AQAST Investigator Project, 2013-2014

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Project duration: June 1, 2013 – May 31, 2014
Title: Processes influencing the daily-to-decadal variability of U.S. background ozone levels

Problem to be solved: As the ozone (O₃) NAAQS threshold is lowered, accurate estimates for background levels are needed. It is important to quantify the contributions of high-O₃ events caused by stratospheric intrusions and by international pollution transport so that they can be accounted for appropriately in an area’s O₃ NAAQS attainment status and implementation plan. Longer-term planning for the 21st century requires understanding the role of changing regional and global emissions in the context of both a warming climate and decadal climate variability.

Project description: With the ~2° GFDL AM3 1980-2012 simulation nudged to NCEP winds, we extend prior analysis on stratospheric intrusions and Asian pollution impacts on high-O₃ events over the western U.S. during spring of 2010 to place those findings in the context of recent decades. We are finding that stratospheric O₃ influence drives a substantial portion of observed day-to-day and inter-annual variability in western U.S. surface O₃ in late spring and early summer. New measurements (beginning 2011) of O₃ and meteorological variables from a monitoring network over Nevada will be used to evaluate the model, and in turn, the model will be applied to interpret background influences on these observations including stratospheric and Asian influence on high-O₃ events. We are scoping out the potential for using AIRS and OMI O₃ retrievals as an indicator for western U.S. surface day-to-day O₃ variability driven by stratospheric O₃ intrusions. With 21st century emission and climate change scenarios (RCP4.5 and RCP8.5) in the GFDL CM3 chemistry-climate model plus additional perturbation simulations we examine the roles of climate change, rising methane, and regional emission controls on U.S. surface O₃ and their contributions to changing seasonality.

Deliverables:
- Information on background influences during high-O₃ events over the western United States, delivered to EPA, state, and regional air quality managers as requested.
- Publications documenting (1) the contribution of stratospheric and Asian influence to inter-annual variations in surface O₃ over the Western U.S. (2) climate versus emissions impacts on U.S. baseline O₃, including changing seasonality, in the 21st century.
- Analysis of background O₃ influence on O₃ measured at new NV monitoring sites.

Expected AQ management outcomes:
- Better estimates of the balance between domestic versus international emission controls needed to attain ever-tightening standards on daily to decadal time scales.
- Enhanced knowledge needed to develop criteria to define exceptional events
- Determine potential for space-based products to indicate background enhancements to surface O₃ over the Western United States with a few days lead time.