POSIDON Science Flight Report

2016-10-12 RF01

Takeoff: 0123 UT October 12 (11:23 Oct 12 Guam local)
Landing: 0705 UT October 12 (17:05 local), duration: 5.7 hours
Mission Scientists: Eric Jensen, Ru-Shan Gao
Pilots: David Johnson, Dom Del Rosso

Summary:

This flight satisfied a number of POSIDON objectives, including sampling clouds and gases in a decaying convective system, a deep profile coincident with an ozone/H_2O sonde launched at Palau, sampling TTL cirrus, and measurement of dehydration near the tropopause along streamlines.

Flight Description:

The objectives of the flight were to compare aircraft measurements of ozone and water vapor with a sonde launched at Palau and to measure TTL cirrus and dehydration across a sharp temperature gradient along the flight path. The flight plan called for ascent to cruise altitude and transit toward Palau. On approach toward Palau, the plan was to climb to maximum altitude before descending, reaching the waypoint near Palau at 45 kft. The MMS maneuvers were to be executed at 45 kft in the turn and thereafter, followed by a continued descent to 32 kft. On the return leg toward Guam, the plan was to profile through the TTL where cirrus were expected. The plan called for the aircraft to continue over Guam into the warmer air northeast (upstream) of Guam, followed by a climb to maximum altitude before final descent.

As takeoff time approached, a strong convective system was apparent in the satellite imagery directly on the flight path toward Palau. The aircraft climbed to 53 kft, and as it headed southwest, the satellite imagery indicated that the convective system was decaying (see Figure 1), so we asked the pilots to descend to 43 kft into the remaining anvil. The pilots reported optically thick cirrus but little or no turbulence. Real-time data indicated very high ice water contents. WAS samples were taken during the dip into the anvil. This profile should provide information about ice crystal size distributions and tracer concentrations in very fresh detrainment from deep convection.

After climbing out of the anvil cirrus, the aircraft ascended to about 56 kft before beginning the descent en route to Palau, reaching 45 kft at the southwest point near Palau. The MMS box maneuver was conducted in the turn, followed by the pitch and yaw maneuvers. The pilots then were granted clearance to descend to 32 kft. The successful balloon launch from Palau was approximately coincident with the WB-57 profile. A preliminary comparison (Figure 2) between

the ozone profile measured with the NOAA ozone instrument and the Palau ECC sonde shows excellent agreement.

