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CMAQ will be applied for the air quality modeling to the United States from January 1st, 2001 to January 31st, 2002. The meteorological input field of the CMAQ was prepared by the MM5. The MM5 has three domains, one has the grid size of 36 km and the other two have the grid size of 12km. The map projection of this model is Lambert conformal projection with the central meridian, 97 W and the standard parallels, 33 N and 45 N. The dimension of the 36 km domain is 164 x 128 with the center coordinate of 40 N and 97 W. One of the 12 km domains is located in Atlanta, GA with the dimension of 27 x 24 and the other is in Houston, TX with the dimension of 12 x 12. The MM5 had been run three episodes, January 1st - 10th, 2001, July 1st - 10th, 2001 and January 1st - 10th, 2002. The MM5 was run twice with different physics parameters for the episode from Jan 1st-10th, 2001 to obtain the parameters of better performance. The first set is the simple ice microphysics, Kain-Fritsch cumulus scheme, Rapid Radiative Transfer Model, Pleim Chang planetary boundary layer and the Pleim-Xu land surface model. The other set is the mixed phase microphysics, Grell cumulus scheme, Rapid Radiation Transfer Model, MRF planetary boundary layer and the OSU land surface model. For the above three episodes, the meteorological model evaluation was performed. The UCAR surface synoptic observation data (<http://dss.ucar.edu/datasets/ds472.0/>) was used as an observation data for the evaluation. Figure 1 is the MM5 model domain. The blue dot is each cell of the 36 km domain and black dot is the UCAR surface synoptic observation sites. From the location of the observation sites, the US continent is easily distinguished

from the sea. The rectangle in the southern east America is the 12 km Atlanta's model domain and the smaller rectangle in the mid southern area is the 12 km model domain centered in Houston. The 36 km domain's evaluation was performed by calculating the grid-by-grid MBE(Mean Bias Error) and RMSE(Root Mean Square Error). The observation data was interpolated according to the 36 km model domain to perform the grid by grid comparison. The interpolated observed data outside of the US continent were not reliable because the sites were not located. So, only the data inside the polygon outlining the US continent were involved in the 36 km grid by grid comparison. Figure 2 is the zoomed-in-figure of the 12 km Atlanta domain from the Figure 1. The blue dot is each cell of the 12 km domain. The evaluation of the 12 km domain was performed by the station by station comparison. Especially, among the UCAR surface synoptic observation sites, three sites marked G (Lat.: 33.78 N, Lon.: 84.52 W) , I (Lat.: 33.65 N, Lon.: 84.43 W) and J (Lat.: 33.88 N, Lon.: 84.30 W) are located close to the PM 2.5 measurement sites, JST (Jefferson Street site – Lat.: 33.78 N, Lon.: 84.41 W), Fort Mc (Fort McPherson Army Center site – Lat.: 33.70 N, Lon.: 84.44 W) and TUC (Tucker site – Lat.: 33.85 N, Lon: 84.21 W). Hence the time series of the meteorological fields were plotted for those three sites.

