

ORACLES P3 Flight Scientist Post-Flight Status Report

Date: 21 October 2018

Flight number: PRF12Y18

Routine flight or target of opportunity? Routine

If target of opportunity, what is the goal? _____

Flight scientist: Robert Wood

Assistant flight scientist: Michael Diamond

Ground scientist: Paquita Zuidema

Asst. Ground scientist: Mike Poellot

Take-off: 06:54:56 UT

Landing: 14:53:29 UT

Quick summary:

Representative ACAOD or ACAOD range for flight: 0.2 ACAOD, 0.25 full-column

Do the models predict crossing a gradient in aerosol age? YES (older in and immediately above boundary layer, younger above)

Yes/No/Unclear

North south gradient in aerosol loading (south more dirty)

Did the flight cross a gradient in macroscopic cloud properties, like cloud fraction?

Yes/No/Unclear

Notes: Cloud cover was extensive south of 3S all the way to 14S. Some breaks at the southern end of the routine track (12-14S).

Did the flight cross a gradient in aerosol loading?

Yes/No/Unclear

Yes, the aerosol loading in the FT plume increased strongly from AOD<0.1 near Sao Tome to 0.25 at 13S.

At any point during the flight, was there a clear separation between the smoke plume(s) and cloud tops?

Yes/No/Unclear

At the southern end of the routine track around 13.5S, there was a very dry clear slot present above clouds for maybe 500 m above cloud.

How many of the following maneuvers took place?

Ramps _1_____

Square spirals ___1_____

MBL legs __3_____

Cloud legs _1_____

Above cloud legs __2_____

Sawtooth legs __2_____

Plume legs __4_____

Above plume legs __outbound transit from TMS to 10S, but to the south of this the plume top was creeping up to the level of the P-3.

Instrument status:

P3	No problems
4STAR	Operated well throughout flight, ACAOD about 0.2-0.3.
HiGEAR	All instruments functional. Performed some useful experiments using the TDMI to look at droplet residuals from the CVI.
HiGEAR AMS	Worked well. Gathered good in-cloud data from CVI.
RSP	Had problems initially, but better later in flight. There were some issues associated with excessive roll from the autopilot.
APR3	Good day, no problem.
Cloud probes	All instruments worked well. Lots of good drizzle and precipitation detected.
CCN/Filters	Everything worked well. Very low concentrations in places.
PTI	Did not operate on flight.
PDI	No problems
Vertical winds	Looked good
WISPR	Data good except from possible drizzle shattering from CVI tip
COMA	Worked well.
SSFR	Instruments worked well. Obtained some good data from below broken clouds with significant column aerosol loading.
HSRL	Good looking flight.
data	System worked well.

PRF12Y18 date 10/21/2018 Mission Report

flight scientist: Robert Wood; assistant: Michael Diamond
ground scientist: Paquita Zuidema

Flight plan and objective:

Routine flight. The goal of the mission was to conduct a routine flight along the N-S line at 7°E transiting at high altitude to map the complete cloud-aerosol column with HSRL and with the other remote sensors, and then to execute a series of profiling legs (legs below, within, above cloud, sawtooths through cloud and profiles/constant altitude legs of free tropospheric aerosols). The cloudiness setting for the flight (Fig. 1) shows extensive decks of low clouds along 5E extending from about 3S to 10S, with somewhat more broken stratocumulus south of 10S. Fig. 2 shows the time-height planned cross section for the flight.

Figure 1: SEVIRI visible reflectance imagery from 07:45 UTC on 10/21/2018 (left); cloud droplet concentration estimates from SEVIRI for the same time and location. Droplet concentrations are moderately polluted south of 10S (concentrations 120-200 cm⁻³) with lower concentrations to the north. The relatively high values close to Sao Tome may be associated with mid-level clouds as opposed to PBL clouds.

