

**MATURE STAGE EXPERIMENT**  
*Flight Pattern Description*

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**Experiment/Module:** Ventilation Module

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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) 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**

**What to Target:** Sample the stationary band complex and region adjacent to the eyewall outer edge.

**When to Target:** TCs in moderate shear and TCs that have substantial dry air in the vicinity. Preference is to have sampling in all quadrants at roughly equal radii. Optimal 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 end point (EP) are arbitrary.

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

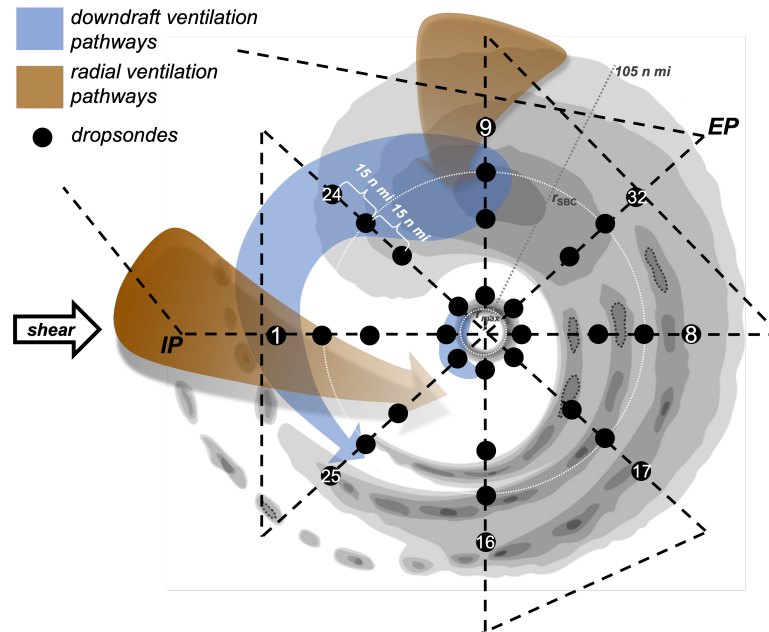
**Leg length or radii:** 105 n mi (195 km)

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

**Expendable distribution:** This pattern requires 32 dropsondes. For each leg, release dropsondes at the radius of the stationary band complex ( $r_{\text{SBC}}$ ) and  $r_{\text{SBC}} \pm 15$  n mi (28 km), where the 15 n mi spacing between dropsondes can be adjusted based on the width of the stratiform rainband. Additionally, release a dropsonde just outside the eyewall, nominally at 5 n mi (9 km) outside the radius of maximum wind ( $r_{\text{max}}$ ).

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

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

**P-3 Pattern #2**

**What to Target:** Sample the stationary band complex and region adjacent to the eyewall outer edge.

**When to Target:** TCs in moderate shear and TCs that have substantial dry air in the vicinity. Preference is to have sampling in all quadrants at roughly equal radii. Optimal 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 end point (EP) are arbitrary.

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

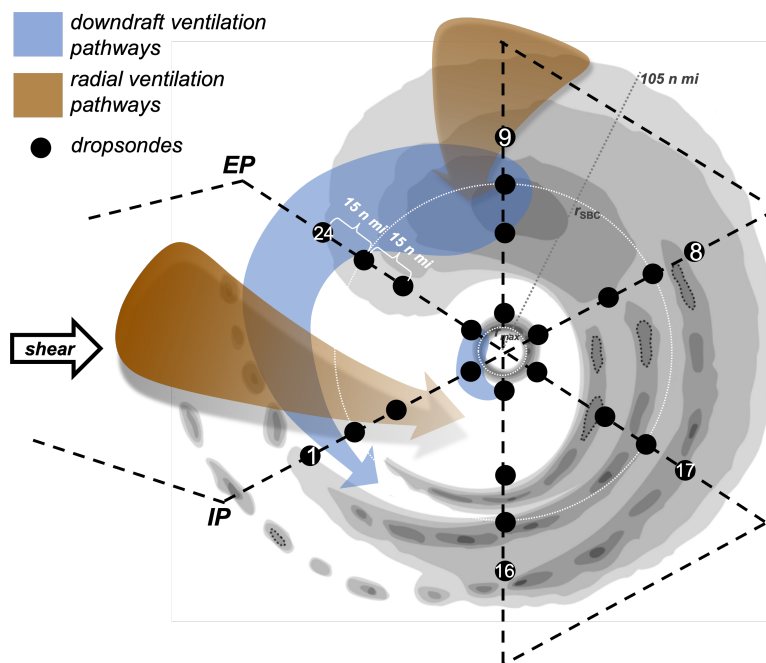
**Leg length or radii:** 105 n mi (195 km)

