P1.6 Comparing MM5 Radiative Fluxes With Observations Taken During The TEXAQS 2000 Air Quality Experiment

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1. Introduction

Recent research has shown that radiative transfer parameterization errors can have an adverse effect on mesoscale numerical weather forecasts of the atmospheric boundary layer (ABL) wind, temperature, and mixing depth. (Zamora et al., 2001). Typically, mesoscale model forecasts of wind, temperature, and mixed layer depth are used by air quality specialists to forecast chemical concentrations of atmospheric pollutants.

During the Texas Air Quality Study 2000 (TEXAQS 2000) The National Oceanic and Atmospheric Administration Environmental Technology Laboratory (NOAA/ETL) made detailed observations of the solar and infrared radiative fluxes at the La Porte, Texas air chemistry site located about 30 km southwest of downtown Houston. In this poster we compare the observed solar irradiance for a six day period beginning at 0000 UTC, August 25, 2000 with real-time forecast values from the NOAA Forecast Systems Laboratory (FSL) coupled weather-chemistry forecast model (P1.28 this session).

2. Numerical Model

The coupled chemistry model was run twice daily on multiple 1-way meshes of 60, 15, 5 and 1.7 km using initial conditions generated by the FSL Rapid Update Cycle (RUC). The Dudhia cloud radiation parameterization was used along with the Burk-Thompson 1.5 order ABL scheme. Radiation was calculated at 30 minute intervals on all the grids. The Grell convective parameterization was used only on the 60, 15 and 5 km grids. We used the Reisner 1 mixed cloud physics package on all five grids. In this poster we show results from the 24-h daily simulations initialized at 0000 UTC

3. Preliminary Results

The La Porte observations beginning at 0000 UTC August 25, 2000 are shown in Figure 1. The observations indicate that the first five days of the period are cloudy ahead of the sea-breeze front followed by clearing in the late afternoon after the front passes the air chemistry site. August 30 was a clear sky day.

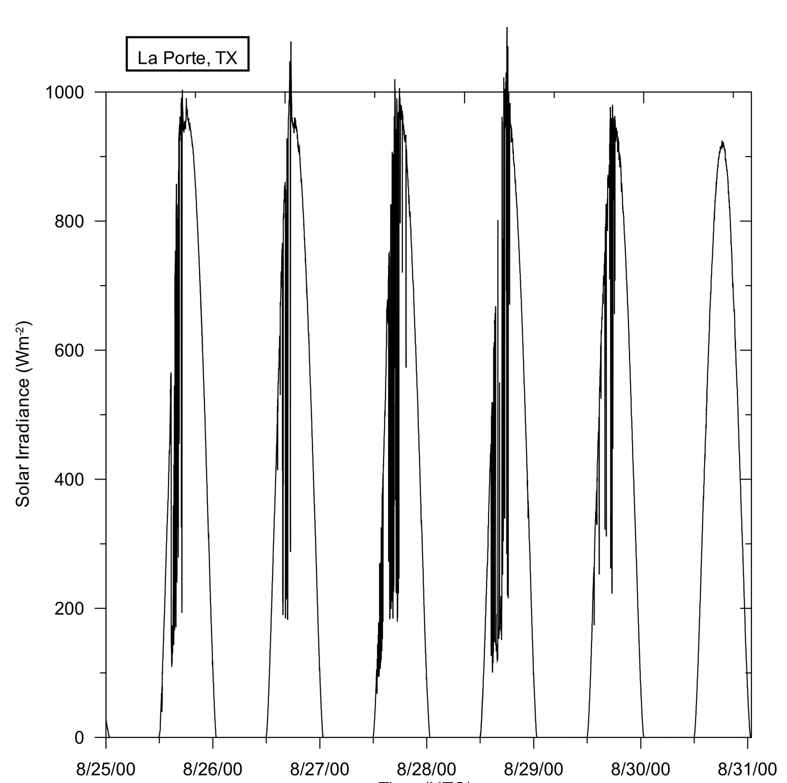

Figure 1. Solar Radiative Flux observed at La Porte, TX, for August 25-30, 2000.