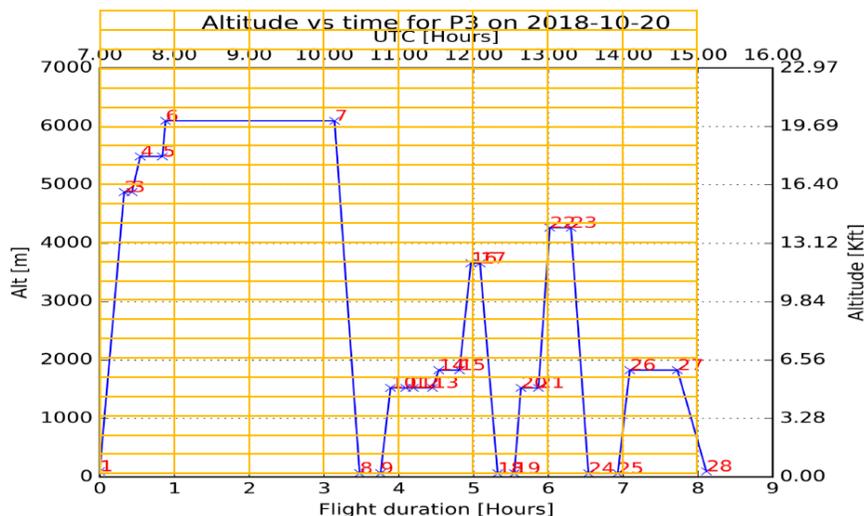
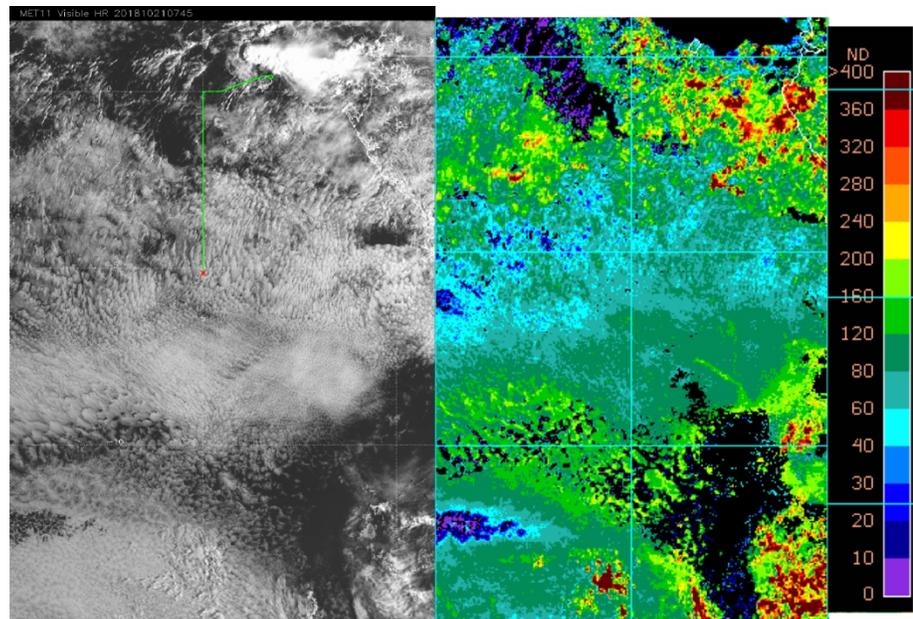


Figure 2: Planned flight profile.

