2020 NOAA/AOML/HRD Hurricane Field Program - IFEX

GENESIS STAGE EXPERIMENT
Flight Pattern Descriptions

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

Investigator(s): Jon Zawislak (Co-PI), Ghassan Alaka (Co-PI), Rob Rogers (Co-PI), Jason Dunion, Paul Reasor, Mark Boothe (Naval Postgraduate School, NPS), Michael Montgomery (NPS), Tim Dunkerton (Northwest Research Associates, NWRA), Blake Rutherford (NWRA)

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 [*IFEX Goal 3*].
2) To investigate the importance of the pouch, including the shear sheath, which tends to indicate a tropical storm, and its relationship to a low-level circulation and organized deep convection within the pouch [*IFEX Goal 3*].
3) 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 [*IFEX Goal 3*].
4) 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 [*IFEX 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 pouch/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 or G-IV (P-3 Pattern #2, 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. DWL (if onboard) should be downward looking, 20° off nadir.

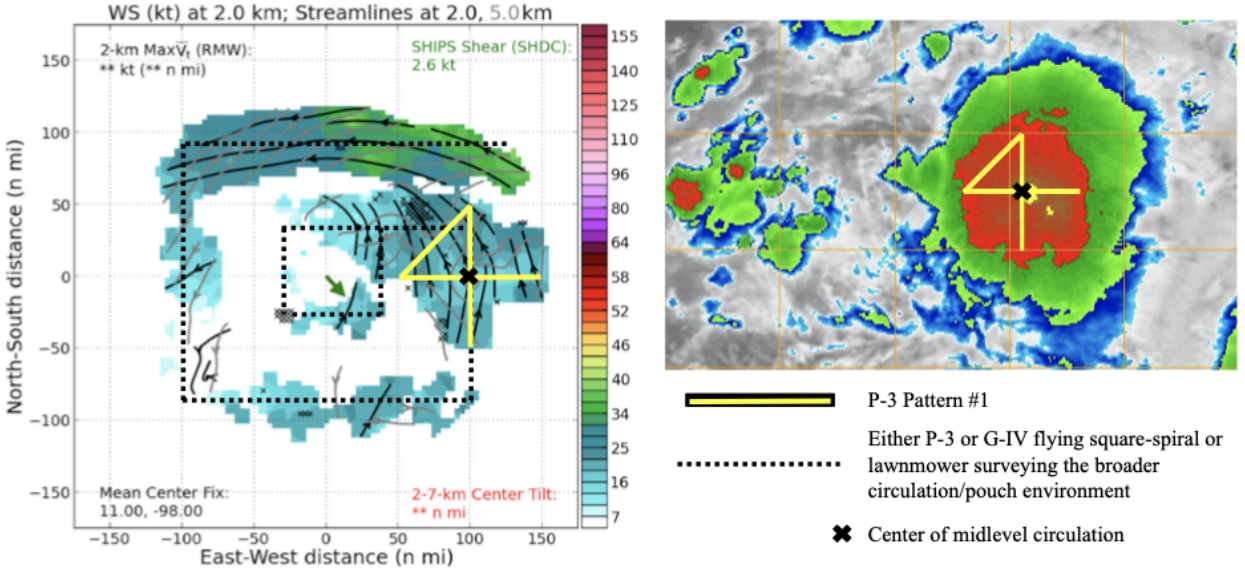

Figure PREFORM-1. Examples of P-3 Pattern #1 (yellow lines) and P-3 Pattern #3 (or G-IV Pattern #2) (black dotted lines) overlaid on a (left) tail Doppler radar composite analysis of 2 km (black) and 5 km (gray) streamlines and 2 km windspeed (shaded), and (right) IR imagery of the mesoscale convective 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 circulation/pouch and the midlevel circulation associated with the MCS are aligned.

P-3 Pattern #2:

What to Target: The wave-pouch 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 (~5 deg. longitude total), spaced 1 degree apart, with option to modify to 0.5-0.75 degree separation for better TDR coverage

Flight altitude: At least 20 kft, radar altitude

Leg length or radii: 300 n mi (555 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 (~1 deg. spacing) for 24 total drops in the Lawnmower; also optionally 3 drops, one every 1 deg., inbound prior to arrival at IP and heading outbound after exiting the pattern.

Instrumentation Notes: None

P-3 Pattern #3:

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

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

Pattern: Standard Square-spiral, spaced 1 degree apart, with option to modify to 0.5-0.75 degree 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 a dropsonde at ~1 deg. spacing, for 26 total drops in square-spiral; also optionally 3 drops, one every 1 deg., prior to arrival at IP and after exiting the pattern.

Instrumentation Notes: None

G-IV Pattern #1:

What to Target: The wave-pouch 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 (~5 deg. longitude total), spaced 1 degree apart, with option to modify to 0.5-0.75 degree separation for better TDR coverage

Flight altitude: 40-45 kft

Leg length or radii: 300 n mi (555 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 drops equally spaced on each east-west leg (~1 deg. spacing) for 24 total drops in the Lawnmower; also optionally 3 drops, one every 1 deg., inbound prior to arrival at IP and heading outbound after exiting the pattern.

Instrumentation Notes: None

G-IV Pattern #2:

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

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

Pattern: Standard Square-spiral, spaced 1 degree apart, with option to modify to 0.5-0.75 degree 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 deg. spacing, for 26 total drops in square-spiral; also optionally 3 drops, one every 1 deg., prior to arrival at IP and after exiting the pattern.

Instrumentation Notes: None