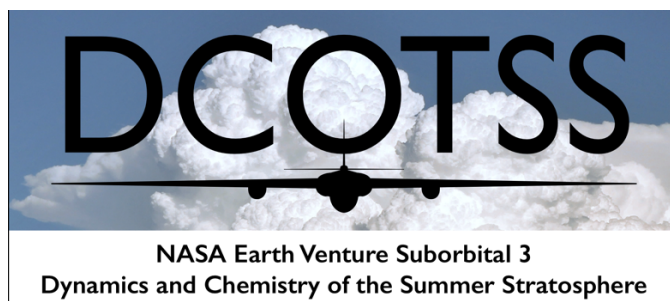


# DCOTSS ER-2 Mission Scientist Flight Summary Report



**Flight identifier:** RF02

**Science goals:** *convective plume sampling and North American monsoon anticyclone survey*

**Start of flight (UTC):** 2021-07-20 14:01Z

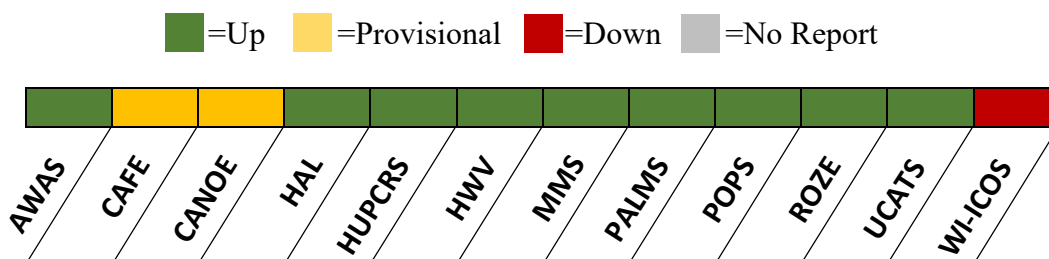
**End of flight (UTC):** 2021-07-20 20:15Z

**ER-2 Pilot:** Gary “Thor” Toroni

**Mission Scientist:** Rei Ueyama

| Version | Report date and time (UTC) | Author      |
|---------|----------------------------|-------------|
| 1       | 2021-07-21 15:00Z          | Ueyama, Rei |
| 2       | 2021-07-21 16:20Z          | Bowman, Ken |

