# Flight report – P-3 ORACLES, Sep 25, 2016

Submitted by Jens Redemann (P-3 Flight scientist); Assistant Flight Scientist: Rob Wood (P3)

Ground Mission Scientists: Paquita Zuidema (P3), Rich Ferrare (ER2)

Goals/Objectives:

1. ER-2 takeoff: 9:30am local   P3 takeoff: 10:00am local
2. Routine flight: coordination with ER-2 in 1 location (10S/0E) at 13:12UT (ER-2 arrival)
3. Coordination with ER-2 after exercising extended (9hr+) reach of P-3
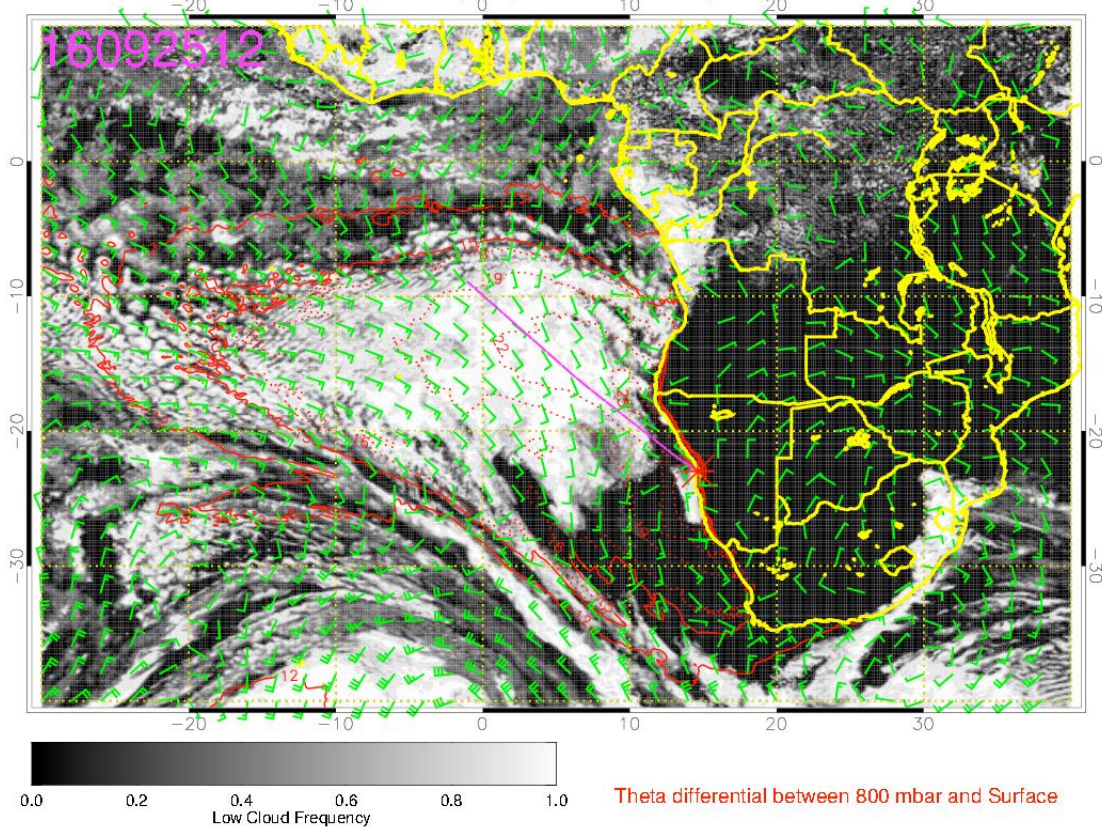
Latitude – time profile
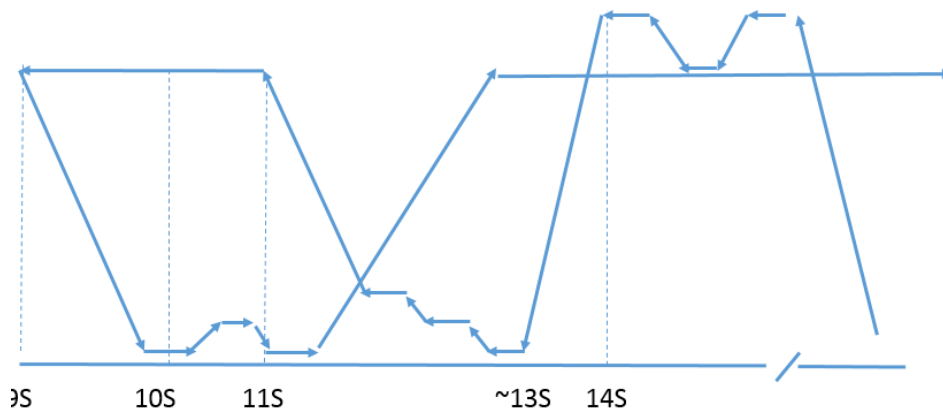
Coordination point **WP11 in ER-2 log**: 10 S   0 E
One coordination:
13:12 UT (ER-2)   ~13:04UT (P-3)
On the way home after extending diagonal to 9E/1W
Altitude depends on cloud conditions:
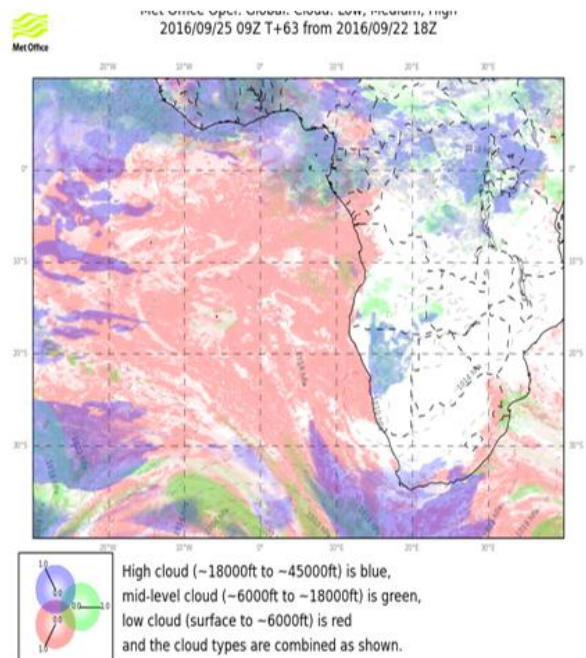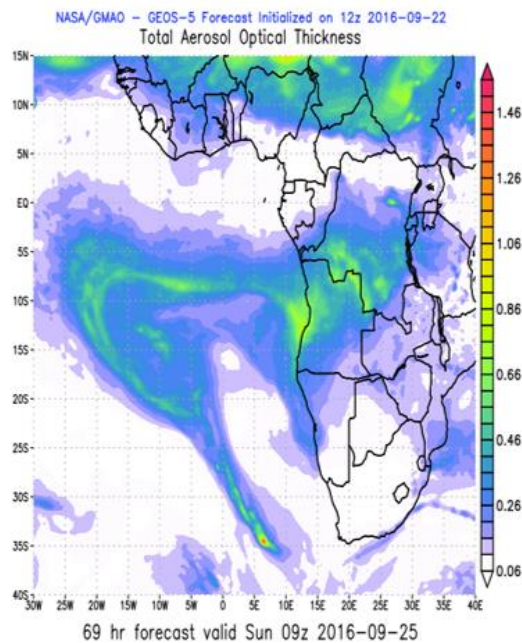Broken clouds: P-3 above or below cloud
Solid cloud: P-3 inside cloud

