

# 2020 NOAA/AOML/HRD Hurricane Field Program - IFEX

## OCEAN SURVEY EXPERIMENT *Flight Pattern Descriptions*

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**Experiment/Module:** Ocean Survey Experiment

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**Requirements:** Categories 1–5

**Ocean Survey Science Objective(s) Addressed:**

- 1) Collect observations targeted at better understanding air-sea interaction processes contributing to hurricane structure and intensity change. [*IFEX Goals 1, 3*]
- 2) Collect observations targeted at better understanding the response of hurricanes to changes in underlying ocean conditions, including changes in sea surface temperature, ocean mixed layer depth, turbulent mixing and ocean heat content [*IFEX Goals 1, 3*]

**P-3 Pattern #1 (Pre-storm):**

**What to Target:** Region before storm passage based NHC's best track

**When to Target:** 48 hours prior to forecast arrival of the TC over the operating area

**Pattern:** Lawnmower, as in Fig. OC-1

**Flight altitude:** 6–8 kft preferable

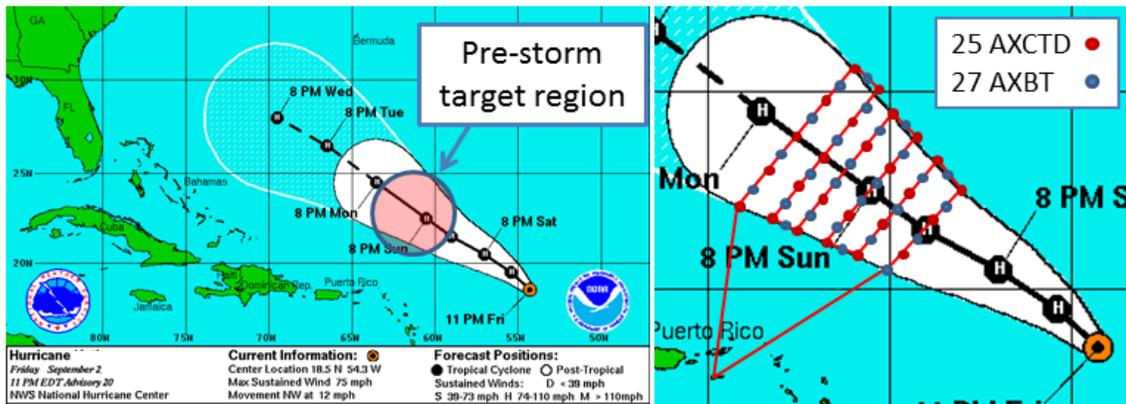
**Leg length or radii:** 105 n mi (195 km)

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

**Expendable distribution:** 50–60 aircraft ocean expendables (AXBTS/AXCTDs) spaced approximately 0.5 deg. apart. AXCP probes may be included if significant gradients (and thus currents) are expected to be observed.

**Instrumentation Notes:** Use straight flight legs as safety permits

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**Figure OC-1:** Left: NHC official forecast track, which pre-storm ocean sampling region highlighted. Target region is centered ~48 hours prior to forecast arrival of storm. Right: P-3 flight track (red line) and ocean sampling pattern consisting of a grid of AXCTD/AXBT probes. Probes are deployed at ~0.5 deg. intervals.

