2023 NOAA/AOML/HRD Hurricane Field Program - APHEX

GENESIS STAGE EXPERIMENT
Flight Pattern Description

Experiment/Module: Precipitation during Formation and Observing its Response across Multiple Scales (PREFORM)

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Requirements: Pre-genesis disturbances (pre-TDs), including NHC-designated "Invests"

Genesis Stage Science Objective(s) Addressed:

The overarching objective is to investigate if a pre-genesis disturbance has matured into a TC, including the organization of convection and the development of a closed low-level circulation.

1) To investigate the precipitation modes that are prevalent during the genesis stage and the response of the vortex to that precipitation organization [*APHEX Goal 3*].
2) To investigate the favorability in both dynamics (e.g., vertical wind shear) and thermodynamics (e.g., moisture) for tropical cyclogenesis in the environment near a pre-TD, especially the downstream environment [*APHEX Goal 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 tropical disturbances that are in the pre-genesis or genesis stage. These measurements include improved three-dimensional representation of the tropical disturbance/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:

What to Target: Sample the mesoscale convective burst area and any accompanying midlevel circulation of a pre-TD or "Invest". If midlevel circulation is identified in TDR analysis or is clearly identified on satellite, center subsequent patterns as best as possible to that location (accounting for translation speed, if possible to determine)

When to Target: Every 12 h [*optimal*] or 24 h [*minimal*], preferably in coordination with a corresponding G-IV or higher-altitude P-3 mission flying the circulation environment (i.e., P-3 Pattern #2, P-3 Pattern #3, G-IV Pattern #1, or G-IV Pattern #2) (see Figure PREFORM-1 for an example pattern)

Pattern: Standard, single Figure-4 that is repeated (rotated Fig. 4, if the only aircraft flying the disturbance)

Flight altitude: 10–12 kft, either radar or pressure altitude, if coordinated with other P-3 (P-3 Pattern #2) or G-IV (G-IV Pattern #1); otherwise, at least 20 kft if only airplane flying the disturbance

Leg length or radii: Adjusted for the size of the precipitating area, but no more than 105 n mi / 195 km. If the only NOAA aircraft sampling the disturbance, fly full 105 n mi legs, and rotate.

Estimated in-pattern flight duration: ~ 4–5 h [for repeated Single Figure-4]

Expendable distribution: Dropsondes at end points, center

Instrumentation Notes: Use straight flight legs as safety permits. Inbound-outbound passes should be uninterrupted.

