Cayenne Flight Plans
A first discussion

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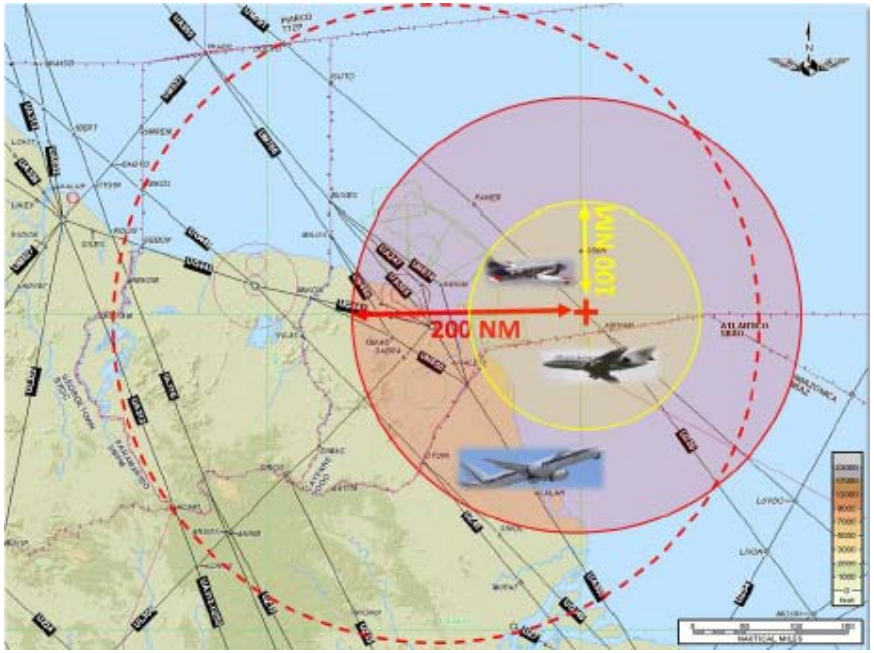
[1] *Work funded by the FAA*

Status of flight plan discussions

- No full-group discussions yet. Some ideas presented in January TLS meeting; some ideas presented in WXR radar discussions
- This presentation has not been discussed with others – a first suggestion by Strapp

Integration of 757 into flight plans

- Suggestions have been put together by Dezitter and WXR radar group
- Integration of 757 into flight plans relatively straight-forward. 757 will approach cloud sampled by F20 and/or CV580 from a distance, measure pilot WXR radar response as a function of distance from in-situ measurements

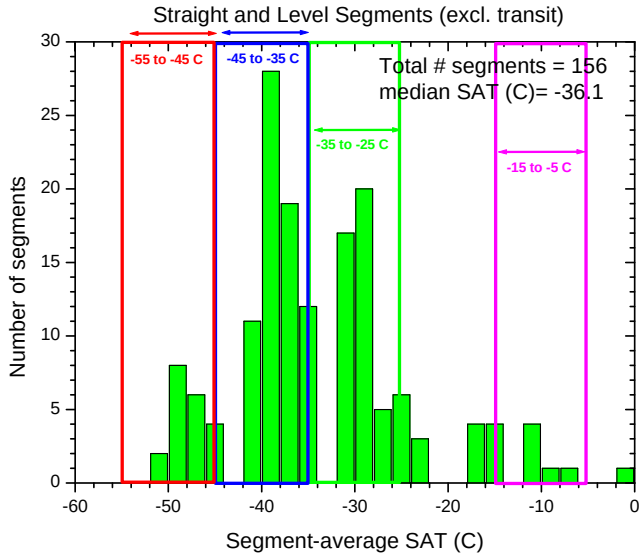


- Further details to be provided by Dezitter – will ask in NYC for his diagrams

Final decision on new temperature intervals after polling EIWG

Add and new temperature level (-40 C) , and widen categories

Temp.	Planned 20-nm pts.	Collected 20-nm pts.	No. of segments
-10 ± 5 ºC	100	11	4
-30 ± 5 ºC	100	131	41
-40 ± 5 ºC	100	148	63
-50 ± 5 ºC	100	21	18



