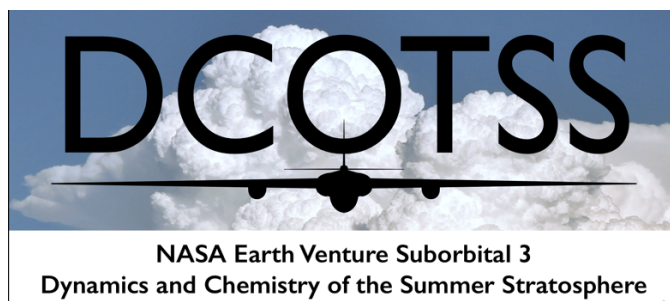


# DCOTSS ER-2 Mission Scientist Flight Summary Report



**Flight identifier:** RF09

**Science goals:** Intensively sample 1–2-day old overshoot material

**Start of flight (UTC):** 2021-08-14 12:06Z

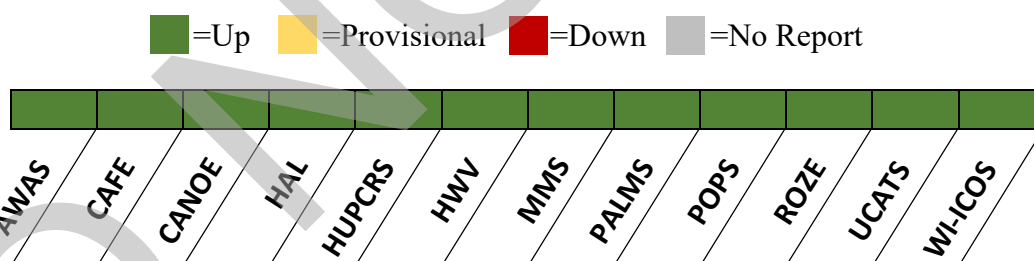
**End of flight (UTC):** 2021-08-14 19:08Z

**ER-2 Pilot:** Dean Neeley

**Mission Scientist:** Cameron Homeyer

Version	Report date and time (UTC)	Author
1	2021-08-15 20:00Z	Homeyer, Cameron
2	2021-08-16 15:00Z	Bowman, Ken

## Instrument Performance:



**Aircraft Performance:** Good

## Science Objectives:

This flight was originally planned for August 13<sup>th</sup>, but was delayed due to an aircraft power issue. Widespread deep and frequent overshooting occurred on the evening of August 12<sup>th</sup> (near 00Z on the 13<sup>th</sup>) in Kansas, northern Missouri, and Illinois (Figure 1; red colors). The resulting overshoot material occupied the lowest 3–4 km of the stratosphere (based on radar and satellite analyses). We had originally planned to target this dense material in northern Missouri on August 13<sup>th</sup> but, due to the aircraft delay, it was located farther north and east, was more

vertically tilted by environmental wind shear, and was concentrated along a somewhat narrow band that extended across the northeast US and well beyond the ER-2 flight range (Figure 2).

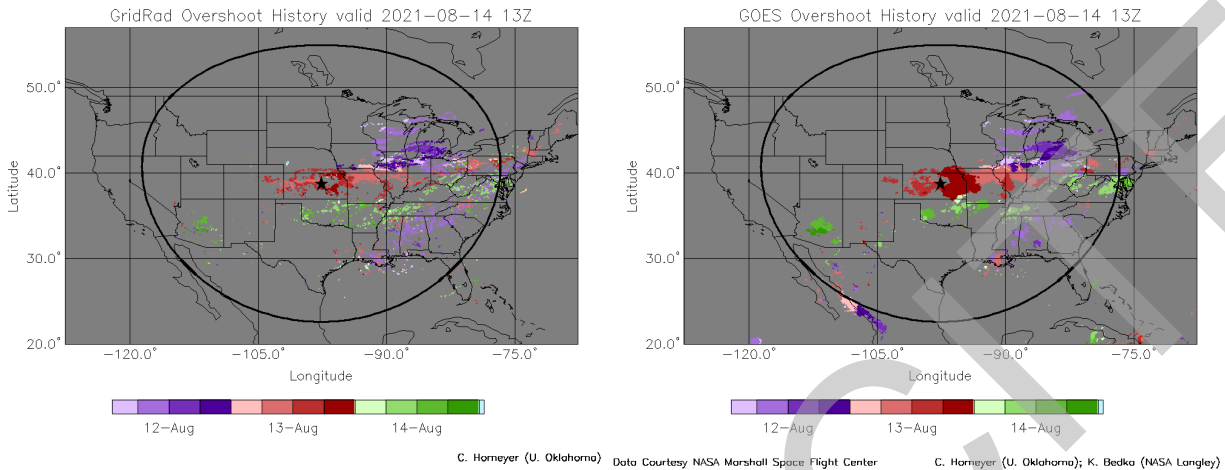


Figure 1: Overshoot history from (left) GridRad and (right) GOES, valid 13 UTC on 14 August 2021.