## Instrument Performance (2021-07-21 at 15:00Z):

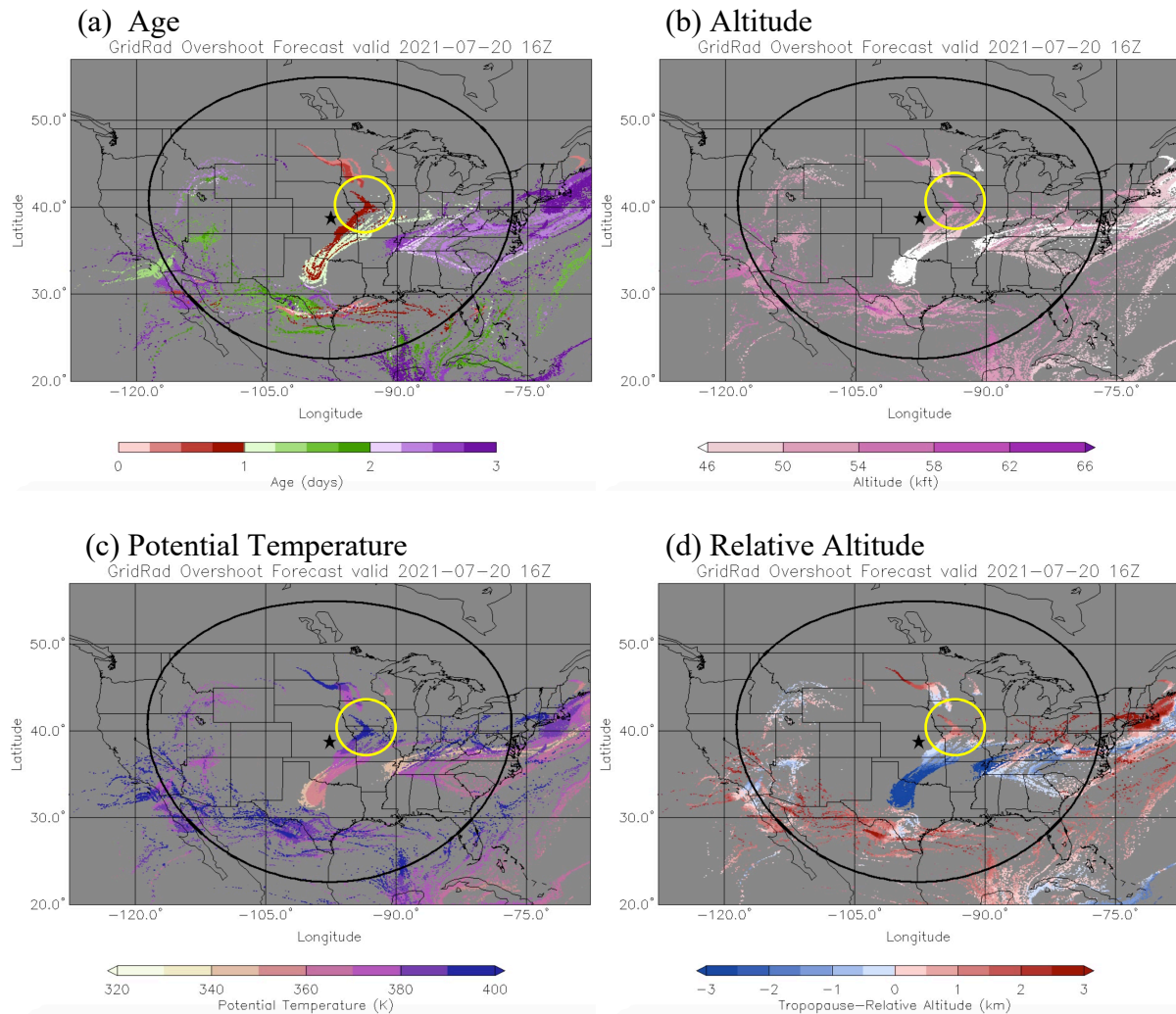


**Aircraft Performance:** Good

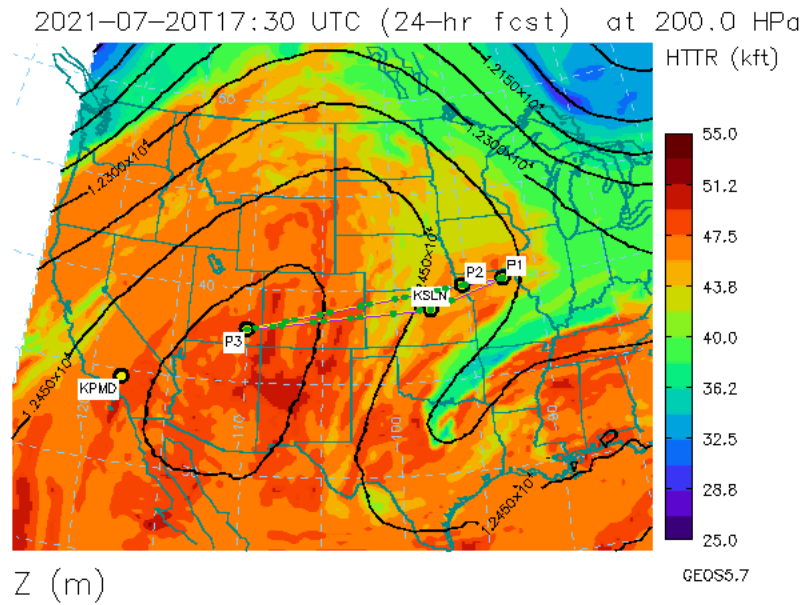
## Science Objectives:

