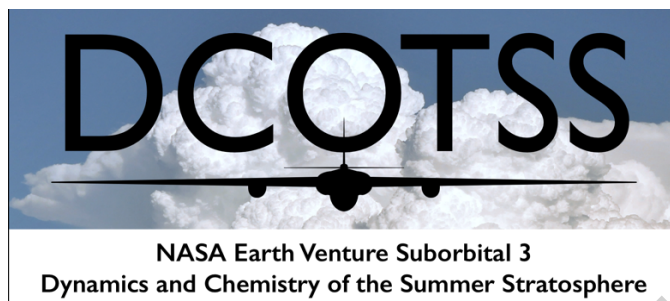


DCOTSS ER-2 Mission Scientist Flight Summary Report



Flight identifier: RF21

Science goals: *survey of the tropical stratosphere and sampling of the HTHH volcanic plume and Sierra Madre convection outflow*

Start of flight (UTC): 2022-07-06 16:11Z

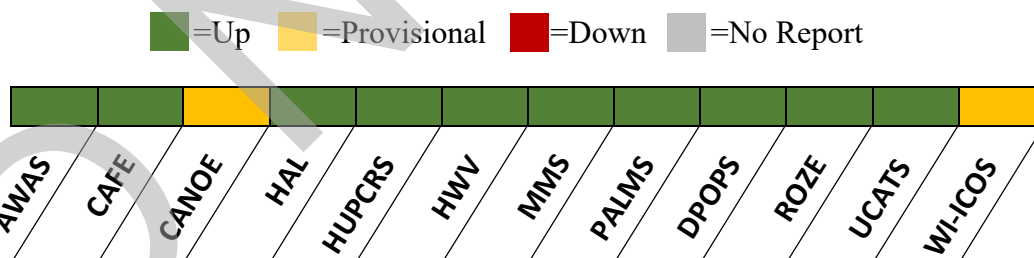
End of flight (UTC): 2022-07-07 00:03Z

ER-2 Pilot: Greg “Coach” Nelson

Mission Scientist: Rei Ueyama

Version	Report date and time (UTC)	Author
1	2022-07-08 16:00Z	Ueyama, Rei
2	2022-07-13 21:30Z	Bowman, Kenneth
3	2022-07-23 12:00Z	Keutsch, Frank

Instrument Performance (2022-07-10, 19:00Z):



Aircraft Performance: Good

Science Objectives:

DCOTSS research flight #21 (RF21) was designed with three objectives: (1) to survey the tropical stratosphere south of Palmdale, CA, (2) to sample the Hunga Tonga – Hunga Ha’apai (HTHH) volcanic plume, and (3) to sample 2-3 day old outflow plume from Sierra Madre overshooting convection. The southern survey from Palmdale, CA provided an opportunity to obtain measurements within the tropical tropopause layer, which were less accessible from

Salina, KS. The eruption of HTHH volcano on 15 January 2022 injected a large amount of H₂O into the stratosphere. Satellite observations had indicated that much of the enhanced H₂O from this volcanic plume was above the ER-2 altitudes (~20-21 km), but CALOP and OMPS-LP data from previous weeks showed clear indications of sulfate aerosols at lower altitudes over various locations (e.g., Fig. 1). The objective was to fly the ER-2 as high in altitude as possible to attempt to sample the bottom portion of this volcanic plume material. There was also a chance that our north-south oriented flight track would intercept material from overshooting convection that had occurred over Sierra Madre on July 3 (Fig. 2). Therefore, a third objective to sample this overshooting convection material was added, although the flight track was not modified for this purpose.