Forecasts:

Mostly solid Sc along flight track. Stable forecast on the large scale. Note eddy circulation near YWB. SH high reforming to the west. Weak winds in our region. Trough moves in – mid-level cloud develops over Namibia. See train of moist regions following jet still extending out to Ascension. 600mb anticyclone develops over Botswana. Moisture blob at 600mb is part of GAP. No mid-level or high-level cloud along routine track. Expected aod up to 0.4 (500 nm).

16092512, 072 hour forecast for surface winds (knots) and Low Cloud Frequency -- ECMWF

Low Cloud Frequency

0.0   0.2   0.4   0.6   0.8   1.0

Theta differential between 800 mbar and Surface

Aerosol Forecasts:

NASA/GMAO - GEOS-5 Forecast Initialized on 12z 2016-09-22
Total Aerosol Optical Thickness

69 hr forecast valid Sun 09z 2016-09-25

Met Office Oper. Global: Cloud: Low, Medium, High
2016/09/25 09Z T+63 from 2016/09/22 18Z

High cloud (~18000ft to ~45000ft) is blue,
mid-level cloud (~6000ft to ~18000ft) is green,
low cloud (surface to ~6000ft) is red
and the cloud types are combined as shown.

Extinction, NW–SE to 10S 0E, date 2016–09–25, [1/Mm]

EXT, NW–SE to 10S 0E, date 2016–09–25, [1/Mm]

General Remarks:

P3 take-off: 07:57UT
P3 landing: 16:35UT
Duration (recorded): 8.8hrs
Initial transit toward 10S/0E inside BB layer at 14 and 18kft. Profiles on outbound legs pretty much flown as planned, with extended low level legs. AOD 0.3-0.4, with the exception of 0.6 near turn-around point. Because of significant tailwind on outbound leg and worries about head wind on return leg, P-3 was ahead of schedule throughout first half of the flight – we moved coordination point with ER-2 to 14S/4E instead of original point at 10.5S. Coordination at 13:45UT, with P-3 in cloud (after a below-cloud leg and before above-cloud legs). HiGEAR reports very clean layer above cloud top near 20S on return leg.

Figure 1. Actual ER-2 (pink) and P-3 flight track (color coded by 4STAR AOD, only sampled for altitudes between 0.6 and 1.8km) for 25 Sep 2016.
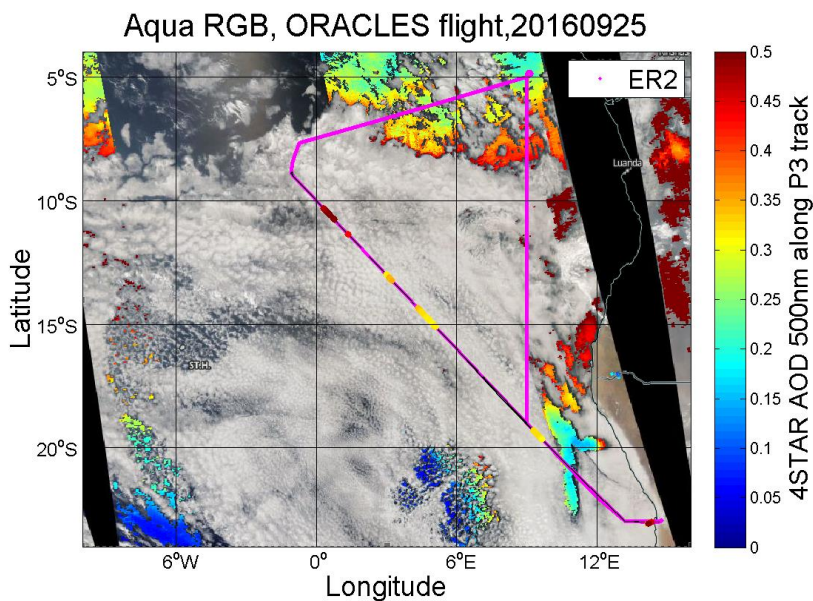

Aqua RGB, ORACLES flight,20160925

Figure 2. Preliminary 4STAR AOD and flight altitude

20160925 flight
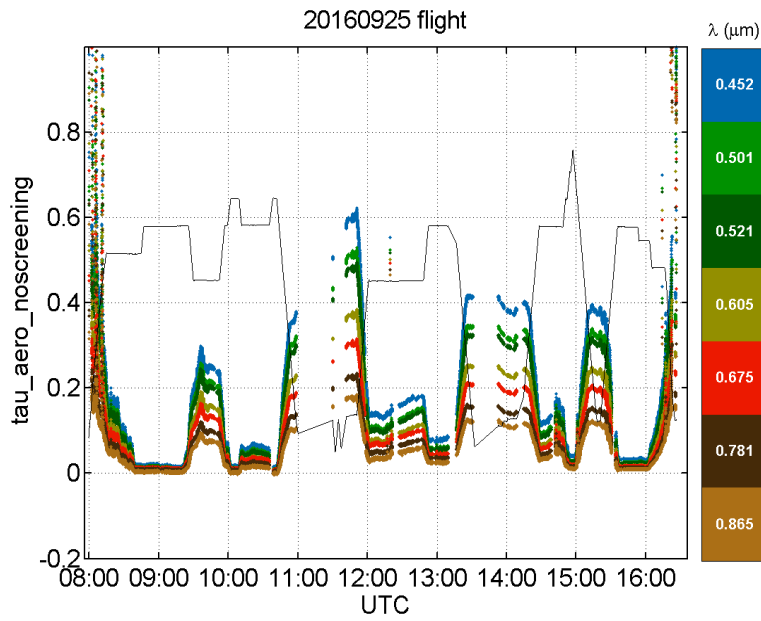
Figure 3. Altitude versus latitude color coded by time.