The two principal science objectives of the DCOTSS research flight #2 (RF02) were (i) to sample a convective outflow plume over northern Missouri and (ii) to survey the North American monsoon (NAM) anticyclone. Isolated convective overshoots were observed over eastern North Dakota at around 16-19Z on 19 July 2021. The outflow from these overshooting convective cloud tops was forecasted to be over the Iowa – Missouri border on the morning of 20 July 2021 (Fig. 1). This one-day old plume was expected to be present within the 50-58 kft altitude (380-400 K potential temperature) range up to 2 km above the tropopause. Associated

with the mid- to upper-level ridge that has been presiding over the Rockies and the southwest U.S. over the past several days, the center of the North American monsoon (NAM) anticyclonic circulation had been situated near the four-corners region and slowly moving eastward (Fig. 2). This flight attempted to characterize the air masses within the upper-level NAM anticyclone.



*Figure 1: Forecasts of overshooting convection outflow valid at 16Z on 20 July 2021: (a) age (days), (b) altitude (kft), (c) potential temperature and (d) relative altitude (with respect to the tropopause) of the outflow plume.*



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Figure 2: GEOS5 forecast of the 200-hPa level geopotential heights (contour) and tropopause altitude (colors, kft) valid on 20 July 2021 at 1730Z.

### Flight Summary:

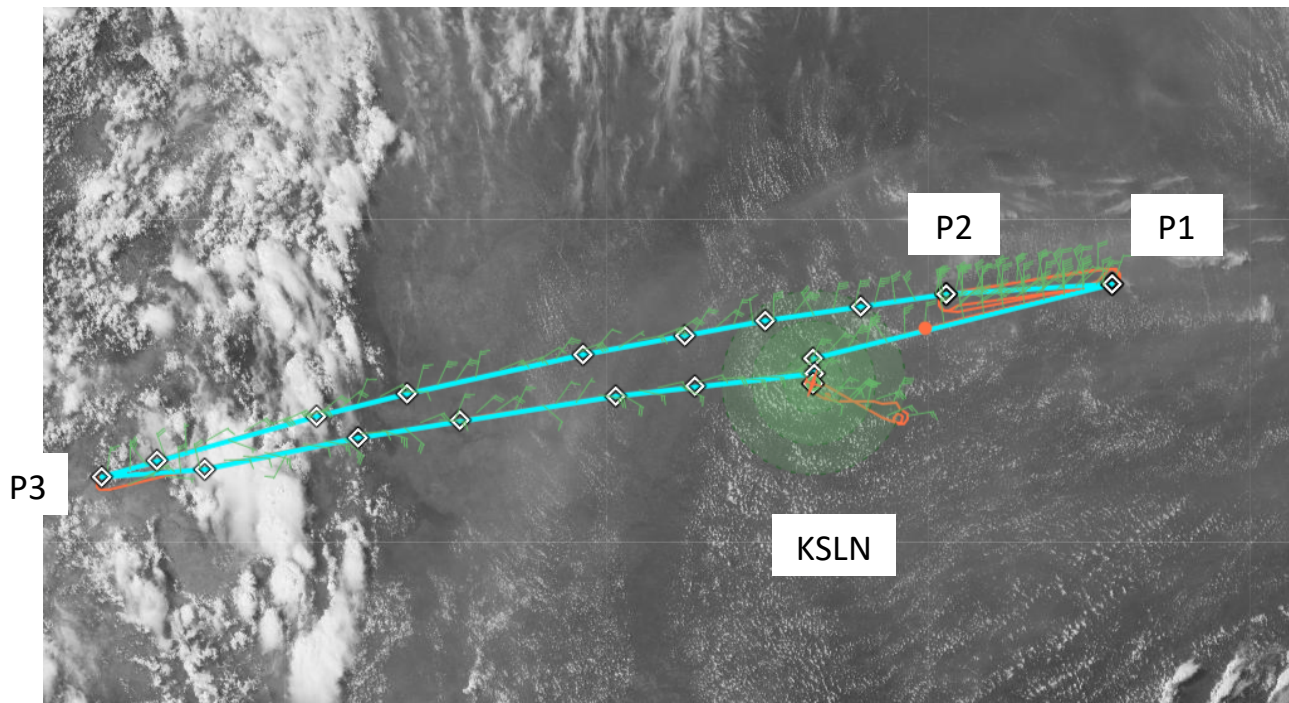


Figure 3: Map of RF02 on MTS overlaid on GOES visible satellite imagery at 2020Z on 20 July 2021.