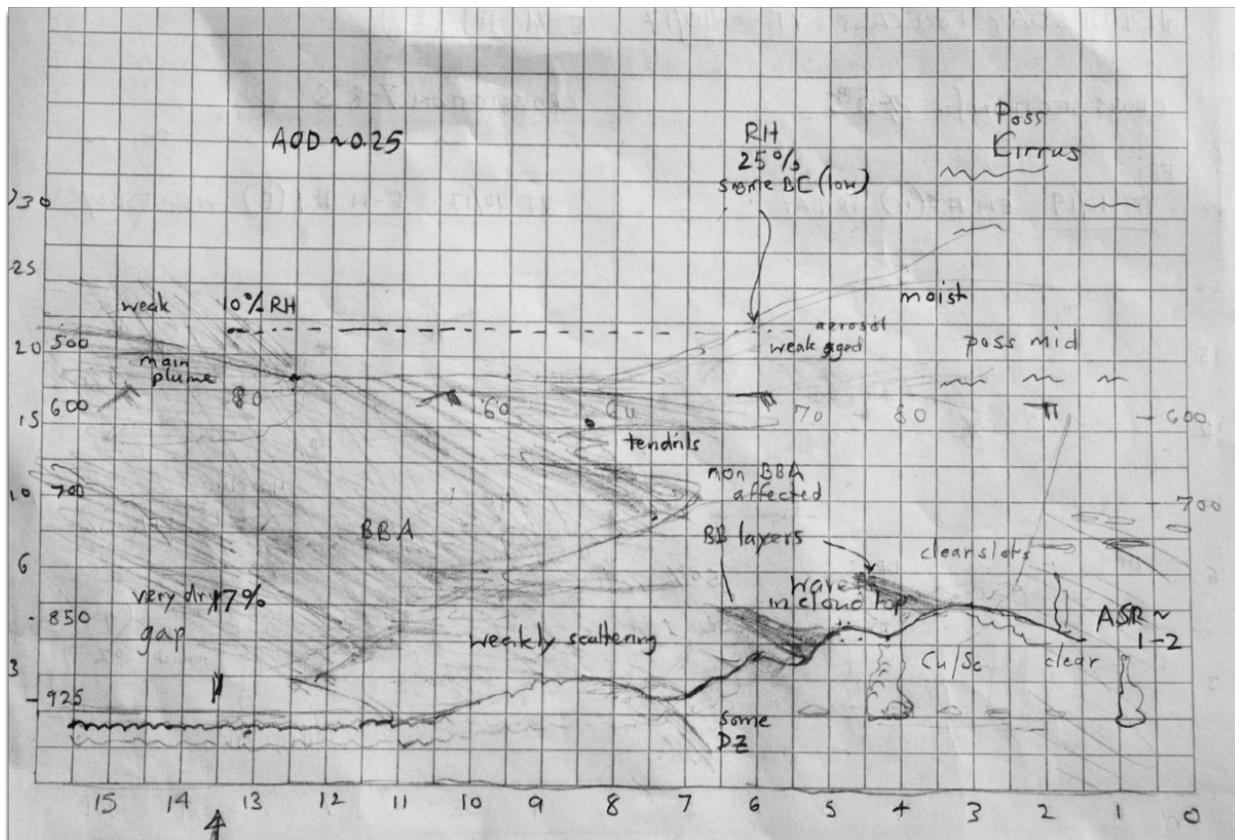


Figure 3: Situational awareness diagram based on forecast information for routine cross-section along 5E from the equator (right) to 15S (left). The y-axis shows height in kft.

Flight Summary:

06:54:56 UTC Takeoff, transit to SW on climb out of TMS. Clouds at multiple levels present near TMS (Fig. 4)



Figure 3 (right): Photo on climbout from TMS showing clouds at low levels and mid-levels.

07:11 to 07:32 Climbing up when fuel allows to stay as high as possible. 18 kft at 07:32. Weak BB aerosol layers up to 7000 ft. Mid-level clouds from 13-16 kft. Sc below at 6000 ft.

07:44 HSRL Calibration completed. Transit south along 5E.

08:00 Relatively modest scattering in plume, but high depolarization ratio (Fig. 5). FT BB aerosol plume has tendril-like structure with numerous layers overlapping (Figs. 5 and 6).

