6.097 Importance of Vertical Mixing on Observed and Modeled Surface Ozone in the Colorado Front Range.

Early Career Scientist

Presenting Author:

Lisa Kaser, National Center for Atmospheric Research, Boulder, CO, USA, kaser@ucar.edu

Co-Authors:

Edward Patton, National Center for Atmospheric Research, Boulder, CO, USA
Gabriele Pfister, National Center for Atmospheric Research, Boulder, CO, USA
Andrew Weinheimer, National Center for Atmospheric Research, Boulder, CO, USA
Christoph Knote, Ludwig-Maximilians-University, Munich, Germany
Denise Montzka, National Center for Atmospheric Research, Boulder, CO, USA
Frank Flocke, National Center for Atmospheric Research, Boulder, CO, USA
Joshua Hacker, National Center for Atmospheric Research, Boulder, CO, USA

Abstract:

Ozone concentrations at the earth's surface are influenced by both meteorological and chemical processes and are a function of advection, vertical mixing, deposition, chemical production and loss. Understanding the relative importance of these mechanisms controlling surface ozone concentrations is an essential component for designing effective control strategies. However, determining the magnitude of these processes contributing to the total ozone budget generally comes with high uncertainties resulting from the diversity of measurements required.

Here we combine ozone vertical profiles measured in summer 2014 in the Colorado Front Range during the DISCOVER-AQ and FRAPPE campaigns with surface measurements of ozone and planetary boundary layer height (PBLH). Vertical profiles obtained 3 times a day at 6 different sites allow us to analyze the diurnal evolution, day-to-day and site-to-site variability of vertical mixing's influence on observed ozone concentrations in Colorado.

Above boundary layer concentrations can lead to both diluting and polluting effects of surface ozone depending on the sign of the concentration jump at the top of the PBL. Overall vertical mixing was found to pollute the surface in the morning and dilute in the afternoon. The time period in between can be characterized as a transition period that is dependent on the day-to-day variability of ozone concentrations in the residual layer and the free troposphere.

We also investigate vertical mixing of ozone in a WRF-CHEM-3D simulation over Colorado compared to the observations. We use additionally WRF-CHEM run as a single column model (WRF-CHEM-SCM) to interrogate vertical mixing in WRF-CHEM for idealized cases to understand the influence of boundary layer height, vertical resolution and emissions on predicted surface ozone concentrations. The work therefore lends to both regional and global importance, as we demonstrate how vertical mixing in WRF-CHEM can be studied

in an idealized framework toward an understanding that can be translated across regions.