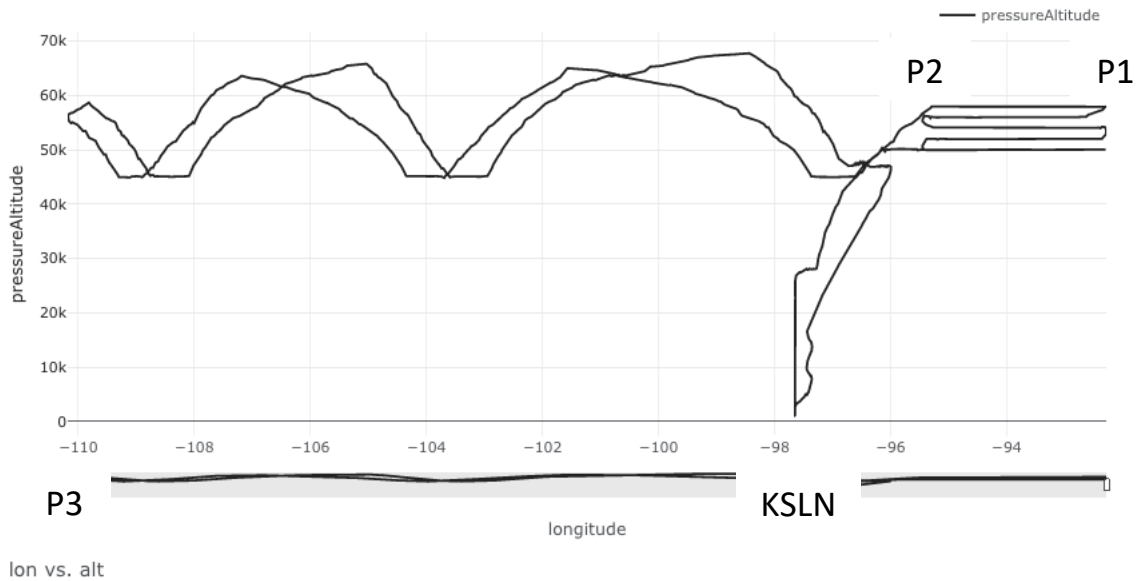


Figure 4: Vertical profiles of the ER-2 as a function of longitude based on IWG1 data.

The ER-2 ground track and vertical profiling are shown in Figures 3 and 4, respectively. The ER-2 took off at 1401 UT (0901 CDT) towards waypoint P1 and ascended to 50 kft. After arriving at P1, the aircraft turned to waypoint P2 to start a series of stacked legs between waypoints P1 and P2 at 50, 52, 54, 56 and 58 kft. The outflow plume was expected to be around 52-54 kft between P1 and P2, tilting higher towards the north. Convective plume signatures may exist along P1 and P2 with slightly enhanced H<sub>2</sub>O (max ~7 ppmv over a background of ~6 ppmv) and CH<sub>4</sub>. Detailed analyses of the measurements are required to assess whether or not the slight enhancements in H<sub>2</sub>O and CH<sub>4</sub> are indeed related to recent convection.

After reaching P2 at 58 kft (~1650Z), the aircraft performed a series of vertical profiling maneuvers between 45 and 65 kft across the tropopause (~52 kft) from P2 to P3, and then from P3 to KSLN (Fig. 4). The concentrations of O<sub>3</sub>, CO and H<sub>2</sub>O, as well as their combinations, were generally consistent with tropospheric vs. stratospheric air sampled during the vertical profiles. There were some indications that we had sampled convectively-influenced aged parcels just above the tropopause within the center of the NAM anticyclone. These may have been aging (>3 day old) outflow plumes from Sierra Madre and/or southwestern U.S. overshooting convection that have been wrapped around by the anticyclone.