ORACLES, 4STAR,20160925
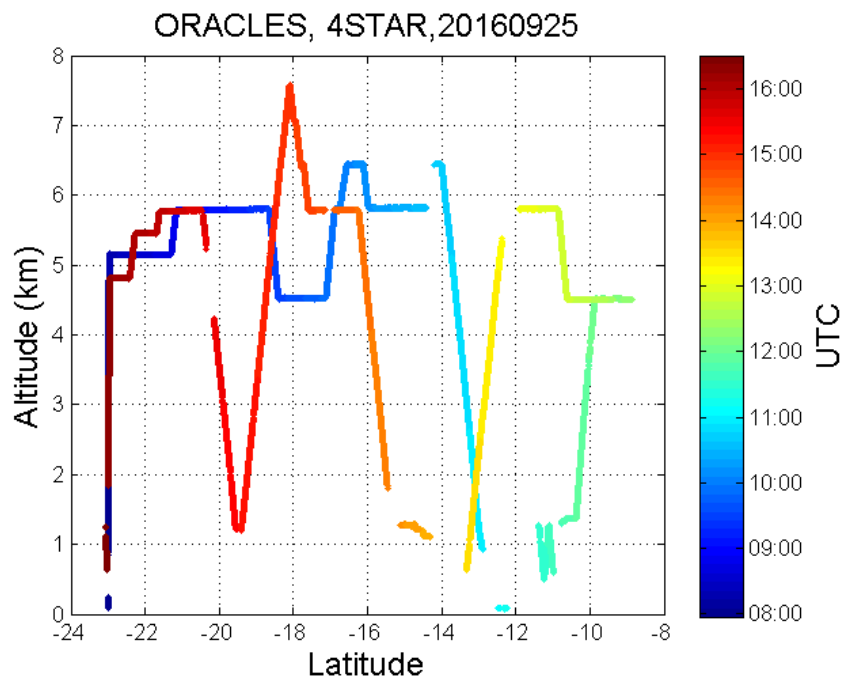
Progress towards Science Objectives: expectation-based estimates need further analysis

green-success likely; red-success uncertain
Direct Forcing
SO1-1 evolution of BBA properties with transport: ~ 352 min 4STAR sun tracking
SO1-2 spectral radiative fluxes   ~ 36 mins (0.6km<alt<1.8km, sun visible, AOD>0.1) +
                                            ~ 186 mins (alt>1.8km, sun visible, AOD>0.1)
SO1-3 factors that control seasonal variation of aerosol   ~ 352 min 4STAR sun tracking

Semi-Direct Effect
SO2-1 relative aerosol-cloud vertical structure   ~6 profiles from altitude>3km to cloud top
SO2-2 constrain aerosol heating rate   ~ 36 mins (0.6km<alt<1.8km, sun visible, AOD>0.1)
                                        ~ 186 mins (alt>1.8km, sun visible, AOD>0.1)
SO2-3 cloud microphysics   ~ at least 45 minutes in or below cloud (estimated based on altitude)

Indirect Effects
SO3-1 aerosol-BL mixing   ~at least 45 minutes in or below cloud (estimated based on altitude)
SO3-2 aerosol-BLcloud microphysics*   ~at least 45? minutes
SO3-3 precipitation susceptibility*   ~at least 45? minutes

General Observations:

