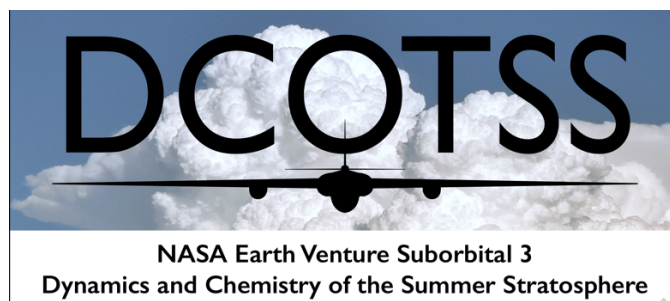


# DCOTSS ER-2 Mission Scientist Flight Summary Report



**Flight identifier:** RF16

**Science goals:** Intensively sample  $\leq 12$ -hr old overshoot material over Oklahoma; max altitude climb to the north for chemistry for 1 hour

**Start of flight (UTC):** 2022-06-08 13:56Z

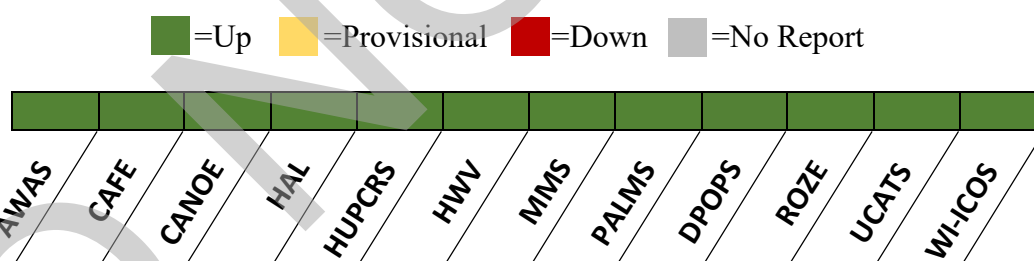
**End of flight (UTC):** 2022-06-08 21:25Z

**ER-2 Pilot:** Tim Williams

**Mission Scientist:** Cameron Homeyer

Version	Report date and time (UTC)	Author
1	2022-06-13 12:00Z	Homeyer, Cameron
2	2022-06-13 15:30Z	Kenneth Bowman, Frank Keutsch

