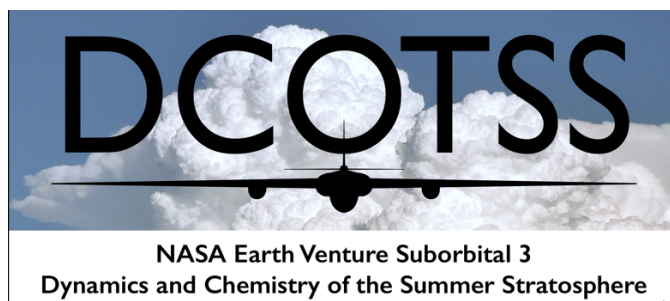


# DCOTSS ER-2 Mission Scientist Flight Summary Report



**Flight identifier:** *RF14*

**Science goals:** *Re-sample aged convective plume material from RF13*

**Start of flight (UTC):** 2022-06-02 15:56 UTC

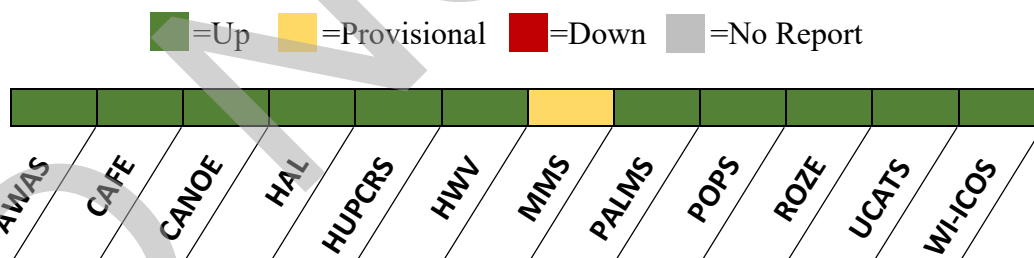
**End of flight (UTC):** 2022-06-02 23:28 UTC

**ER-2 Pilot:** Tim Williams

**Mission Scientist:** Rei Ueyama

Version	Report date and time (UTC)	Author
1	2022-06-03 23:00 UTC	Ueyama, Rei
2	2022-06-05 16:00 UTC	Keutsch, Frank
3	2022-06-05 16:15 UTC	Bowman, Ken

**Instrument Performance (as of 2022-05-27 at 17:00Z):**



**Aircraft Performance:** Good

**Science Objectives:**

The primary objective of Research Flight 14 (RF14) was to sample 2-day old convective overshooting plume material located to the east of Kansas. This material was presumably from the same air mass sampled during RF13 on May 31, a flight which sampled fresh (a few hours) outflow downstream of active (i.e., ongoing) convection. The aged overshooting plume material was expected to be widespread and relatively dense at altitudes between 46 and 58 kft (Fig. 1).

Since scattered convection was forecasted to develop near Louisiana and Mississippi in the afternoon, the proposed flight plan targeted the plume material near the KY - TN border (Fig. 2).

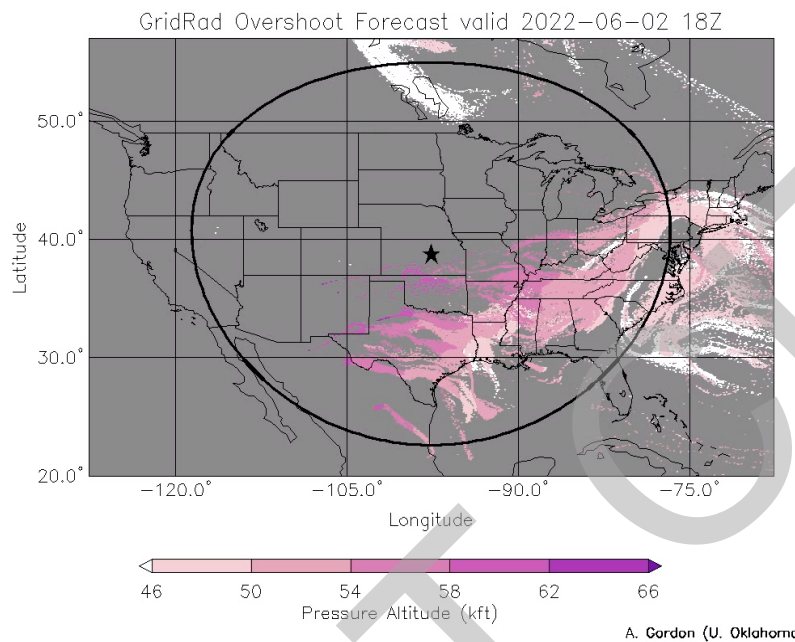


Figure 1: Convective overshooting plume material forecast for 2 June 18 UTC (approximately two hours after takeoff) shows a widespread region of relatively dense material at multiple altitudes to the east and southeast of Salina.