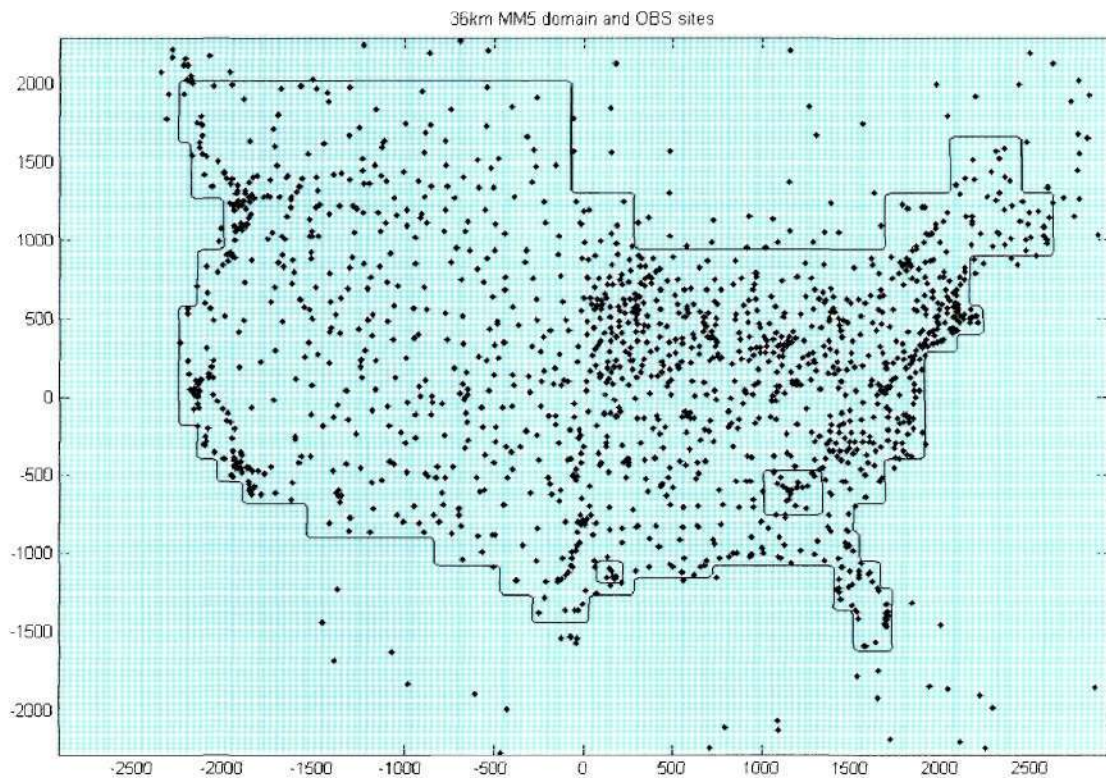


Fig 1. MM5 model domain. The projection is the Lambert conformal projection with the central meridian, 97 W and the standard parallels, 33 N and 45 N. The blue dot is each cell of the 36 km domain and black dot is the UCAR surface synoptic observation sites. The rectangle in the southern east America is the 12 km Atlanta's model domain and the smaller rectangle in the mid southern area is the 12 km model domain centered in Houston. The data inside the polygon outlining the US continent were involved in the 36 km grid by grid comparison.

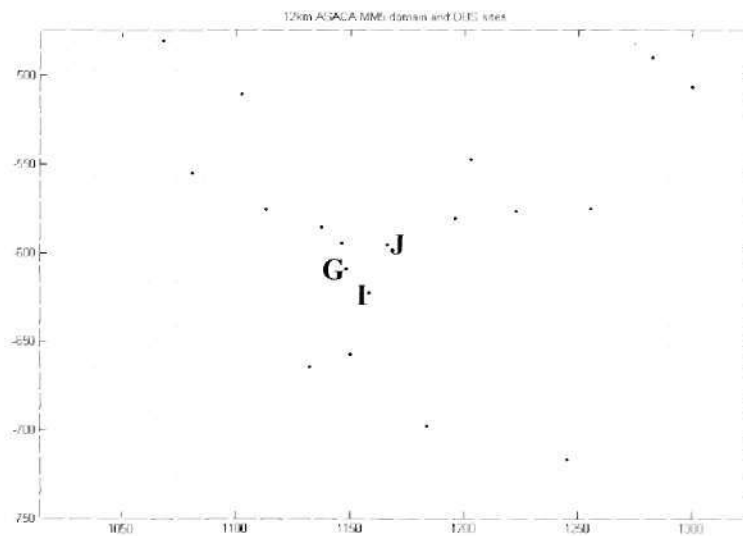


Figure 2 The zoomed-in-figure of the 12 km Atlanta domain from the Figure 1. Lambert conformal projection with the central meridian, 97 W and the standard parallels, 33 N and 45 N. The blue dot is each cell of the 12 km domain and black dot is the UCAR surface synoptic observation sites. Three sites marked G (Lat.: 33.78 N, Lon.: 84.52 W) , I (Lat.: 33.65 N, Lon.: 84.43 W) and J (Lat.: 33.88 N, Lon.: 84.30 W) are located close to the PM 2.5 measurement sites in Atlanta.