In contrast the MM5 forecast values for the 60-km grid, averaged over the six grid points surrounding La Porte show no signs of cloud with the exception of August 29 (Fig. 2). The difference between the observations and MM5 are shown in Figure 3.

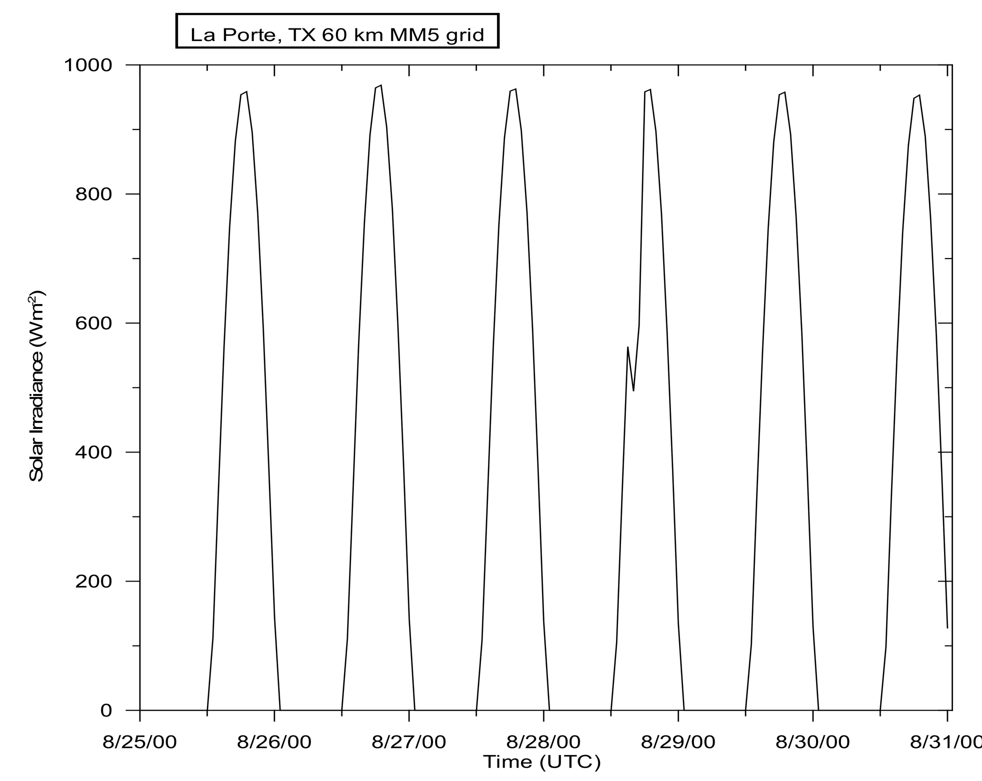

Figure 2. MM5 predicted solar radiative flux for La Porte,TX, August 25-30, 2000.