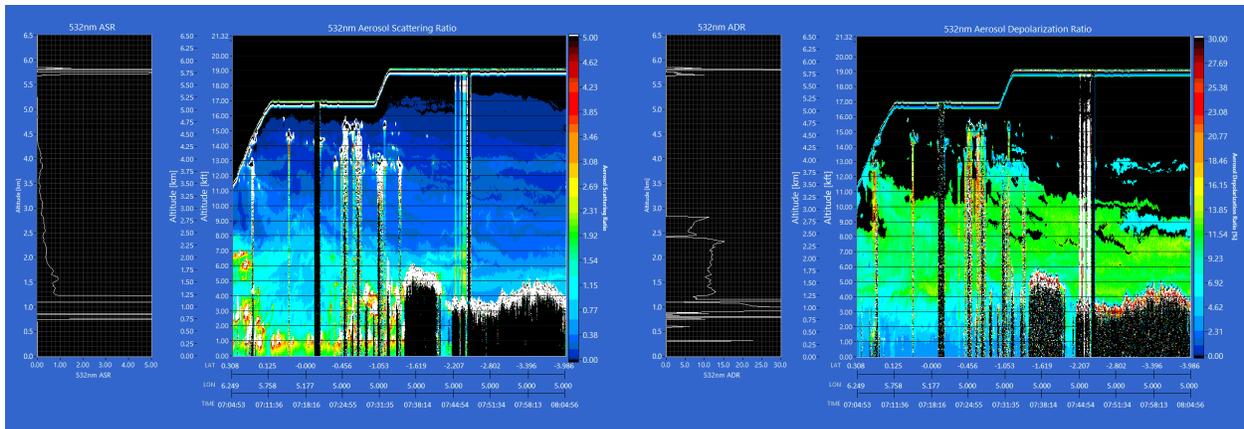


Figure 5: HSRL aerosol scattering ratio (left) and depolarization (right) from TMS to 4S.

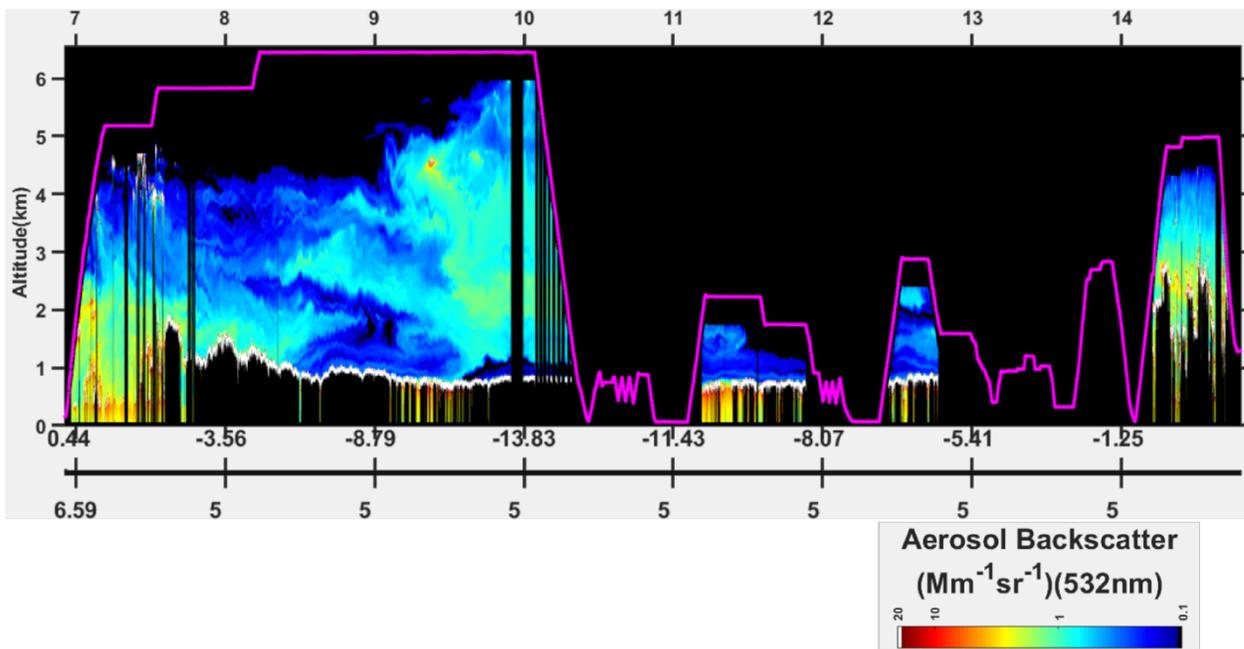


Figure 6: HSRL backscatter for entire flight. Outbound portion to almost 14S, then return with low level and in-plume sampling.

