

Supplement S1. Formulas for statistical evaluation indexes

1. Mean Bias

$$MB = \frac{1}{N} \sum_1^N (Sim - Obs)$$

5 2. Mean Average Gross Error

$$MAGE = \frac{1}{N} \sum_1^N |Sim - Obs|$$

3. Root Mean Square Error

$$RMSE = \sqrt{\frac{1}{N} \sum_1^N (Sim - Obs)^2}$$

4. Index of agreement, IOA

$$10 \quad IOA = 1 - \frac{\sum_{i=1}^N (Sim - Obs)^2}{\sum_{i=1}^N (|Sim - \overline{Obs}| + |Obs - \overline{Obs}|)^2}$$

5. Wind Normalized Mean Bias

$$WNMB = \frac{\sum_{i=1}^N (Sim - Obs)}{N \times 360^\circ} \times 100\%$$

3. Wind Normalized Mean Error

$$WNME = \frac{\sum_{i=1}^N |Sim - Obs|}{N \times 360^\circ} \times 100\%$$

15 6. Mean Fractional Bias

$$MFB = \frac{2}{N} \sum_1^N \left( \frac{Sim - Obs}{Sim + Obs} \right)$$

7. Mean Fractional Error

$$MFE = \frac{2}{N} \sum_1^N \left| \frac{Sim - Obs}{Sim + Obs} \right|$$

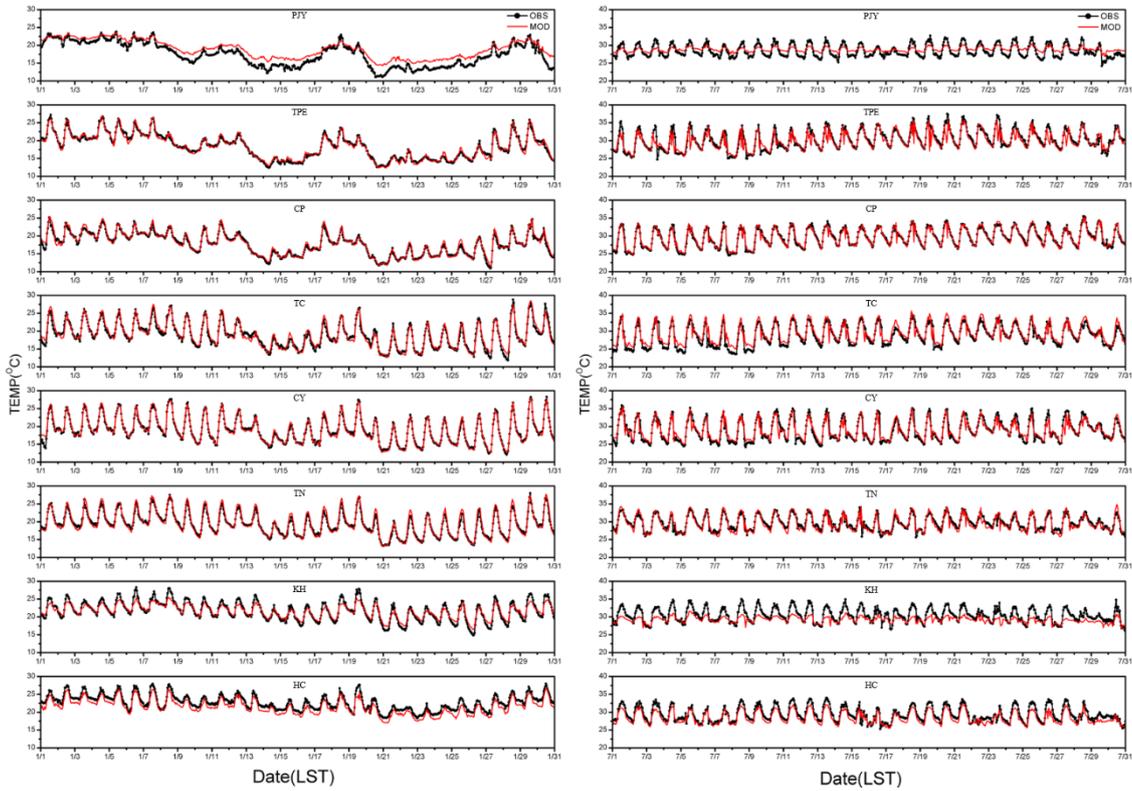
8. Correlation coefficient (R)

$$20 \quad R = \frac{1}{N} \sum_{i=1}^N \left[ \frac{(Sim - \overline{Sim})(Obs - \overline{Obs})}{S_p S_o} \right]$$

$$S_p = \left[ \frac{1}{N} \sum_{i=1}^N (Sim - \overline{Sim})^2 \right]^{\frac{1}{2}}$$