- How long does it take on the F20 to reach -45 C (top level)?
- My estimate is 60 minutes from Darwin-14 flights

F20 flight plans

- For solo flights, or flights with 757 alone, propose that F20 would follow the same methodologies as in Darwin
- Anticipate earliest possible takeoff to catch anticipated oceanic convective early morning peak intensity
- From Darwin experience, estimates of time for F20 to reach different tempepature levels (with full fuel)
  - 30 minutes to -30 C, 45 minutes to -40 C, 90 minutes to -50 C. Anticipate 60 minutes to reach bottom of top temperature level (-45 C).
- 300 nm radius of operation has been proposed to ATC
  - Assuming target is 200 nm away, it would take F20 ~30 minutes to reach (can be at -30 C)
- Option 1: collect more data in -30 and -40 temperature intervals

F20 flight plans (cntd)

- Option 2: Stay low to collect some data at -10 C upon arrival at the storm, then climb when fuel permits , e.g.
    - 30 minute transit to cloud
    - 30 minutes at -10 C
    - 15 minute climb to -45
    - 1 hr 45 mins at -45 to -55 C
    - 30 minute transit back to Cayenne

Integration of CV580

- Issue: how early can CV580 takeoff ?
- Assumption:
  - Both CV580 and F20 can both takeoff before sunrise, but can only start cloud sampling at sunrise
  - i.e. both aircraft can arrive at the cloud at the same time (with CV580 taking off earlier)

Integration of CV580

- Assuming same scenario of target 200 nm from Cayenne, transit of CV580 to target would be ~ 50 minutes, F20 about 30 minutes

- Objectives:
  - Reach cloud as early as possible so as not to sample cloud too late in cycle
  - Get both F20 and CV580 on the same cloud at the same time

- Options:

- (1) Takeoff CV580 about 15 minutes before F20
    - CV580 works cloud at -10 C for about 2.8 hours
    - F20 initially works cloud at -30 to -40 C, and then when fuel burn sufficient, climbs to -45 C and higher, time on cloud about 2.5 hours

Integration of CV580

- Option (2):
  - CV580 takes off at same time as F20, F20 arrives at the cloud 20 minutes early, and then:
    - F20 30 minutes at -10 C, 15 minute climb to -45, 1 hr 45 mins at -45 to -55 C
    - CV580 up to 2.8 hours on cloud at -10 C
    - Aircraft on-station time at the cloud again about the same for both aircraft
- Option 2 could be used if CV580 is delayed for whatever reason
- Option 2 does have the advantage of providing some -10 C data for the F20

F20/CV580 flight plans (oceanic)

- Propose that F20 adopt the same sampling strategies as in Darwin
  - Initial runs provided by ground controllers
  - Pilot/onboard scientist have discretion to adjust runs based on pilot's radar and other cues
  - Attempt to identify area of maximum IWC, and then do survey (e.g. parallel runs) of that area