The temperature, the wind speed and the wind direction are the variables which were used to evaluate the model results. From Jan 1st – 10th, 2001, MM5 was run both with the OSU land surface model and the PX land surface model. Table 1 is the 36 km MM5 domain's evaluation results comparing each of the MM5 (OSU land surface model) output and the MM5 (PX land surface model) output with the observed data from Jan 1st – 10th, 2001. Table 2 is the 12 km Atlanta MM5 domain's evaluation result for the same period with the Table 1. Because for both of the 36 km and 12 km domain, the PX land surface model is performed better in general, PX land surface model was selected for the other episodes' modeling. Table 3 is the 36 km MM5 domain's evaluation results for three episodes, Jan 1st- 10th, 2001, Jul 1st – 10th, 2001 and Jan 1st- 10th, 2002. These results are the comparison of the MM5 (PX land surface model) output with the observed data. Table 4 is the 12 km MM5 domain's evaluation result with the same period as Table 3.

Table 1.

| 36 km domain: grid by grid comparison | | | |
|---------------------------------------|----------------|-------------------|------------------------|
| MBE(Mean Bias Error) | Jan 1-10, 2001 | | |
| | Temperature(K) | Wind Speed(m/sec) | Wind direction(degree) |
| Model (PX) - Observation | -0.97 | 0.201 | 37.64 |
| Model(OSU) - Observation | -2.05 | 0.022 | 35.35 |
| RMSE(Root Mean Square Error) | Jan 1-10, 2001 | | |
| | Temperature(K) | Wind Speed(m/sec) | Wind direction(degree) |
| Model (PX) - Observation | 3.23 | 1.638 | 110.36 |
| Model(OSU) - Observation | 4.04 | 1.76 | 122.5 |

Table 2.

| 12 km Atlanta domain: station by station comparison | | | |
|---|----------------|-------------------|------------------------|
| MBE(Mean Bias Error) | Jan 1-10, 2001 | | |
| | Temperature(K) | Wind Speed(m/sec) | Wind direction(degree) |
| Model (PX) - Observation | -0.96 | 0.112 | 68.52 |
| Model(OSU) - Observation | -2.29 | -0.15 | 62.23 |
| RMSE(Root Mean Square Error) | Jan 1-10, 2001 | | |
| | Temperature(K) | Wind Speed(m/sec) | Wind direction(degree) |
| Model (PX) - Observation | 2.41 | 1.412 | 122.1 |
| Model(OSU) - Observation | 3.21 | 1.56 | 126.8 |

Table 3.

| 36 km domain: grid by grid comparison | | | |
|---------------------------------------|-------------------------|-------------------|------------------------|
| MBE(Mean Bias Error) | Model(PX) - Observation | | |
| | Temperature(K) | Wind Speed(m/sec) | Wind direction(degree) |
| January 1-10, 2001 | -0.97 | 0.201 | 37.64 |
| July 1-10, 2001 | -0.82 | -0.36 | 33.5 |
| January 1-10, 2002 | -0.86 | 0.066 | 29.71 |
| RMSE(Root Mean Square Error) | Model(PX) - Observation | | |
| | Temperature(K) | Wind Speed(m/sec) | Wind direction(degree) |
| January 1-10, 2001 | 3.23 | 1.638 | 110.36 |
| July 1-10, 2001 | 3.22 | 1.709 | 104.17 |
| January 1-10, 2002 | 3.02 | 1.698 | 117.53 |

Table 4.

| 12 km Atlanta domain: station by station comparison | | | |
|---|-------------------------|-------------------|------------------------|
| MBE(Mean Bias Error) | Model(PX) - Observation | | |
| | Temperature(K) | Wind Speed(m/sec) | Wind direction(degree) |
| January 1-10, 2001 | -0.96 | 0.112 | 68.52 |
| July 1-10, 2001 | 0.2 | 0.148 | 87.06 |
| January 1-10, 2002 | -1.34 | 0.011 | 34.42 |
| RMSE(Root Mean Square Error) | Model(PX) - Observation | | |
| | Temperature(K) | Wind Speed(m/sec) | Wind direction(degree) |
| January 1-10, 2001 | 2.41 | 1.412 | 122.1 |
| July 1-10, 2001 | 2 | 1.41 | 152.99 |
| January 1-10, 2002 | 2.48 | 1.629 | 103.01 |

Figure 3, 4 and 5 are the time series of the surface temperature, surface wind speed and surface wind direction at site G, I and J (marked in figure 2), for three episodes, Jan 1st-10th, 2001, Jul 1st-10th, 2001 and Jan 1st-10th, 2002.

