A13C-1355. TC4 campaign results: validating the Aura OMI total ozone data in tropics with the airborne CAFS and DIAL ozone measurements .

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DC-8 at San Jose airport ready to fly on July 22, 2007

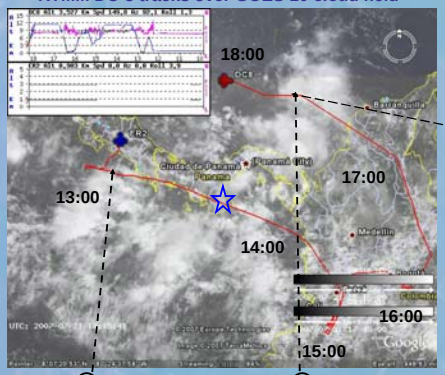
Highly resolved UV and Visible actinic flux measurements were taken by the CCD Actinic Flux Spectrometer (CAFS) instrument (R. Shetter, NCAR) onboard the NASA DC-8 aircraft as part of the Tropical Composition, Clouds and Climate Coupling (TC4) campaign in Costa Rica. The partial ozone columns above the aircraft products were derived from the CAFS actinic flux measurements as part of the continuous validation of the Aura ozone products. Although substantial parts of the NASA DC-8 flights were flown in clouds that somewhat inhibited the CAFS ozone retrieval algorithm, a sizable data set of partial ozone columns along the tracks of the Aura satellite were obtained. Preliminary analysis of the CAFS measurements shows the ability of the CAFS retrieval to produce good quality ozone data from measurements taken under thin cirrus clouds. Partial ozone column data above the aircraft were derived under conditions of high-sun and low ozone. The set of combined CAFS and climatological ozone data was used for validation of the Ozone Monitoring Instrument (OMI) total ozone column under these conditions. In addition, we present preliminary results of comparisons between the OMI total ozone column and combined stratospheric ozone columns derived from the CAFS measurements and tropospheric ozone columns integrated from the Differential Airborne Lidar (DIAL) measurements onboard the NASA DC-8 aircraft. Results of the OMI total ozone column validation during the TC4 campaign, preliminary comparisons between DIAL tropospheric ozone columns and 4D climatology for the summer tropical troposphere are discussed. Results of the analysis include estimates of uncertainties in the CAFS retrievals due to its limited sensitivity to the ozone distribution above the aircraft altitude, as well as uncertainties due to effects of the bright surfaces (clouds) on the CAFS and OMI ozone retrievals.

DC-8 team at San Jose airport during the TC4, July 2007

CAFS, DIAL and OMI match criteria

- Use latitude and time matches as selection criteria
- Integrate DIAL profiles below DC-8 pressure level and above surface/cloud top pressure
- Match DIAL and CAFS data (average of 10 min)
- Limit OMI/DC-8 longitude differences to less than 5 degrees as preferred match
- Limit CAFS data with pitch and roll of the aircraft larger than 4 degrees, and whenever DIAL IR scattering ratio above DC-8 is larger than 2 (cloud or aerosols).

RTMM DC-8 tracks over GOES 10 cloud field



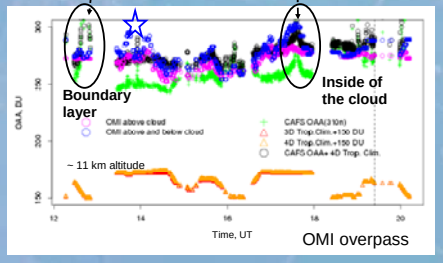


Figure 1. Ozone column data: **CAFS** (column above DC-8), Tropospheric ozone **climatology** (column below DC-8), **CAFS +climatology**, **OMI** above cloud, **OMI** total column (including ghost ozone below the effective altitude of the cloud top)

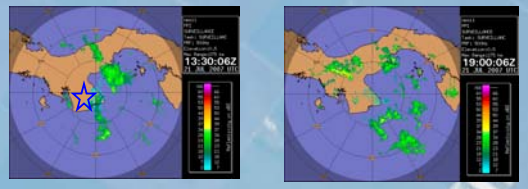


Figure 2. NASA NPOL radar scans at two time periods on July 21, 2007. The blue star identifies location of the DC-8 at 13:30 UT. Notice the difference between location of clouds between two periods of time. OMI overpass is at ~19:00 UT. The DC-8 location at 19:00 UT is outside of the lidar range.