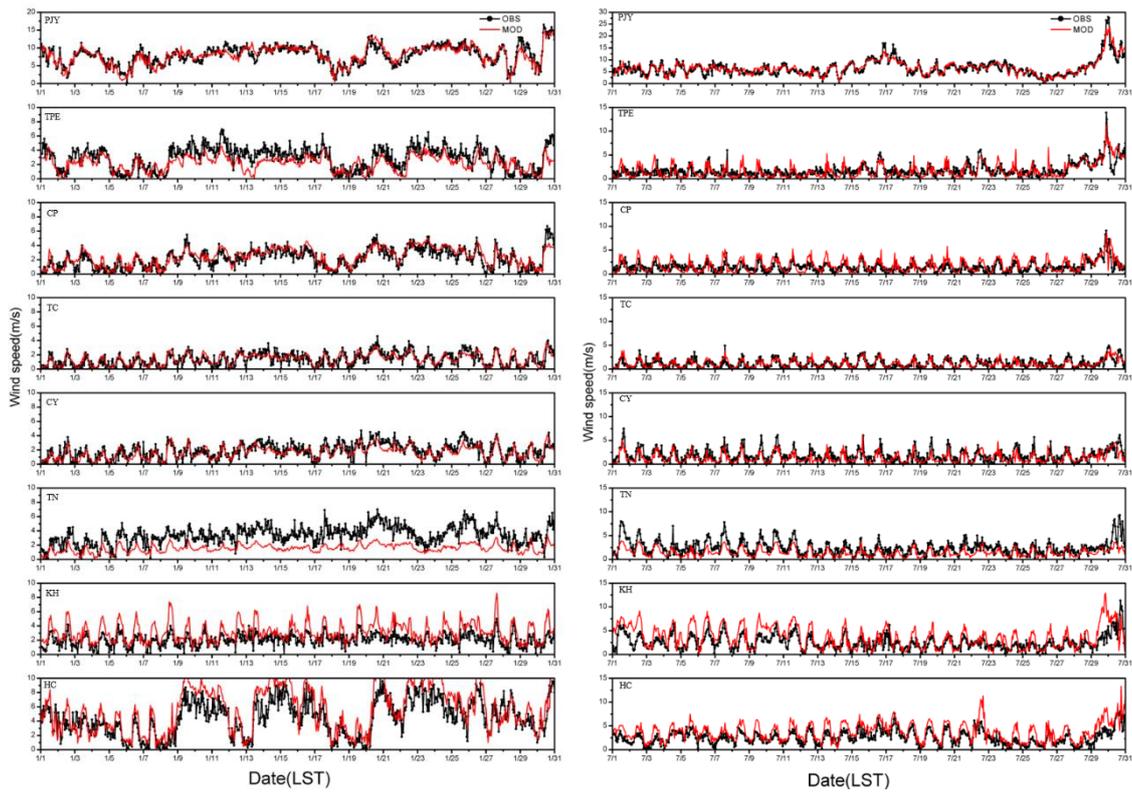
$$S_o = \left[ \frac{1}{N} \sum_{i=1}^N (Obs - \overline{Obs})^2 \right]^{\frac{1}{2}}$$

Supplement S2 Supplementary figures



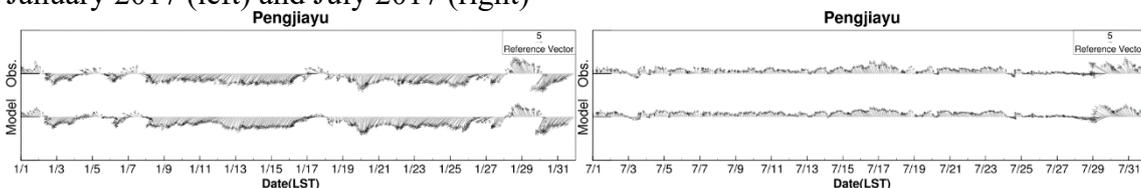
25

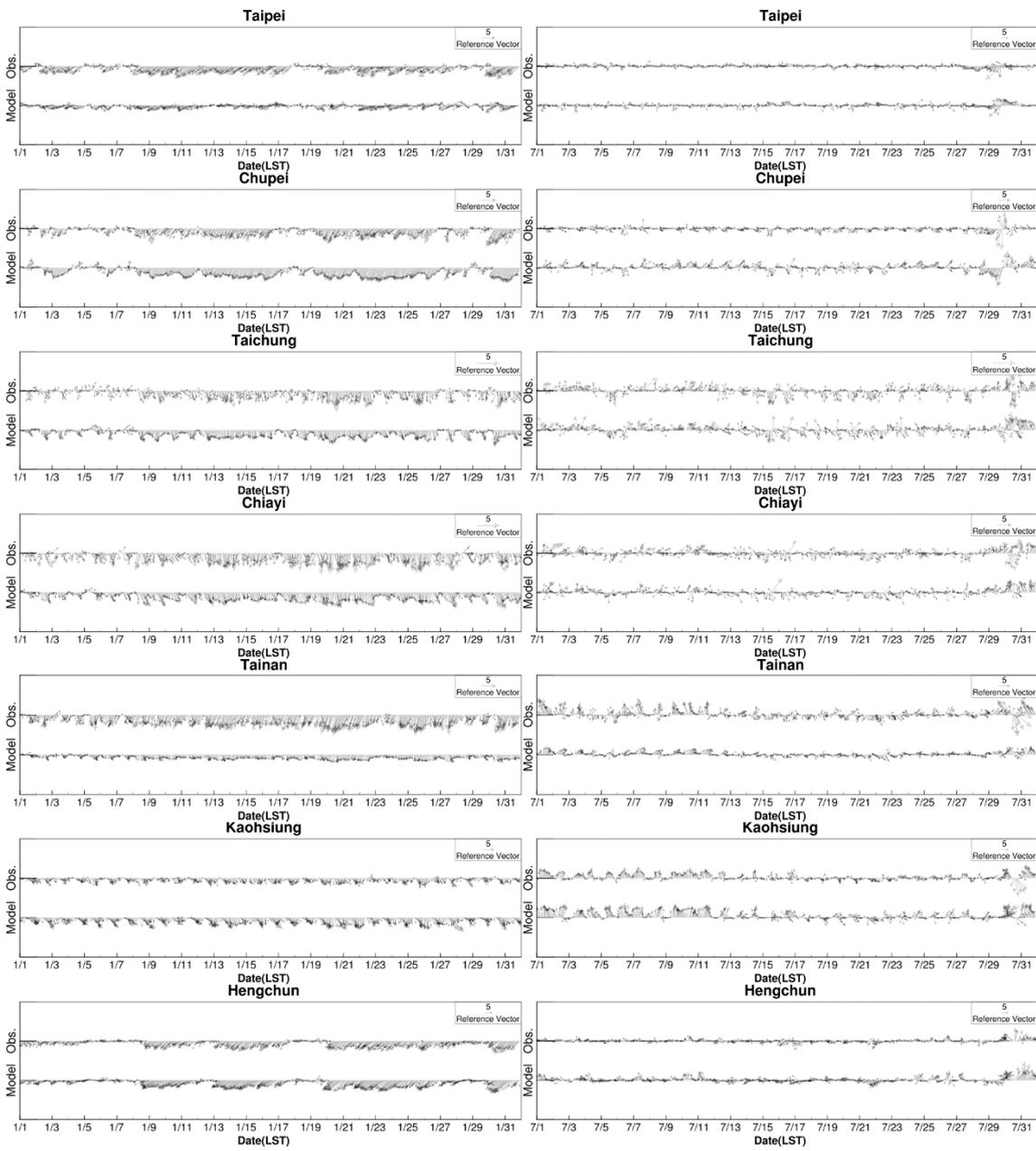
Fig. S2.1 The observed (black dot) and simulated (red line) temperature at eight representative sites for January 2017 (left) and July 2017 (right)