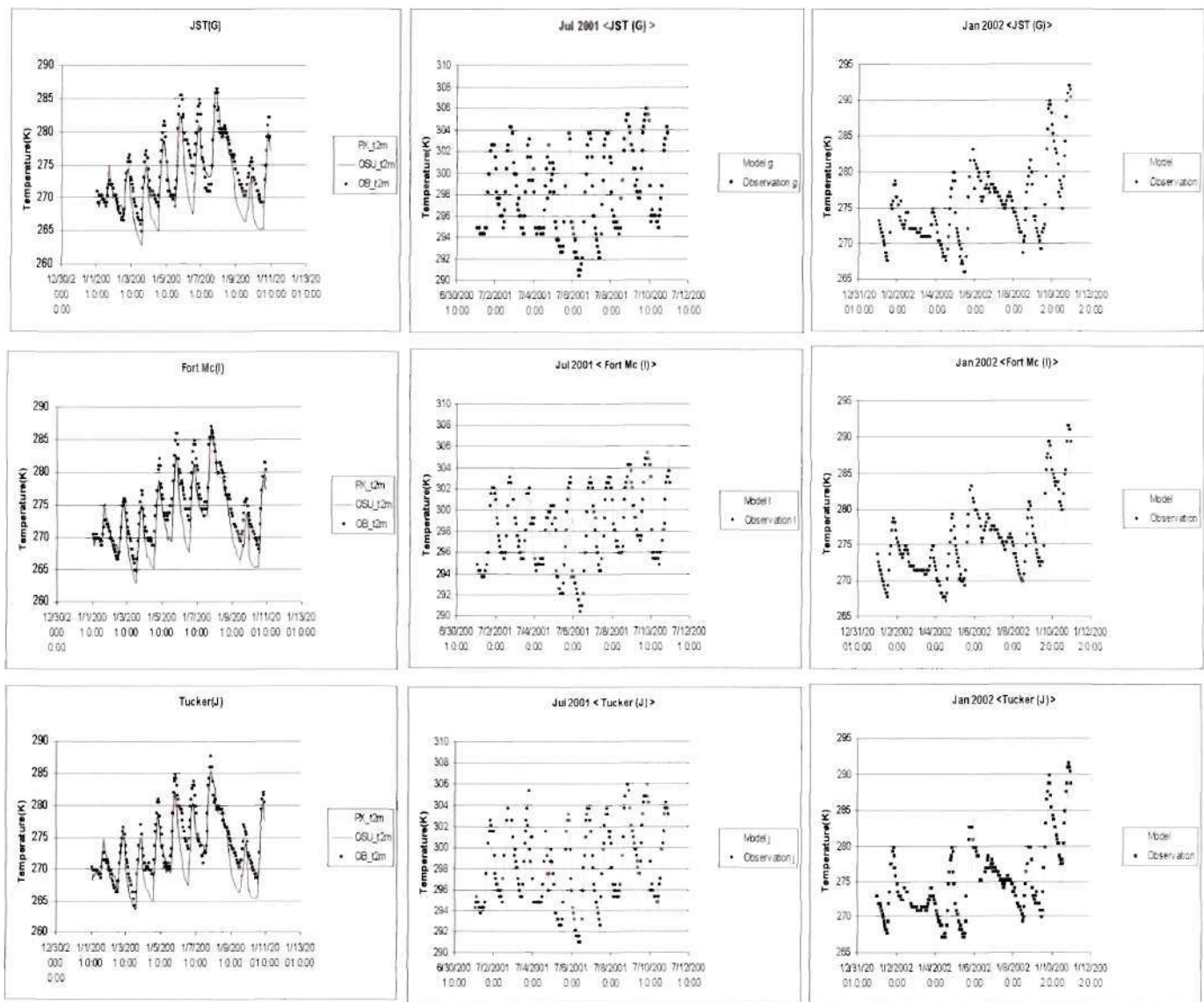


Figure 3. Time series of surface temperature comparing the model results and the observed data for JST, Fort Mc and Tucker from Jan 1st-10th, 2001, Jul 1st-10th, 2001 and Jan 1st-10th, 2002.