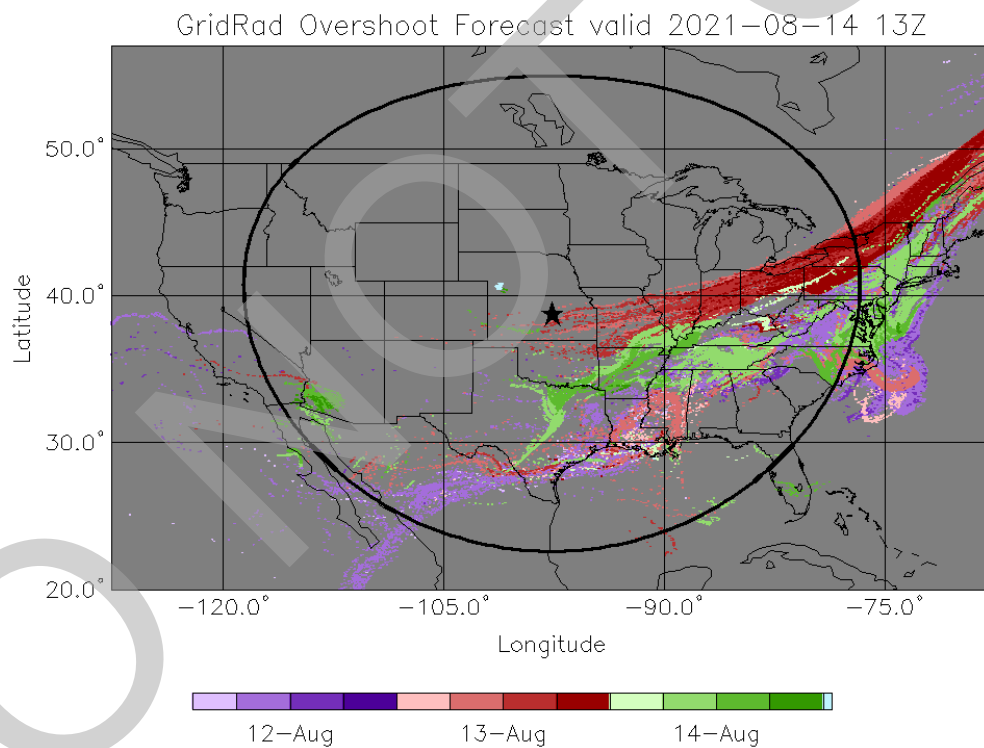


Figure 2: Forecast locations of overshoot trajectory particles, valid 13UTC on 14 August 2021.

Figure 3 summarizes the flight plan, showing a map of the path overlaid on overshoot trajectory forecasts during the flight (from MTS). The main plume was targeted over central Ohio, where the northwest-to-southeast segment was a racetrack stepping up in altitude. Higher altitude material was targeted on the northeast-to-southwest segment over western Ohio. This overshoot material was the sole target of the mission.