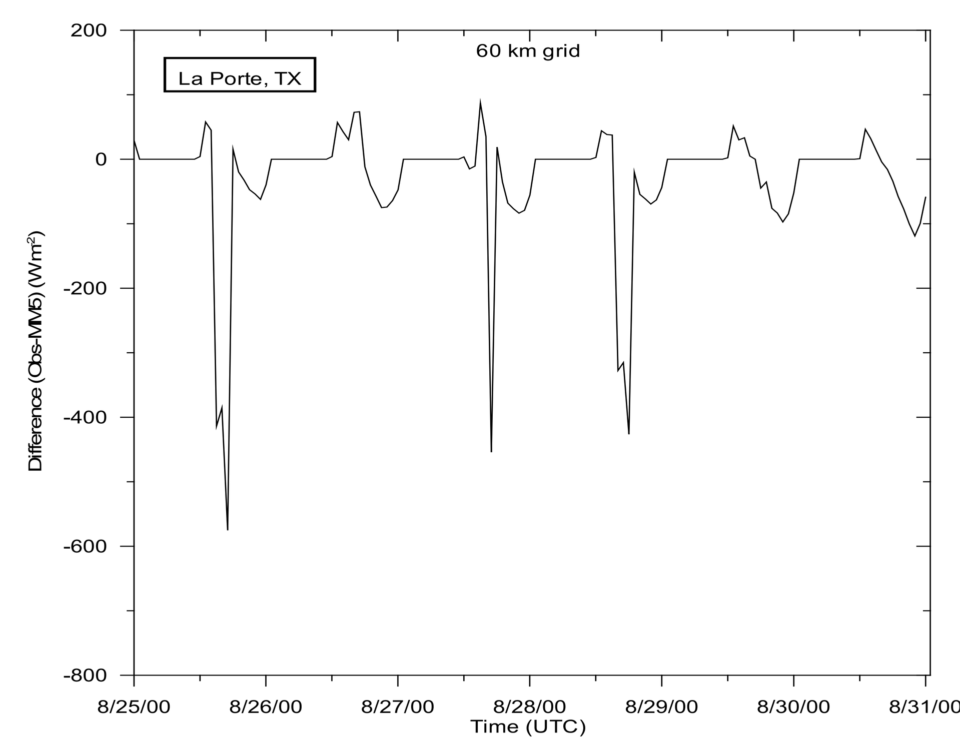

Figure 3. MM5 predicted solar radiative flux for La Porte,TX, August 25-30, 2000.

The largest differences found can be attributed to heavy early morning cloud cover over the La Porte site on Aug 25, 27 and 28. A more subtle difference is apparent each day. In the morning the MM5 simulated solar fluxes are smaller than the observations by about 50 $W\ m^{-2}$. In contrast the afternoon MM5 fluxes are around 80 $W\ m^{-2}$ higher than the observations. During the clear sky day afternoon the model shows the near 100 $W\ m^{-2}$ bias noted by Zamora et al. (2001).

We also find that the phase and amplitude of the solar cycle in MM5 depends on both the model grid and radiation time step. Figure 4 indicates that the best agreement with the observations was found when we used the 1.67 km grid and a 5 second radiation time step. The early morning positive errors on the clear sky morning of August 30 suggest that clouds and timing errors are responsible for the difference between MM5 and the observations.