**P-3 Pattern #2 (In-storm):**

**What to Target:** Sample the *core region* of a TC

**When to Target:** No constraint

**Pattern:** Standard Rotated Figure-4, as in Fig. OC-2

**Flight altitude:** 10 kft preferable

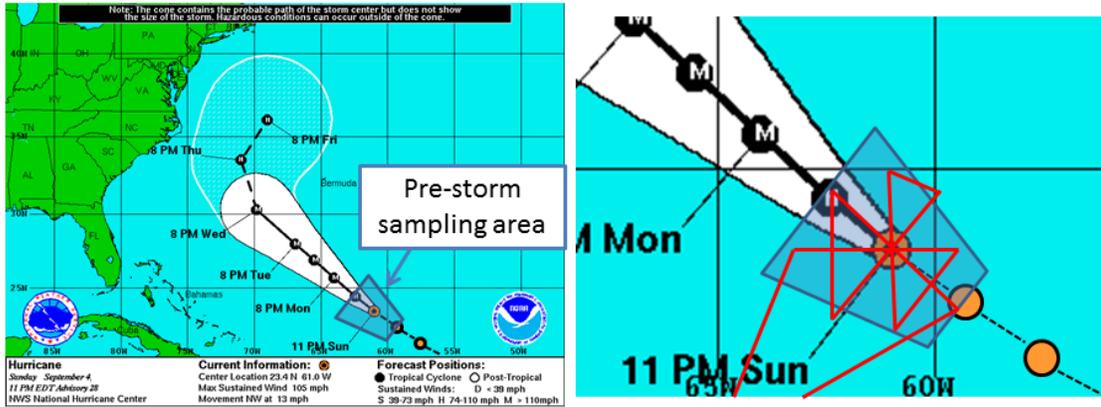
**Leg length or radii:** 105 n mi (195 km)

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

**Expendable distribution:** 20–30 AXBTs in combination with dropsondes

**Instrumentation Notes:** Use straight flight legs as safety permits. Preferably flown with the WSRA.

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**Figure OC-2:** Left: NHC official forecast track at time of in-storm mission, with pre-storm sampled region highlighted. Right: P-3 in-storm flight pattern centered on storm and over previously sampled ocean area. Typical pattern is expected to be a Rotated Fig-4.

**P-3 Pattern #3 (Post-storm):**

**What to Target:** Sample the same *pre-storm* region, with slight pattern adjustments made based on the known storm track

**When to Target:** Post storm

**Pattern:** Lawnmower, as in Fig. OC-3

**Flight altitude:** 8 kft preferable

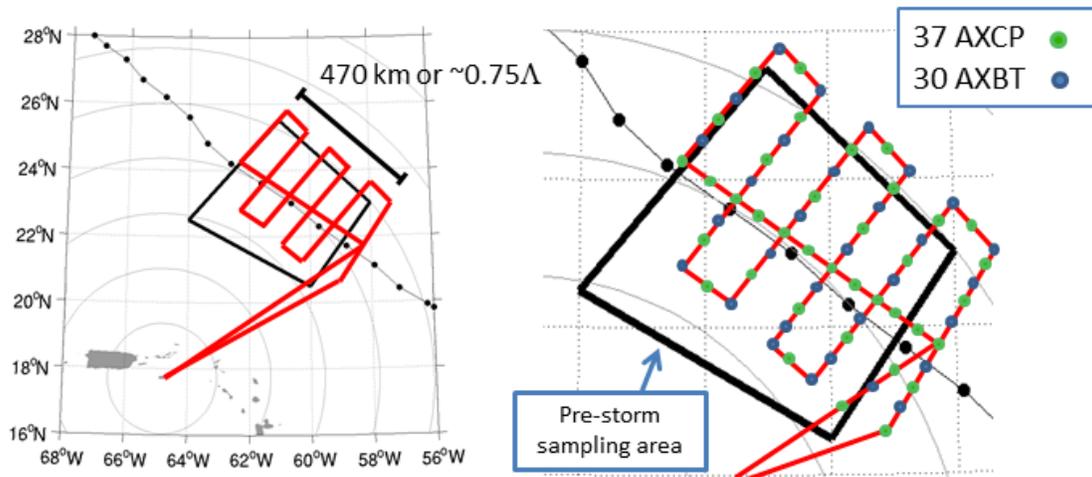
**Leg length or radii:** 105 n mi (195 km)

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

**Expendable distribution:** 60–70 aircraft ocean expendables (AXBTs/AXCPs)

**Instrumentation Notes:** None

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**Figure OC-3:** Left: Post-storm ocean sampling flight pattern (red line), over previously sampled area (black box). In this example, the pattern extends around 470 km in the along-track dimension, or around 0.75 of a near-inertial wavelength. Right: Flight pattern with expendable drop locations, consisting of a combination of AXCP and AXBT probes.

