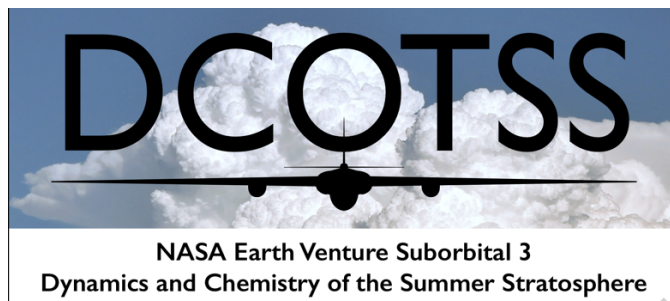


# DCOTSS ER-2 Mission Scientist Flight Summary Report



**Flight identifier:** RF03

**Science goals:** 0-3 day old convective plume sampling and North American monsoon anticyclone survey

**Start of flight (UTC):** 2021-07-23 13:53Z

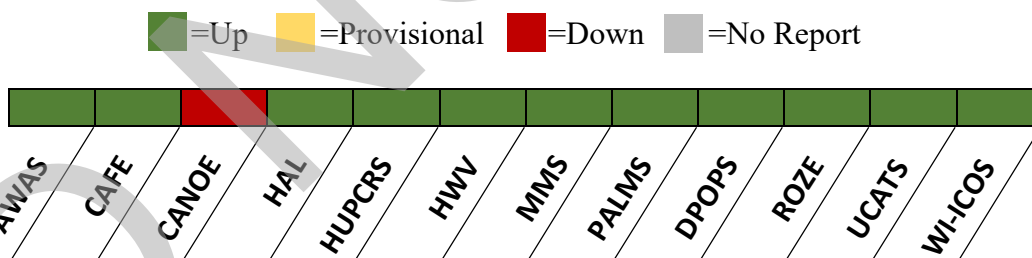
**End of flight (UTC):** 2021-07-23 20:35Z

**ER-2 Pilot:** Greg “Coach” Nelson

**Mission Scientist:** Rei Ueyama

Version	Report date and time (UTC)	Author
1	2021-07-24 18:00Z	Ueyama, Rei
2	2021-07-24 19:00Z	Bowman, Ken

## Instrument Performance (post-flight debrief, 22:XXZ):



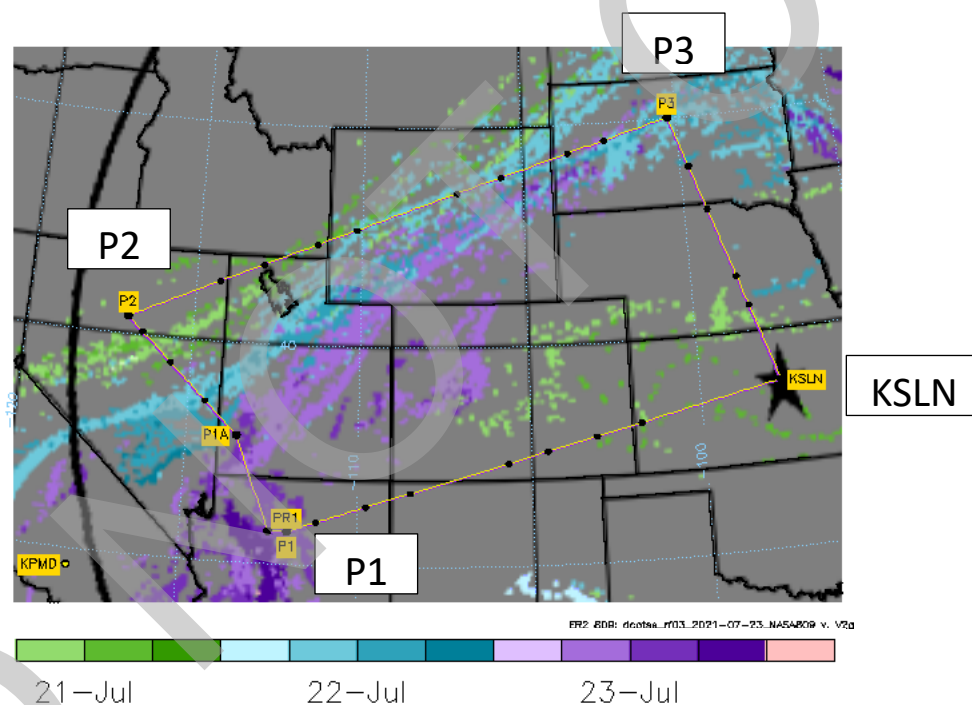
**Aircraft Performance:** Good

## Science Objectives:

The science objectives of the DCOTSS research flight #3 (RF03) were (i) to sample very recent (<1 day old) and aged (1-3 day old) convective outflow plumes and (ii) to survey the North American monsoon (NAM) anticyclone including its vertical structure.