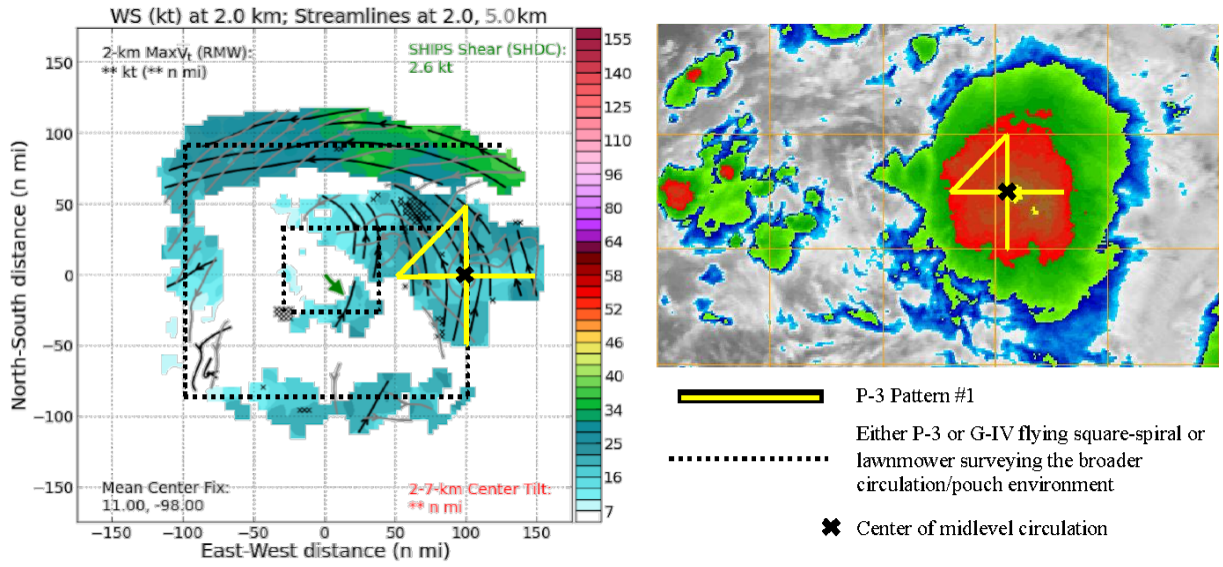

Figure PREFORM-1. Examples of P-3 Pattern #1 (yellow lines) and P-3 Pattern #3 (or G-IV Pattern #2) (black dotted lines) overlaid on a (left) tail Doppler radar composite analysis of 2 km (black) and 5 km (gray) streamlines and 2 km windspeed (shaded), and (right) IR imagery of the mesoscale convective system where P-3 Pattern #1 is sampling. The overlap between the survey pattern and P-3 Pattern #1 will depend on how well the low-level and the midlevel circulations associated with the MCS are aligned.

P-3 Pattern #2:

What to Target: The wave that also encompasses organized convection, especially the area that is observed by P-3 Pattern #1, if flown

When to Target: Every 12 h [*optimal*] or 24 h [*minimal*], preferably in coordination with a corresponding P-3 mission flying precipitation in P-3 Pattern #1

Pattern: Standard Lawnmower; extend east-west legs an additional degree longitude (~3° longitude total), spaced 0.6° apart, with option to modify to 0.5–0.75° separation for better TDR coverage

Flight altitude: At least 20 kft, radar altitude (with a preference for as high of an altitude as feasible)

Leg length or radii: 180 n mi (333 km) east-west legs (modified from standard)

Estimated in-pattern flight duration: ~ 5 h

Expendable distribution: Modify standard dropsonde locations for Lawnmower by having 6 drops equally spaced on each east-west leg (~0.6° spacing) for 36 total drops in the Lawnmower. As a minimum requirement, 5 drops equally spaced on each east-west leg (~0.75° spacing) for 25 total drops.

Instrumentation Notes: None

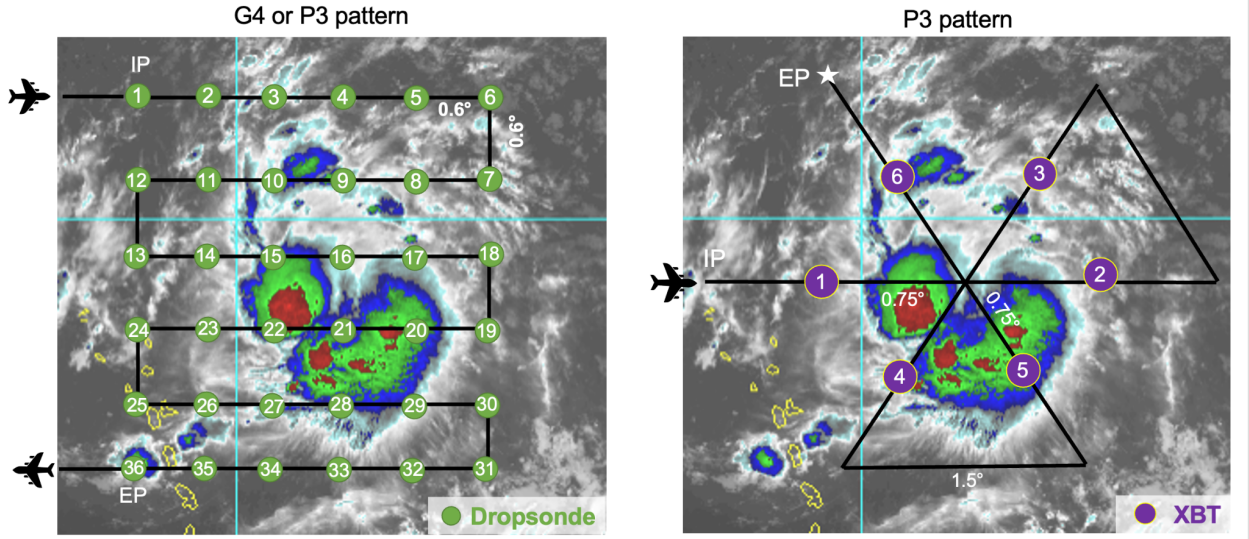

Figure PREFORM-2. Thermodynamic Precursors of Intensity Change module (TPIC) flight pattern. Examples of P-3 Pattern #2 (or G-IV Pattern #1) (black lines) overlaid on a IR imagery of the mesoscale convective system where P-3 Pattern #2 (or G-IV Pattern #1) is sampling. (right) The corresponding P3 pattern #3 that releases AXBT in the middle of each inbound/outbound leg.

