2024 NOAA/AOML/HRD Hurricane Field Program - APHEX

MATURE STAGE EXPERIMENT
Flight Pattern Description

Experiment/Module: Ventilation Module

Investigator(s): Brian Tang (UAlbany), Jun Zhang, Kristen Corbosiero (UAlbany), Rosimar Rios-Berrios (NCAR)

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) Collect observations targeted at better understanding the response of mature hurricanes to their changing environment, including changes in vertical wind shear, moisture and underlying oceanic conditions [*APHEX Goals 1, 3*].

P
-3 Pattern #1

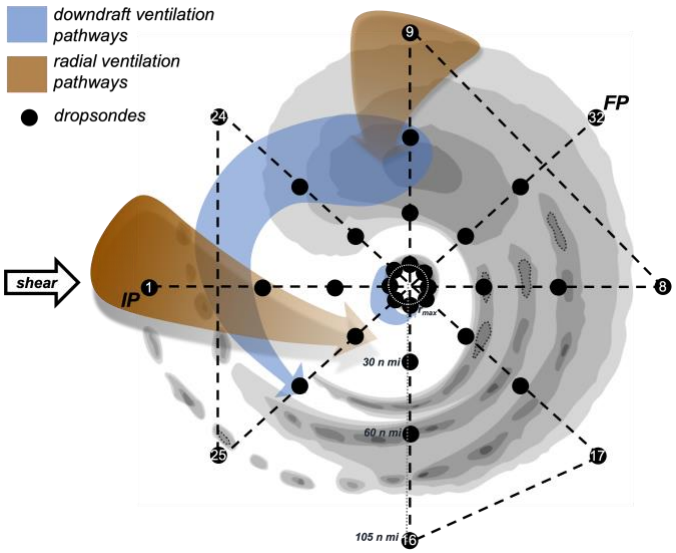

Fig. 1. *P-3 Pattern #1 (rotated figure-4) for a TC in westerly shear. Background illustration of reflectivity adapted from Hence and Houze (2012).*

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

When to Target: TCs in moderate shear that are tilted. Preference, although not critical, to have this pattern flown as close in time as possible to G-IV Pattern #1.

Pattern: Rotated figure-4 (see Fig. 1), oriented such that the passes are aligned relative to the shear (e.g., upshear to downshear, left-of-shear to right-of-shear, downshear-right to upshear-left, and upshear-right to downshear-left) and centered on the low-level center. Alternatively, passes can be oriented relative to the vortex tilt. The initial point (IP) and final point (FP) are arbitrary.

Flight altitude: 10–12 kft, either radar or pressure altitude; potentially up to 20 kft, if hazard avoidance possible

Leg length or radii: 105 n mi (195 km)

Estimated in-pattern flight duration: ~5 h

Expendable distribution: This pattern requires 32 dropsondes. For each leg, release dropsondes at 105 n mi (end point), 60 n mi, 30 n mi, and radius of maximum wind (RMW).

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

P-3 Pattern #2

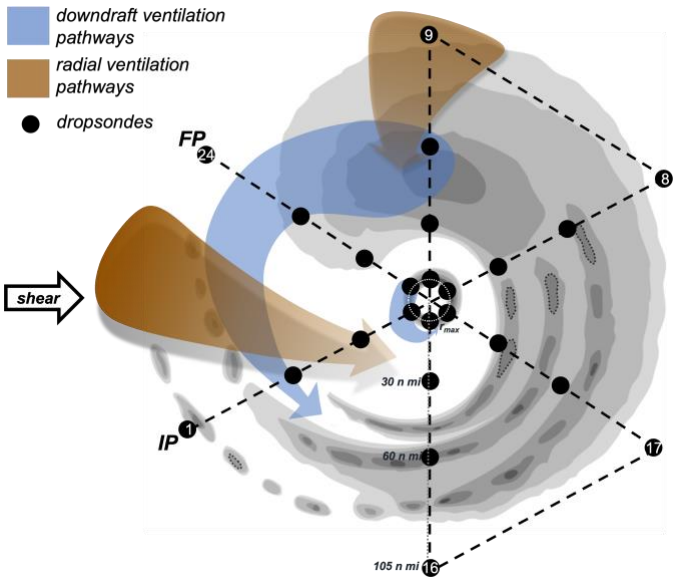

Fig. 2. *P-3 Pattern #2 (butterfly) for a TC in westerly shear.*

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

When to Target: TCs in moderate shear that are tilted. Preference, although not critical, to have this pattern flown as close in time as possible to G-IV Pattern #1.

Pattern: Butterfly pattern (Fig. 2), oriented such that the passes are aligned relative to the shear (e.g., upshear-right to downshear-left, left-of-shear to right-of-shear, and downshear-right to upshear-left) and centered on the low-level center. Alternatively, passes can be oriented relative to the vortex tilt. The initial point (IP) and final point (FP) are arbitrary.

Flight altitude: 10–12 kft, either radar or pressure altitude; potentially up to 20 kft, if hazard avoidance possible

Leg length or radii: 105 n mi (195 km)

Estimated in-pattern flight duration: ~3 h 25 min

Expendable distribution: This pattern requires 24 dropsondes. For each leg, release dropsondes at 105 n mi (end point), 60 n mi, 30 n mi, and RMW.

