"Investigating sources of ozone over California using AJAX airborne measurements and models: Assessing the contribution from long range transport"

- Name of the Journal(s): Atmospheric Environment
- Publisher(s): Elsevier
- Publication Date(s): April 2017
- Journal URL / website(s): https://www.journals.elsevier.com/atmospheric-environment

Ju-Mee Ryoo a, b, Matthew S. Johnson a, Laura T. Iraci a, Emma L. Yates a, b, Warren Gore a
a Earth Science Division, NASA Ames Research Center, Moffett Field, CA, United States
b Bay Area Environment Research Institute, Moffett Field, CA, United States

Manuscript (journal article) for Atmospheric Environment

Abstract: High ozone (O3) concentrations at low altitudes (1.5e4 km) were detected from airborne Alpha Jet Atmospheric eXperiment (AJAX) measurements on 30 May 2012 off the coast of California (CA). We investigate the causes of those elevated O3 concentrations using airborne measurements and various models. GEOS-Chem simulation shows that the contribution from local sources is likely small. A backtrajectory model was used to determine the air mass origins and how much they contributed to the O3 over CA. Low-level potential vorticity (PV) from Modern Era Retrospective analysis for Research and Applications 2 (MERRA-2) reanalysis data appears to be a result of the diabatic heating and mixing of airs in the lower altitudes, rather than be a result of direct transport from stratospheric intrusion. The Q
diagnostic, which is a measure of the mixing of the air masses, indicates that there is sufficient mixing along the trajectory to indicate that O3 from the different origins is mixed and transported to the western U.S. The back-trajectory model simulation demonstrates the air masses of interest came mostly from the mid troposphere (MT, 76%), but the contribution of the lower troposphere (LT, 19%) is also significant compared to those from the upper troposphere/lower stratosphere (UT/LS, 5%). Air coming from the LT appears to be mostly originating over Asia. The possible surface impact of the high O3 transported aloft on the surface O3 concentration through vertical and horizontal transport within a few days is substantiated by the influence maps determined from the Weather Research and Forecasting Stochastic Time Inverted Lagrangian Transport (WRF-STILT) model and the observed increases in surface ozone mixing ratios. Contrasting this complex case with a stratospheric-dominant event emphasizes the contribution of each source to the high O3 concentration in the lower altitudes over CA. Integrated analyses using models, reanalysis, and diagnostic tools, allows high ozone values detected by in-situ measurements to be attributed to multiple source processes.