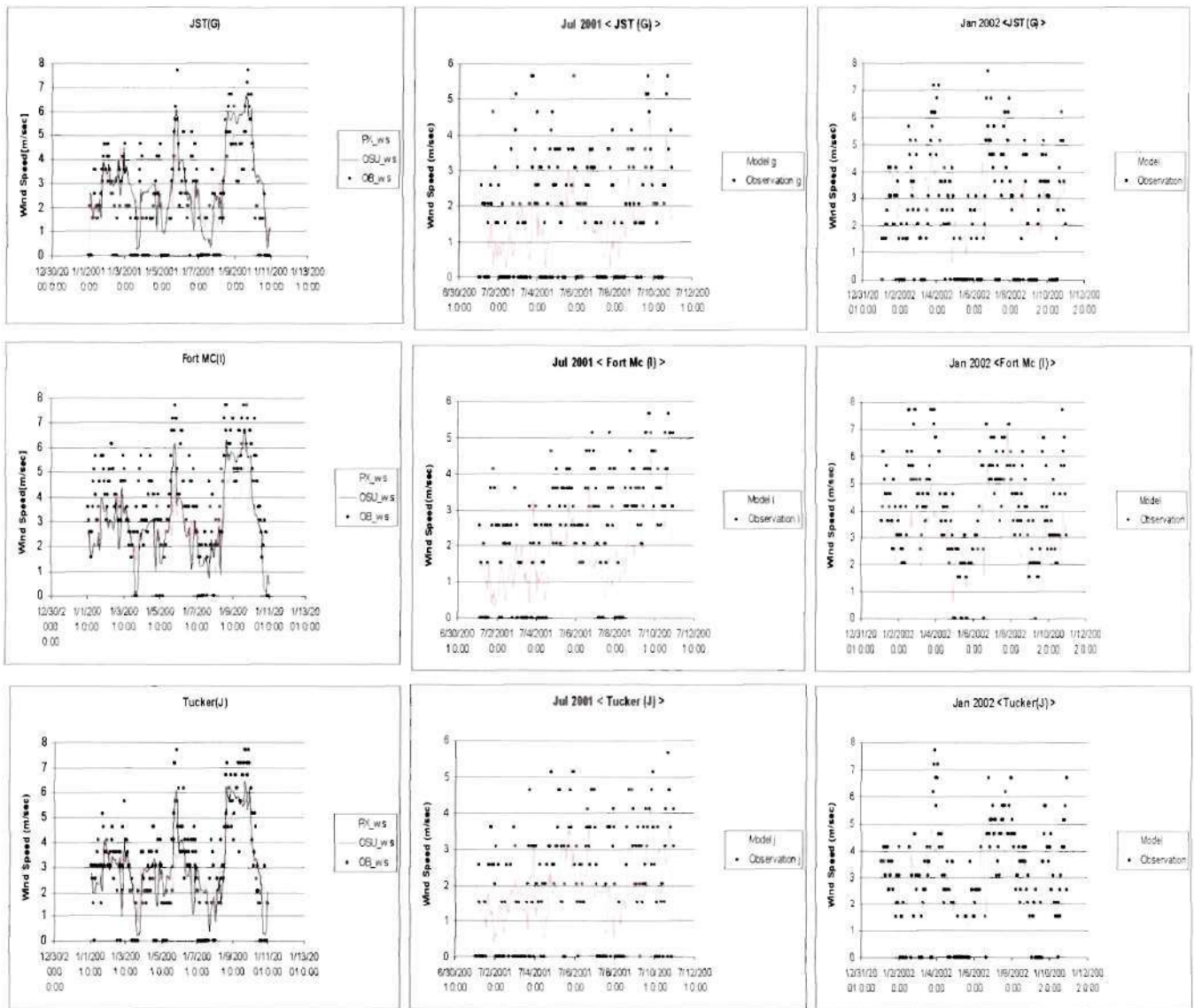


Figure 4. Time series of surface wind speed comparing the model results and the observed data for JST, Fort Mc and Tucker from Jan 1st-10th, 2001, Jul 1st-10th, 2001 and Jan 1st-10th, 2002.

