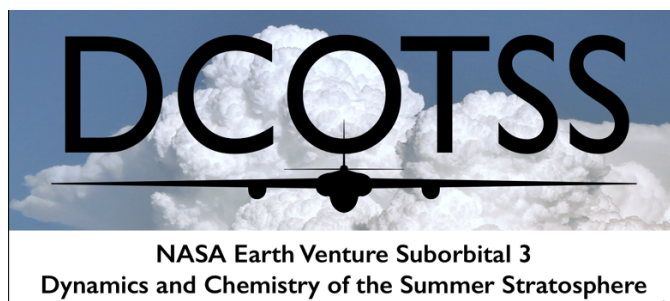


# DCOTSS ER-2 Mission Scientist Flight Summary Report



**Flight identifier:** TR03

**Science goals:** *Sample stratospheric air intrusion associated with the upper-level low and aged convective outflow en route to Salina from Palmdale*

**Start of flight (UTC):** 2022-05-26 17:01 UTC

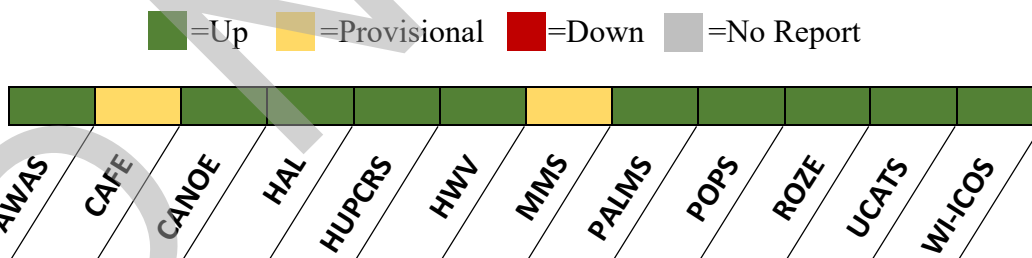
**End of flight (UTC):** 2022-05-26 22:23 UTC

**ER-2 Pilot:** Kirt “Skirt” Stallings

**Mission Scientist:** Rei Ueyama

Version	Report date and time (UTC)	Author
1	2022-05-31 16:00 UTC	Ueyama, Rei
2	2022-05-31 22:00 UTC	Bowman, Ken
3	2022-06-05 16:00 UTC	Keutsch, Frank

**Instrument Performance (as of 2022-05-27 at 1700 UTC):**



**Aircraft Performance:** Good

## Science Objectives:

The duration of DCOTSS transit flight #3 from Palmdale to Salina was extended to approximately five hours in order to address several science objectives: (i) to sample air within the stratospheric air intrusion associated with an upper-level trough centered over eastern Kansas (in comparison to the background stratospheric air between Palmdale and Salina), and (ii) to sample an aged (~2-day old) convective outflow plume east of Salina. The large-scale

meteorological pattern over the past several days consisted of a trough situated over Kansas, moving slowly eastward. A large-scale stratospheric intrusion associated with this low pressure system provided a unique opportunity to sample the strong gradients in various chemical (e.g., O<sub>3</sub>, CO) fields between Palmdale and Salina (Fig. 1).

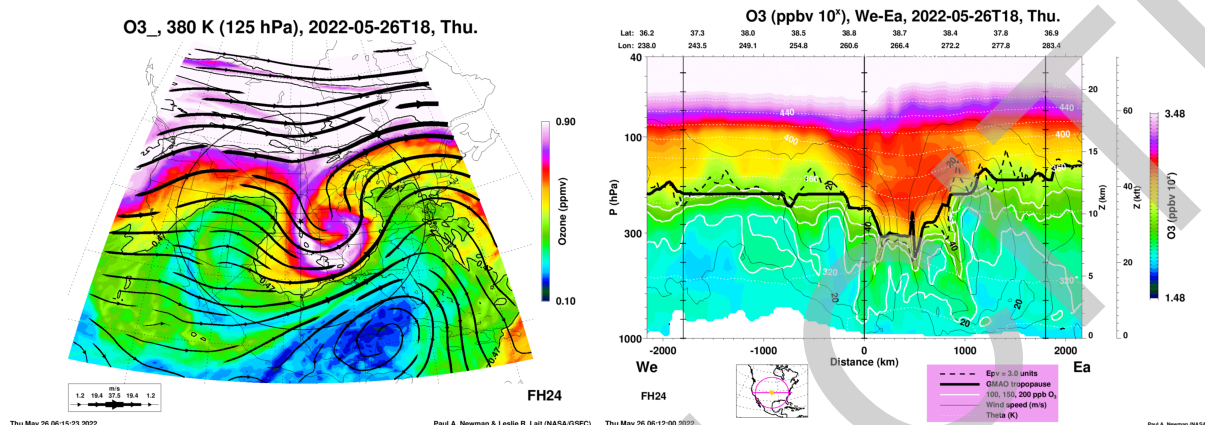


Figure 1: GEOS5 forecast of the ozone mixing ratios valid at 26 May 2022 at 1800 UTC (1000 PT, 1200 CDT): (left) ozone field at 380 K potential temperature level, (right) west-to-east cross-section of ozone centered on Salina.