08:00 Interesting wave-like structure in low clouds from 1.9-3S, with wavelength of ~ 100 km (see also situational awareness diagram Fig. 3 above).

08:10 Climb to 20 kft. Some BC evident at this level although most of BBA plume tops out around 12 kft.

08:26 AOD is approximately 0.1 at 5S, increasing to the south. Evidence of aerosol contact with cloud north of 5S and also at 11S (Fig. 8)

Evidence of N-S mesoscale banding in Sc cloud layer below (Fig. 7)

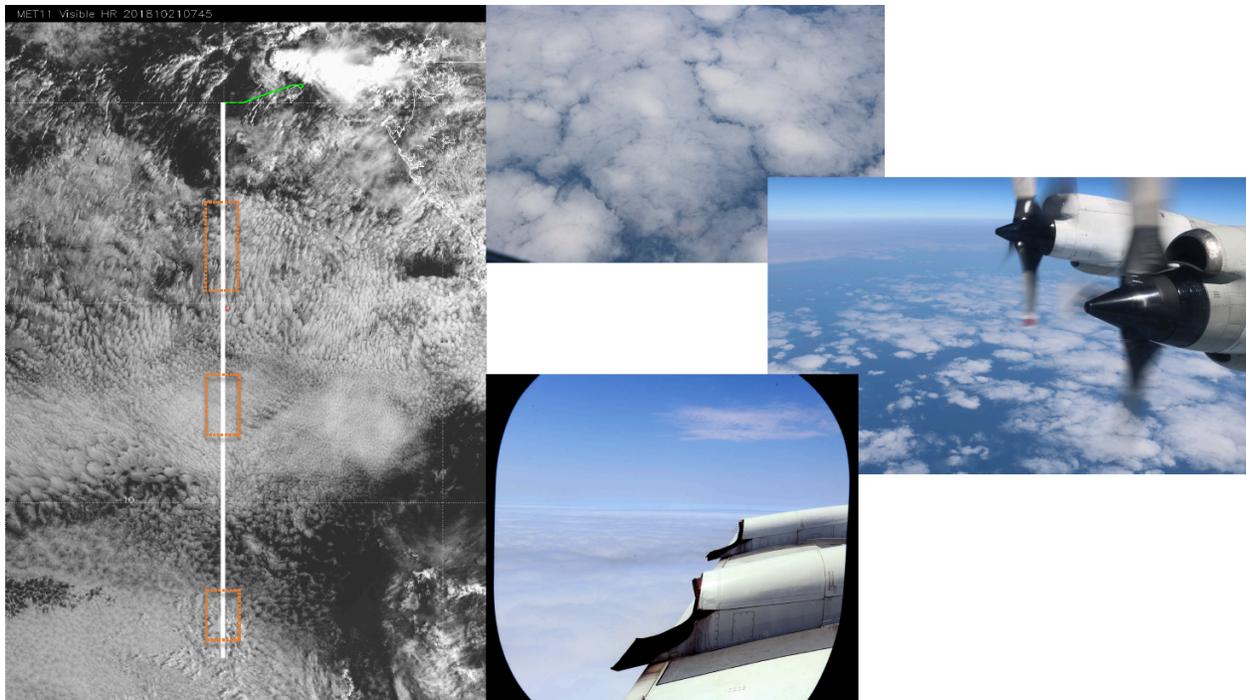


Figure 7: SEVIRI visible imagery from 07:45 UTC on 10/21. Photographs are from different locations along the flight.

