An Assessment of Community Multiscale Air Quality Model Performance of Oxides of Nitrogen, Reactive Oxidized Nitrogen, and Ozone over Rural and Urban New York State during summer 2015

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This study examined how accurately two model versions predicted concentrations of oxides of nitrogen ([NO_x]), reactive oxidized nitrogen ([NO_y]), and ozone ([O_3]) over rural and urban New York State (NYS) during the summer of 2015. The platforms used were 1) the National Air Quality Forecast Capability North American Multi-scale Model (NAM) – Community Multiscale Air Quality (CMAQ) model Version 4.6 (v4.6), and 2) an updated version of the first platform, CMAQ model Version 5.0.2 (v5.0.2) with the operational NAM. NO_x, NO_y, and O_3 model predictions and NO_x and O_3 measurement data from summer 2015 for one rural NYS site, Pinnacle State Park (PSP) in Addison, New York (NY), and one urban NYS site, Queens College (QC) in Flushing, NY, were used. From this data, two key discrepancies between model output and raw observations were found: 1) poor model representation of the observed diurnal NO_x concentrations over QC and PSP, and 2) insufficient nighttime nitric oxide (NO) titration over QC by both CMAQ model versions. To explore both of these issues, the model-forecasted planetary boundary layer height (PBLH) was compared to the observed PBLH to see how well the models captured the observed evolution of the boundary layer.

In addition, the ozone production efficiency (OPE) was analyzed at PSP and QC during the summer of 2015 by plotting CMAQ v4.6 and CMAQ v5.0.2 forecasted concentrations of odd oxygen ([O_x] = [O_3] + nitrogen dioxide [NO_2]) versus NO_z ([NO_z] = [NO_y] – [NO_x]) during photo-chemically productive hours. This study specified photo-chemically productive hours ranging from 9 AM to 4 PM Eastern Standard Time (EST) for both sites. Through analyzing the OPE from both CMAQ versions, the differences in how the two models predicted [NO_x], [NO_y], and [O_3] concentrations over rural and urban NYS were explored in further detail, and the relationship between the local meteorology and the OPE over rural and urban NYS was also considered.