A STUDY OF OZONE AT RAILROAD VALLEY, NV and TRINIDAD HEAD, CA

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Abstract

Ozone is an air pollutant and toxic in the lowest part of the atmosphere, and inhaling it could cause permanent damage to animals’ respiratory system. Long term exposure to high concentrations of O₃ has been linked with the development of asthma in children. Because of its complicated role in our atmosphere, scientists are studying its depletion and recovery in the stratosphere, and the minimization of ozone formation in the boundary layer (the lowest part of the atmosphere). Here at NASA Ames Research Center (ARC), the Atmospheric Branch of Earth Science Division is conducting a study to examine and compare ozone concentrations in the atmosphere boundary layer (0 to ~2 km above the surface of the Earth) to those of the free troposphere (~2 km to ~10 km, where the regional transport occurs), and to validate the accuracy of the ozone instrument used in the experiment. Using a 2BTechnology, Inc., Dual Beam Ozone Monitor installed inside the wing pod of an Alpha jet aircraft based at Moffett Field, California, vertical profiles of O₃ concentrations have been collected at Trinidad Head (THD), California, and Railroad Valley (RRV), Nevada. The airborne data at THD are also compared to standard measurements collected by the National Atmospheric and Oceanic Administration (NOAA) using a balloonborne DMT Electrochemical Concentration Cell Ozone analyzer. My area of research is to support the calibration of the O₃ instrument, to aggregate the ozone measurements, and to analyze the data collected.

The Atmospheric Boundary Layer

The atmospheric boundary layer (ABL) is the mixed layer of the atmosphere closest to the ground, where people live, work, and play. As such, it has significant influence on a number of important atmospheric and environmental issues. Fig. 1.

Why Railroad Valley?

RRV is a dry lake bed (playa), flat desert site with virtually no vegetation. It is a target site for calibration of various satellite radiometers. Figure 2.

Why Trinidad Head?

THD is an important site to observe both regional and global influences. There is insignificant anthropogenic influence. Figure 3.

Instrumentation

Ozone is launched on a lightweight balloon that is mated to a conventional meteorological radiosonde. It transmits information on O₃ to a ground receiving station. It ascends to altitudes of about 150,000 ft (~55 km) before it bursts. Figure 5.

Data Comparison

O₃ minimum and maximum mixing ratio (taken from 25Jun11 & 26Jun11 flight):

- ABL: 8 ppbv & 68 ppbv
- Free Troposphere: 21 ppbv & 115 ppbv

- That the higher the altitude, the higher the O₃ mixing ratio.
- Figure 6 suggests that higher O₃ mixing ratio is associated with higher altitude originates mainly from China. Further study is suggested.

Results

HYSLIT trajectories show air in the:
- ABL originates from the Pacific Ocean.
- Free Troposphere originates mainly from China.
- ABL often had been in the free troposphere during the previous 10 days.

Future work

- RRV 2012 field deployment and observations are to be made on an annual basis.
- More test flights for Alpha jet at RRV, THD, & Bay Area coast.
- Regular O₃ sensor calibration.

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