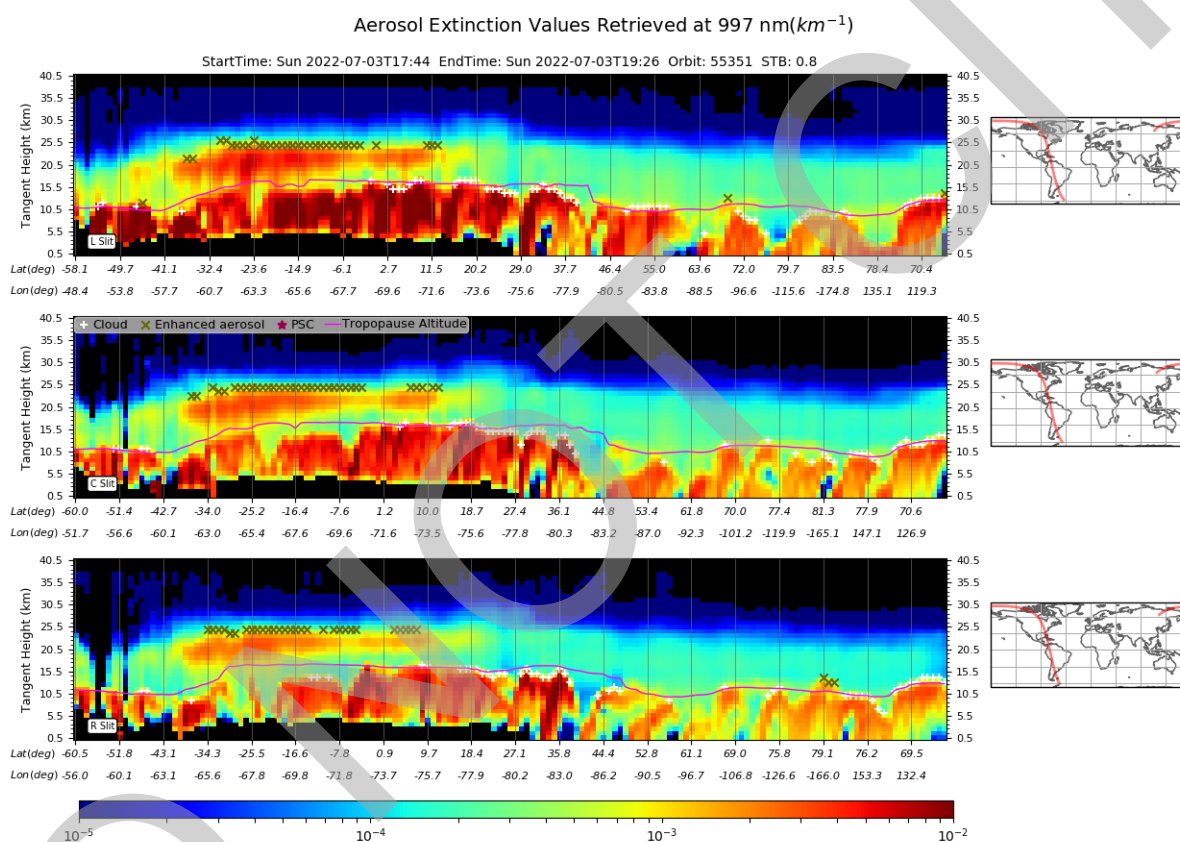


Figure 1: OMPS-LP aerosol extinction values at 997 nm (km⁻¹) on 3 July 2022 between 1744 and 1926 UTC. This segment of the curtain plot shows aerosol extinction values over the Gulf of Mexico, an approximate source region of air masses to be sampled by the ER-2 on July 6. Aerosol enhancement in the stratosphere is mainly observed within the tropics (X marks and warm colors), but the plume appears to extend to ~20N. The bottom of the enhanced aerosol layer is approximately ~20 km.