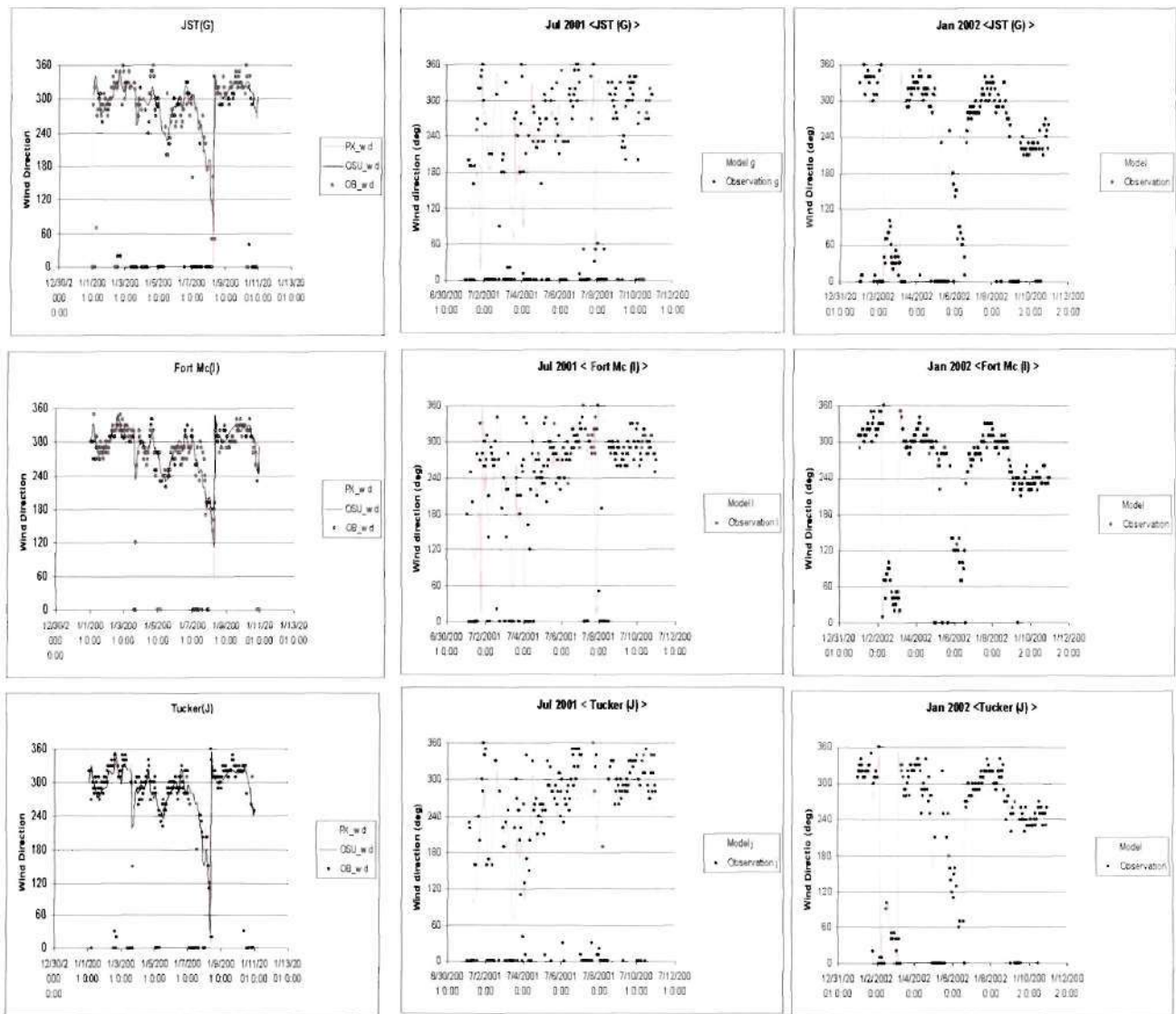


Figure 5. Time series of surface wind direction comparing the model results and the observed data for JST, Fort Mc and Tucker from Jan 1st-10th, 2001, Jul 1st-10th, 2001 and Jan 1st-10th, 2002.