In addition to this chemical feature, we also expected relatively dense overshooting plume material to the east of Salina (Fig. 2). The source of this overshooting material was convection over Texas approximately two days earlier.

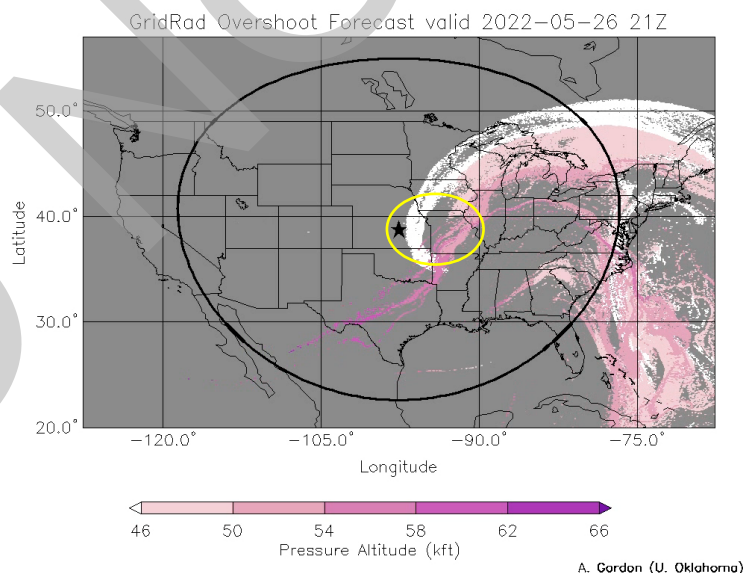


Figure 2: Overshooting convection plume material valid on 26 May 2022 at 2100 UTC. Colors represent the altitude of the convective plumes.

TR03 flight plan, shown in Figure 3, was designed:

- To sample background stratospheric air via (i) three level legs at 45, 50 and 55 kft (between California and central Colorado) and (ii) long cruise climb across the ozone gradient (between central Colorado and Salina) at maximum altitude;
- To sample overshooting plume material east of Salina at 55, 47 and 41 kft; and
- To sample upper tropospheric air at 30 kft.

MMS maneuver at 60 kft after takeoff from Palmdale and a 10-min hold at 10 kft prior to descent to Salina for instrument warm-up were also included.

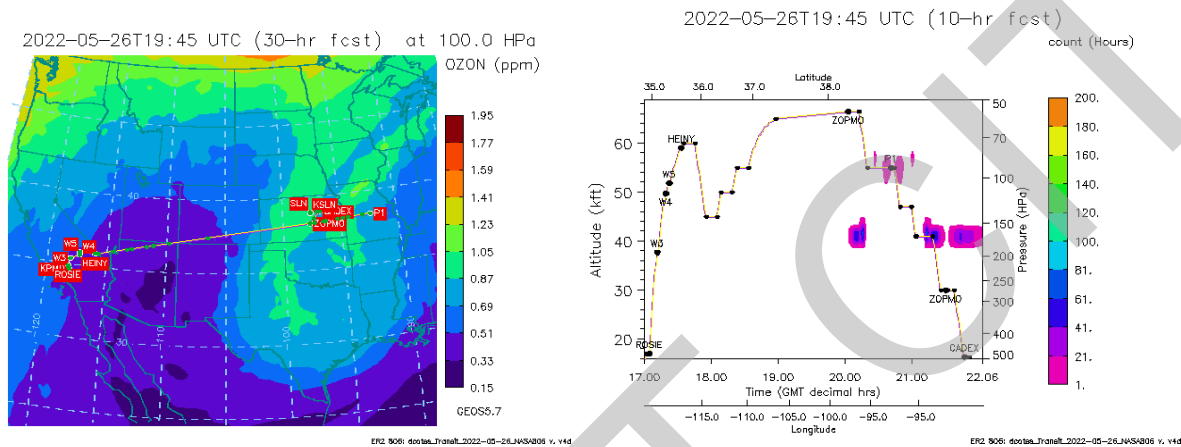


Figure 3. Planned flight track superimposed on (left) GEOS5 forecasted ozone mixing ratios at the 100 hPa level and (right) overshooting plume parcel counts valid on 26 May 2022 at 1945 UTC.