Overshooting convective cloud tops were observed over Arizona over the past several days. The outflow from these convective systems was being caught by the upper-level monsoon anticyclonic circulation such that the bulk of the outflow material was being sheared and transported towards the north and then northeast (Fig. 1). Several isolated overshooting storms also occurred in Arizona the night before the flight, with outflow reaching up to a few kilometers above the local tropopause. This very recent plume material was also expected to be on our flight track over Arizona.

Since the center of the NAM anticyclone was centered almost directly over Salina at the 100 hPa level on 23 July 2021, a second objective of this flight was to survey the anticyclone. We planned for two deep dives down to 40 kft to obtain vertical profiles across the tropopause. The first dive was performed on the westbound track to sample the interior of the anticyclone. The second deep dive to 40 kft was performed on the eastbound track near the latitude of the mid-latitude jet.



*Figure 1: RF03 planned flight track overlaid on the overshooting convection plume forecast. The flight track from P1 to P3 samples outflow plumes of varying age (i.e., 0-3 day old plumes that have occurred between 21 and 23 July 2021).*

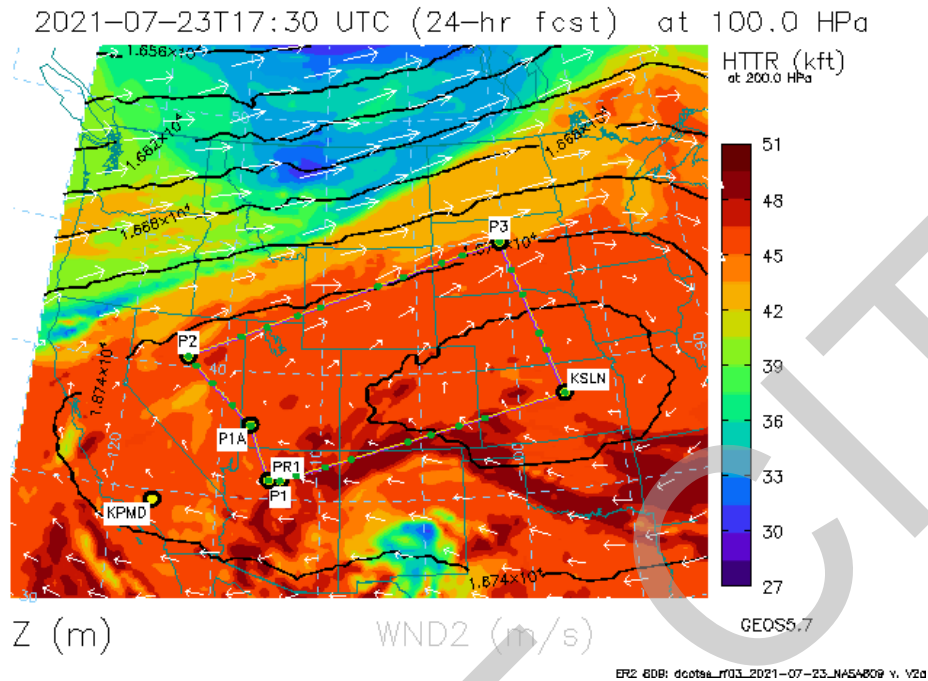


Figure 2: GEOS5 forecast of the 100-hPa level geopotential heights (contour) and tropopause altitude (colors, kft) valid on 23 July 2021 at 1730Z (approximately in the middle of the flight).

### Flight Summary:

The ER-2 ground track and vertical profiling are shown in Figures 3 and 4, respectively. The ER-2 took off at 1353 UT (0853 CDT) towards waypoint P1 and ascended to 62 kft. Between KSLN and P2, the aircraft performed a series of vertical profiles between 45 and 62 kft. On one of the vertical profiles near P1, the aircraft descended to 40 kft. Between P2 and P3, the aircraft porpoised between 45 and 65 kft, with another deep profile down to 40 kft before P3. At P3, the aircraft turned to KSLN, climbed to max altitude (~68-69 kft), and then descended to 44 kft for the MMS maneuver. It landed at KSLN at 2035 Z. All of the ascents and descents, except for the last ascent to max altitude, included a 10-min level leg.