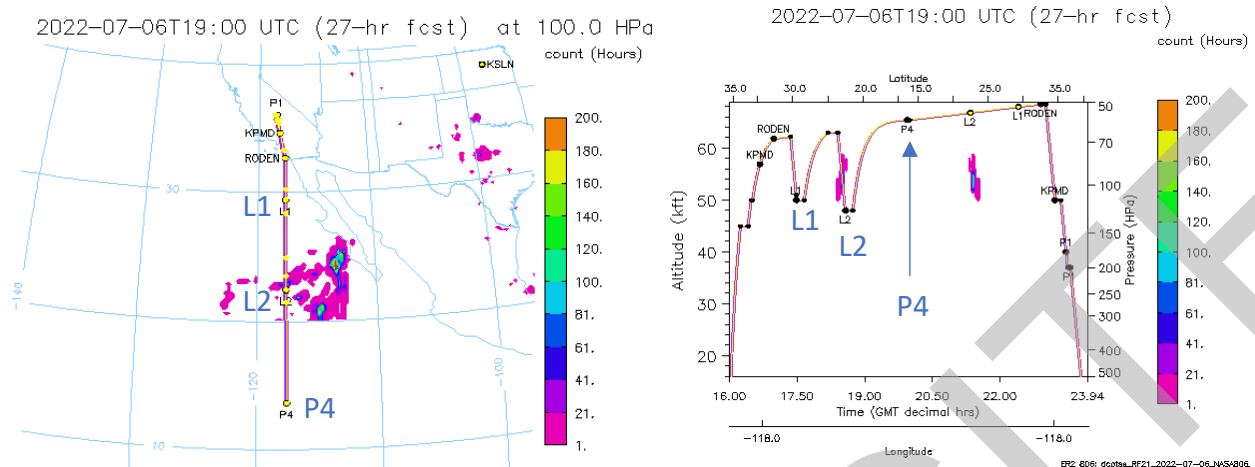


Figure 2: RF21 planned flight track superimposed on overshooting convection material forecasted on 6 July 2022 at 19 UTC based on forward trajectories from GOES-observed overshooting convection: (a) map view and (b) curtain plot.

Flight Summary:

The ER-2 departed Palmdale at 1611 UTC and climbed to ~45-50 kft within the Edwards range where MMS maneuver was executed at 45 kft. After exiting the Edwards range, the ER-2 headed approximately due south, which allowed the ER-2 to reach as far south as possible (13.6N) for the HTHH plume sampling. The MMS maneuver within the Edwards range allowed the ER-2 to burn some fuel and thus ascend to higher altitudes at the southernmost waypoint (P4).

On the southbound leg to P4, the ER-2 executed two deep vertical profiles down to the tropopause at 50 kft. The flight plan included a second dive to 48 kft, but Pilot Coach did not receive approval from air traffic control in time to descend below 50 kft. We appeared to have crossed the tropopause (~195 K at ~51.5 kft) and be flying within the upper troposphere at 50 kft. Therefore, we proceeded with the rest of the flight as planned with a climb to maximum altitude towards P4. Preliminary data were inconclusive regarding a successful sampling of Sierra Madre convection outflow. However, water vapor measurements on the first vertical profile showed distinct enhancements at ~51 kft (Fig. 3), indicative of a relatively moist layer of a few thousand feet deep centered at ~51 kft.

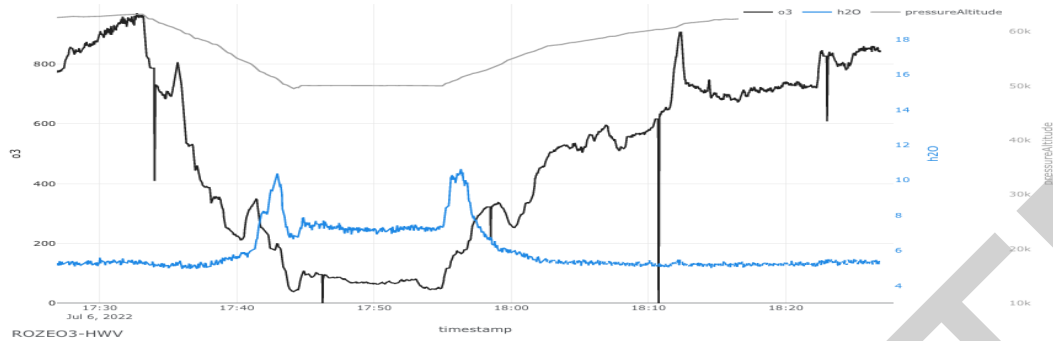


Figure 3: Time series of Harvard water vapor (blue), ROZE ozone (black) and IWG pressure altitude (gray) between ~1730 and ~1820 UTC as the ER-2 completed the first vertical profile around waypoint L1.

The ER-2 reached P4 at approximately 2013 UTC. Maximum altitude was ~20.8 km pressure altitude or 21.15 km geometric altitude. At P4, the ER-2 turned back north and cruise climbed (additional ~1 km) all the way back to Palmdale along the same flight track. There was no indication of aerosol enhancement near P4 or along the high-altitude leg back to Palmdale in the real-time data. However, Pilot Coach noted a faint layer above the horizon before the approach to P4 (Fig. 4). This layer was also somewhat visible in the forward-looking camera on the ER-2 (Fig. 5).



Figure 4: A picture taken from the ER-2 cockpit by Pilot Coach on the southbound leg approximately 200 nm prior to reaching S4. A faint layer is visible above the horizon.



Figure 5: A picture taken from the forward-looking camera on the ER-2. The aircraft is turning 360 degrees at P4.