30

Fig. S2.2 The observed (black line) and simulated (red line) wind speed at eight representative sites for January 2017 (left) and July 2017 (right)





35

Fig. S2.3 The observed (upper) and simulated (lower) wind direction at eight representative sites for January 2017 (left) and July 2017 (right)

40

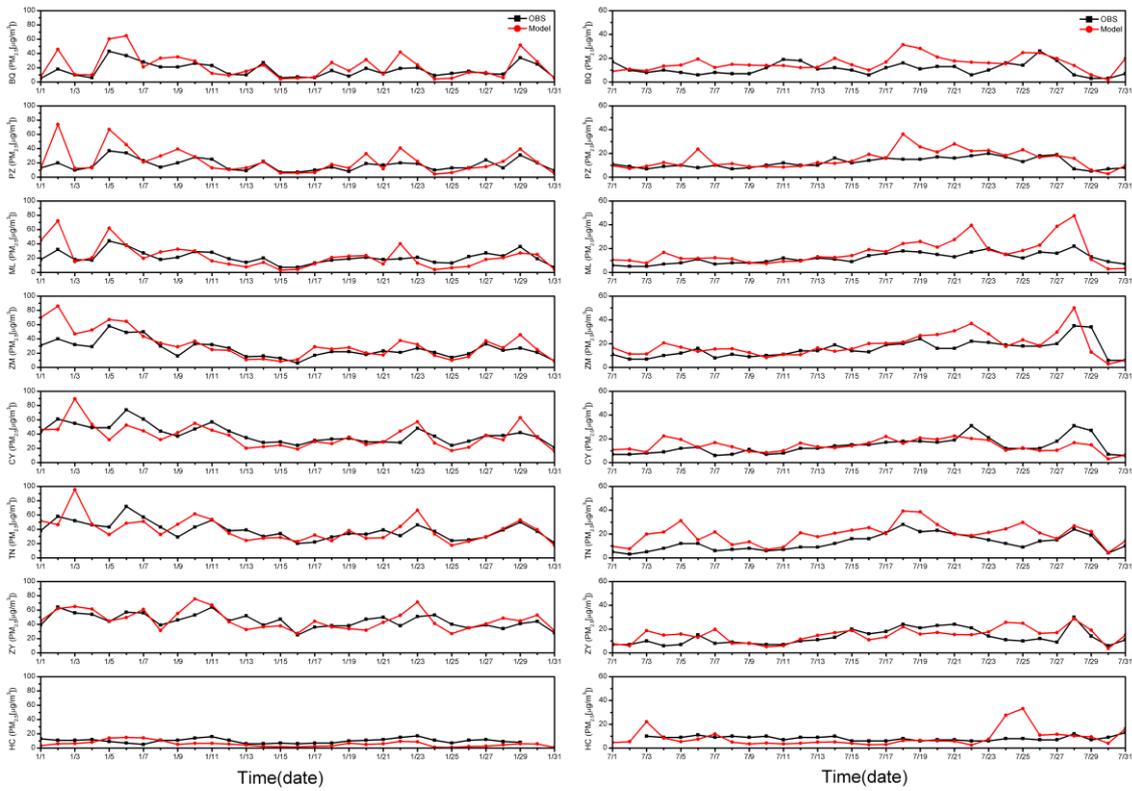


Fig. S2.4 The observed (black line) and simulated (red line)  $PM_{2.5}$  at eight representative sites for January 2017 (left) and July 2017 (right)