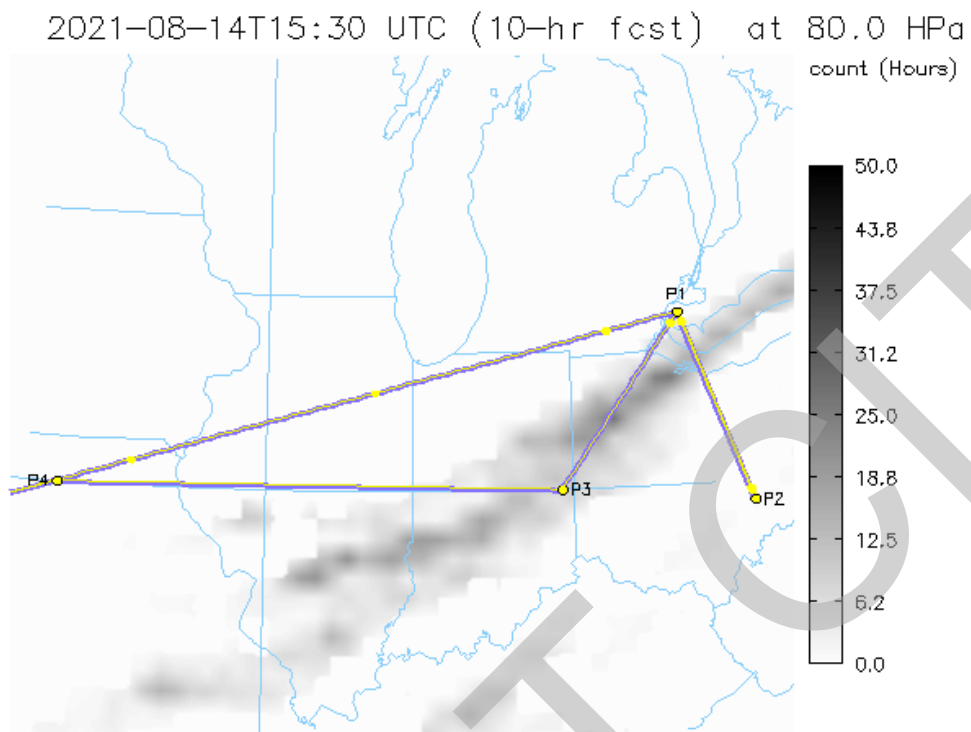


Figure 3: Map of forecast trajectory particle density at the 80 hPa pressure level during RF09 and the flight plan superimposed.

## Flight Summary:

We departed Salina as early as possible on August 14<sup>th</sup> to reach the downstream overshoot material before it was advected out of the ER-2 range. The tropopause was ~46 kft along the flight, including over Ohio where we targeted the overshoot material. Changes were made in flight to account for offsets seen in the initial legs between forecast plume altitudes (geopotential heights) and realized pressure altitudes.

The original sampling strategy for the aged overshoot material was sequential horizontal legs (ER-2 racetrack) every 1.5 kft, from 50 to 57.5 kft pressure altitude over central Ohio. After the overshoot material was apparently topped at 56 kft, we requested to cut the last leg of the racetrack short and spend more time on the planned high-altitude northeast-to-southwest segment over western Ohio, which was originally intended to be a single 59 kft pass. Three level legs were completed along the middle of that path at 56, 54, and 52 kft pressure altitude, and successfully sampled overshoot material (especially at 54 kft, which was the revised target). Figure 4 shows the actual flight path, excluding the final approach.

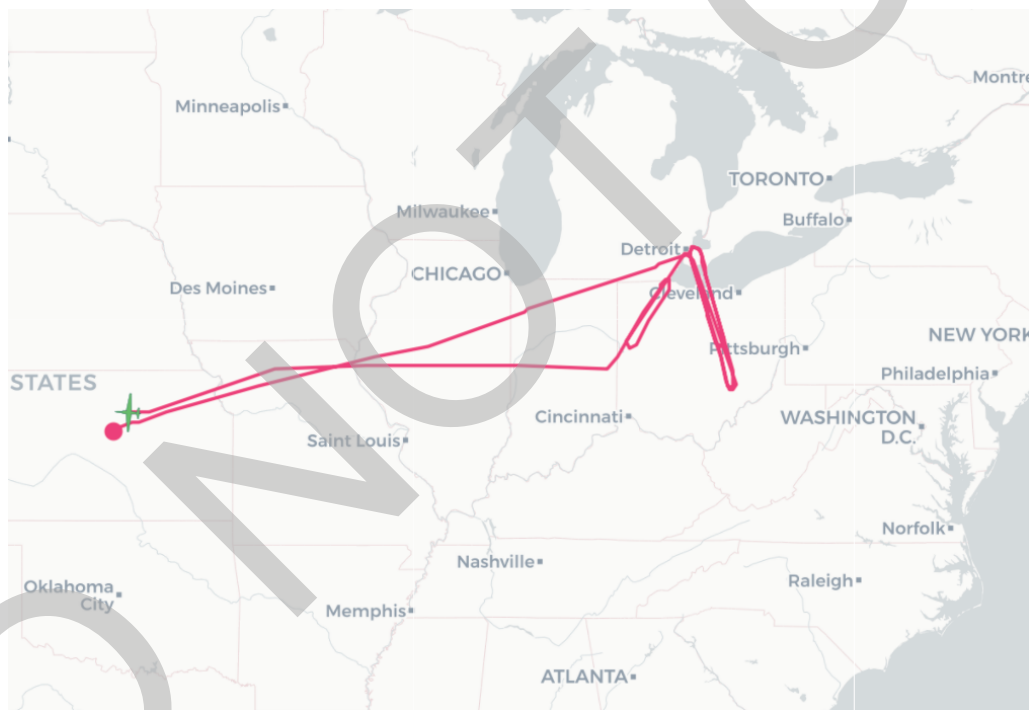


Figure 4: Actual flight path for RF09 (from MTS).

