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Analysis of Summer-time Ozone and Precursor Species in the Southeast United States

Ozone (O_3) is a greenhouse gas and toxic pollutant which plays a major role in air quality and atmospheric chemistry. The understanding and ability to model the horizontal and vertical structure of O_3 mixing ratios is difficult due to the complex formation/destruction processes and transport pathways that cause large variability of O_3. The Environmental Protection Agency has National Ambient Air Quality Standards for O_3 set at 75 ppb with future standards proposed to be as low as 65 ppb. These lower values emphasize the need to better understand/simulate the transport processes, emission sources, and chemical processes controlling precursor species (e.g., NO_x, VOCs, and CO) which influence O_3 mixing ratios. The uncertainty of these controlling variables is particularly large in the southeast United States (US) which is a region impacted by multiple different emission sources of precursor species (anthropogenic and biogenic) and transport processes resulting in complex spatio-temporal O_3 patterns.

During this work we will evaluate O_3 and precursor species in the southeast US applying models, ground-based and airborne in situ data, and lidar observations. In the summer of 2013, the UAH O_3 Differential Absorption Lidar (DIAL) (part of the Tropospheric Ozone Lidar Network (TOLNet)) measured vertical O_3 profiles from the surface up to ~12 km. During this period, the lidar observed numerous periods of dynamic temporal and vertical O_3 structures. In order to determine the sources/processes impacting these O_3 mixing ratios we will apply the CTM GEOS-Chem (v9-02) at a 0.25° × 0.3125° resolution. Using in situ ground-based (e.g., SEARCH Network, CASTNET), airborne (e.g., NOAA WP-3D – SENEX 2013, DC-8 – SEAC4RS), and TOLNet lidar data we will first evaluate the model to determine the capability of GEOS-Chem to simulate the spatio-temporal variability of O_3 in the southeast US. Secondly, we will perform model sensitivity studies in order to quantify which emission sources (e.g., anthropogenic, biogenic, lighting, wildfire) and transport processes (e.g., stratospheric, long-range, local scale) are contributing to these TOLNet-observed dynamic O_3 patterns. Results from the evaluation of the model and the study of sources/processes impacting observed O_3 mixing ratios will be presented.