**P-3 Pattern #4 (Loop Current, Pre- and Post-storm):**

**What to Target:** Sample the loop current and associated eddy field (Gulf of Mexico warm eddy)

**When to Target:** Pre- (1–3 days prior to storm passage over the loop current) and post-storm (over same area as pre-storm survey, 1–3 days after storm passage)

**Pattern:** As in Fig. OC-4

**Flight altitude:** 6–8 kft preferable (launched via free-fall chute)

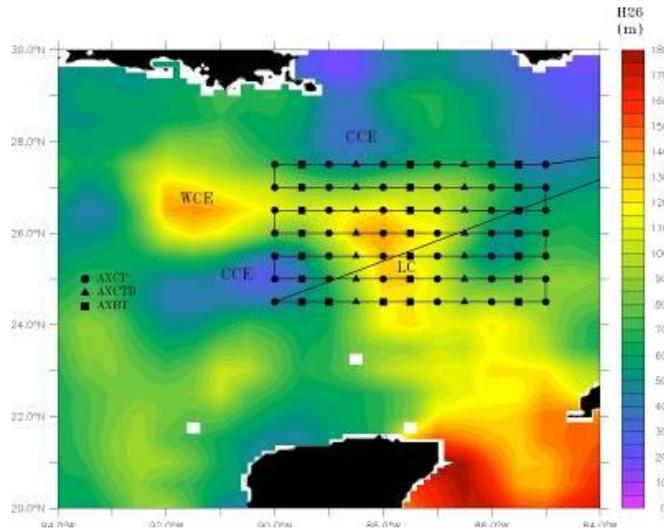
**Leg length or radii:** 250 n mi (465 km)

**Estimated in-pattern flight duration:** ~ 8 h

**Expendable distribution:** a total of 60–80 aircraft ocean expendables (AXBTs, AXCPs, and AXCTDs)

**Instrumentation Notes:** Use straight flight legs as safety permits

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*Figure OC-4: Typical pre- or post-storm pattern with ocean expendable deployment locations relative to the Loop Current. Specific patterns will be adjusted based on actual and forecasted storm tracks and Loop Current locations. Missions generally are expected to originate and terminate at AOC.*

**P-3 Pattern #5 (Loop Current, In-storm):**

**What to Target:** Sample the *core region* of a TC and loop current eddy field

**When to Target:** In storm, no constraint

**Pattern:** Standard Rotated Figure-4, as in Fig. OC-2

**Flight altitude:** 8–10 kft

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

**Estimated in-pattern flight duration:** ~ 4 h 45 min for Figure-4 + Rotated Figure-4 [45 n mi (85 km) legs]

**Expendable distribution:** A total of 40 aircraft ocean expendables (AXBTs, AXCPs, and AXCTDs).

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

**P-3 Pattern # 6 (Float and Drifter):**

**What to Target:** Sample the *core region* of a TC

**When to Target:** In storm, no constraint

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**Pattern:** As in Fig. OC-6

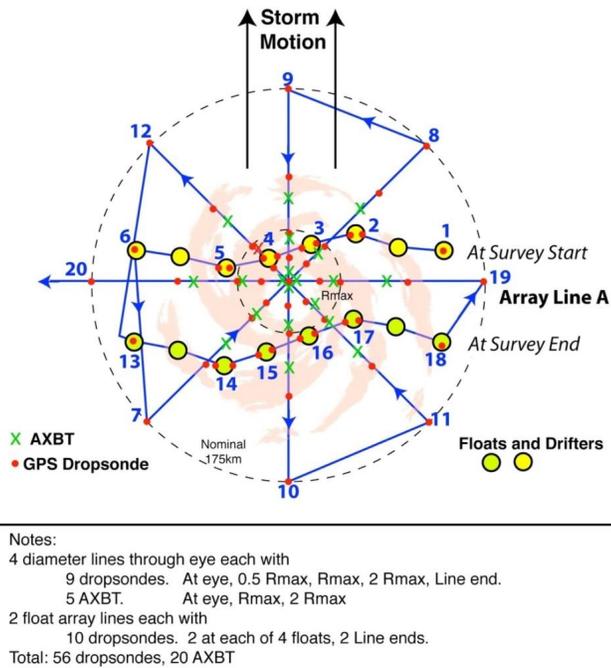
**Flight altitude:** 10–12 kft preferable

