Motivation: Change in observed seasonal cycle of surface \( \text{O}_3 \) over Northeastern United States (NE US) following a ~25% decrease in regional NO\(_x\) emissions

21st Century Scenarios

Large \( \text{NO}_x \) reductions offset climate penalty on \( \text{O}_3 \) extremes

Surface \( \text{O}_3 \) seasonal cycles at the beginning and the end of the 21st C

Evaluation of NOAA GFDL CM3 with surface \( \text{O}_3 \) observations over NE US atmosphere cubed sphere grid (48°-2°x2°; 48 levels to 80km)

RCP4.5 & RCP8.5

NE US 36-46N 80-70W

Reduction NO\(_x\) emissions play a role in increasing surface \( \text{O}_3 \) during the winter in polluted regions [US EPA, 2014]

While \( \text{NO}_x \) exerts a dominant influence on the shape of the surface \( \text{O}_3 \) seasonal cycle, global \( \text{CH}_4 \) abundance influences the baseline surface \( \text{O}_3 \) abundance during all months

Does climate forcing from the doubling of \( \text{CH}_4 \) under RCP8.5 have any detectible influence on the surface \( \text{O}_3 \) response over the NE US?

Month in which peak monthly mean surface \( \text{O}_3 \) occurs under RCP8.5

NE US 36-46N 80-70W

Clear shift in the peak from summer to winter/early spring over Eastern US

NE US 36-46N 80-70W

Climate change penalty predominantly affects surface \( \text{O}_3 \) during the photochemically active season, May-September, in regions with sufficiently high anthropogenic \( \text{NO}_x \) emissions


How will the surface \( \text{O}_3 \) seasonal cycle over the NE US respond to further changes in regional and global precursor emission changes, as well as climate, during the rest of 21st Century?