**2023 NOAA/AOML/HRD Hurricane Field Program - APHEX**

**OCEAN OBSERVING EXPERIMENT**
***Flight Pattern Description***

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**Experiment/Module:** Ocean Survey Experiment

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**Requirements:** No requirements: flown at any stage of the TC lifecycle

**Ocean Observing Science Objective(s) Addressed**

1) Collect observations targeted at better understanding air-sea interaction processes contributing to hurricane structure and intensity change. [*APHEX 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 [*APHEX Goals 1, 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 TCs. These measurements include improved three-dimensional representation of the hurricane wind field, more spatially dense thermodynamic sampling of the boundary layer, and more accurate measurements of ocean surface winds and underlying ocean conditions [*APHEX Goal 2*]

## P-3 Pattern #1: Ocean Survey (Pre-storm)

**What to Target:** Region before storm passage based NHC's official forecast

**When to Target:** 24-48 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 (Launched through free-fall chute)

**Leg length or radii:** 105 n mi

**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. A transect of 6-10 A-Sized DWSTM wave drifters to establish a wave field.

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

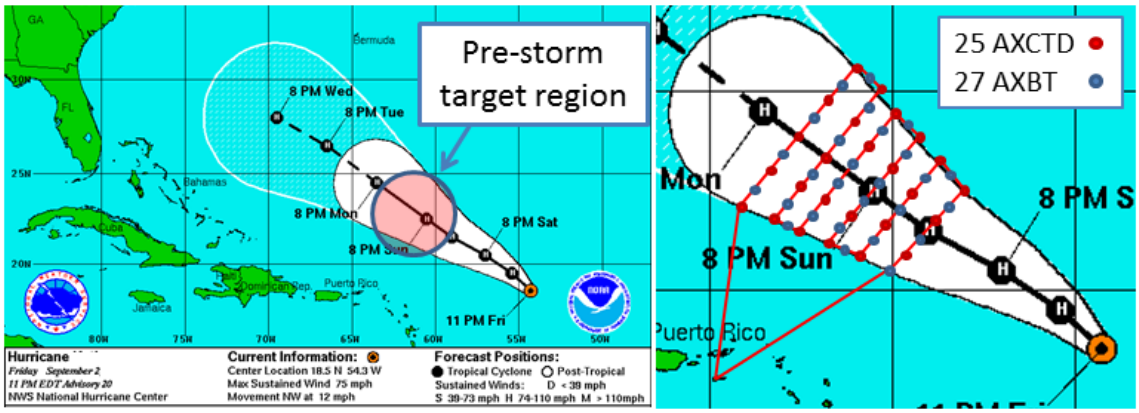


***Figure OC-1:*** *Left: NHC official forecast track, which pre-storm ocean sampling region highlighted. Target region is centered ~48 hours prior to the forecast arrival of the storm. Right: P-3 flight track (red line) and ocean sampling pattern consisting of a grid of AXCTD/AXBT probes. Probes are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

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

**What to Target:** Sample the same area as pre-storm, include front quadrants, *core, and wake 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

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

**Expendable distribution:** 20–30 AXBTs, 4-8 A-Sized DWSTM wave drifters, distributed into the 4 quadrants of the storm to determine building wave state, in combination with dropwindsonde measurements.

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

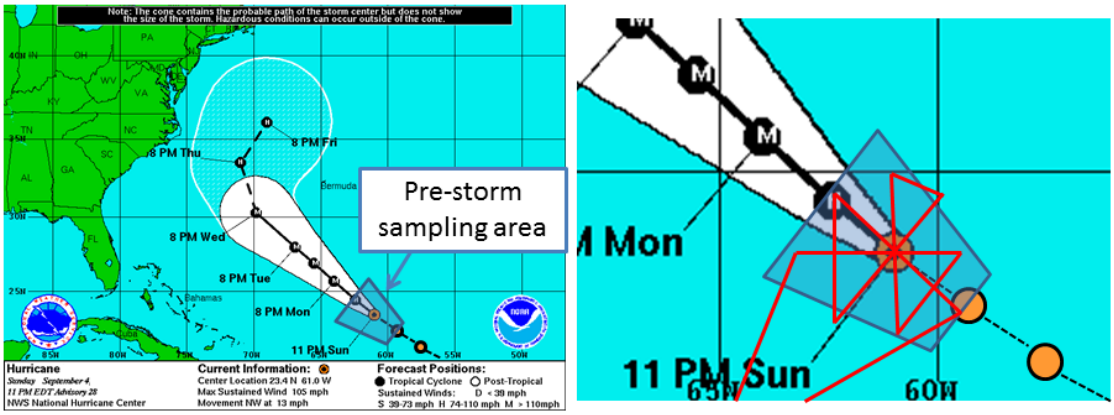


***Figure OC-2:*** *Left: NHC official forecast track at time of in-storm mission, with pre-storm sampled region highlighted. Right: P-3 in-storm flight pattern centered on storm and over previously sampled ocean area. Typical pattern is expected to be a Rotated Fig-4.*