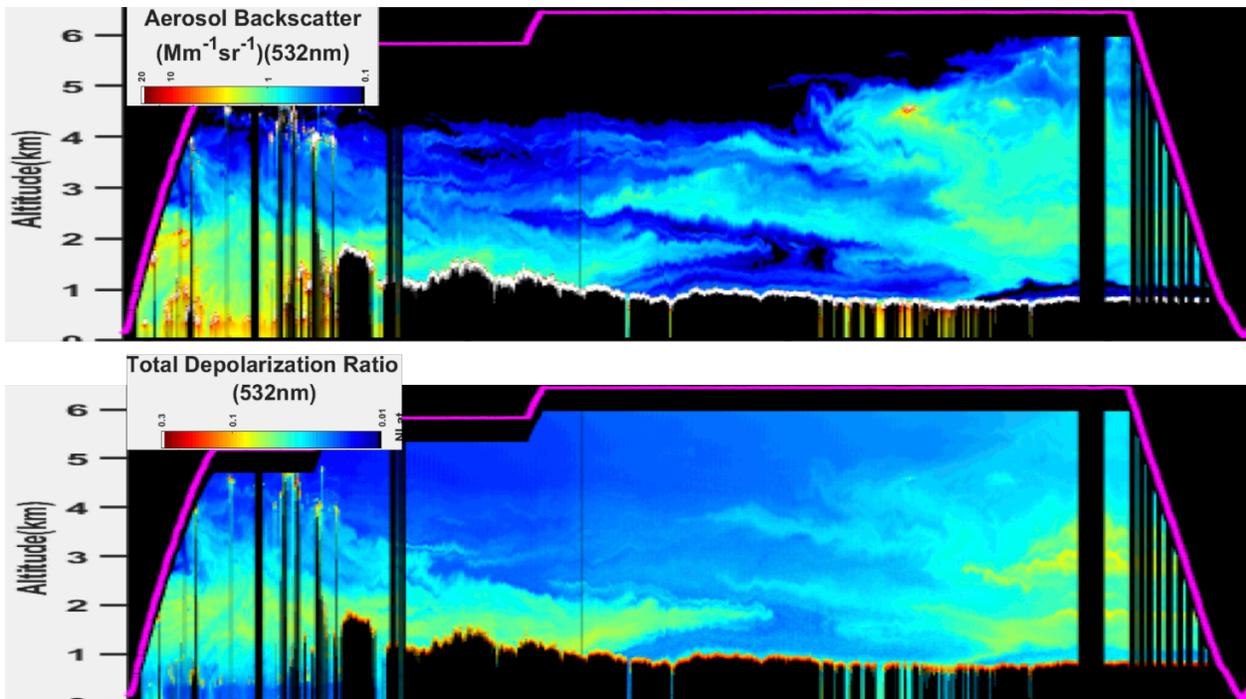


Figure 8: Aerosol backscatter (top) and depolarization ratio (bottom) for the high level portion of the routine flight (top of descent on right is 14S).

09:23 At 12S. Flying above some mid-level clouds whose tops (14-15 kft) are increasing in height to the south. AOD above cloud ~ 0.22. Low cloud tops at 2500 ft with a relatively shallow clean gap immediately above clouds at southern end of track (see Fig. 8). P-3 is slowly entering the plume, whose top is also rising to the south (Fig. 8).

09:51 Reached 13.5S. Continue past end point for RSP sampling.

09:54 90/270 turn to head back north to 13.5S for square spiral. CN ~ 400 /cm³ at top.

10:03-10:25: Square spiral from 21 kft to 200 ft. Plume levels of CO etc are all around half of the typical values previously seen in plumes. CO~175 ppmv. Plume is thicker lower down with CO~190. Some large "Rose" type particles detected on descent. Aerosol well-aged in lower part of plume (Fig. 9) and air is dry (<20% RH). Cloud tops at 2750ft and bases at 1700 ft. CO from 65-70 in the PBL and ~80 above cloud. Some whitecaps in the PBL.

10:25-10:46: Sawtooth through cloud and into lower FT (500 ft above cloud top 500 ft below bases). PBL is very clean.