P-3 Pattern #3:

What to Target: The wave that sampled by P-3 Pattern #2 or G-4 Pattern #2, if flown

When to Target: Every 12 h [*optimal*] or 24 h [*minimal*]

Pattern: Standard Butterfly, and can be adjusted to be oriented such that the upshear (focusing on dry air intrusion) or downshear (focusing on asymmetric precipitation) quadrants contain the most radial legs. Can be centered on the low-level or mid-level center. Each inbound/outbound leg of 90 n mi (166 km) (see the right panel of Figure PREFORM-2 for an example pattern).

Flight altitude: 10–12 kft, either radar or pressure altitude

Leg length or radii: N/A

Estimated in-pattern flight duration: ~ 4-5 h

Expendable distribution: If coinciding G-IV Pattern #2 or P-3 Pattern #3, modify standard by moving the midpoint dropsonde to half of the G-IV or P-3 zonal leg (~0.75°). Dropsondes at mid- and turn points and center, for 12–15 dropsondes total. AXBTs preferably paired with dropsondes at midpoints of each inbound/outbound leg with the length of 1.5°, for 6 total AXBT (see the right panel of Figure PERFORM-2).

Instrumentation Notes: Use TDR defaults. Use straight flight legs as safety permits. Inbound-outbound passes should be uninterrupted

P-3 Pattern #4:

What to Target: The wave disturbance, when the center is better defined

When to Target: Every 12 h [*optimal*] or 24 h [*minimal*]

Pattern: Standard Square-spiral, spaced 1° apart, with option to modify to 0.5–0.75° separation for better TDR coverage (see Figure PREFORM-1 for an example pattern)

Flight altitude: At least 20 kft

Leg length or radii: N/A

Estimated in-pattern flight duration: ~ 5 h 50 min

Expendable distribution: Modify standard dropsonde locations for the Square-spiral by having dropsonde at ~1° spacing, for 26 total drops in square-spiral; also, optionally 3 drops, one every 1°, prior to arrival at IP and after exiting the pattern.

Instrumentation Notes: None

G-IV Pattern #1:

What to Target: The wave that also encompasses organized convection, especially the area that is observed by P-3 Pattern #1, if flown

When to Target: Every 12 h [*optimal*] or 24 h [*minimal*], preferably in coordination with a corresponding P-3 mission flying precipitation in P-3 Pattern #1

Pattern: As with the P-3 Pattern #2, modified Lawnmower; extend east-west legs an additional degree longitude (~3° longitude total), spaced 0.6° apart, with option to modify to 0.75° separation depending on the availability of dropsondes.

Flight altitude: 40–45 kft

Leg length or radii: 180 n mi (333 km) east-west legs (modified from standard)

Estimated in-pattern flight duration: ~ 4 h

Expendable distribution: Modify standard dropsonde locations for Lawnmower by having 6 (5) drops equally spaced of 0.6° (or 0.75°) on each east-west leg for 36 (25) total drops.

Instrumentation Notes: None

G-IV Pattern #2:

What to Target: The wave disturbance, when the center is better defined

When to Target: Every 12 h [*optimal*] or 24 h [*minimal*]

Pattern: Standard Square-spiral, spaced 1° apart, with option to modify to 0.5–0.75° separation for better TDR coverage (see Figure PREFORM-1 for an example pattern)

Flight altitude: 40–45 kft

Leg length or radii: N/A

Estimated in-pattern flight duration: ~ 3 h 20 min

Expendable distribution: Modify standard dropsonde locations for the Square-spiral by having a dropsonde at ~1° spacing, for 26 total drops in square-spiral; also, optionally 3 drops, one every 1°, prior to arrival at IP and after exiting the pattern.

Instrumentation Notes: None