2019 NOAA/AOML/HRD Hurricane Field Program - IFEX

SATELLITE VALIDATION EXPERIMENT
Flight Pattern Descriptions

Experiment/Module: ADM-Aeolus Satellite Validation Module

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Requirements: No requirements: flown at any stage of the TC lifecycle

Science Objective(s):

1) Validate ADM-Aeolus atmospheric profiles of winds and aerosols derived from ADM-Aeolus satellite in a variety of tropical environments using aircraft data.
2) Evaluate and potentially enhance the impact of ADM-Aeolus data on both global and regional numerical weather prediction of tropical cyclones (TCs).

P-3 Module 1:

What to Target: Coordinated underflights of the ADM-Aeolus satellite in the environments of tropical disturbances (e.g., African easterly waves, invests, and TCs) and the Saharan air Layer (SAL).

When to Target: P-3 flight patterns will be adjusted to coordinate temporal and spatial overlap with overpasses by the ADM-Aeolus satellite. GPS dropsonde, P-3 Doppler Wind Lidar (DWL) and P-3 tail Doppler radar (TDR) sampling should be timed to be ≤30 min and ≤15 n mi (25 km) of collocated ADM-Aeolus wind and aerosol retrievals and will depend on the area of operation (determined on a case-by-case basis).

Pattern: This is a breakaway pattern that involves a straight-line leg that underflies the ADM-Aeolus satellite and requires an offset of 125 n mi (230 km) from nadir (due to the 35^{o} scan angle of the satellite's Aladin lidar instrument). The P-3 leg should ideally begin ~10-15 min before and continue for ~10-15 min after the satellite passes "overhead". This will equate to a P-3 leg length of ~90-135 n mi (165-250 km). NASA's MTS aircraft software should be used to coordinate the underflight.

For ADM-Aeolus satellite *ascending* orbital passes (see Fig. 1):
- ADM-Aeolus crosses the equator (SSE-NNW) at 1800 LST
- P-3 underflight legs will be generally oriented SSE-NNW
- P-3 underflight legs will offset 125 n mi (230 km) to the east of nadir

For ADM-Aeolus satellite *descending* orbital passes (see Fig. 1):
- ADM-Aeolus crosses the equator (NNE to SSW) at 0600 LST
- P-3 underflight legs will be generally oriented NNE-SSW
- P-3 underflight legs will offset 125 n mi (230 km) to the west of nadir

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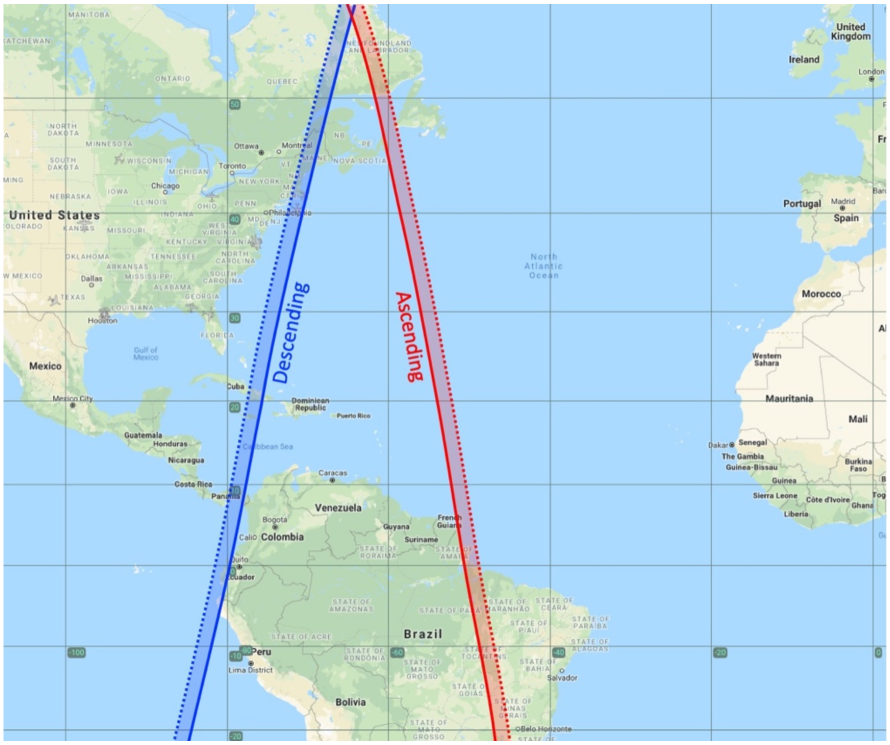

Fig. 1: Sample ADM-Aeolus ascending (red) and descending (blue) satellite passes. The solid lines denote the nadir points directly below the satellite. The dashed curves denote the desired aircraft underflight locations offset 125 n mi (230 km) to the east (ascending orbit) and west (descending orbit) of the satellite nadir.

