QOS2016-199, 2016
Quadrennial Ozone Symposium of the International Ozone Commission

21 century U.S. surface ozone extremes: influence of climate warming, rising methane and reductions in nitrogen oxide emissions

H.E. Rieder (1,2), A.M. Fiore (2,3), G. Correa (2), O. Clifton (2,3), L.W. Horowitz (4), and V. Naik (4)

(1) University of Graz, Wegener Center for Climate and Global Change and IGAM/Department of Physics, Graz, Austria , (2) Lamont-Doherty Earth Observatory, Columbia University, Palisades, NY, USA, (3) Department of Earth and Environmental Sciences, Columbia University, New York, NY, USA, (4) Geophysical Fluid Dynamics Laboratory, National Oceanic and Atmospheric Administration, Princeton, NJ, USA

Nitrogen oxide (NO_x) emission controls have led to fewer U.S. high-ozone pollution events over the past two decades, but concerns have been raised that climate warming may offset some of these gains in the coming decades. Here we analyze the effect of projected future changes of emissions and climate, in isolation and combination, on U.S. surface ozone (O_3) during the 21st century in an ensemble of simulations performed with the GFDL chemistry-climate model CM3. We analyze two Representative Concentration Pathway (RCP) scenarios: RCP4.5 and RCP8.5, with pronounced NO_x emissions decreases and additional simulations where well-mixed greenhouse gases follow the respective RCP but O_3 and aerosol precursor emissions are held at 2005 levels. These simulations enable us to isolate the role of well-mixed greenhouse gas induced climate change from that of emission reductions. Another set of simulations, following RCP8.5 but with methane (CH_4) held fixed at 2005 levels, allows us to quantify the influence of global CH_4 on background O_3. For each scenario we examine the changes in the surface O_3 distribution over the 21st century in individual seasons and for four U.S. regions. Furthermore, we introduce a statistical transfer function that allows calculating policy relevant statistics i.e., the number of days above the U.S. national ambient air quality standard (NAAQS) for O_3 at site level from regional model projections. We find that the high-ozone season changes from summer to springtime in scenarios where NO_x emissions decline but CH_4 rises. In the absence of emission changes, climate warming generally worsens regional air quality, consistent with earlier work.