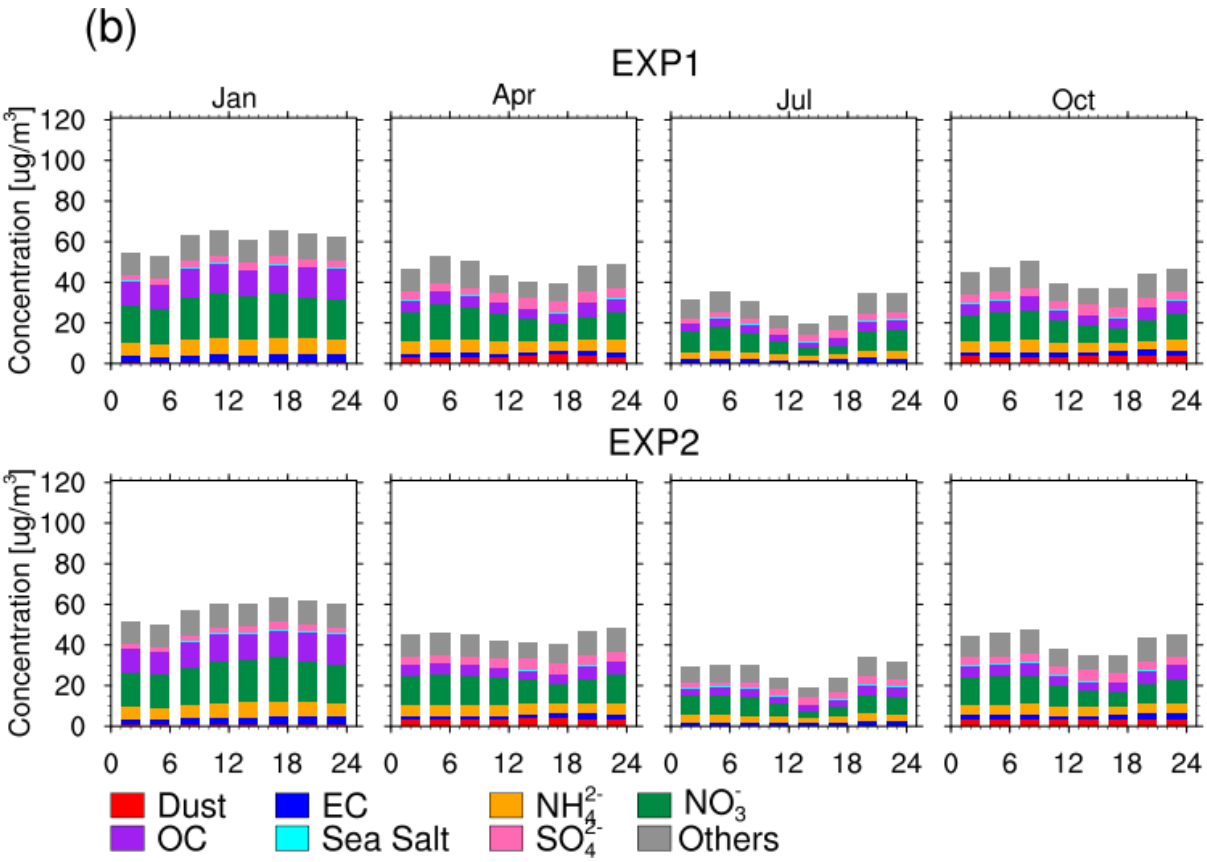


**Figure S8b.** Same as Fig. S8a but for Hangzhou.

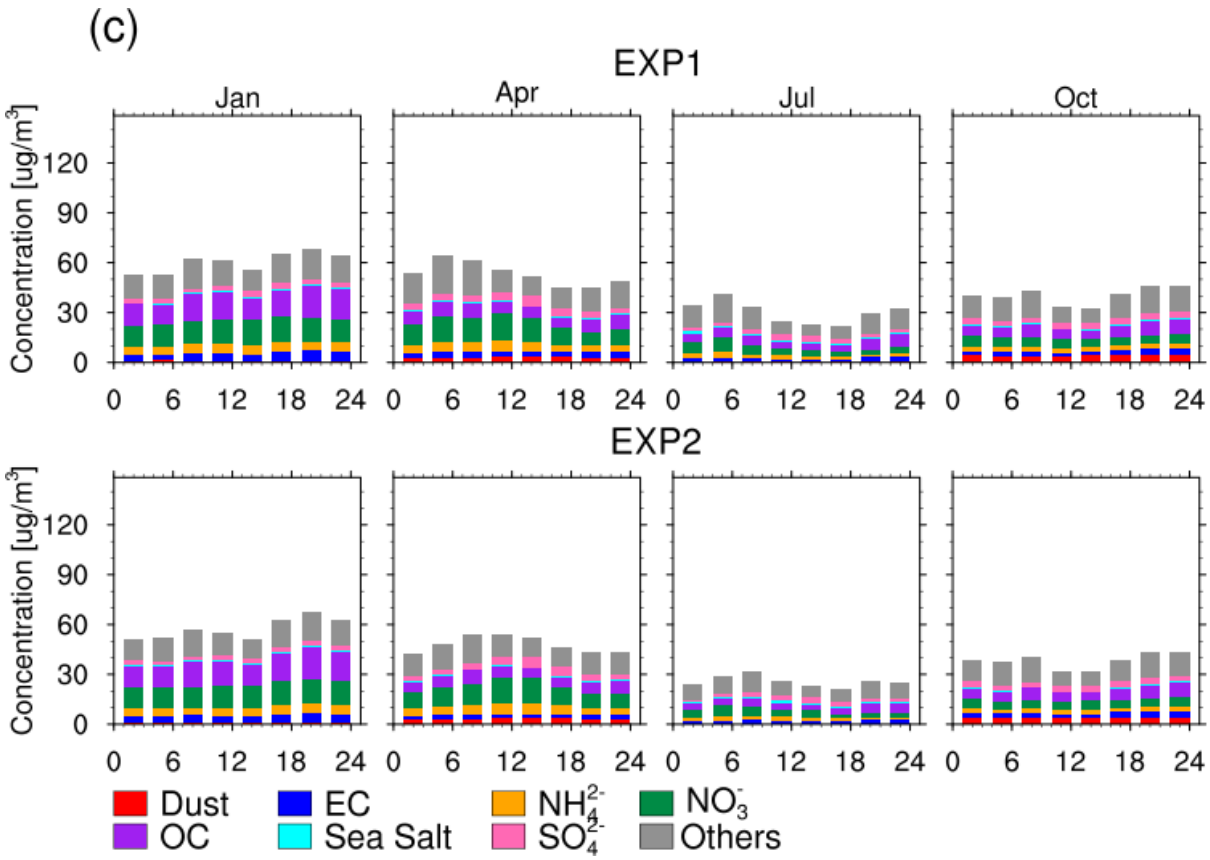


**Figure S8c.** Same as Fig. S8a but for Shanghai.

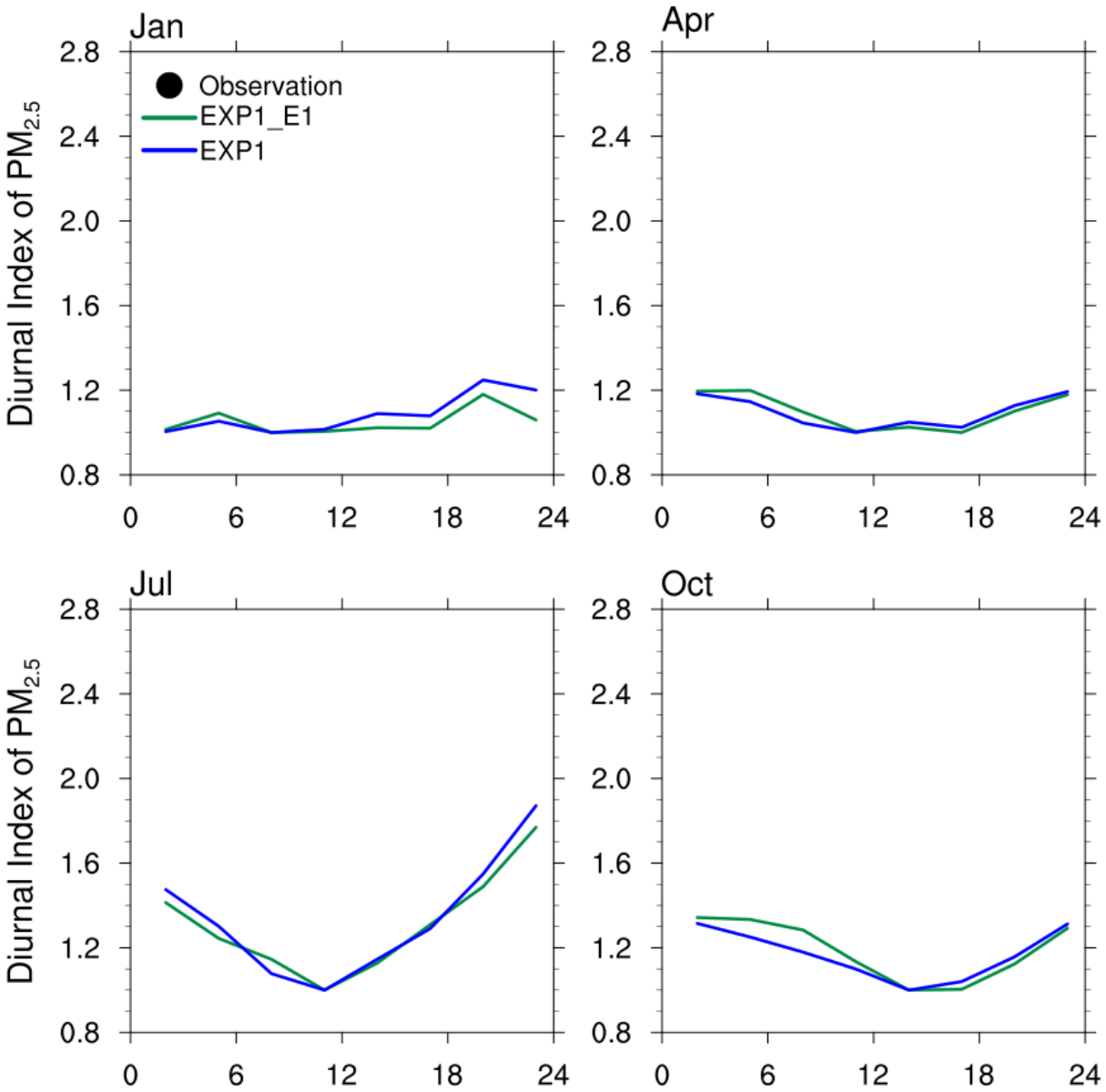


**Figure S9.** Diurnal index of surface $PM_{2.5}$ concentration within 24-hour averaged over South Anhui for January, April, July, and October of 2018 from the experiments EXP1_E1 and EXP1.