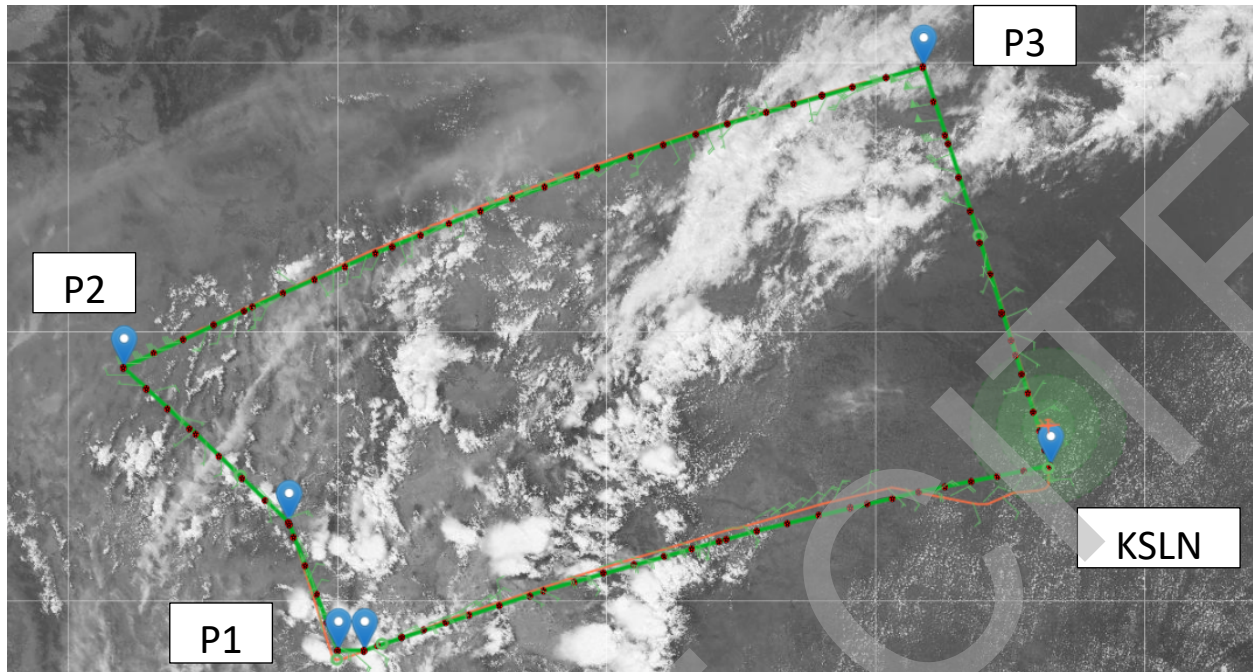


Figure 3: Map of RF02 on MTS overlaid on GOES visible satellite imagery at 2000Z on 23 July 2021.

