

Observed and Model-Derived Ozone Production Efficiency over Urban and Rural New York State

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This study examined the model-derived and observed ozone production efficiency (OPE = $\Delta\text{O}_x / \Delta\text{NO}_z$) in one rural location, Pinnacle State Park (PSP) in Addison, New York (NY), and one urban location, Queens College (QC) in Flushing, NY, in New York State (NYS) during photo-chemically productive hours (11 a.m. – 4 p.m. Eastern Standard Time (EST)) in summer 2016. Measurement data and model predictions from Community Multiscale Air Quality (CMAQ) model Version 4.6 (v4.6) and CMAQ Version 5.0.2 (v5.0.2) were used to assess the OPE at both sites. CMAQ-predicted and observed OPEs at PSP and QC were both in reasonable agreement, with model-predicted and observed OPEs ranging from approximately 6-11 and 11-20, respectively, at PSP, and 5-8 and 4-8, respectively, at QC. The observed and modeled relationship between OPE and oxides of nitrogen (NO_x) was studied at PSP to examine where the OPE turnover point occurred. Summer 2016 observations at PSP showed a clear OPE turnover point at a $[\text{NO}_x]$ concentration of about 0.22 ppb, while neither CMAQ model version predicted an OPE turnover point. This was likely due to the low values of model-predicted $[\text{NO}_x]$ concentrations at PSP. The observed OPEs for QC mentioned above were found by using species-specific reactive odd nitrogen (NO_y) instruments and an estimated value for nitrogen dioxide (NO_2), since observed OPEs determined using non-specific NO_x and NO_y instruments yielded observed OPEs that 1) varied from 3-23, and 2) were inconsistent with CMAQ-predicted OPE. This difference in observed OPEs at QC depending on the suite of instruments used suggests that species-specific NO_x and NO_y instruments may be needed to obtain reliable urban OPEs.