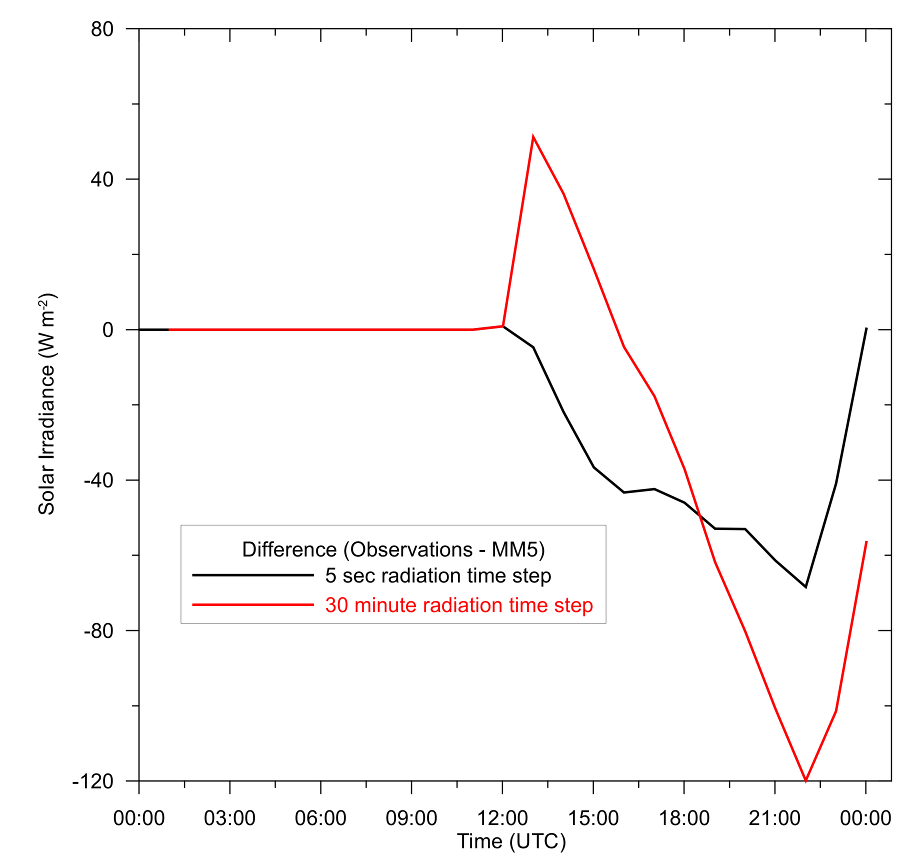

Figure 4. Difference (Observations - MM5) solar radiative fluxes for La Porte, TX August 30, 2000 1.67 km grid.

The phase shifting caused by using too long a radiation time step is shown in Figure 5 for the 1.67 km mesh. The phase agreement is improved when a 5 sec radiation time step is used (Fig. 6).

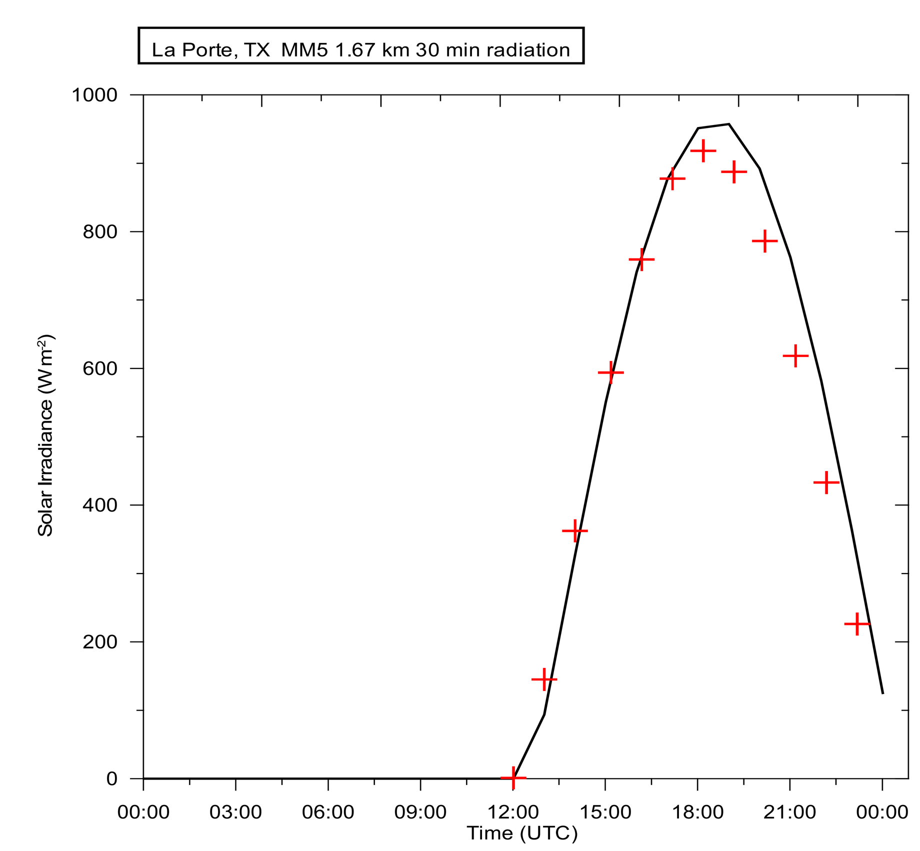

Figure 5. La Porte, TX observed solar radiative fluxes (solid) and MM5 predicted (crosses) solar radiative fluxes for August 30, 2000. 30 minute radiation time step.