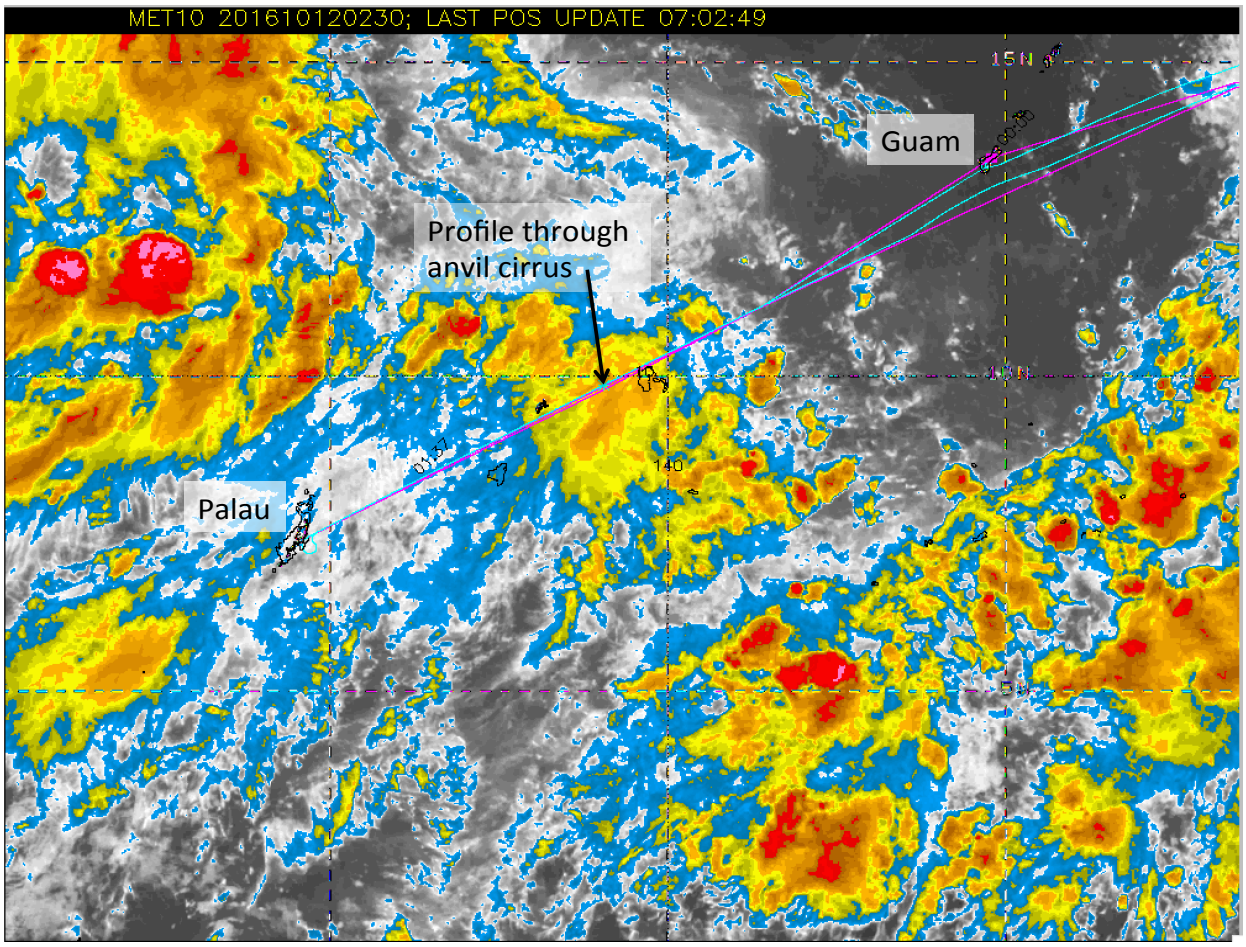

Figure 1. Infrared satellite image at the time of the profile to 43 kft through the decaying convective system. The planned (magenta) and flown (cyan) flight paths are shown.