The ER-2 departed on time from Palmdale. Soon after takeoff, the pilot noticed a fail light associated with the aircraft (not an instrument fail light), which delayed the climb to 60 kft within the AFRC air space. Due to this delay, the MMS maneuver was skipped in order to proceed with the rest of flight as planned.

Ozone mixing ratios reached a maximum of about 2500 ppbv at maximum altitude (>65 kft) near ZOPMO (a waypoint just south of KSLN). A relatively large gradient in ozone was observed within the cutoff low. There was little indication of convective plume material in the real-time data at 55 and 47 kft altitudes. However, on the descent from 47 to 41 kft and along the 41 kft altitude leg, the ER-2 appeared to have encountered convective outflow plumes characterized by sudden increases in  $H_2O$  mixing ratios. Tropopause crossing occurred on the descent from 41 to 30 kft at about 2115 UTC. An MMS maneuver was executed after a ~10-min straight-and-level leg at 30 kft.

During this flight, there were three balloonsonde launch attempts in Salina. The ozonesonde launch at 1400 CDT was unsuccessful due to a hole in the balloon (max altitude reached was ~6 km). The second launch at 1545 CDT was successful. The balloonsonde team from Lawrence Livermore National Lab also attempted a launch during this flight, but the launch was scrubbed due to high winds.

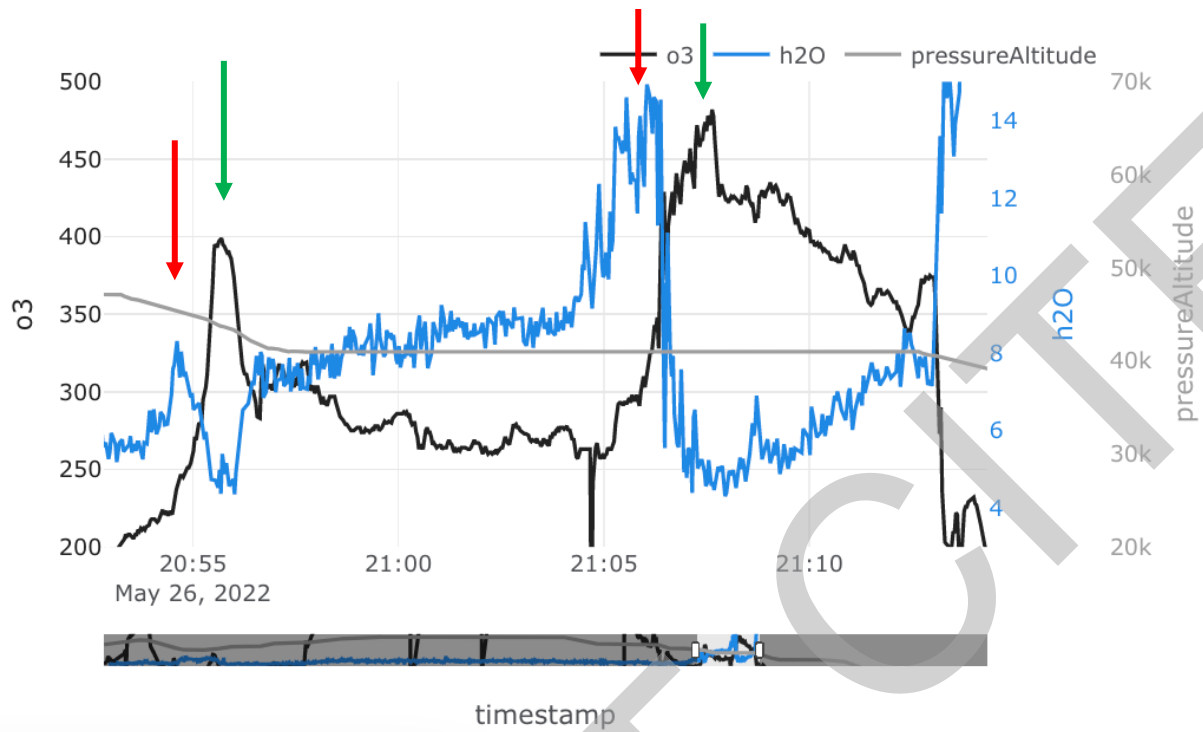


Figure 4: Real-time measurements of IWG pressure altitude (gray), HWV H<sub>2</sub>O (blue) and ROZE O<sub>3</sub> (black) between ~2053 and ~2115 UTC. Clear indications of convective plume material (red arrows) and stratospheric air (green arrows) between 47 and 41 kft.