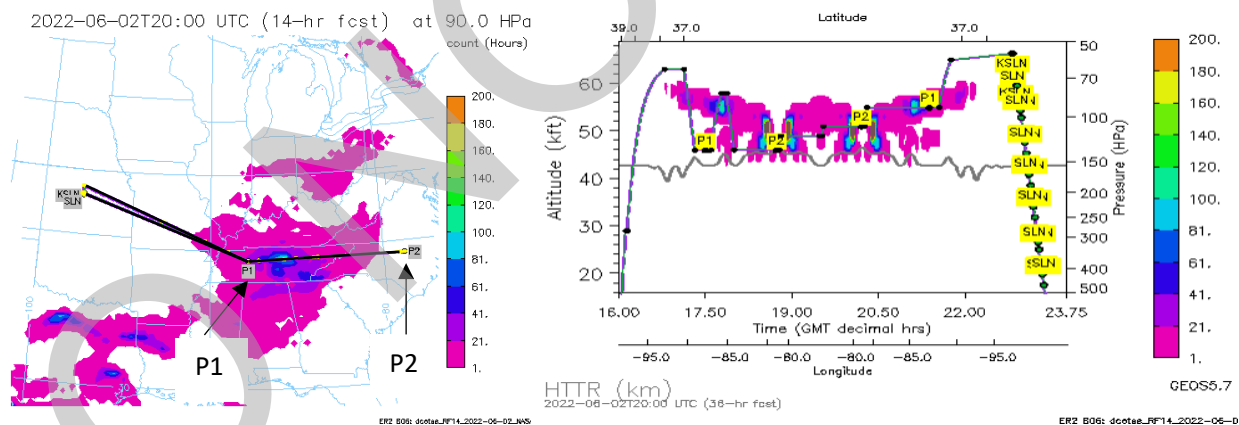


Figure 2: Proposed flight track superimposed on convective plume material density: (a) map of plume density at the 90 hPa (~55 kft) level and (b) time-altitude curtain plot of plume material. The forecast indicates vertically-tilted plume with lower altitude material to the east (near P2) and higher altitude material to the west (near P1).

The ER-2 took off four minutes early at 1556 UTC. Aircraft communication network issues during the first hour of the flight prevented the ground scientists from viewing real-time data from the instruments, except from PALMS, CAFÉ and CANOE. This issue was resolved around 1732 UTC when the ER-2 was completing the first vertical profile from 58 to 46 kft between P1 and P2 (Fig. 2). Real-time data during the descent suggested a layer of convective material

(identified by enhanced  $\text{H}_2\text{O}$  and reduced  $\text{O}_3$ ) at about 52-53 kft (Fig. 3). Relatively large variations in  $\text{H}_2\text{O}$  mixing ratios were observed along this lowest altitude (46 kft) level leg to P2 (easternmost point) with occasional anticorrelation with  $\text{O}_3$  mixing ratio variations. At P2, the ER-2 ascended to 49 kft and flew straight-and-level towards P1 for 40 min (not all the way to P1). The ER-2 appeared to have flown through convective plume material on the eastern portion of this 49 kft leg, flying out of the (presumably) vertically-tilted plume (Fig. 4). The pilot diverted from the planned flight track a few times along these two lower altitude level legs to avoid convective cells reaching ~40-45 kft.

The 51 kft level leg towards P2 was characterized by a broad plume structure in  $\text{H}_2\text{O}$ , in comparison to the sharp spikes in  $\text{H}_2\text{O}$  we had seen in many previous flights. The ER-2 appeared to have exited the plume near P2, upon which the aircraft ascended to 53 kft on the return to P1. We adjusted the altitude of this final level leg in real time, based on the plume height estimated from the vertical profile measurements near the beginning of the flight. Some enhancements in  $\text{H}_2\text{O}$  as well as relatively large variations in  $\text{O}_3$  were observed along the eastern half of the P1-P2 level leg at 53 kft.