## Instrument Performance:

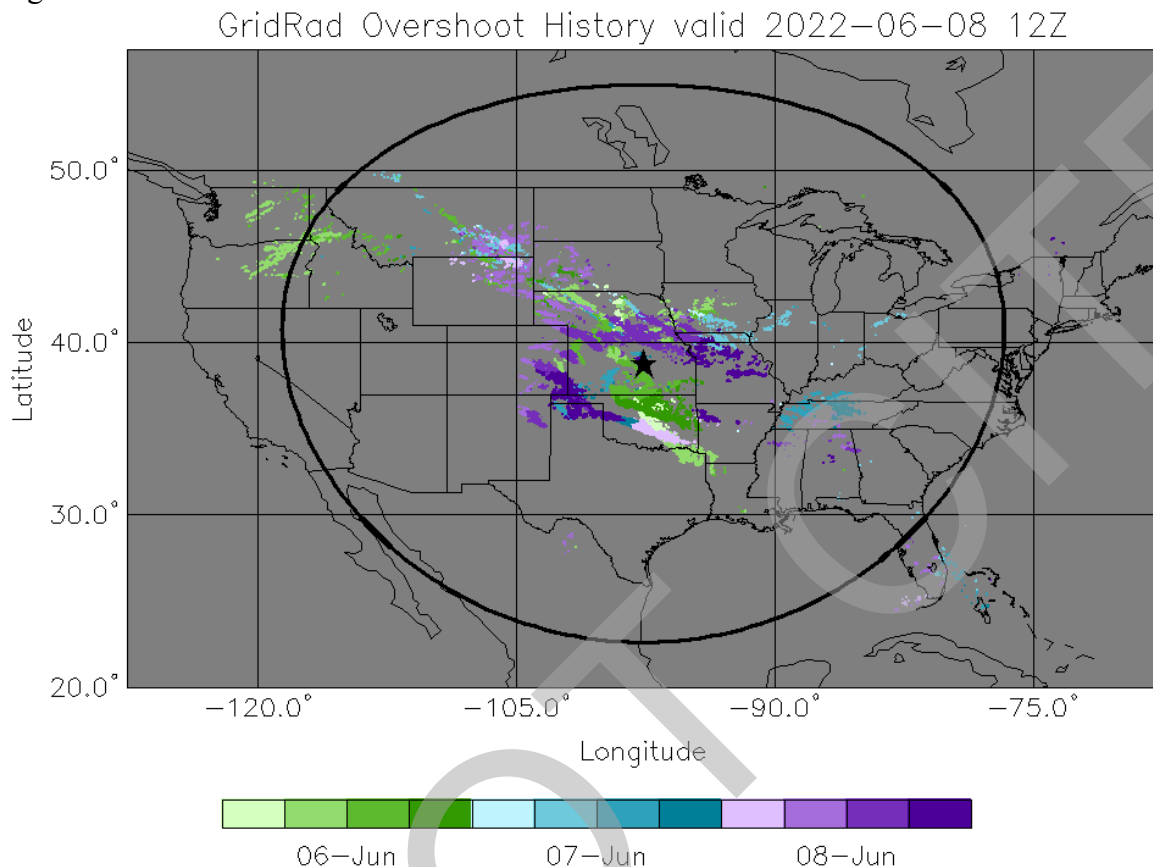


**Aircraft Performance:** Good

## Science Objectives:

Deep overshooting from southeast Colorado into the Texas panhandle and western Oklahoma overnight (Figure 1, purple colors) resulted in dense plume material over Oklahoma from the tropopause ( $\sim 47$  kft) up to 58 kft on the morning of June 8. This very fresh overshoot material was the primary target of the mission and was forecast to be embedded within a cold ( $\leq 200$  K) LS environment. Given its proximity to Salina, sampling the overshoot material required only 5.5 hours of flight time, so a secondary target of sampling stratospheric chemistry at maximum

altitude was added to the end of the mission. The maximum altitude portion extended due north along the 96.7°W meridian.



C. Horneyer (U. Oklahoma)

Figure 1: Overshoot history from GridRad, valid 12 UTC on 08 June 2022.

Figures 2, 3 and 4 summarize the flight plan, showing a map of the path overlaid on overshoot trajectory altitude forecasts during the flight (from MTS) and vertical curtains of forecast GridRad overshoot particle density and GEOS-5 temperature along the planned flight path, respectively. The northeast-to-southwest oriented segment of the track was a 1-kft racetrack pattern. The northeastern half of the segment included a racetrack from 50 kft to 53 kft, the full length of the track was observed at 54 kft, and the southwestern half of the track included a racetrack from 55 to 57 kft. Following the racetrack pattern for overshoot sampling, the aircraft turned north and climbed to maximum altitude for deep stratospheric sampling for the remainder of the flight (the secondary objective).