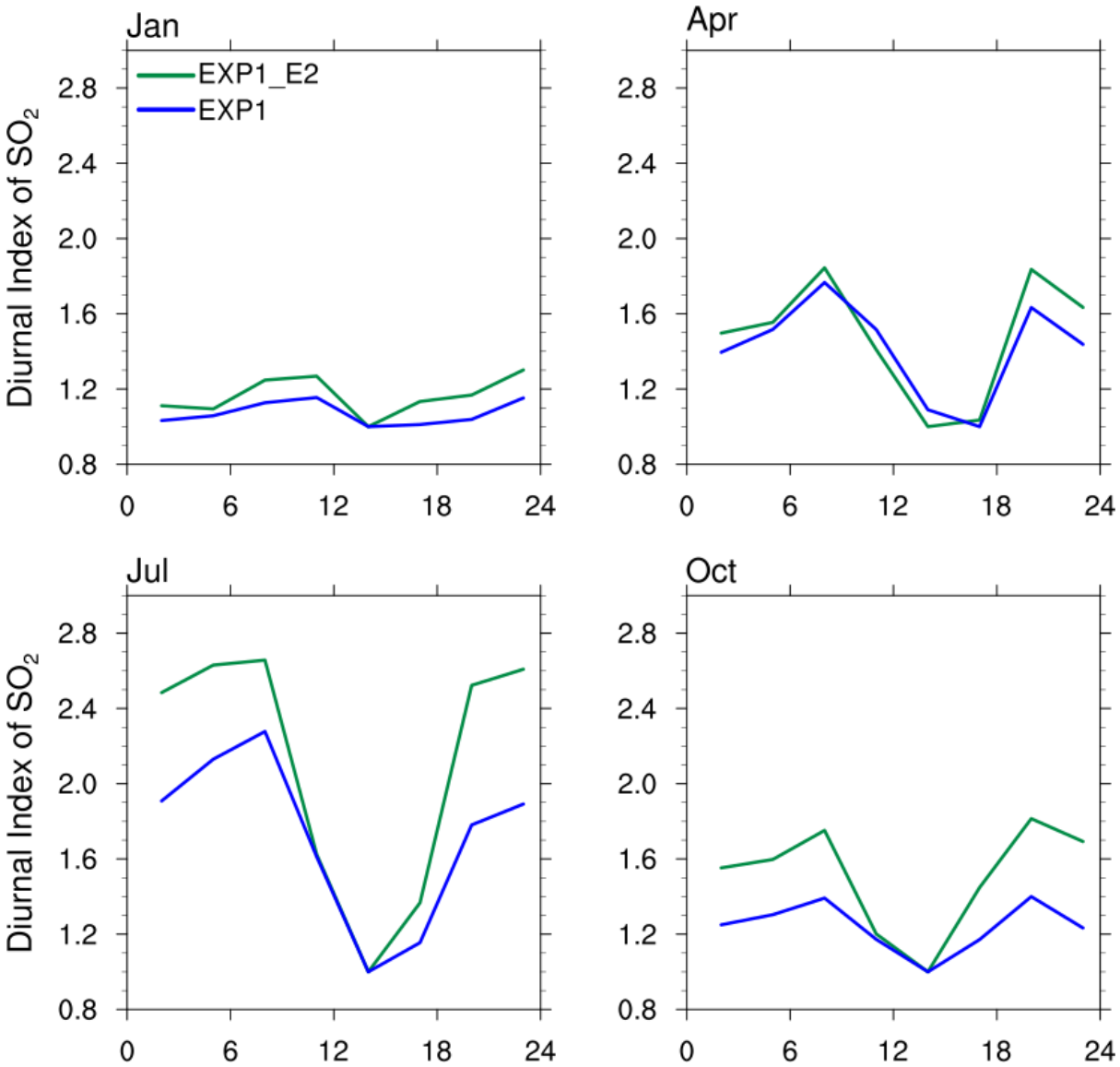


**Figure S10.** Diurnal index of surface $SO_2$ concentration within 24-hour averaged over Nanjing, Jiangsunan power plant (118.76°E, 32.21°N) for January, April, July, and October of 2018 from the experiments EXP1_E2, EXP1, and observations.

