2022 NOAA/AOML/HRD Hurricane Field Program - APHEX

MATURE STAGE EXPERIMENT
Flight Pattern Description

Experiment/Module: Eye-Eyewall Mixing

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Requirements: Categories 2–5

Mature Stage Science Objective(s) Addressed:

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

2) Test new (or improved) technologies with the potential to fill gaps, both spatially and temporally, in the existing suite of airborne measurements in mature hurricanes. These measurements include improved three-dimensional representation of the hurricane 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:

What to Target: This module requires a category-4 or category-5 TC with a clearly defined, visible eye and closed eyewall.

When to Target: The module can be included within any missions during aircraft passage through the eye.

Pattern: The purpose of this pattern is to gather Doppler radar data in the eyewall at an approximately constant sampling rate in the search for low-level small-scale features, and to track these features as they move rapidly around the eye. It is a break-away pattern that is compatible with any standard pattern with an eye passage (all P-3 patterns except the Square spiral or Lawnmower). The eye must be large enough for the P-3 to safely perform circles within the eye. The P-3 will penetrate the eyewall at the standard-pattern altitude. Once inside the eye, the P-3 will perform at least three clockwise or counter-clockwise orbits of the eye at an approximately constant bank with the flight-level circulation center within the orbits. The size of all the orbits will be the same, and should allow for the completion of each orbit approximately every 6 min, 7.5 min, or 10 min (circle diameter about 7-13 n mi depending on ground speed) at crew discretion. The flight level of the orbits can be adjusted for safety considerations at the pilot's discretion. If a center fix is required, this pattern can be done either before or after the center fix.

Flight altitude: The flight altitude will largely be the same as the standard pattern altitude, but can be adjusted for safety reasons.

Leg length or radii: The P-3 will circumnavigate the eye at least three times with consistent orbit size allowing for completion of each circle every 6, 7.5, or 10 min.

Estimated in-pattern flight duration: Depending upon the size of the eye, this pattern should take between 0.25 and 0.5 h.

Expendable distribution: No expendables required.

Instrumentation Notes: It is highly desirable, though not required, that an sUAS be conducting an Eyewall/Radius of Maximum Winds Module while this pattern is being executed.

P-3 Pattern #2:

What to Target: This module requires a category-4 or category-5 TC with a clearly defined, visible eye, closed eyewall, and inversion and an eye diameter of at least 30 n mi.

When to Target: The module should only be attempted during daytime missions. It can be included within any missions during aircraft passage through the eye.

Pattern: The purpose of this pattern is to search for small-scale features near the eyewall at flight level and at low levels directly below the aircraft at or near the surface radius of maximum wind speed. It is a break-away pattern that is compatible with any standard pattern with an eye passage (all P-3 patterns except the Square spiral or Lawnmower). The eye must be ≥ 25 n mi in diameter, and for asymmetric or non-circular eyes, the narrowest cross section from eyewall to eyewall must be ≥ 25 n mi. Additionally, a constant separation distance of 2-5 n mi from the inner edge of the eyewall should be maintained; the separation distance will be selected based on the flight level and eye size and will be determined in real-time by the LPS in consultation with aircraft crew. The P-3 will penetrate the eyewall at the standard-pattern altitude. Once inside the eye, the P-3 will maintain the flight level of the main mission and perform a single orbit (in either a clockwise or counter-clockwise direction) of the eye with a separation distance of at least 2 n mi from the edge of the eyewall. Neither straight flight legs nor a constant bank are required for this pattern; it is most important to try to keep a nearly constant distance from the radar eyewall during the pattern. The flight level of the orbit can be adjusted for safety considerations at the pilot's discretion. If a center fix is required, this pattern can be done either before or after the center fix.

Flight altitude: The flight altitude will largely be the same as the standard pattern altitude, but can be adjusted for safety reasons.

Leg length or radii: The P-3 will circumnavigate the eye about 2 n mi from the edge of the eyewall.

Estimated in-pattern flight duration: Depending upon the size of the eye, this pattern should take between 0.25 and 0.5 h.

Expendable distribution: No expendables required.

Instrumentation Notes: This module should be performed using the aircraft on which either the IWRAP and/or a lidar is available. It is highly desirable, though not required, that an sUAS be conducting an Eyewall/Radius of Maximum Winds Module while this pattern is being executed.

P-3 Pattern #3:

What to Target: Any category-4 or category-5 hurricane with a well-defined eyewall.

When to Target: During any transit across what is believed to be the strongest region of the eyewall.

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Pattern: The pattern will not deviate from the regular eyewall penetration during any mission.

Flight altitude: A regular altitude for the main purpose of the flight.

Leg length or radii: N/A

Estimated in-pattern flight duration: This module does not add any time to the mission.

Expendable distribution: Dropwindsondes will be dropped as quickly as possible across the wind-speed maximum of the eyewall. The dropwindsondes should be space as close together as possible, though releases should be at least 2 s apart. *The goal is to have the second-outermost dropwindsonde to be coincident with the flight-level radius of maximum wind speed, and the second-innermost dropwindsonde to be coincident with the surface radius of maximum wind speed.*

Instrumentation Notes: The goal is to have as many dropwindsondes as possible in the air at the same time to investigate the structure of an individual miso- or meso-scale vortex.