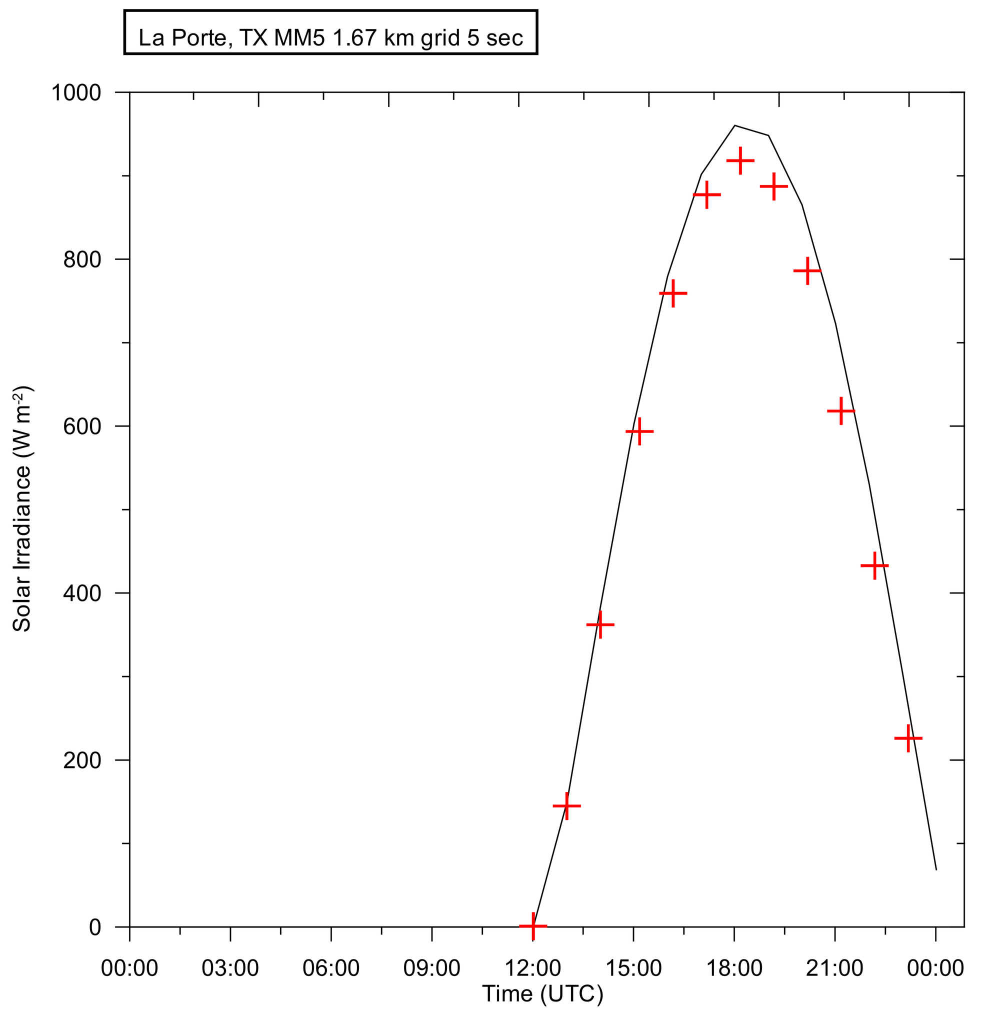

Figure 6. La Porte, TX observed solar radiative fluxes (solid) and MM5 predicted (crosses) solar radiative fluxes for August 30, 2000. 5 second radiation time step.

4. Concluding Remarks

These preliminary results suggest that the phase of the diurnal heating cycle in the 60 km model results could be impacted by the convective parmeterization, the explicit MM5 microphysical package, and the radiation scheme. The large scale differential heating function for the smaller grids comes from the 60 km mesh. The motion and strength of the sea-breeze front depends on having the correct thermal gradient between land and water. Thus, we expect that if the large scale (60 km) diurnal heating cycle is in error, these errors can propagate through all the meshes.

5. References

Zamora, R. J., S. Solomon, E.G. Dutton, J.W. Bao, M. Trainer, R.W. Portmann, A.B. White, and D.W. Nelson., 2001: Comparing MM5 radiative fluxes with observations gathered during the 1995 and 1999 Nashville Southern Oxidants Studies. Submitted to Journal of Geophysical Research.

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