2021 NOAA/AOML/HRD Hurricane Field Program - APHEX

EARLY STAGE EXPERIMENT
Flight Pattern Description

Experiment/Module: Hurricane Boundary layer (HBL)

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Requirements: TD, TS, Category 1

Early Stage Science Objective(s) Addressed:

1) Collect datasets that can be used to improve the understanding of intensity change processes, as well as the initialization and evaluation of 3-D numerical models, particularly for TCs experiencing moderate vertical wind shear [*APHEX Goals 1, 3*].

2) Collect observations targeted at better understanding internal processes contributing to mature hurricane structure and intensity change [*APHEX Goals 1, 3*].

3) Test new (or improved) technologies with the potential to fill gaps, both spatially and temporally, in the existing suite of airborne measurements in early stage TCs. These measurements include improved three-dimensional representation of the TC wind field, more spatially dense thermodynamic sampling of the boundary layer, and more accurate measurements of ocean surface winds [*APHEX Goal 2*].

P-3 Pattern #1: Rotated Figure-4

What to Target: Sample the inner core and near environments of the TC

When to Target: Any strength TC; no land restrictions. This module complements standard Tail Doppler Radar (TDR) missions.

Pattern: The rotated Figure-4 pattern instead of a single Figure-4 is preferable to better resolve higher (than 1) wavenumber asymmetric structure. It is preferable to fly the pattern as orthogonal pairs of radials as the flight proceeds. The initial (IP) and final (FP) points of the pattern are arbitrary. We will not consider a single Figure-4 pattern for the BL module.

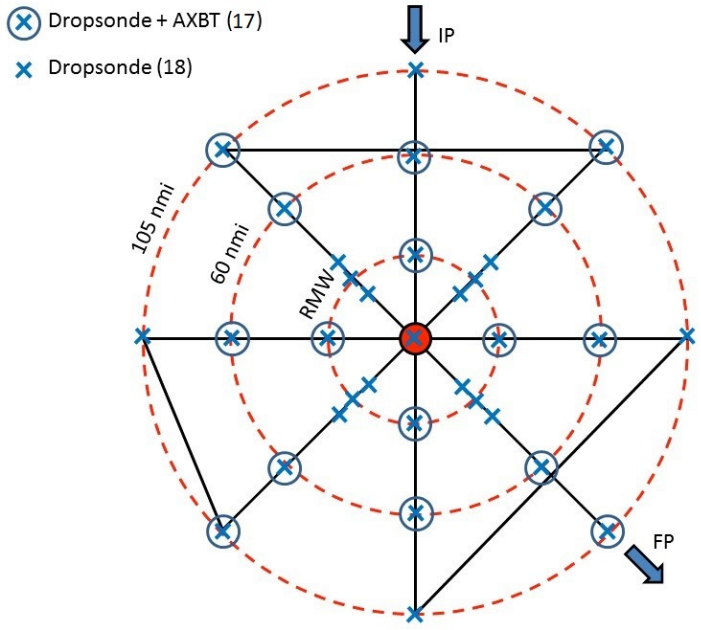

Figure EA-1. *Description of the boundary layer module.*

Flight altitude: 10–12 kft or as high as possible. Either radar or pressure altitude is good.

Leg length or radii: Leg lengths can follow the TDR mission. The standard radial leg length for TDR missions is 105 n mi (195 km), but this can be adjusted as needed for land restrictions and ferry times.

Estimated in-pattern flight duration: See the listing of standard pattern figures in the section entitled "Standard Patterns and Expendable Locations" section. The flight duration is ~ 5 h for a P3 mission.

Expendable distribution: This pattern requires 34 dropsondes and 16 AXBTs. Dropsondes are deployed at 105 n mi and 60 n mi radii, the radius of maximum wind (RMW) along each of 8 radial legs (rotated Figure-4 pattern), and storm center. On 4 of the 8 passes across the RMW, rapid deployment (~1 min spacing) of 3 dropsondes is requested. Center drops are requested on the initial and final pass through the eye. AXBT (17 total) deployments are paired with dropsondes at the indicated locations. The number of AXBTs can be reduced to 4 if IRsondes are used in the storm center and outside the RMW. Optionally, small uncreweed aircraft systems (sUAS) can be utilized in conjunction with these instruments to augment the boundary layer measurements from AXBTs and dropsondes (see RICO SUAVE experiment).

Instrumentation Notes: Use TDR defaults. Use straight flight legs as safety permits.

P-3 Pattern #2: Butterfly

What to Target: Sample the inner core and near environments of the TC

When to Target: Any strength TC; no land restrictions. This module complements standard Tail Doppler Radar (TDR) missions.

Pattern: Butterfly pattern. The initial (IP) and final (FP) points of the pattern are arbitrary.

Flight altitude: 10–12 kft or as high as possible. Either radar or pressure altitude is good.

Leg length or radii: Leg lengths can follow the TDR mission. The standard radial leg length for TDR missions is 105 n mi (195 km), but this can be adjusted as needed for land restrictions and ferry times.

Estimated in-pattern flight duration: See the listing of standard pattern figures in the section entitled "Standard Patterns and Expendable Locations" section. The total duration is ~ 3 h 25 min for a P3 mission with Butterfly pattern.

Expendable distribution: This module requires 21 dropsondes and 12 AXBTs. Dropsondes are deployed at the storm center, 105 n mi radii (i.e., end point), the radius of maximum wind (RMW), and the mid-point between the RMW along each of 6 radial legs (Butterfly pattern). Center drops are requested on the initial and final pass through the eye. AXBT (12 total) deployments are paired with dropsondes at the RMW and mid-point along each of 6 radial legs. The number of AXBTs can be reduced to 4 if IRsondes are used outside the RMW. Optionally, small uncreweed aircraft systems (sUAS) can be utilized in conjunction with these instruments to augment the boundary layer measurements from AXBTs and dropsondes (see RICOSUAVE experiment).

Instrumentation Notes: Use TDR defaults. Use straight flight legs as safety permits.

P-3 Pattern #3: Circumnavigation

What to Target: Sample the inner core and near environments of the TC

When to Target: Any strength TC; no land restrictions. This module complements standard Tail Doppler Radar (TDR) missions.

Pattern: P3 Circumnavigation pattern. The initial (IP) and final (FP) points of the pattern are arbitrary.

Flight altitude: 10–12 kft or as high as possible. Either radar or pressure altitude is good.

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Leg length or radii: Leg lengths can follow the TDR mission. The standard radial leg length for TDR missions is 105 n mi (195 km), but this can be adjusted as needed for land restrictions and ferry times.

Estimated in-pattern flight duration: See the listing of standard pattern figures in the section entitled "Standard Patterns and Expendable Locations" section. The total duration is ~ 4 h 5 min for a P3 mission.

Expendable distribution: This module requires 21 dropsondes and 8 AXBTs. Dropsondes are deployed at the storm center of first pass, the end points of Figure-4 (105 n mi), vertices of octagon and the radius of maximum wind (RMW). Center drops are requested on the initial and final pass through the eye. AXBT (12 total) deployments are paired with dropsondes at vertices of octagon flight path and at the RMW. The number of AXBTs can be reduced to 4 if IRsondes are used outside the RMW. Optionally, small uncreweed aircraft systems (sUAS) can be utilized in conjunction with these instruments to augment the boundary layer measurements from AXBTs and dropsondes (see RICOSUAVE experiment).

Instrumentation Notes: Use TDR defaults. Use straight flight legs as safety permits.