7:49 start taxi

Time: 269 08:10:06 Longitude: -22 58.7 Latitude: +013 44.0 Pressure Altitude: 12885ft GPS Altitude (WGS84)13668ft
NASA P-3 Forward (1357) 2016-09-25 08:10:05

8:20 – Leveled off at 16kft; would like to go to 18kft but too heavy

Time: 269 08:33:14 Latitude: -22 00.2 Longitude: +012 08.5 Pressure Altitude: 16006ft GPS Altitude (WGS84)16890ft
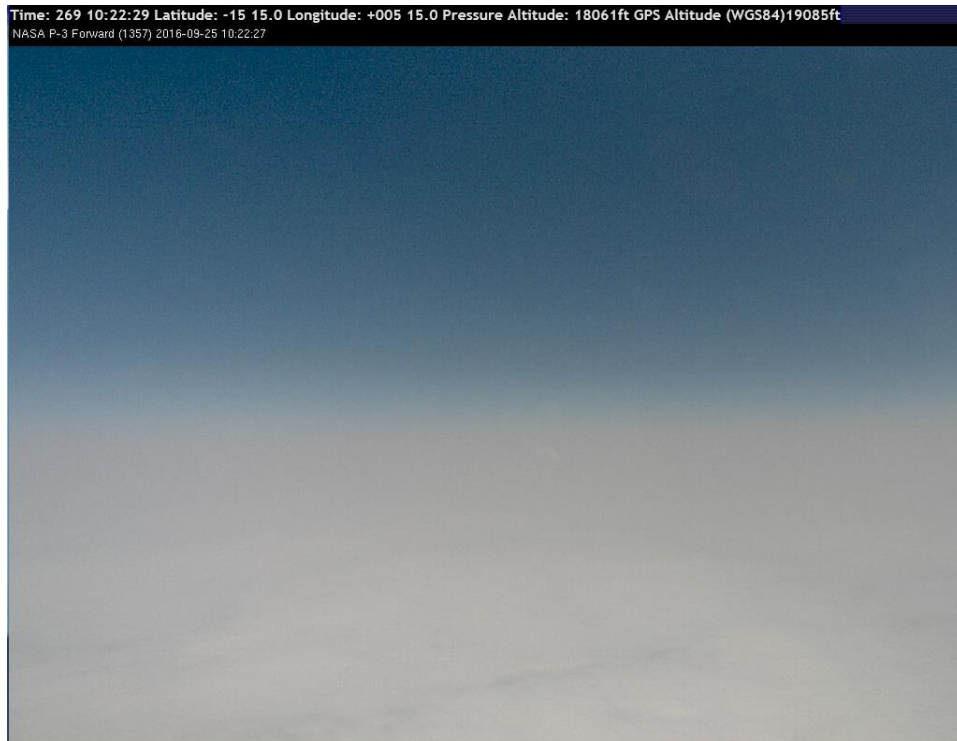NASA P-3 Forward (1357) 2016-09-25 08:33:13

8:37 plume over right wing (N) is higher and thicker (it seems); ahead and to the South plume is much less visible

8:45 climbing to 18kft

Descending to 14kft

9?:53 climbing to 18kft – we are about 8mins ahead of schedule

Time: 269 10:22:29 Latitude: -15 15.0 Longitude: +005 15.0 Pressure Altitude: 18061ft GPS Altitude (WGS84)19085ft
NASA P-3 Forward (1357) 2016-09-25 10:22:27

10:25 transiting to 14S inside layer at 18kft

10:41 descending to 4kft at 1000ft/min, then 500ft/min below

Time: 269 09:57:11 Latitude: -16 51.8 Longitude: +006 49.2 Pressure Altitude: 18090ft GPS Altitude (WGS84)19072ft
NASA P-3 Forward (1357) 2016-09-25 09:57:10

Time: 269 10:47:06 Longitude: -13 39.1 Latitude: +003 39.1 Pressure Altitude: 14674ft GPS Altitude (WGS84)15479ft
NASA P-3 Nadir (1347) 2016-09-25 10:47:06

10:54 AOD = 0.3 plume bottom at 6500ft

Time: 269 10:56:51 Latitude: -13 04.7 Longitude: +003 04.7 Pressure Altitude: 5260ft GPS Altitude (WGS84) 5472ft
NASA P-3 Forward (1357) 2016-09-25 10:56:50