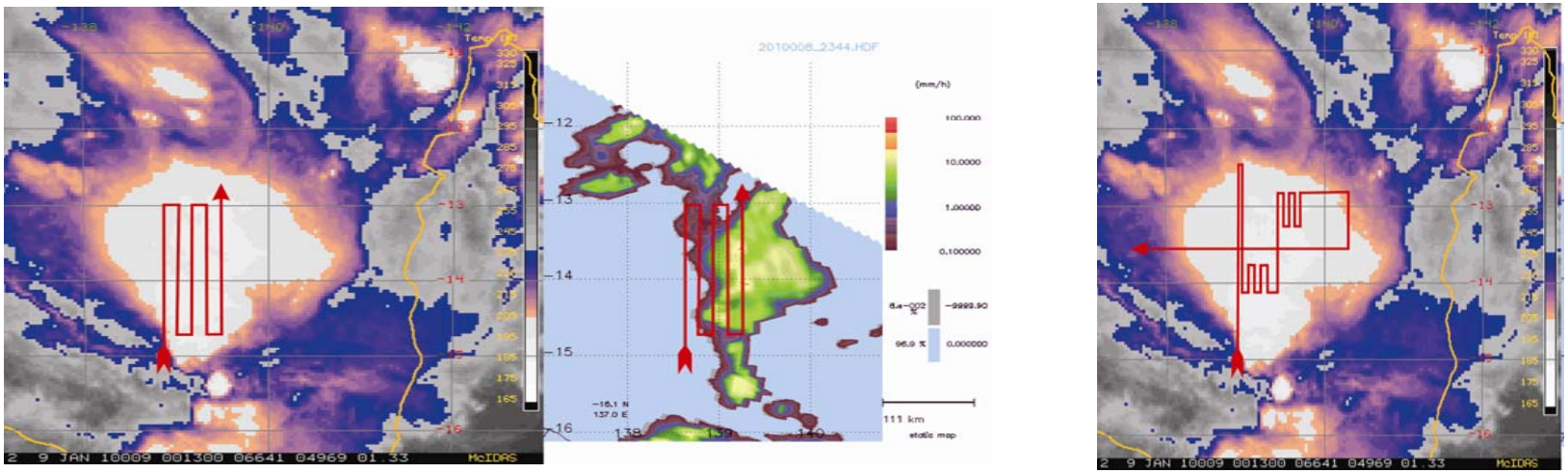


Figure 6.6: Sample flight plan for MCS over water. On left is a satellite IR image as in Fig. 6.4. At right is a depiction of low-level radar reflectivity, in this case from TRMM. The flight track is shown as the red line.

F20/CV580 flight plans (oceanic) Independent operation on same cloud

- Propose that CV580 for the most part operate on the same cloud independently using the same strategy
  - Probably more on-board decisions due to the likelihood of red-echoes near the aircraft (especially below freezing level)
  - Guidance from ground flight directors as to proposed first runs and general area of operation

- Advantages of independent operation:
  - More efficient data collection
  - Much simpler coordination

F20/CV580 flight plans (oceanic) vertically coordinated runs

- Propose that there should be some vertically coordinated runs, perhaps once the routine of working two aircraft has been established
- Objective: collect simultaneous vertical radar cross sections, in-situ data vertically aligned on same cloud at same time in other's radar volumes
- Attempt to align the 2 aircraft vertically along the same track
- How to avoid radar interference and possible damage of receivers?
    - Radar experts to comment?
    - Possible solutions:
        - Cv580 starts run and F20 follows behind with no intersection along run
        - Runs are designed to intersect at the midpoint of a line, but runs are offset (e.g. by 0.1 nm, TBD)

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Other F20/CV580 flight plans

- Land-based afternoon convection:
  - F20 would operate as originally planned:
    - At high altitude as close to the updraft regions as safety permits, perhaps 30 nm away from flight-level high reflectivity regions
  - Not clear that CV580 would be able to operate near cloud due at -10 C to potential severity of convection (TBD)
  - Could be some value in measurements below the F20 in the stratiform region of the convection

- CLOUDSAT overpasses
  - Probably a lot of scientific interest in coordinating CLOUDSAT overpasses with two aircraft if no conflict with regulatory goals

- Instrument intercomparisons
  - Would be valuable to intercompare F20 and CV580 measurements, especially in cloud, or perhaps for radars
  - Need some proposals from scientists

Concluding Remarks

- Coordinating 3 aircraft will be more challenging than Darwin-14
- Flight plans should be simple, especially at the beginning of the Cayenne program
- Should there be a dedicated meeting on this subject? How to conclude on flight plans?

End of presentation

Thank you, merci

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