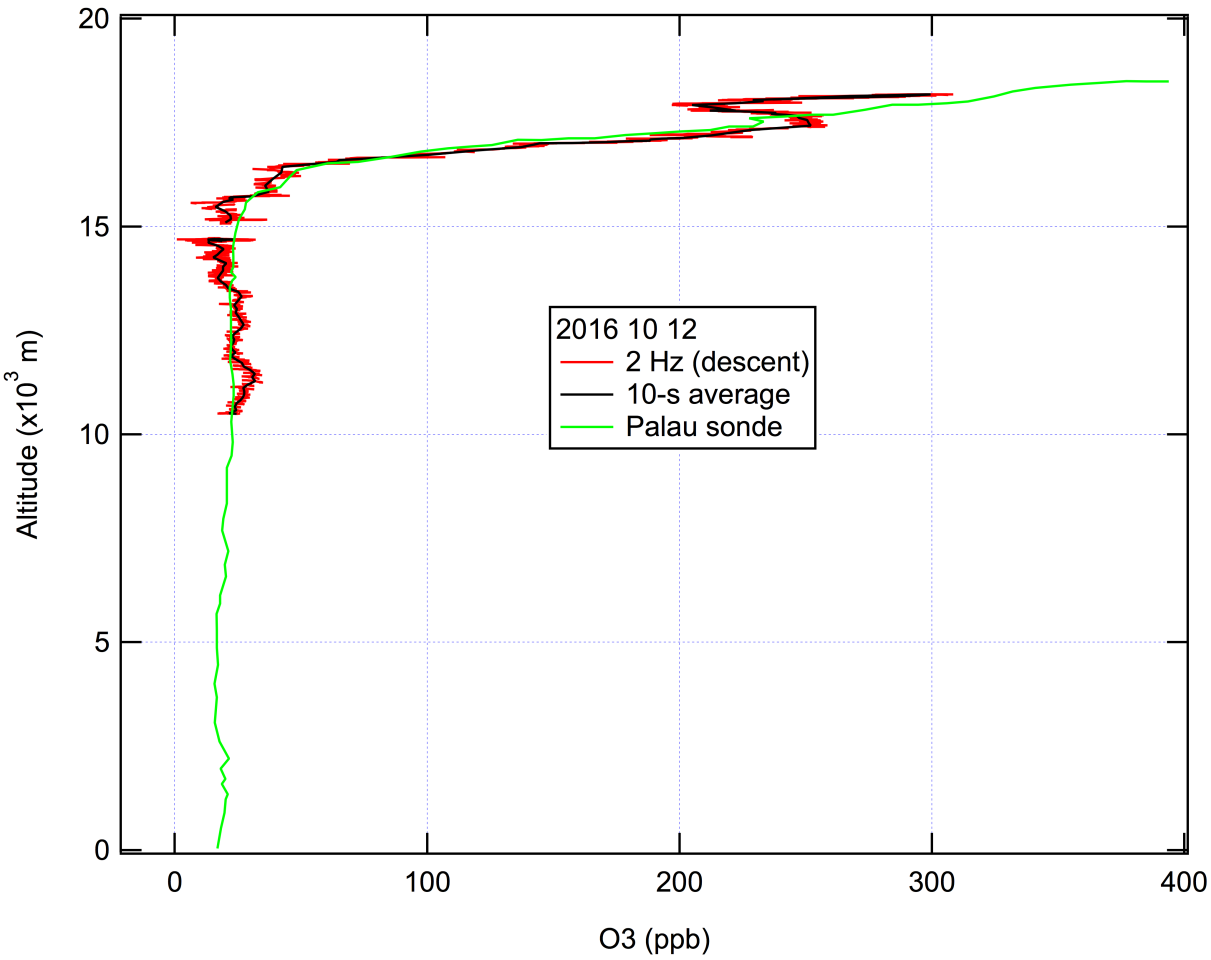

Figure 2. Preliminary data showing the profiles of ozone concentration from the ECC sonde launched at Palau (green curve, courtesy Katrin Müller) and the NOAA-O_3 instrument on the WB-57 (red and black curves) are shown.

On the leg back northeast toward Guam, the aircraft profiled through the TTL between 43 and 55 kft. The aircraft continued on the northeast path past Guam into warm, cloud-free air near the tropopause. Three full up-and-down profiles were completed on the northeast leg. (The height and temperature time series are shown in Figure 3.) As the aircraft approached the northeast point, the climb to maximum altitude was initiated, continuing through the turn and on the return leg to Guam, reaching 58.8 kft before the final descent into Guam.

Cirrus was present intermittently at various altitudes through the TTL southwest of Guam. As predicted by trajectory calculations, tropopause-level water vapor concentrations were about 5 ppmv in the warm region northeast of Guam, decreasing to less than 3 ppmv (both inside and outside cirrus) in the colder air along the southwest portion of the flight path. This case provides clear evidence of irreversible TTL dehydration by in situ cirrus.

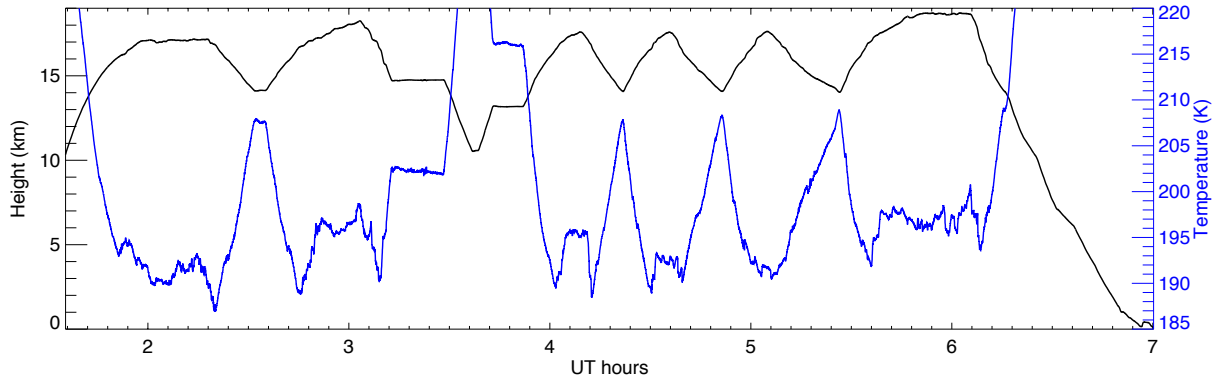

Figure 3. Time series of geometric altitude and static temperature measured by MMS.