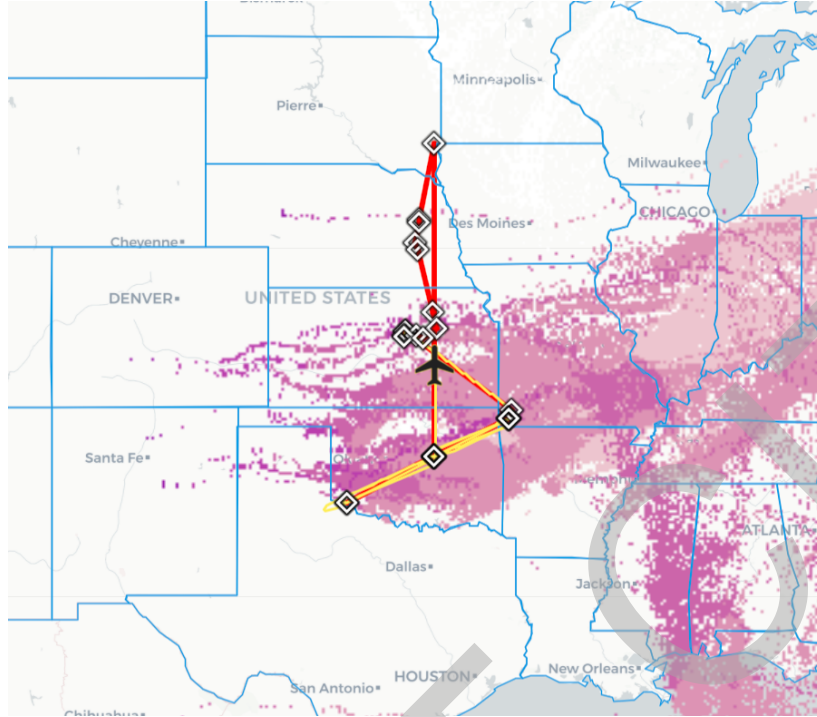


Figure 2: Map of forecast trajectory particles during RF11 and the flight plan superimposed (from MTS).

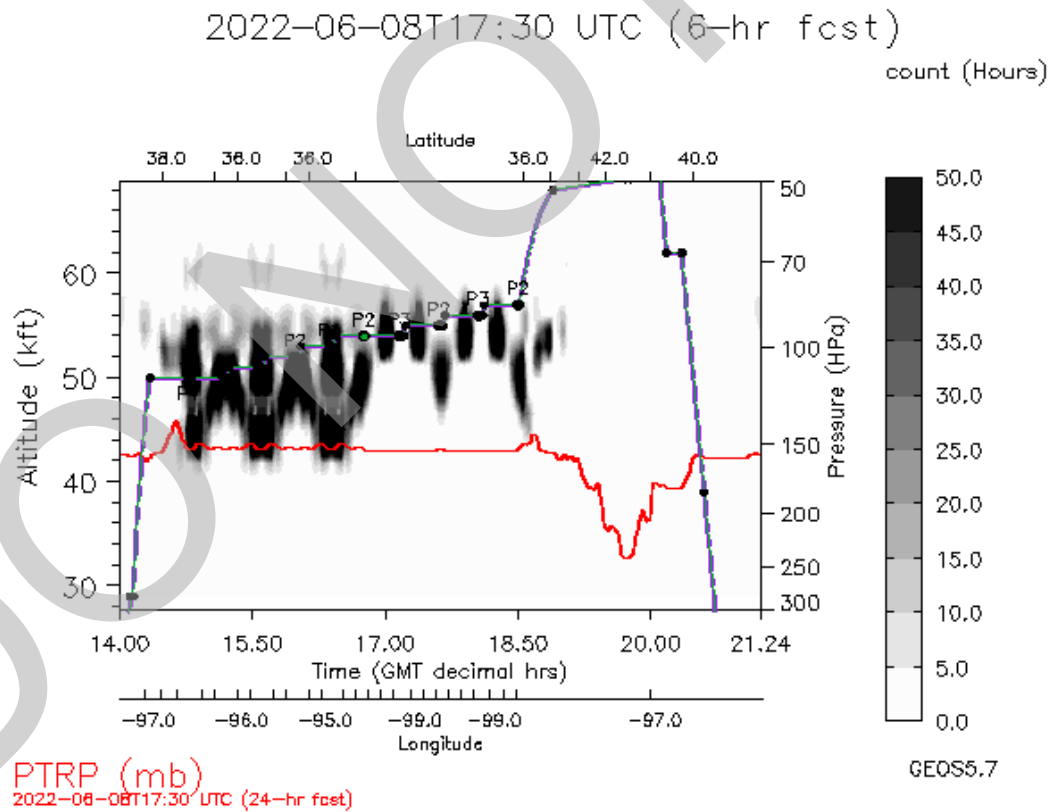


Figure 3: Curtain of forecast GridRad-initialized trajectory particle density along the flight path. The red line is the GEOS-5 tropopause height.