10:46-10:50: Short above-cloud leg at 2800 ft. Two sky scans of 4STAR completed.

10:52-11:02: PBL leg at 200 ft.

11:14-11:35: FT Plume leg at 7000 ft. At 10S at 11:22 UTC.

11:35 Descend to 5500 ft for second in-plume leg.

11:37-11:58 FT Plume leg at 5500 ft sampling plume with high depolarization ratios.

11:59 Turn and descend to south for 10 minute sawtooth through clouds.

11:59-12:08 Sawtooth#2. Cloud tops 2400 ft, bases 1400 ft.

12:08 End sawtooth then turn back to north.

12:11-12:32 Long PBL leg at 200 ft.

12:32-12:42 Climb to 9000 ft for plume leg.

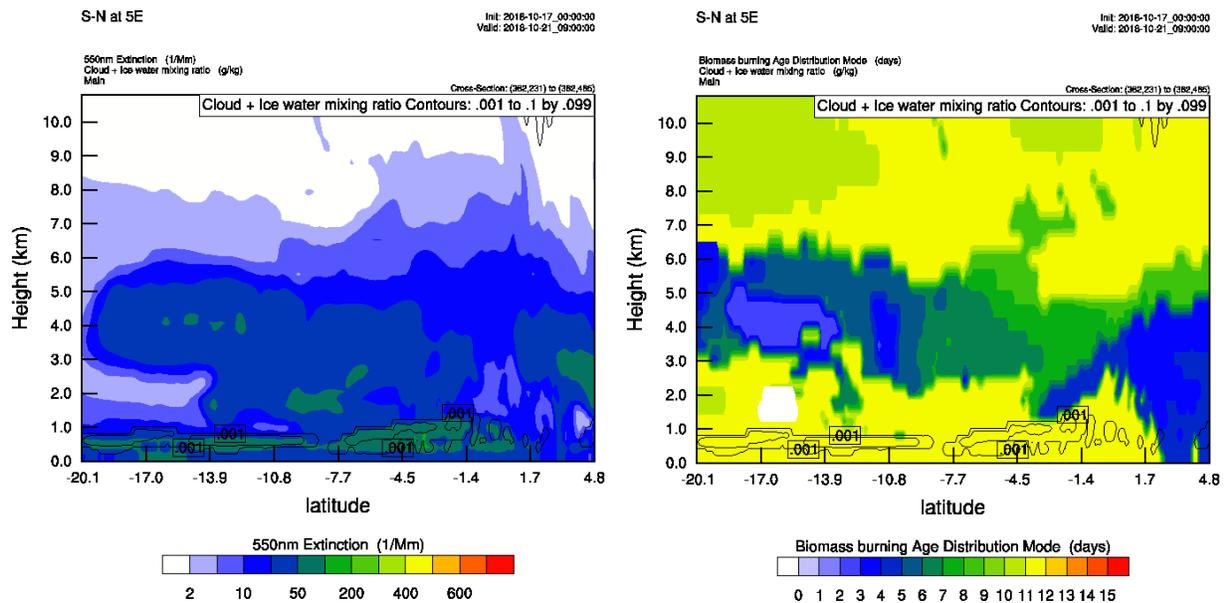


Figure 8: Aerosol extinction (left) and median plume age (right) from WRF-AAM forecast (48 hr) showing relatively fresh aerosol from 3-6 km altitude near the southern end of the routine flight. Aerosol lower down tends to be >10 days old, apart from some relatively fresh aerosol around Sao Tome.

Descend down to 2400 ft for leg in cloud

12:58-13:08 In-cloud leg at 2400 ft. Drizzle evident on windshield. Mid-level clouds above low cloud.

13:26-13:53: Legs in upper PBL at 3200 ft, then leg in lower PBL followed by leg above cloud at 7 kft.

14:05 Profile from 200 ft to above cloud and then transit back to TMS. Sc tops around 7000 ft.

14:53:29 LAND.