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

**Estimated in-pattern flight duration:** ~ 4 h 45 min for Figure-4 + Rotated Figure-4 [45 n mi (85 km) legs]

**Expendable distribution:** 56 dropsondes and 20 aircraft ocean expendables

**Instrumentation Notes:** Use straight flight legs as safety permits



**Figure OC-6:** P-3 pattern over float and drifter array. The array has been distorted since its deployment on the previous day and moves relative to the storm during the survey. The pattern includes two legs along the array (waypoints 1–6 and 13–18) and an 8 radial line survey. Dropsondes are deployed along all legs, with double deployments at the floats. AXBTs are deployed in the storm core.

**P-3 Pattern # 7 (Underwater Hurricane Gliders):**

**What to Target:** Sample the *core region* of a TC

**When to Target:** In storm, no constraint. Standard Figure-4 or Rotated Figure-4 pattern with radial leg or downwind leg overpass the location of gliders.

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**Pattern:** An example of the flight pattern is shown in Fig. OC-7. This flight pattern was tested in Hurricane Dorian (2019).

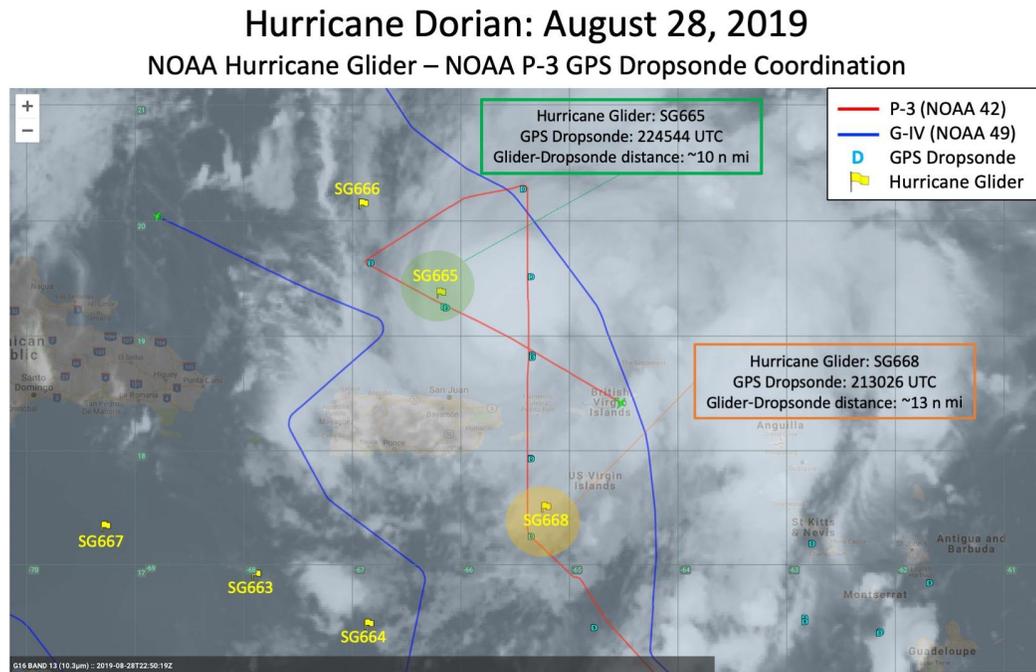
**Flight altitude:** 10–12 kft preferable

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

**Estimated in-pattern flight duration:** ~ 4 h 45 min for Figure-4 + Rotated Figure-4 [45 n mi (85 km) legs]

**Expendable distribution:** 12 dropsondes and 4 aircraft ocean expendables

**Instrumentation Notes:** Use straight flight legs as safety permits



**Figure OC-7:** P-3 pattern over underwater hurricane gliders SG665 and SG668. Dropsondes are deployed along all legs, with deployments at the locations of gliders. AXBTs are also deployed at glider locations.