45

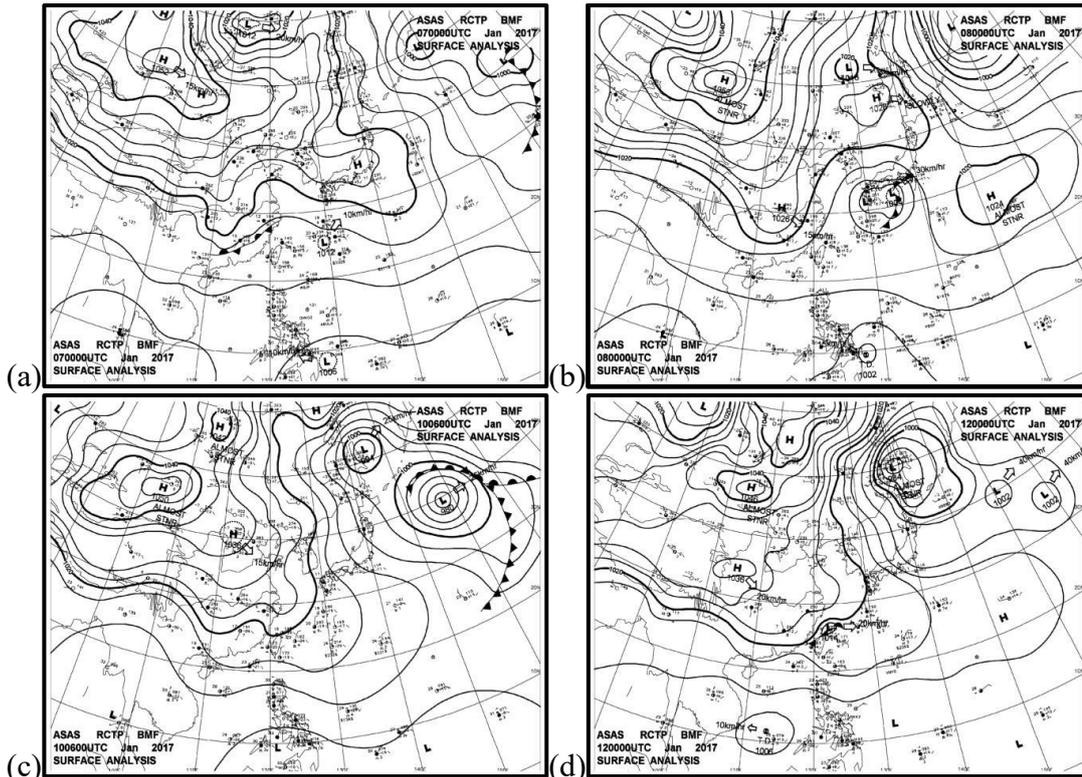


Fig. S2.5 The surface weather map on 08:00 LST Jan 7th (a), 08:00 LST Jan 8th (b), 14:00 LST Jan 10th (c), and 08:00 LST Jan 12th (d) 2017

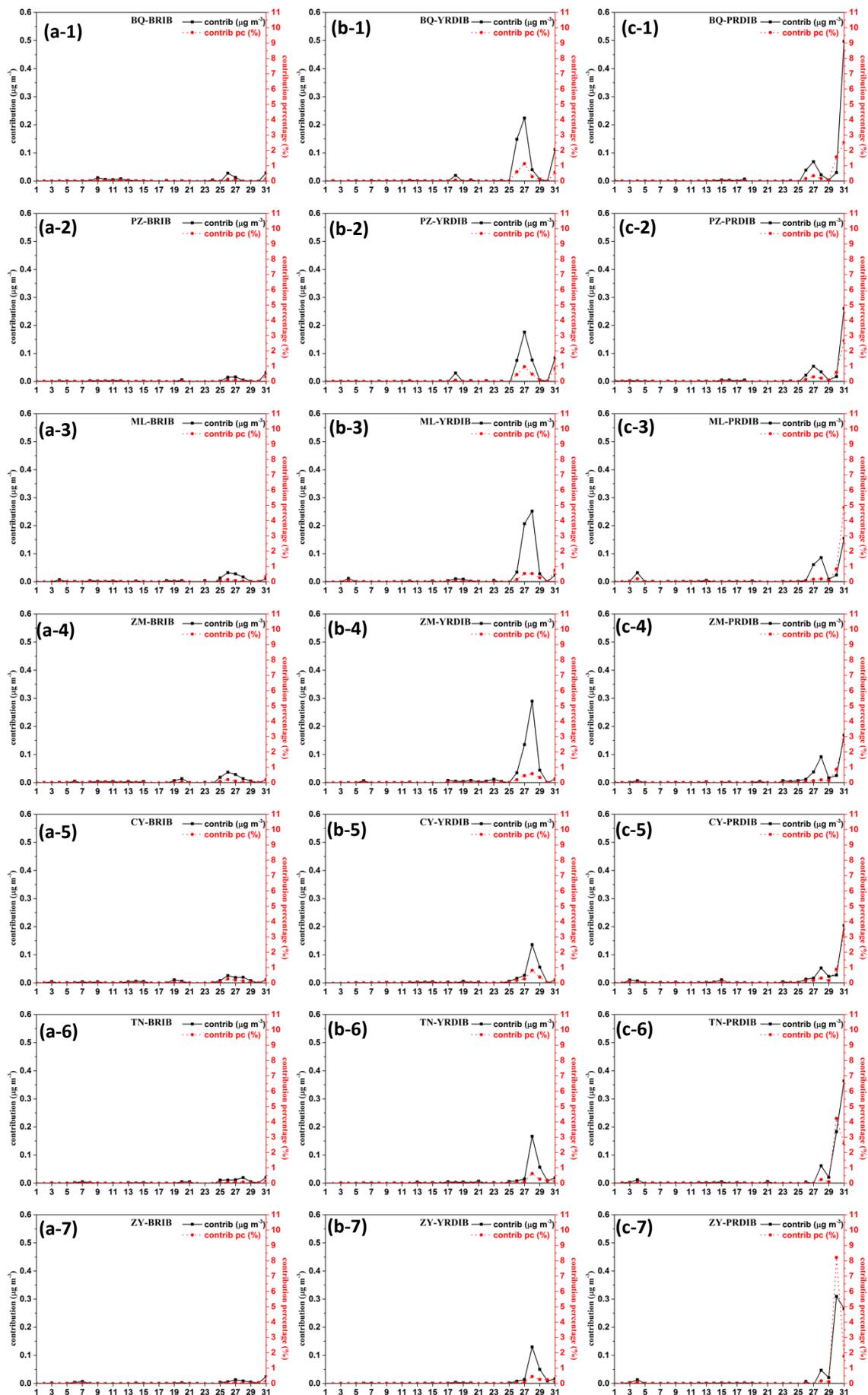
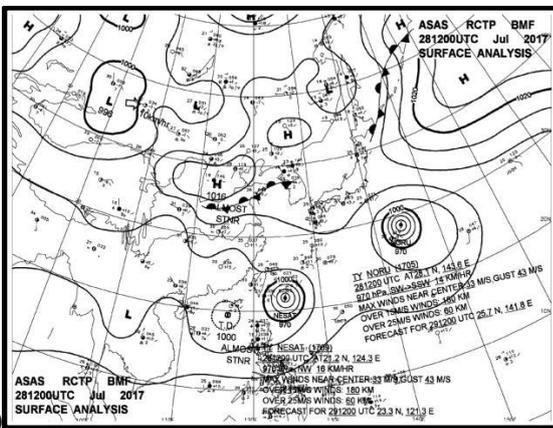


