2023 NOAA/AOML/HRD Hurricane Field Program - APHEX

SATELLITE VALIDATION EXPERIMENT
Flight Pattern Description

Experiment/Module: TROPICS Satellite Validation Module

Investigator(s): Brittany Dahl (co-PI), Jason Dunion (co-PI), Rob Rogers (co-PI), Trey Alvey, William Blackwell (MIT, Lincoln Laboratory)

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

Early Stage Science Objective(s) Addressed:

1) Test new (or improved) satellite technologies with the potential to fill gaps, both spatially and temporally, in the existing suite of airborne measurements in TCs. These measurements include improved three-dimensional representation of the hurricane wind field and thermodynamic structure and more accurate measurements of ocean surface winds and underlying ocean conditions [APHEX Goal 2]

P-3 Pattern #1

What to Target: Coordinated underflights of TROPICS satellites in the TC inner core (R ≤ 150 km), near environment (R = 150-300 km), and far environment (R > 300 km).

When to Target: P-3 flight patterns will be adjusted to coordinate temporal and spatial overlap with overpasses by the TROPICS satellite. GPS dropsonde and P-3 tail Doppler radar (TDR) sampling should be timed to be ≤30 min and ≤400 n mi (750 km) from satellite nadir. TROPICS Pathfinder crosses the equator at 1330 LTAN, and constellation satellites are in a low-Earth orbit at a 30° inclination angle. NASA's MTS aircraft software should be used to coordinate the underflight.

Pattern: This is a breakaway pattern that involves a straight-line leg that underflies the TROPICS satellite. The full satellite swath width is ~2000 km, but the highest priority is coverage of nadir and the area within +/- 750 km of nadir. 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). P-3 ferries to and from the storm can also be used to target satellite underflights in the far environment.

Flight altitude: 10-12 kft (5 kft is minimum altitude for dropsonde launches) in the TC inner core and near environment and 20+ kft in the TC far environment

Leg length or radii: N/A

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

Expendable distribution: During the TROPICS underflight, GPS dropsonde spacing should generally be 10 n mi (20 km), which will require ~10-14 dropsondes.

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.

G-IV Pattern #1

What to Target: Coordinated underflights of TROPICS satellites in the TC inner core (R ≤ 150 km), near environment (R = 150-300 km), and far environment (R > 300 km).

When to Target: G-IV flight patterns will be adjusted to coordinate temporal and spatial overlap with overpasses by the TROPICS satellite. GPS dropsonde and P-3 tail Doppler radar (TDR) sampling should be timed to be ≤30 min and ≤400 n mi (750 km) from collocated satellite nadir temperature, and moisture, and precipitation retrievals and will depend on the area of operation (determined on a case-by-case basis). TROPICS crosses the equator at 1330 LTAN, and constellation satellites are in a low-Earth orbit at a 30° inclination angle. NASA's MTS aircraft software should be used to coordinate the underflight.

Pattern: This is a breakaway pattern that involves a straight-line leg that underflies the TROPICS satellite. The full satellite swath width is ~2000 km, but the highest priority is coverage of nadir and the area within +/- 750 km of nadir. 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). G-IV ferries to and from the storm can also be used to target satellite underflights in the far environment.

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 TROPICS underflight, GPS dropsonde spacing should generally be ~10 n mi (20 km), which will require ~14-21 dropsondes.

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.