Water vapor enhancements indicative of overshoot material were sampled at all pressure altitudes between 50 and 56 kft, though the largest were seen below 56 kft. Most of the enhancements were strongly anticorrelated with ozone. The largest water vapor concentrations seen were ~10 ppmv (approximately double the background concentrations). In addition to the abundant overshoot material sampled, a notable stratospheric feature of unknown origin was observed near 14:45 UTC at the northern end of the 51.5 kft pressure altitude leg over central Ohio (with increases in water vapor, carbon monoxide, and aerosol, and decreases in nitrogen dioxide and ozone). This feature and all water vapor enhancements are noted in Figure 5.

Building on prior flights, sampling with the Advanced Whole Air Sampler (AWAS) appeared to successfully target the overshoot material. Cans were opened for nearly every enhanced water vapor feature and two fortuitously coincided with very short time samples of water vapor enhancements. Finally, during the debrief, the pilot noted light turbulence experienced near the southern end of the northwest-to-southeast legs over central Ohio, no visible cirrus present during the level legs that targeted overshoot material, and that ATC requested the final descent to Salina to be done quickly (primarily from 68-46 kft).

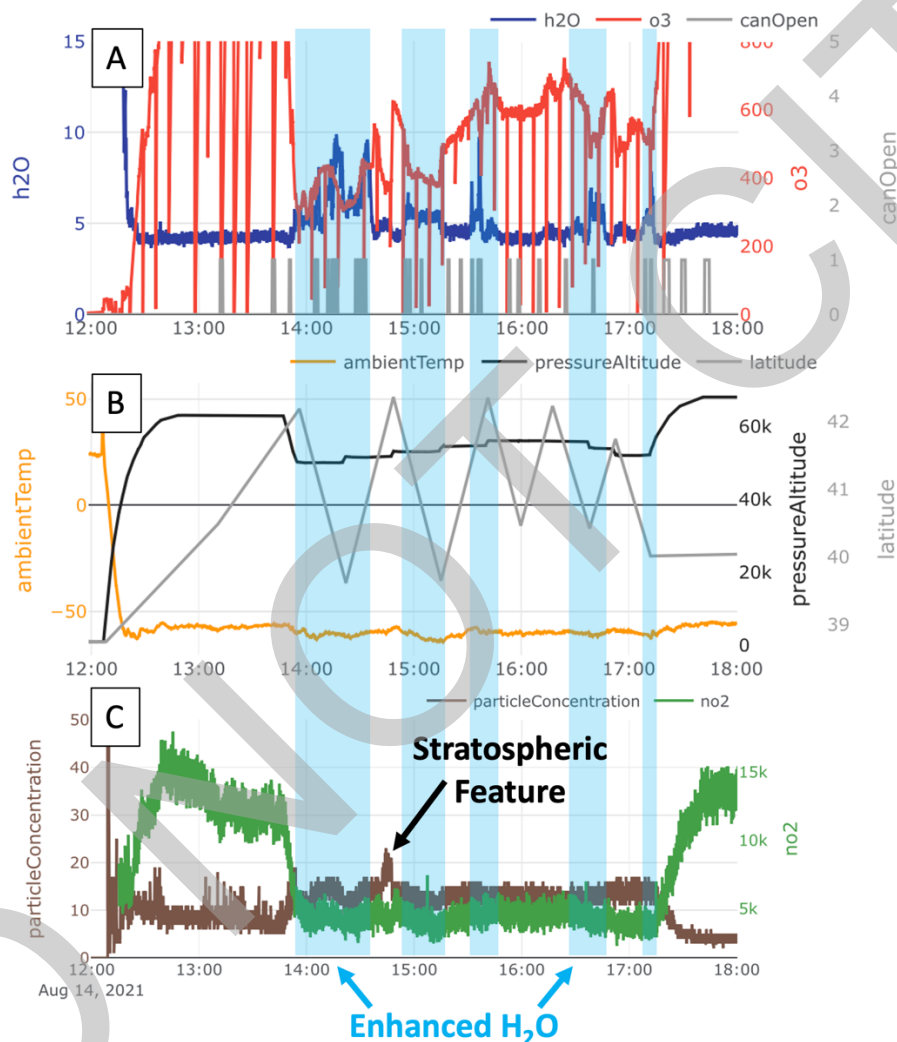


Figure 7: Timeseries of (a) ozone, LyA water vapor, and AWAS can samples, (b) pressure altitude, temperature, and latitude, and (c) aerosol concentration and nitrogen dioxide from MTS during the majority of the flight. Time periods during the horizontal legs where evidence of enhanced water vapor (relative to typical background concentrations) was observed are indicated by blue vertical color-fill.