ABSTRACT

Yang, Kate Jr-Shiuan, Ph.D., Purdue University, December 2004. Regional Climate-Chemistry Model Simulations of Ozone in the Lower Troposphere and Its Climatic Impacts. Major Professor: Robert B. Jacko.

The Purdue Regional Climate and Chemistry Model (PRCCM), a three-dimensional regional-scale coupled climate-chemistry model, has been developed to predict ozone concentrations in the lower troposphere with real-time modeled meteorological data and to investigate their climatic impacts at the regional scale with the radiative feedback process. The PRCCM performs photolysis calculation, chemistry modeling, chemical tracer transport as well as the radiation calculation simultaneously or ***on-line*** with atmospheric modeling. The PRCCM has been utilized to simulate an ozone episode during July 16–22, 1998 over the Lake Michigan region in this study. The PRCCM modeled ozone concentrations have been compared with the ground-based and airborne measurements, and have correlation coefficients of 0.742 and 0.771 with these measurements, respectively. Furthermore, the three-dimensional ozone concentrations predicted by the PRCCM have been real-time updated within the radiation code during atmospheric modeling process in order to investigate their resulting regional climatic impact in detail. For the simulation period, the increases of tropospheric ozone have been found to cause surface warming over highly polluted area but cooling over other areas. The model results also indicate their strong effects on the radiative balance and moisture distribution, which may affect regional dynamic circulation and climate. With the radiative feedback by tropospheric ozone included in the PRCCM, the model results also show improvements on meteorological predictions, e.g., 4.9% on relative humidity.