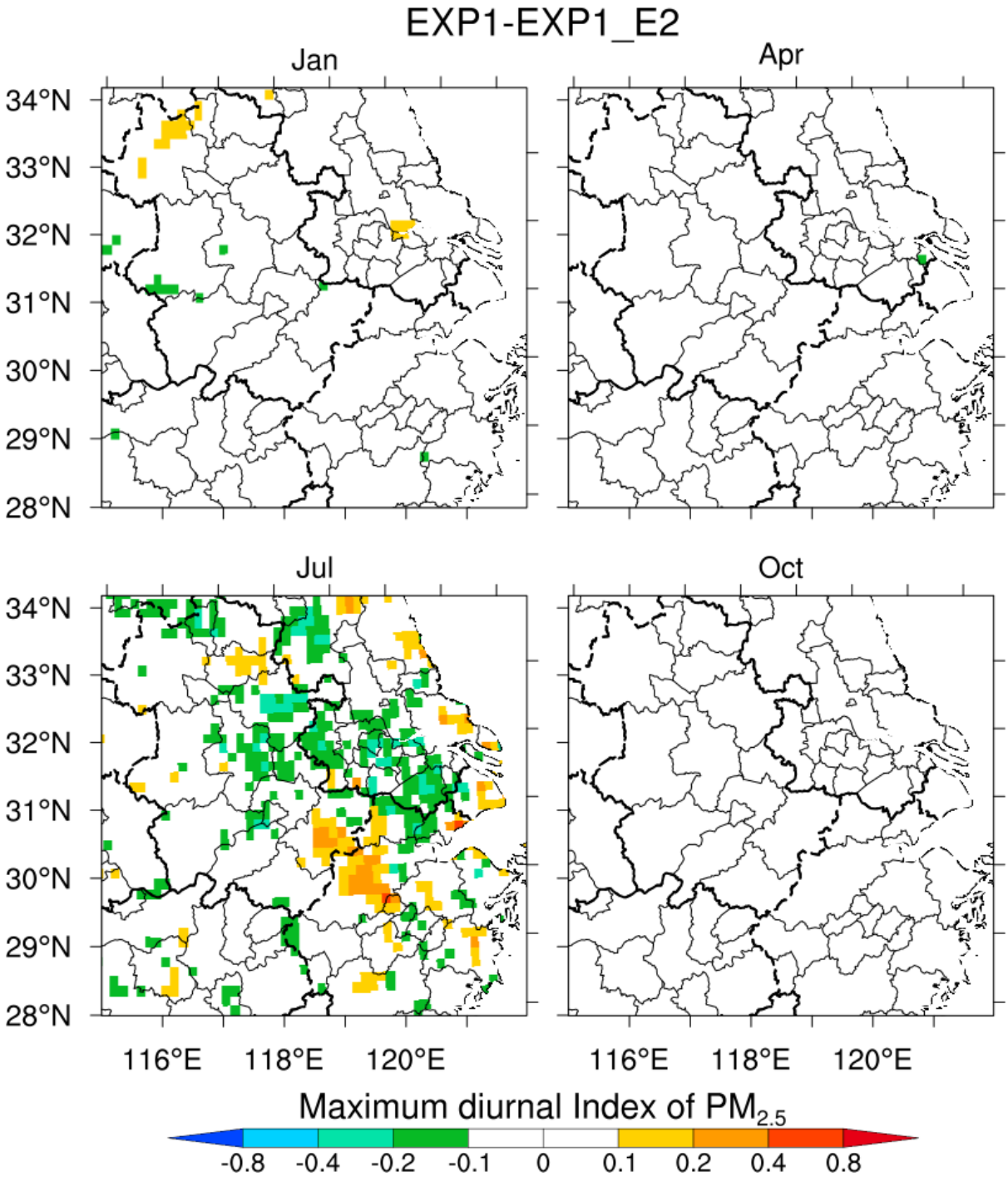


**Figure S11.** Spatial distribution of the difference in daily maximum diurnal index of surface $PM_{2.5}$ between the experiments EXP1_E2 and EXP1 over East China in January, April, July, and October of 2018.