The pilot noted cloud tops above 45 kft over Colorado near the westernmost waypoint P3 (Figs. 5 and 6) though no overshoots were detected from these isolated storms.



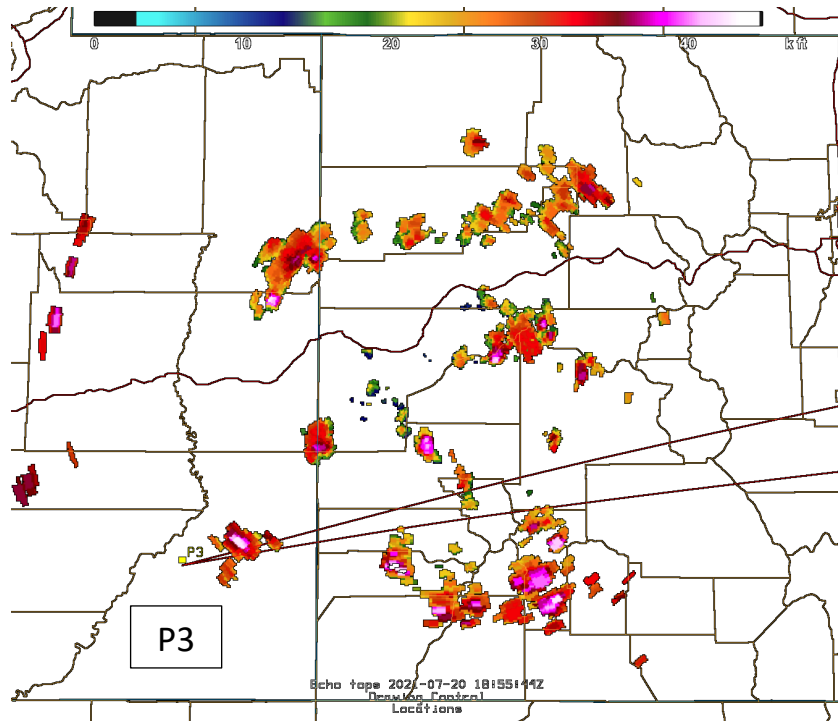


Figure 5: ER-2 flight track overlaid on echo tops that reach above 45 kft near the westernmost waypoint P3, as noted by the pilot.

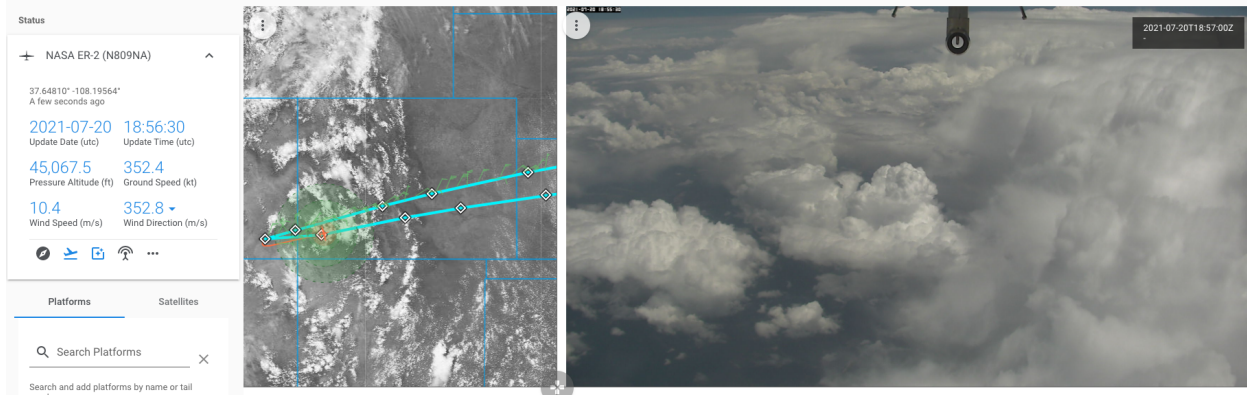


Figure 6: Camera feed near waypoint P3 at the bottom of the dive to 45 kft.