Time: 269 11:03:08 Latitude: -12 44.6 Longitude: +002 44.6 Pressure Altitude: 1330ft GPS Altitude (WGS84) 1463ft
NASA P-3 Forward (1357) 2016-09-25 11:03:07

Time: 269 11:03:08 Latitude: -12 44.6 Longitude: +002 44.6 Pressure Altitude: 1330ft GPS Altitude (WGS84) 1463ft
NASA P-3 Forward (1357) 2016-09-25 11:03:07

12:2? Turned at 9S to coordinate with ER-2

12:47: ascending to 18kft, will level out there for enough time to descend to ~cloud level and coordinate with ER-2 overpass at 14S/4E

Time: 269 13:01:08 Latitude: -11 23.3 Longitude: +001 23.3 Pressure Altitude: 18020ft GPS Altitude (WGS84)19032ft
NASA P-3 Forward (1357) 2016-09-25 13:01:07

13:01 solid plume below
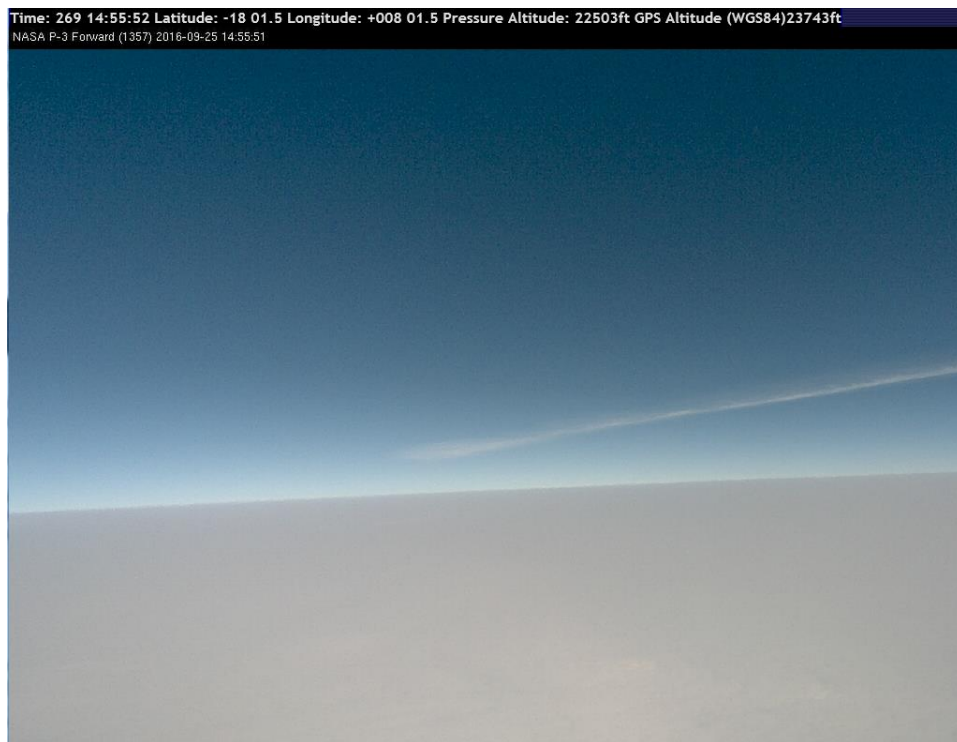
13:33 below cloud at 200ft

13:45 ER-2 overpass time

13:55 doing above cloud work; two 4STAR scans

14:03 speed runs: 2mins each at 200, 240, 280knots

14:2? Ascending to 18kft for transit home

14:55 solid layer below

Time: 269 14:55:52 Latitude: -18 01.5 Longitude: +008 01.5 Pressure Altitude: 22503ft GPS Altitude (WGS84)23743ft
NASA P-3 Forward (1357) 2016-09-25 14:55:51

14:56 en route descent into layer and descent to top of clouds

15:18 sky scans at top of clouds

15:24 evidence of clear layer

Time: 269 15:24:52 Latitude: -19 47.9 Longitude: +009 47.7 Pressure Altitude: 7938ft GPS Altitude (WGS84) 8307ft
NASA P-3 Forward (1357) 2016-09-25 15:24:51