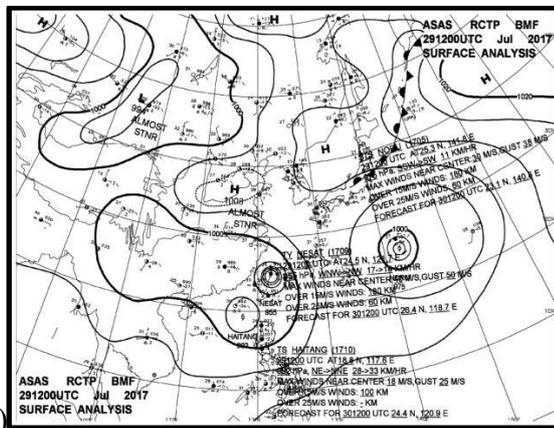
Fig. S2.6: The daily average impact of PM<sub>2.5</sub> from BRIR, YRDIR, PRDIR on air quality stations in Taiwan in July 2017

60

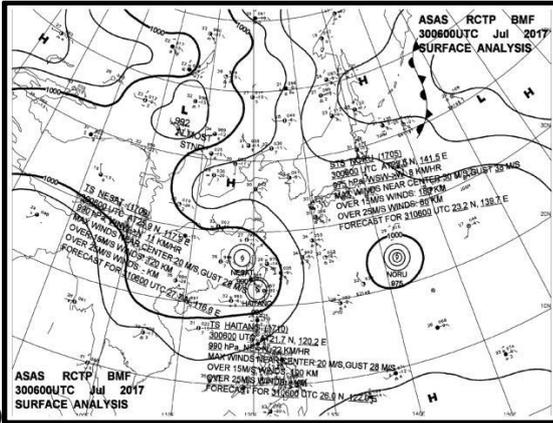
(a)



(b)



(c)



(d)

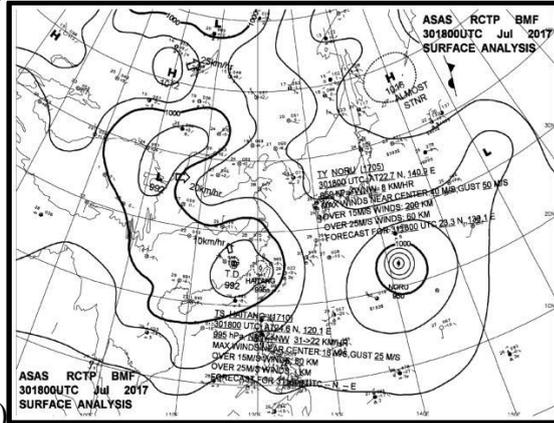


Fig. S2.7 The surface weather map on 20:00 LST July 28th (a), 20:00 LST July 29th (b), 14:00 LST July 30th (c), and 02:00 LST July 31st (d) 2017