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

**Expendable distribution:** This pattern requires 24 dropsondes. For each leg, release dropsondes at the radius of the stationary band complex ( $r_{SBC}$ ) and  $r_{SBC} \pm 15$  n mi (28 km), where the 15 n mi spacing between dropsondes can be adjusted based on the width of the stratiform rainband. Additionally, release a dropsonde just outside the eyewall, nominally at 5 n mi (9 km) outside the radius of maximum wind ( $r_{max}$ ).

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



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

**G-IV Pattern #1**

**What to Target:** Sample the near environment, stationary band complex, and upshear-right inner core.

**When to Target:** TCs in moderate shear and TCs that have substantial dry air in the vicinity. Preference is to have sampling in all quadrants at roughly equal radii. Optimal to have this pattern flown as close in time as possible to P-3 Pattern #1 or #2.

**Pattern:** Double circumnavigation (octagonal) pattern centered on the low-level center (Fig. 3). Optimal to have downshear-left to upshear-right portions of the circumnavigations be continuous. If time allows and hazards can be avoided, add inward and outward legs.

**Flight altitude:** 40–45 kft

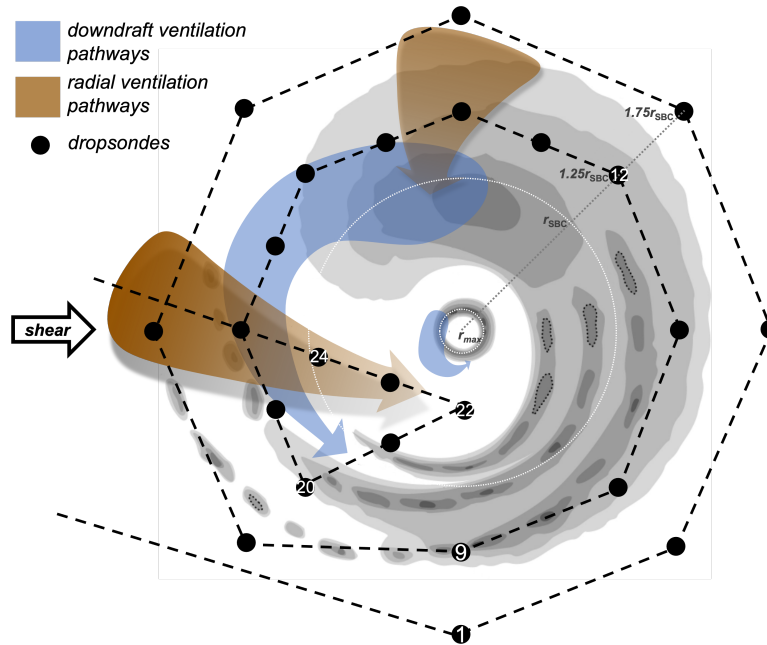
**Leg length or radii:** The outer circumnavigation is at a constant radius of  $1.75 \times r_{SBC}$ , or nominally 90 n mi (145 km) if  $r_{SBC}$  is unknown. The inner circumnavigation is at  $1.25 \times r_{SBC}$ , or nominally 60 n mi (97 km) if  $r_{SBC}$  is unknown. The inner radius can be adjusted outward to avoid hazards if needed. The inward leg is to the right-of-shear point midway between  $r_{max}$  and  $r_{SBC}$ , having a nominal leg length of 45 n mi (73 km). The outward leg is to the upshear vertex of the inner circumnavigation, having a nominal leg length of 65 n mi (105 km). These legs may be adjusted to avoid hazards if needed.

**Estimated in-pattern flight duration:** ~2.5 h

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**Expendable distribution:** This pattern requires 24 dropsondes. For the circumnavigations, release a dropsonde at each turn point (vertex). Additionally, for the inner circumnavigation, release a dropsonde at midpoints between vertices from downshear-left to upshear-right. For the inward and outward legs, release dropsondes every ~20 n mi (37 km).

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



**Fig. 3.** G-IV Pattern #1 (double circumnavigation with offset inward and outward legs) for a TC in westerly shear.