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

P-3 Pattern #3

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

When to Target: TCs in moderate shear that are tilted. Preference, although not critical, to have this pattern flown as close in time as possible to G-IV Pattern #1.

Pattern: Circumnavigation pattern with the figure-4 oriented along shear and cross shear. Alternatively, the figure-4 may be oriented relative to the vortex tilt. The initial point (IP) and final point (FP) are arbitrary.

Flight altitude: 10–12 kft, either radar or pressure altitude; potentially up to 20 kft, if hazard avoidance possible

Leg length or radii: 105 n mi (195 km)

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

Expendable distribution: This pattern requires 18 dropsondes. Dropsondes are released at standard pattern locations with added dropsondes released at the RMW.

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

G-IV Pattern #1

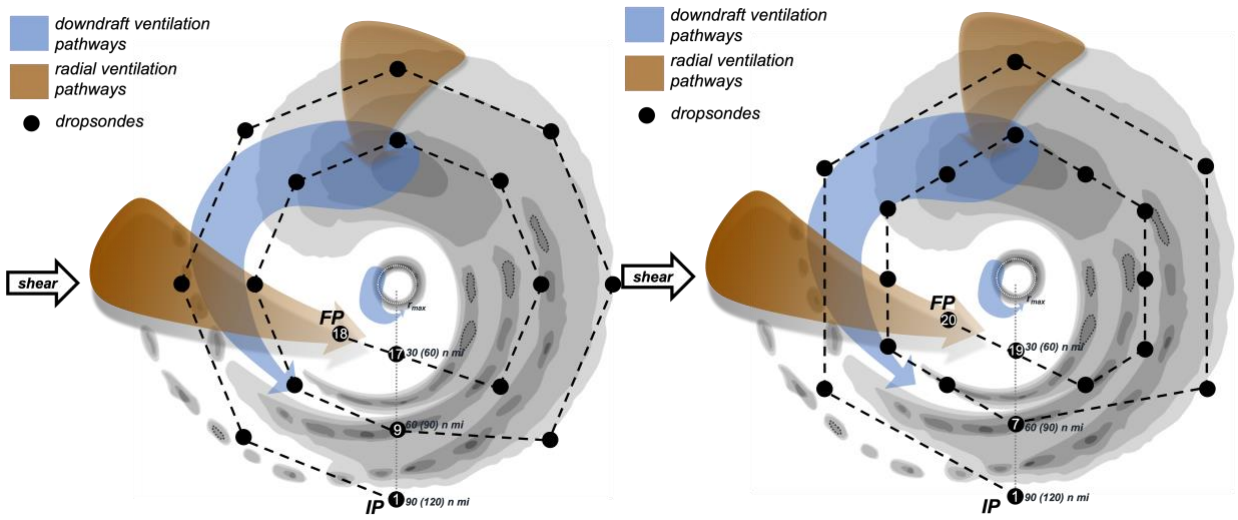

Fig. 3. *G-IV Pattern #1 (double circumnavigation with right-of-shear leg) for a TC in westerly shear. Left figure shows octagonal pattern, and right figure shows hexagonal pattern. For Plan B (see leg length or radii section below), use radii in parentheses.*

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

When to Target: TCs in moderate shear that are tilted. Preference, although not critical, to have this pattern flown as close in time as possible one of the P-3 patterns above.

Pattern: Double circumnavigation pattern centered on the low-level center (Fig. 3). Preference is for IP to be to the right of the shear (e.g., south side of the storm for westerly shear), so that upshear-right to downshear-left portions of the circumnavigations are continuous. Preference for octagonal pattern but may be flown with hexagonal pattern. If time allows and hazards can be avoided, add leg on the right-of-shear side from the last inner circumnavigation point to the FP upshear-right of the center.

Flight altitude: 40–45 kft

Leg length or radii:
Plan A (if safety permits)
The outer circumnavigation is at 90 n mi (167 km) from the center. The inner circumnavigation is at 60 n mi (111 km). The right-of-shear leg, from the last inner circumnavigation point to the FP at ~30 n mi (56 km) upshear-right of the center, has a length of ~70 n mi (130 km).

Plan B
The outer circumnavigation is at 120 n mi (222 km) from the center. The inner circumnavigation is at 90 n mi (167 km). The right-of-shear leg, from the last inner circumnavigation point to the FP at ~60 n mi (111 km) upshear-right of the center, has a length of ~105 n mi (194 km).

Estimated in-pattern flight duration: ~2.5 h for Plan A; ~3.25 h for Plan B

Expendable distribution: This pattern requires 18 dropsondes for an octagonal pattern and 20 dropsondes for a hexagonal pattern. For the circumnavigations, release a dropsonde at each turn point (vertex). For the hexagonal pattern, also release a dropsonde at midpoints between vertices for the inner circumnavigation. For the right-of-shear leg, release dropsondes at the right-of-shear point and upshear-right point.

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