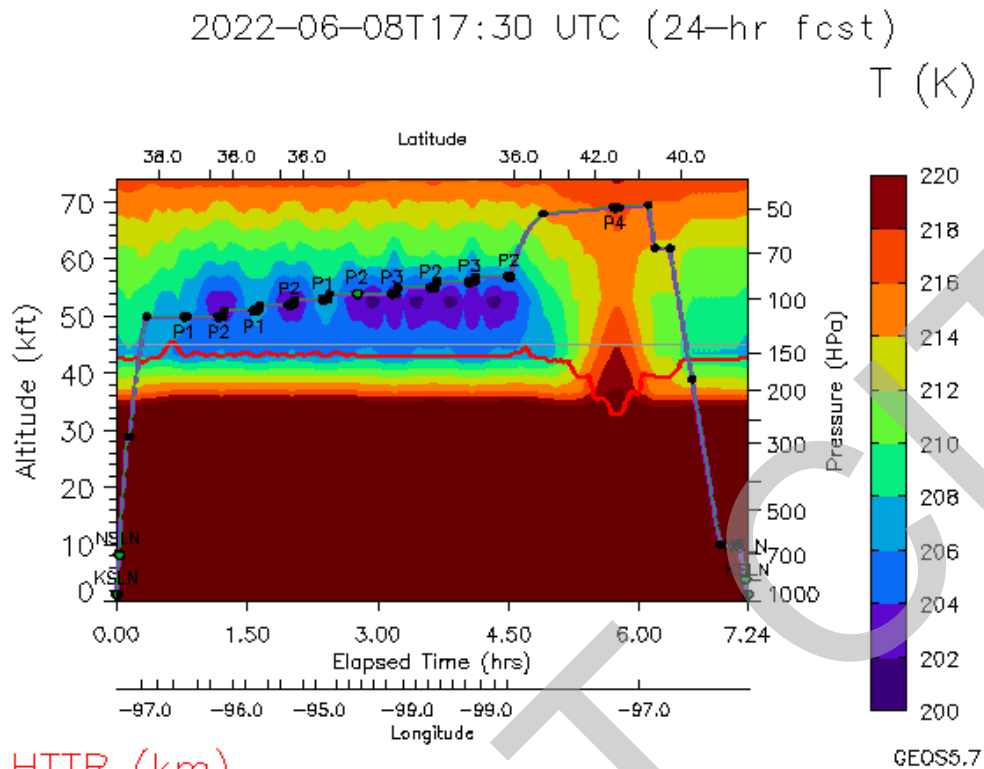


Figure 4: Curtain of GEOS-5 forecast temperature along the flight path.

### Flight Summary:

The ER-2 departed Salina as planned, flew to the southeast, and ascended to 50 kft to begin the racetrack pattern over Oklahoma. The overnight storms responsible for the targeted overshoot material intensified once again near takeoff and other overshooting storms formed near the flight track. Fortunately, the flight path did not have to change in real time as the storms were slightly out of sync in time to the aircraft passages. The closest encounters with overshooting storms occurred during the 50 and 51 kft legs.

Figure 4 provides timeseries of the real-time data feed from MTS during the flight. Shortly into the 50 kft leg and prior to the turn into the northeast-to-southwest oriented racetrack pattern, the ER-2 encountered overshoot material (evidenced by enhanced water vapor) and remained within material for nearly 2 hours straight. During initial sampling of the overshoot material at 50 and 51 kft, the ER-2 encountered cirrus cloud at ~14:45 to ~15:15 UTC, indicated well by increased DPOPS particle counts and by WI-ICOS total water excess compared to HWV water vapor. The ER-2 pilot reported the cirrus to be visually dense at 50 kft and thin at 51 kft. After encountering cirrus during these two legs, no more cirrus was observed. The ambient temperature during the sampling of overshoot material was near 200 K or lower in most cases, consistent with the forecast. Two minor modifications to the flight plan were made during the overshoot sampling portion of the flight. First, the northwest-to-southeast leg at 56 kft was extended by 5 minutes past the southwestern endpoint of the racetrack pattern to attempt to sample background

stratosphere air. While ultimately successful, the sampling time in background air was limited. Second, we decided to descend to 55 kft for ~5 minutes near the end of the 57 kft leg to get a shallow profile of the overshoot material prior to the final ascent to the north. The maximum altitude leg was flown as planned and the highest altitude reached was ~68.25 kft. An MMS calibration maneuver was completed at 62 kft prior to the final descent on return to Salina.