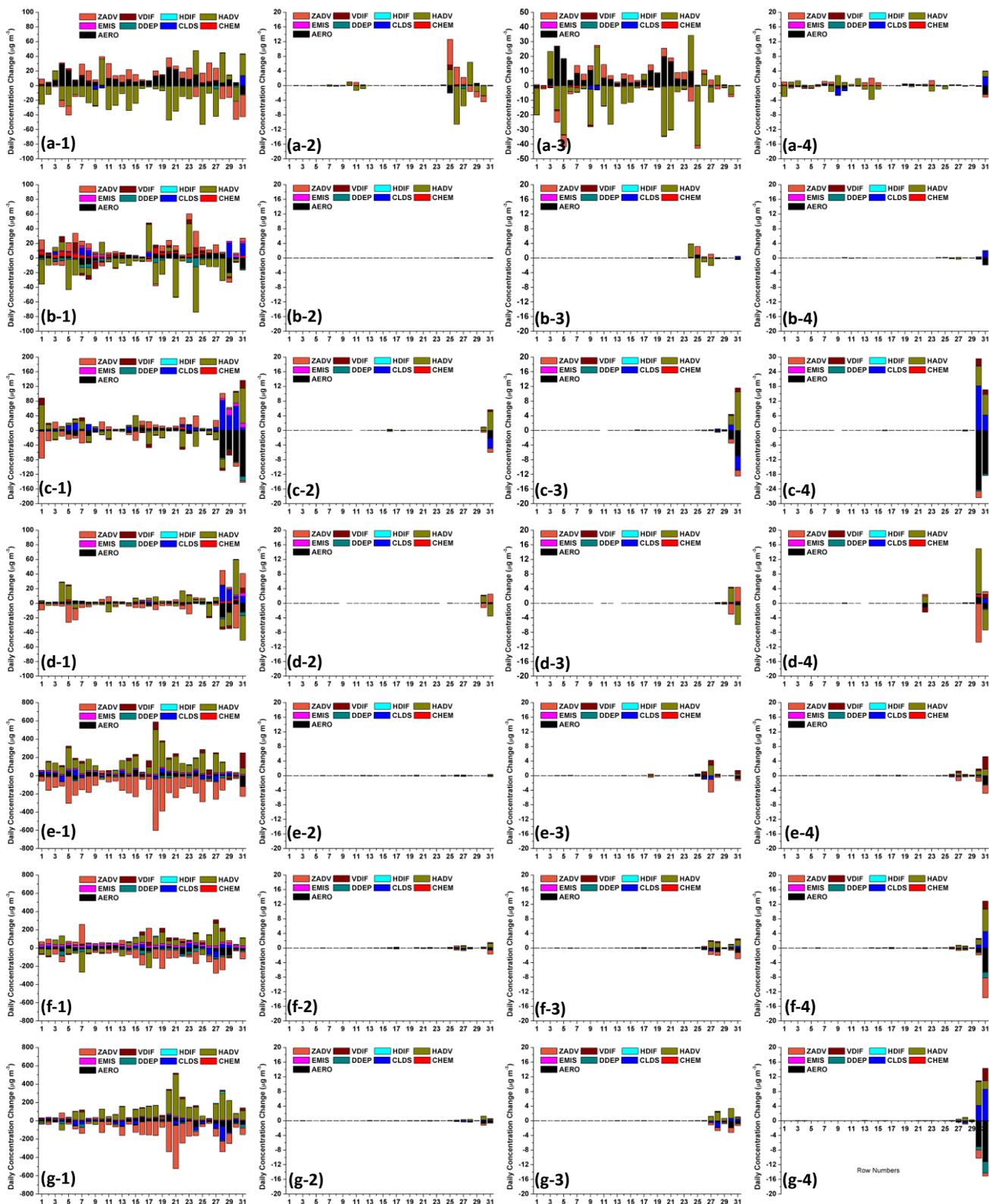
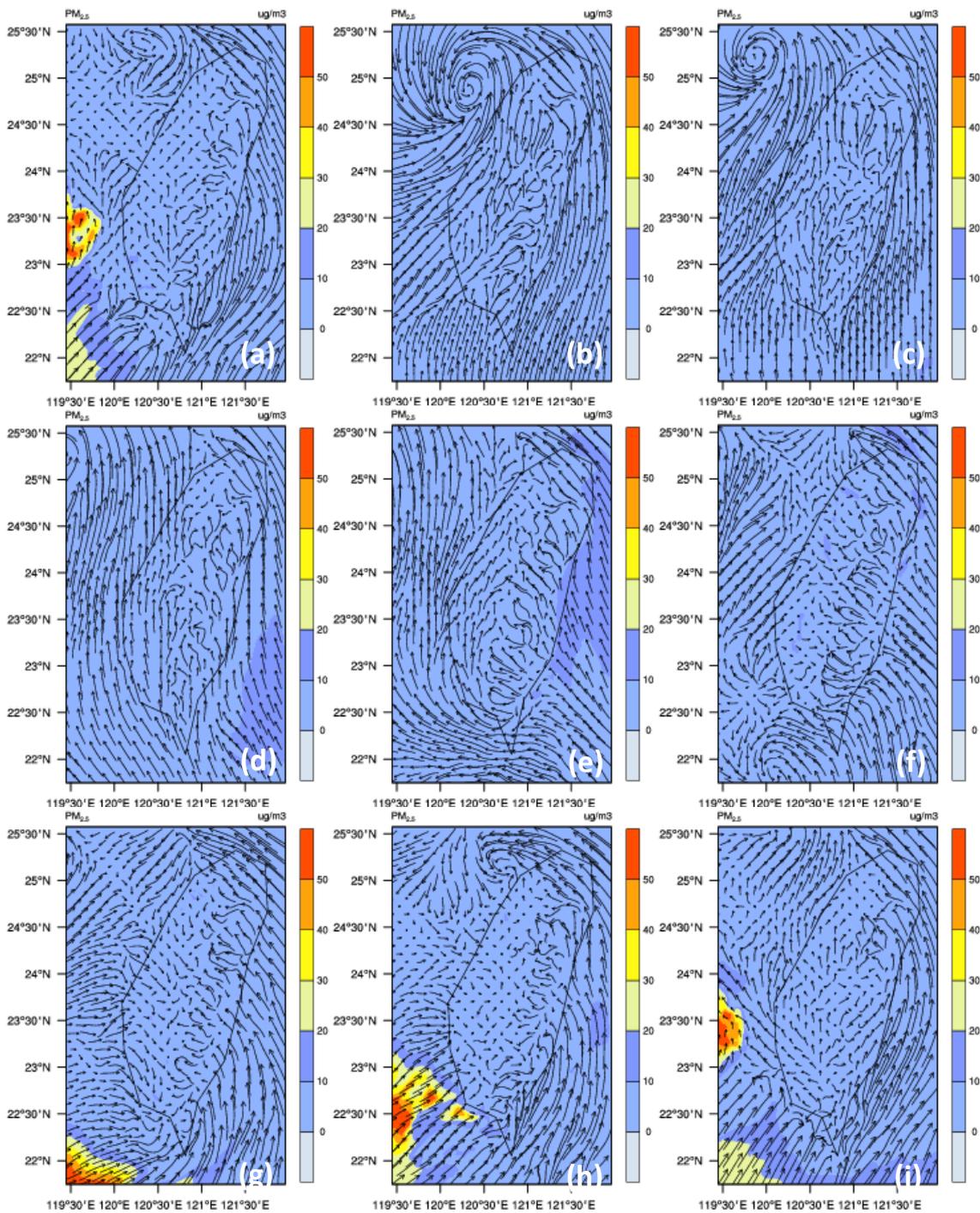