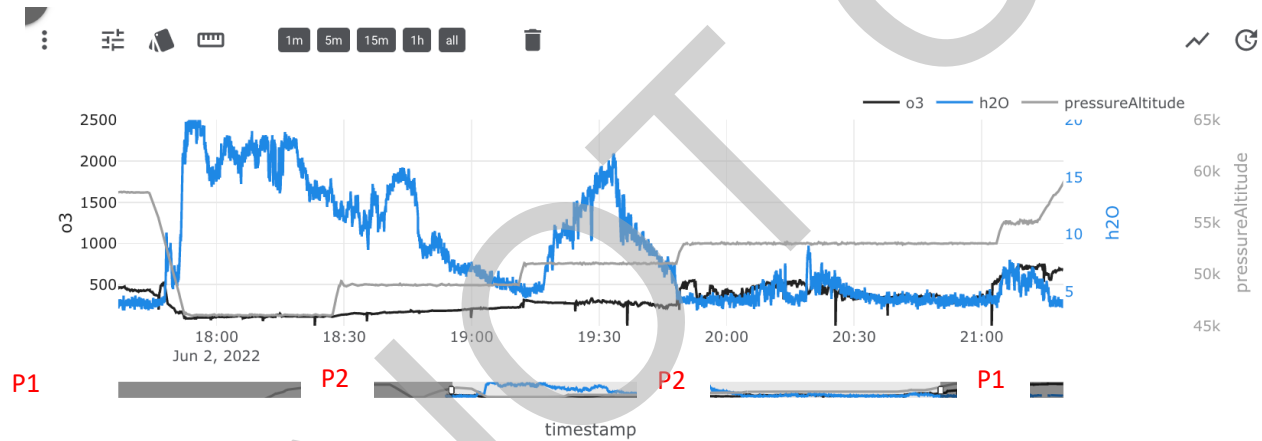


Figure 3: Real-time data as displayed on the Mission Tools Suite: ROZE  $\text{O}_3$  (black), IWG1 pressure altitude (gray), and HWV  $\text{H}_2\text{O}$  (blue). Waypoints P1 and P2 are noted in red.

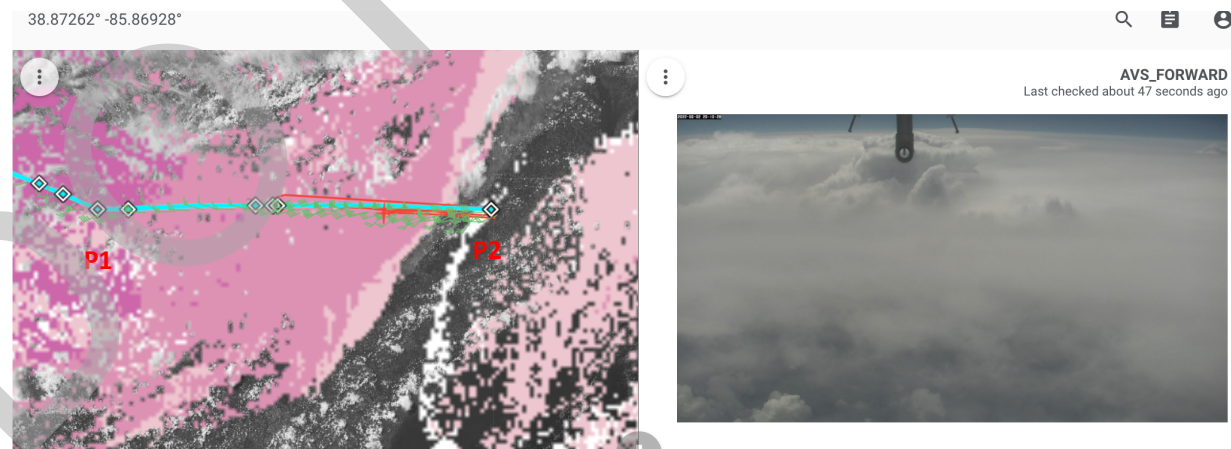


Figure 4: (left) Planned flight track of RF14 (cyan) and the actual track flown by the ER-2 (red) at 2011 UTC superimposed on visible satellite imagery and overshoot trajectory plume altitudes (same color scale as Fig. 1). A portion of the actual flight track (e.g., near P1) is displayed underneath the planned flight track

so is not visible. (right) Picture of convective cells along the track taken from the forward-viewing camera on the ER-2. The pilot deviated from the proposed track slightly to avoid these cells.

After reaching P1, the ER-2 ascended to 55 kft on the way to Salina. The MMS maneuver was executed at that altitude, followed by a climb to max altitude (~68 kft) towards Salina. O<sub>3</sub> and frost-point hygrometer sondes were released from Salina at 2127 UTC, in coordination with the spiral descent of the ER-2 (Fig. 5).

The pilot noted that the aircraft was above all cirrus clouds throughout this flight (Fig. 6), though he observed very thin cirrus approximately 100 km west of P2. He also noted slowly “gliding” up and down along a portion of the 53 kft altitude level leg from P2 to P1.



Figure 5: Nadir view of Salina from 52 kft during the spiral descent.



Figure 6: Picture of the convective cells along the P1-P2 flight track taken from the ER-2 cockpit.