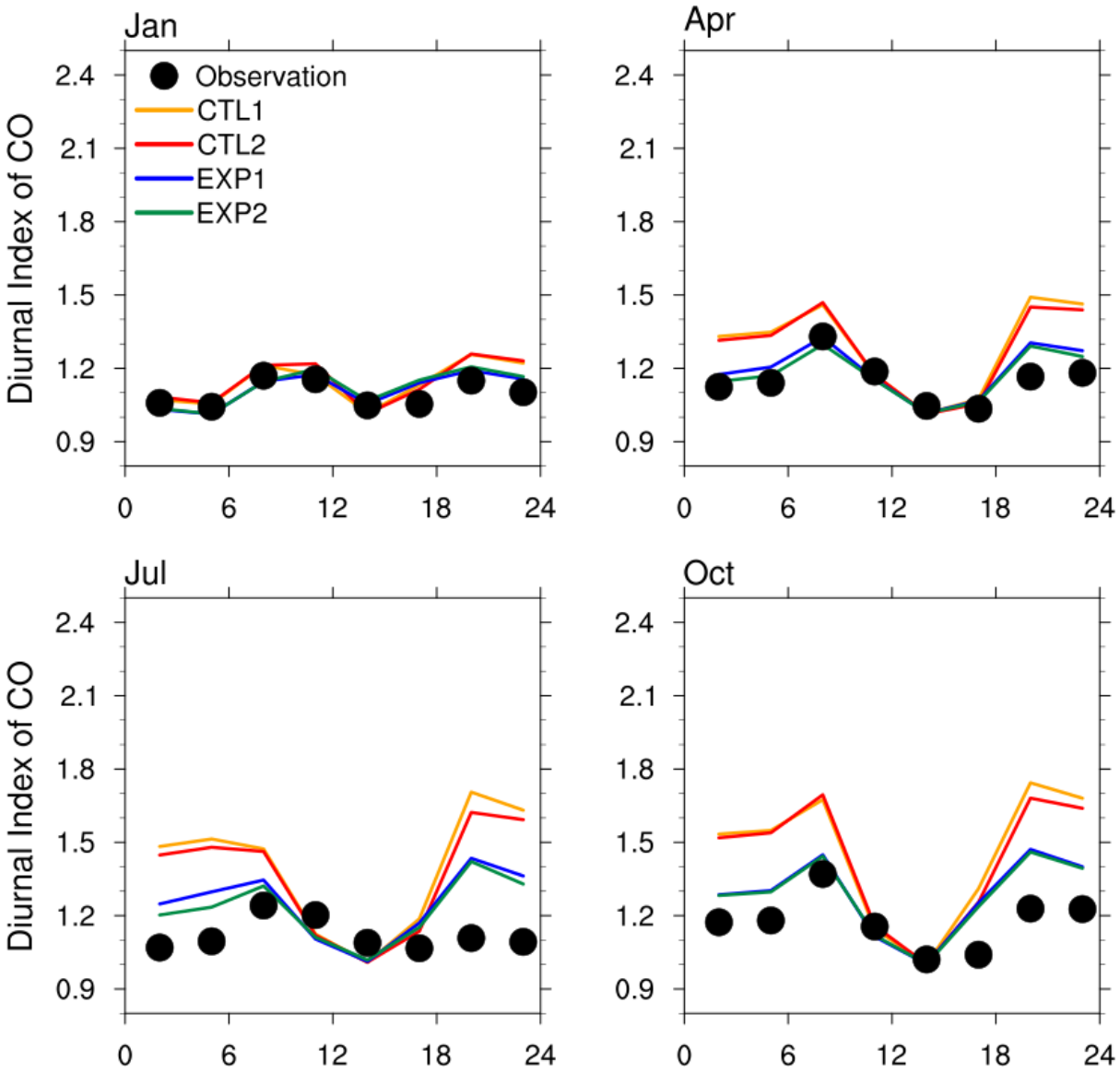


**Figure S12.** Diurnal index of surface CO concentration within 24-hour averaged over the YRD region of East China (within black box of Fig. 1a) for January, April, July, and October of 2018 from the experiments CTL1, CTL2, EXP1, EXP2, and observations.

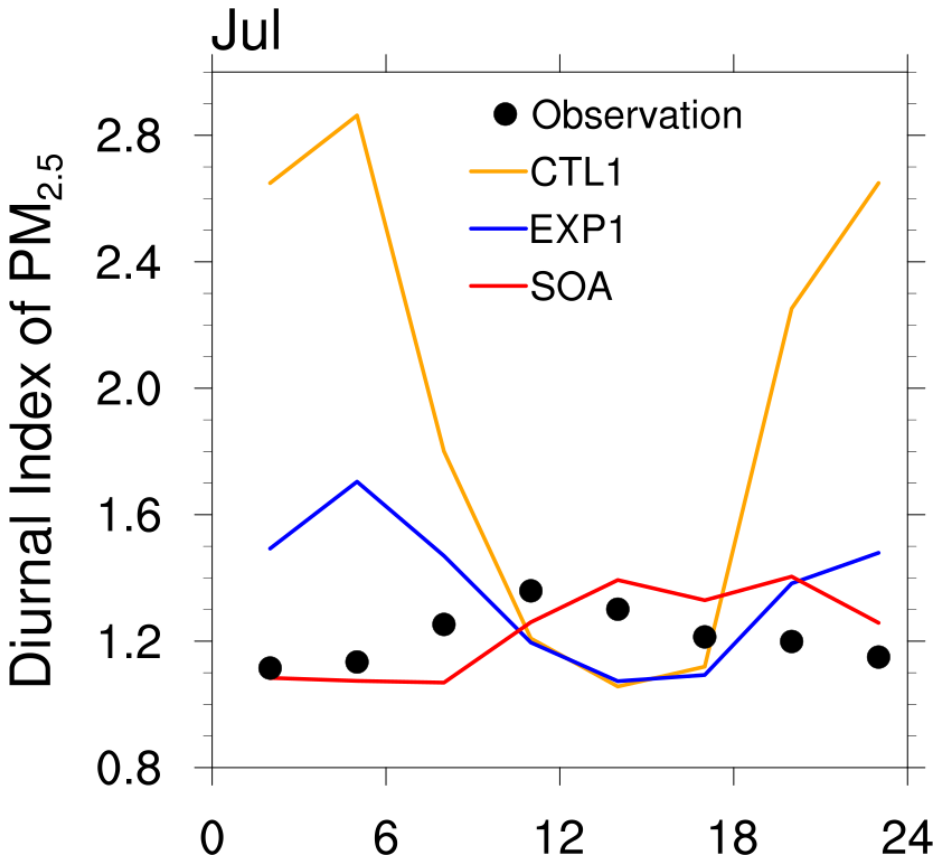


**Figure S13.** Diurnal index of surface $PM_{2.5}$ concentration within 24-hour averaged over the YRD region of East China (within black box of Fig. 1a) for January, April, July, and October of 2018 from the experiments CTL1, EXP1, SOA, and observations.