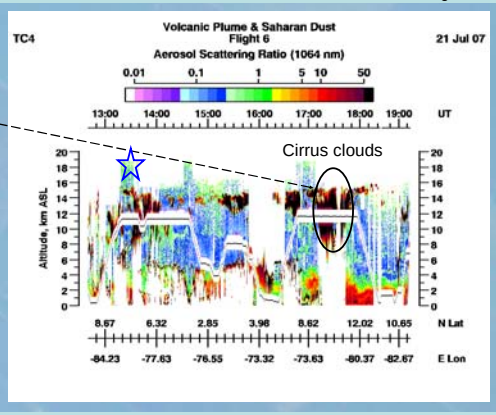


Figure 3. The DIAL Aerosol scattering Ratio at 1064 nm channel as a function of time (axis at the top), latitude and longitude (two axes at the bottom)

Figure 1 results show an increase in the CAFS column ozone between 17 and 18 UT, whereas the DC-8 altitude is constant. The NASA DC-8 forward camera and DIAL Polarization and IR scattering ratio data indicate the presence of the cloud above the NASA DC-8. Therefore, the CAFS samples ozone within the cloud. The combined CAFS ozone above the DC-8 and 4D tropospheric ozone climatology agree with the OMI-TOMS TO after adding the ghost ozone column below the climatological cloud altitude. Comparisons of the latitude co-located CAFS and OMI derived ozone data above the clouds is complicated by discrepancy in geo-location of underlying clouds during the NASA DC-8 aircraft measurements and satellite over-pass.

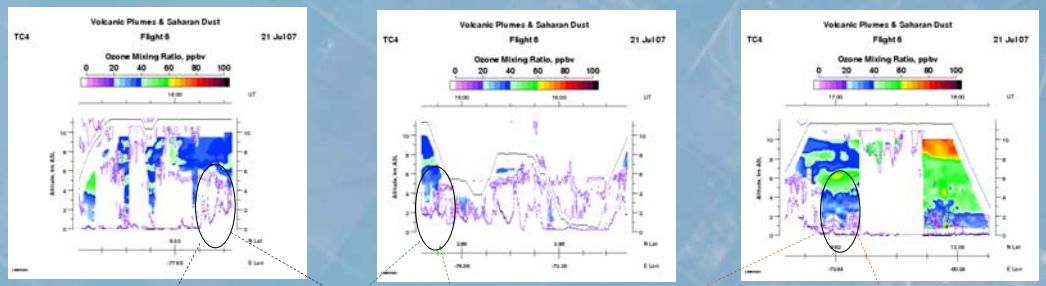


Figure 4. Tropospheric ozone profiles derived by the DIAL instrument on board the NASA DC-8 flight on July 21, 2007. Three segments show DIAL derived ozone profiles as function of altitude and time. The FASTOZ in-situ ozone mixing ratio data were used to fill in the gaps between the top of the DIAL tropospheric ozone profile and the NASA DC-8 altitude (black line). The ozone profiles were integrated between the DC-8 altitude (black line) and underlying surface (purple lines) that represent either the ground surface or the top of the cloud.

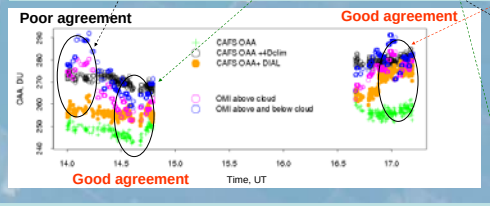


Figure 5. **CAFS** partial ozone column retrievals for three segments of the July 21, 2007 flight, **CAFS and climatology** combined, **CAFS and DIAL** tropospheric columns combined, **OMI** above cloud, **OMI** total column (including ghost ozone below the effective altitude of the cloud top)

DIAL cloud top altitude and OMI-TOMS cloud top climatology do not agree – **poor** agreement between CAFS+DIAL and OMI or **good** agreement

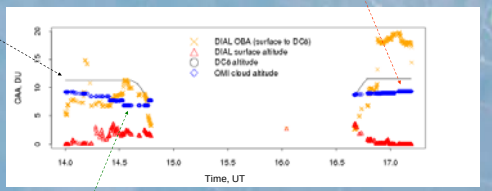


Figure 5. DIAL tropospheric ozone column below DC-8 and above the cloud top, DIAL ground surface albedo, **DC-8 altitude**, **OMI-TOMS cloud top climatology**

DIAL cloud top altitude and OMI-TOMS cloud top climatology agree – **good** agreement between CAFS_DIAL and OMI

Results of the TC4 campaign

- Good agreement between OMI-TOMS total column and combined CAFS and climatology is found for the TC4 campaign.
- DIAL tropospheric ozone column will be used to test quality of the tropospheric ozone climatology in CAFS and OMI comparisons.
- Validation question arise whenever the DIAL-measured cloud top altitude do not agree with the OMI-TOMS climatology.
- The cloud field can change rapidly and a close geo-location and time match is required for a meaningful satellite validation.

CAFS, DIAL, FASTOZ, NPOL and OMI data are available from the Aura Validation Center Archive GSFC DAAC at http://avdc.gsfc.nasa.gov. The OMI total ozone data are based on the OMI-TOMS version 8 retrieval algorithm [see algorithm description by PK Bhartia in *Observing Systems for Atmospheric Composition,* 2007]. For OMI ozone validation results see papers by Kroon et al., and McPeters et al. JGR 2007, in press]. The NASA DC-8 forward and nadir camera movies are available from the NSERC archive http://archive.nserc.und.edu/