Flight altitude: 10-12 kft (5 kft is minimum altitude for dropsonde launches).

Leg length or radii: N/A

Estimated in-pattern flight duration: ~20-30 min

Expendable distribution: During the ADM-Aeolus underflight, GPS dropsonde spacing should generally be ~20 n mi (35 km), which will require ~4-8 dropsondes. The sampling frequency can be increased to 10 n mi (20 km) in high gradient areas (e.g., near the TC radius of 34 kt winds or the Saharan Air Layer).

Instrumentation Notes: Use TDR defaults. Use straight flight legs as safety permits. All GPS dropsonde data should be transmitted to the Global Telecommunication System (GTS) in real-time to ensure availability for assimilation into forecast models. For P-3 Module 1, DWL scanning should be as follows:

- P-3 flight level <10,000 kft: set the DWL to a conical scan down 4 and up 1-2 depending on the amount of aerosol above the flight level and will be determined by the Co-PIs.
- P-3 flight level ≥10,000 kft: set the DWL to standard conical, scanning only down.

Note: for DWL upward scans in the "cleaner" environment around the TC, it is not likely that the DWL will provide returns (i.e., provide measurements) above z~7 km.

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G-IV Module 1:

What to Target: Coordinated underflights of the ADM-Aeolus satellite in the environments of tropical disturbances (e.g., African easterly waves, invests, and TCs) and the Saharan air Layer (SAL).

When to Target: G-IV flight patterns will be adjusted to coordinate temporal and spatial overlap with overpasses by the ADM-Aeolus satellite. GPS dropsonde and tail Doppler radar (TDR) sampling should be timed to be ≤30 min and ≤15 n mi (25 km) of collocated ADM-Aeolus wind and aerosol retrievals and will depend on the area of operation (determined on a case-by-case basis).

Pattern: This is a breakaway pattern that involves a straight-line leg that underflies the ADM-Aeolus satellite and requires an offset of 125 n mi (230 km) from nadir (due to the 35^{o} scan angle of the satellite's Aladin lidar instrument). The G-IV leg should ideally begin ~10-15 min before and continue for ~10-15 min after the satellite passes "overhead". This will equate to a G-IV leg length of ~140-210 n mi (260-390 km). NASA's MTS aircraft software should be used to coordinate the underflight.

For ADM-Aeolus satellite *ascending* orbital passes (see Fig. 1):
- ADM-Aeolus crosses the equator (SSE-NNW) at 1800 LST
- G-IV underflight legs will be generally oriented SSE-NNW
- G-IV underflight legs will offset 125 n mi (230 km) to the east of nadir

For ADM-Aeolus satellite *descending* orbital passes (see Fig. 1):
- ADM-Aeolus crosses the equator (NNE to SSW) at 0600 LST
- G-IV underflight legs will be generally oriented NNE-SSW
- G-IV underflight legs will offset 125 n mi (230 km) to the west of nadir

Flight altitude: 40–45 kft or as high as possible to provide better vertical sampling by dropsondes that are deployed.

Leg length or radii: N/A

Estimated in-pattern flight duration: ~20-30 min

Expendable distribution: During the ADM-Aeolus underflight, GPS dropsonde spacing should generally be ~35 n mi (65 km), which will require ~4-6 dropsondes. The sampling frequency can be increased to 15 n mi (30 km) in high gradient areas (e.g., near the TC radius of 34 kt winds or the Saharan Air Layer).

Instrumentation Notes: Use TDR defaults (though not a requirement for this experiment). Use straight flight legs as safety permits. All GPS dropsonde data should be transmitted to the Global Telecommunication System (GTS) in real-time to ensure availability for assimilation into forecast models.