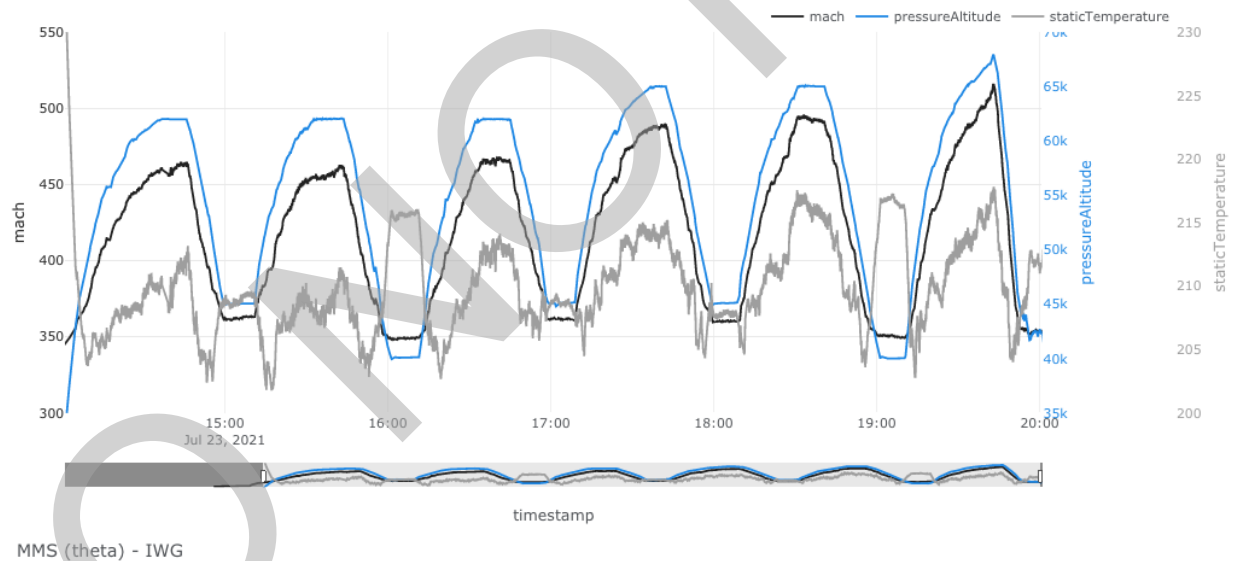


Figure 4: Vertical profiles of the ER-2 as a function of IWG1 pressure altitude (ft) and MMS potential temperature (K; incorrectly labeled as “mach” in the MTS). MMS static temperatures (K) are also shown for an indication of the tropopause level.

The outflow plume was expected to be around 50-54 kft between P1 and P3. Real-time in situ measurements such as  $>10$  ppmv  $\text{H}_2\text{O}$  above the tropopause (Fig. 5) suggested that we had indeed sampled some overshooting plumes in the lower stratosphere, although further analysis is needed to confirm this. This flight should have collected useful *in situ* measurements of various chemical species to characterize the NAM anticyclone.

The pilot noted cirrus decks only near P1.

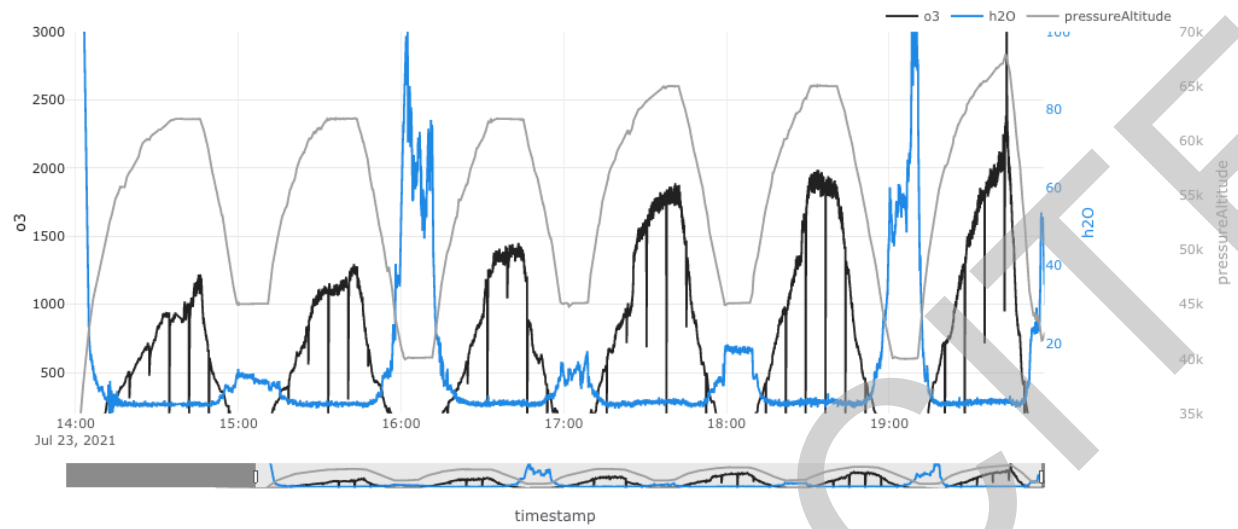


Figure 5: Measurements of H<sub>2</sub>O from the Harvard WV instrument and O<sub>3</sub> from the ROZE instrument collected on RF03. Also plotted are IWG1 pressure altitudes indicating the multiple vertical profiles.