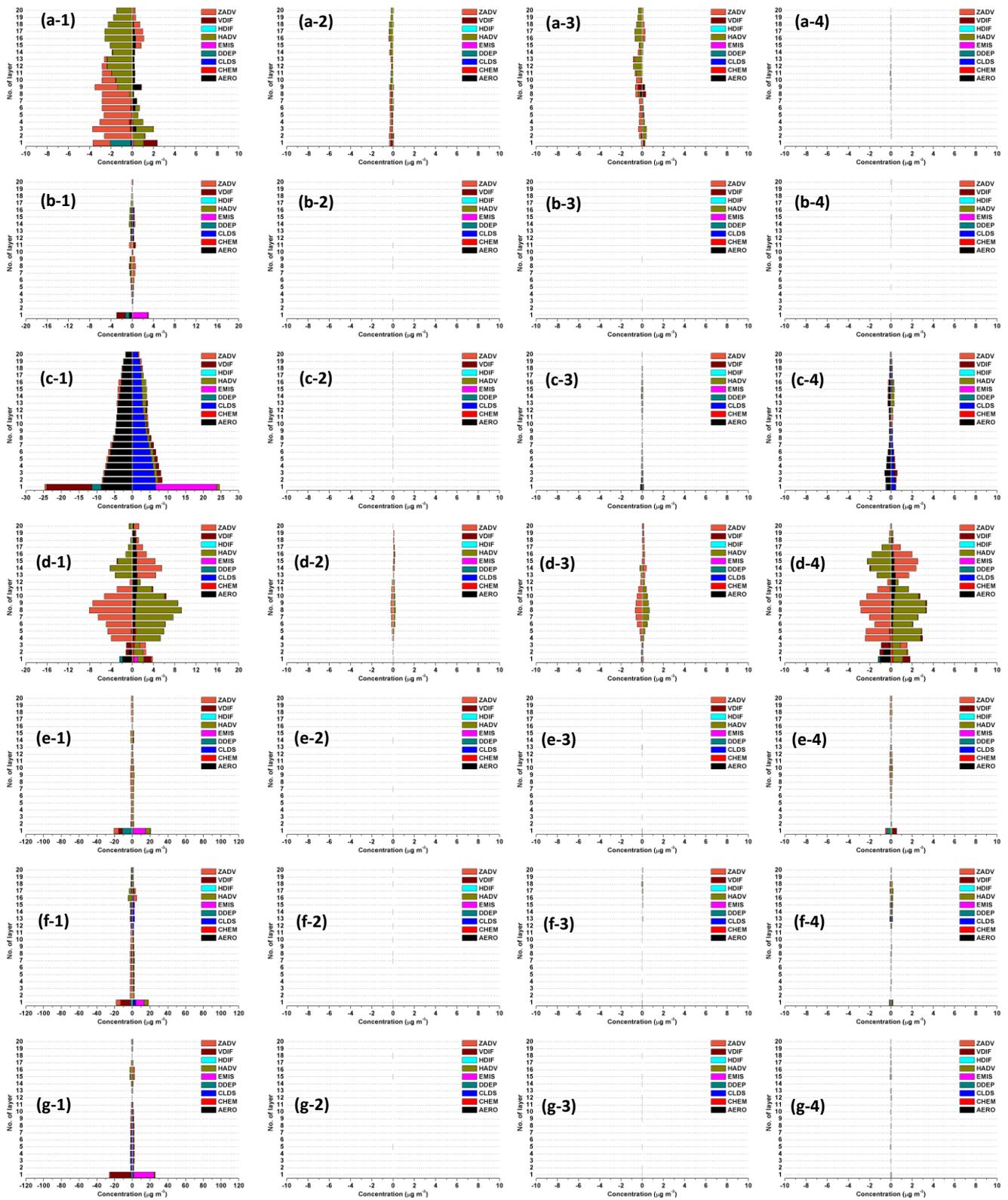