Two additional reports by the pilot are noted here. First, occasional moderate turbulence was encountered during the 50 kft and 51 kft legs. Second, at and above 54 kft, light surfing (altitude displacements from varying vertical wind) was experienced and characterized as random (i.e., no discernible period).

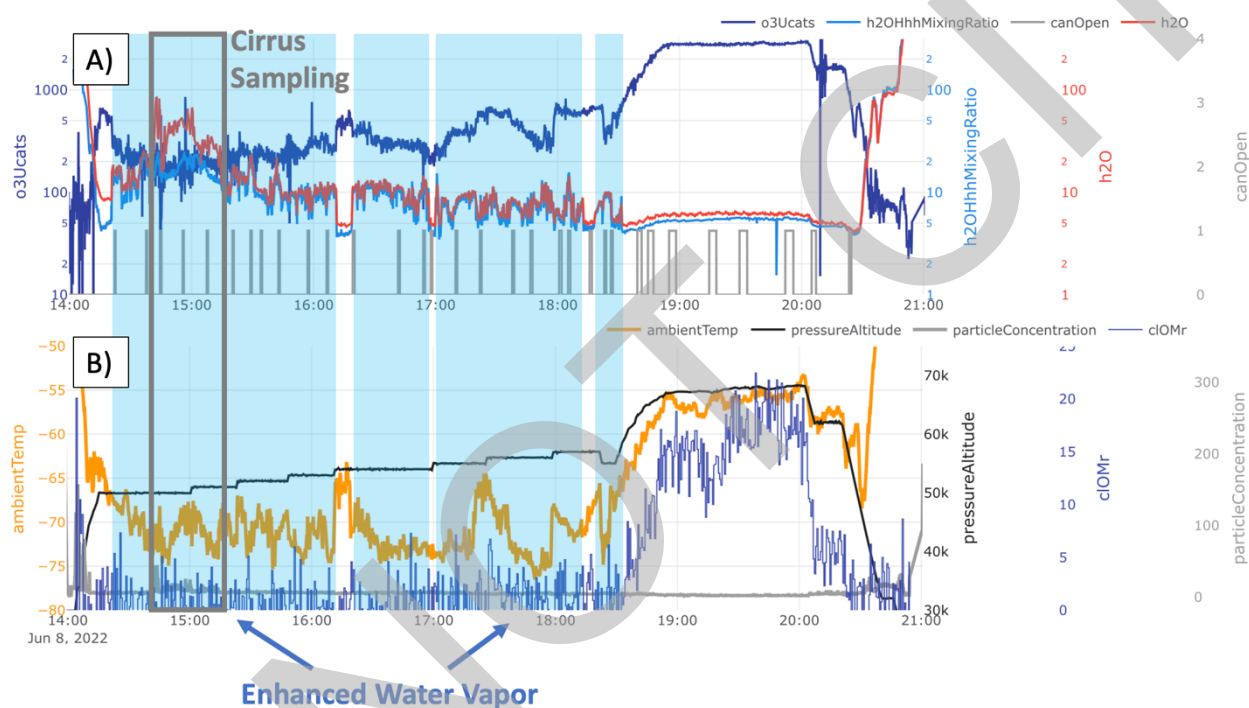


Figure 5: Timeseries of (a) UCATS ozone (dark blue), HWV water vapor (light blue), WI-ICOS total water (red), and AWAS open can times (gray), and (b) pressure altitude (black), ambient temperature (orange), DPOPS particle concentration (gray), and HAL CIO (blue) from MTS during the flight. Time periods during the horizontal legs where enhanced water vapor was observed are indicated by blue vertical color-fill. The time periods where the aircraft encountered cirrus cloud is encompassed by the gray box centered on 15:00 UTC.