Fig. S2.8: The daily contributions of individual processes to the concentrations of PM<sub>2.5</sub> in July 2017, a,b,c,d,e,f, and g represent #17, #18, #19, #20, BQ, ZM, and CY, respectively ; 1, 2, 3, and 4 represent influence of total emissions, BRIR, YRDIR, and PRDIR, respectively



85 Fig. S2.9 The every 3 hour simulated wind vector and PM<sub>2.5</sub> distribution on the event at 00:00 LST (a) 03:00 LST (b) 06:00 LST (c) 09:00 LST (d) 12:00 LST (e) 15:00 LST (f) 18:00 LST (g) 21:00 (h) July 30 2017.

90



95

Fig. S2.10 The hourly average contribution of physical process at each layer on July 30th 2017, a,b,c,d,e,f, and g represent #17, #18, #19, #20, BQ, ZM, and CY, respectively ; 1, 2, 3, and 4 represent influence of total emissions, BRIB, YRDIB, and PRDIB, respectively.

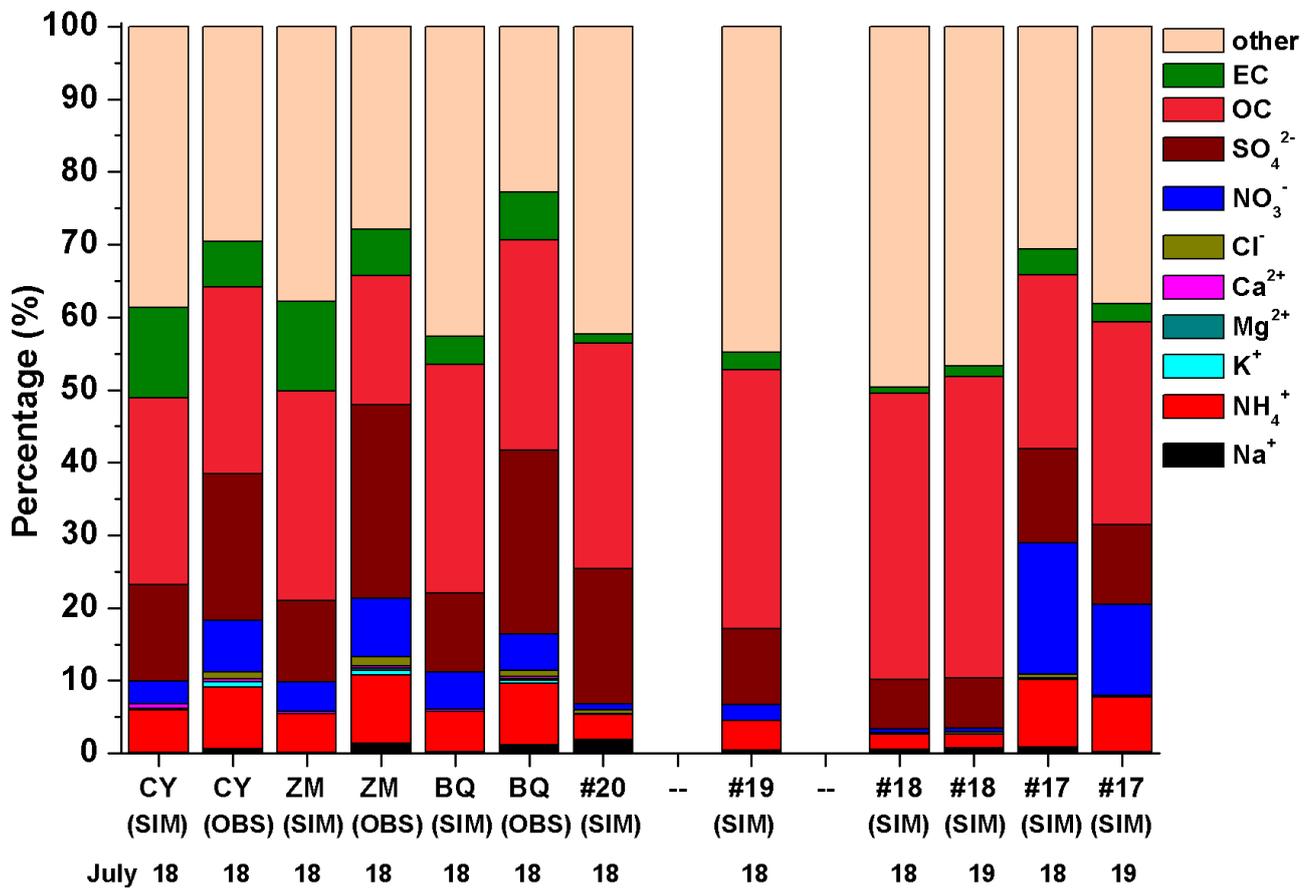


Fig. S2.11: The comparison of simulation (SIM) and observation (OBS) of PM<sub>2.5</sub> compositions at #17-#20 and BQ, ZM, and CY on July 18th and 19th 2017

100

105

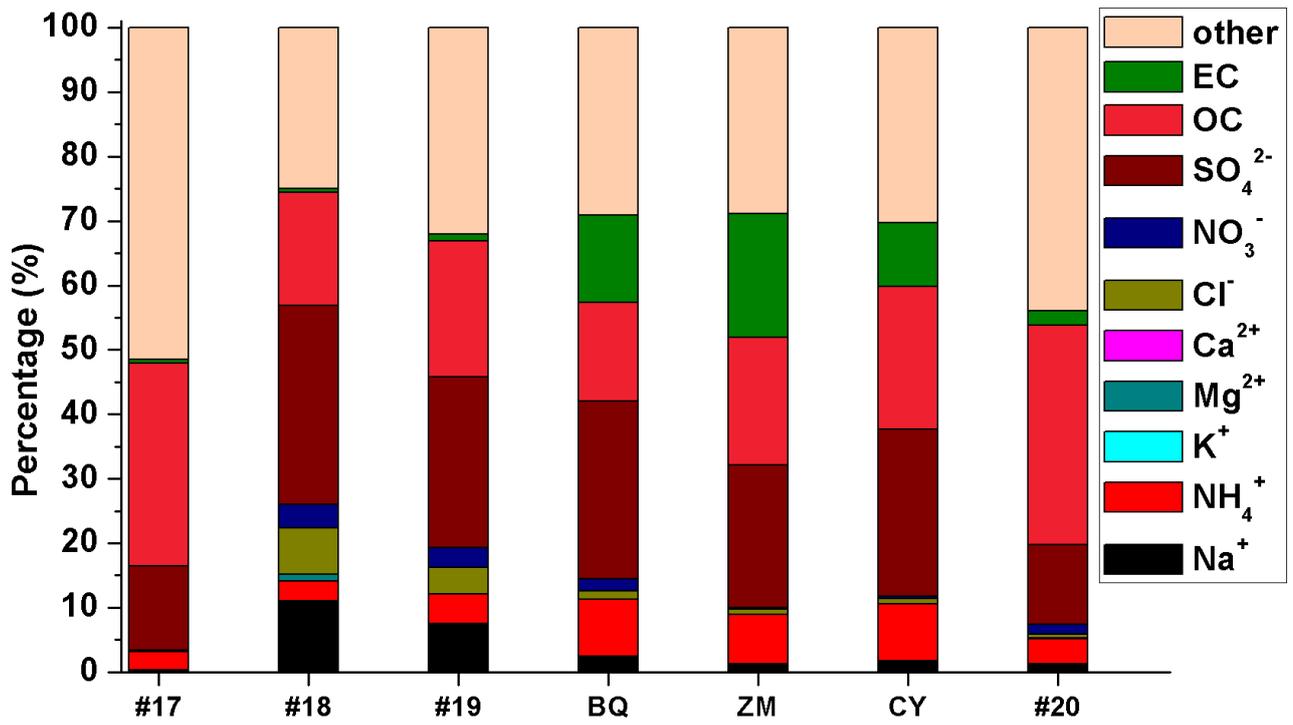


Figure S2.12: The simulation of PM<sub>2.5</sub> compositions on July 30th 2017 (There is no observations due to bad weather, i.e. the thermal low in Fig. S2.7)