## P-3 Pattern #3: Ocean Survey (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:** 24-48h Post storm

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

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

**Leg length or radii:** 105 n mi

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

**Expendable distribution:** 60–70 aircraft ocean expendables (AXBTs/AXCPs and 6-10 A-Sized DWSTM wave drifters).

**Instrumentation Notes:** None

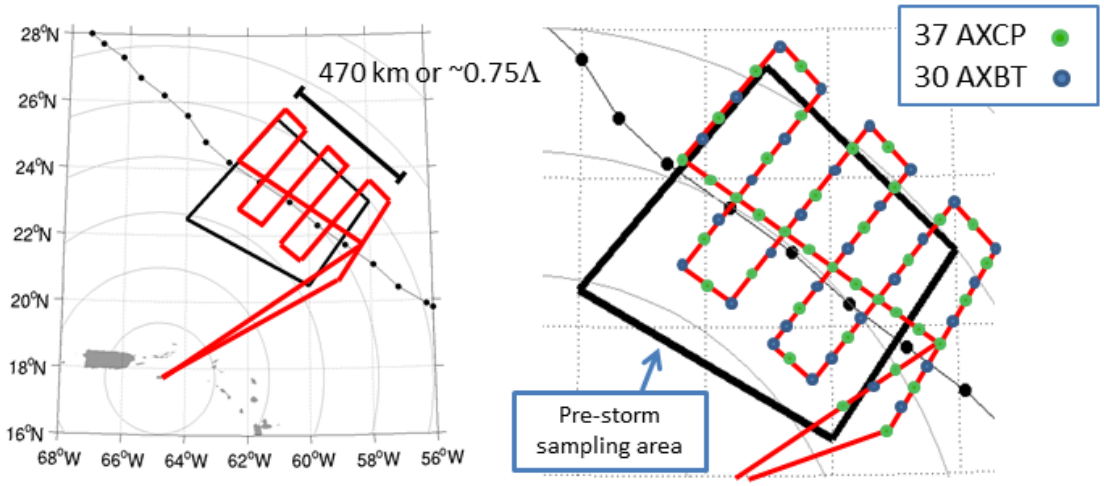


***Figure OC-3:*** *Left: Post-storm ocean sampling flight pattern (red line), over previously sampled area (black box). In this example, the pattern extends around 470 km in the along-track dimension, or around 0.75 of a near-inertial wavelength. Right: Flight pattern with expandable drop locations,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

## P-3 Pattern #4: Ocean Survey (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

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

**Expendable distribution:** a total of 60–80 aircraft ocean expendables (AXBTs, AXCPs, and AXCTDs, and 6-10 A-Sized DWSTM wave drifters)

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

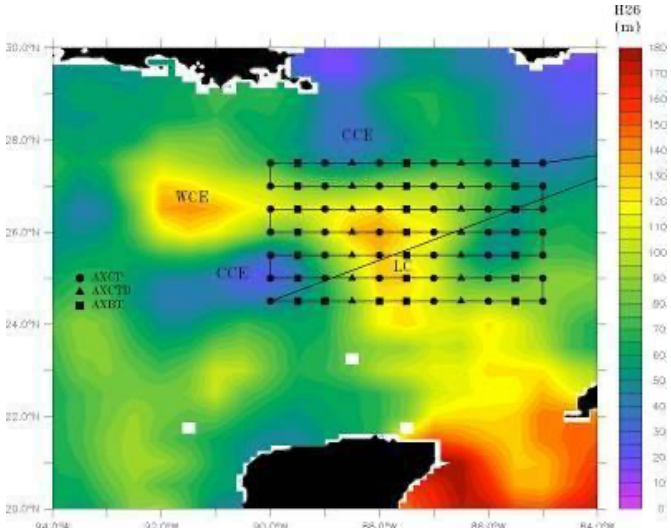


***Figure OC-4:*** *Typical pre- or post-storm pattern with ocean expendable deployment locations relative to the Loop Current. Specific patterns will be adjusted based on actual and forecasted storm tracks and Loop Current locations. Missions generally are expected to originate and terminate at AOC.*

**P-3 Pattern #5: Ocean Survey (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:** 6-8 kft (Launched via free-fall chute)

**Leg length or radii:** 105 n mi

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

**Expendable distribution:** A total of 40 aircraft ocean expendables (AXBTs, AXCPs, and AXCTDs, and 6-10 A-Sized DWSTM wave drifters)

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

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

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

**When to Target:** 24-48h In storm, no constraint

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

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

**Leg length or radii:** 105 n mi

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

**Expendable distribution:** 56 sondes and 20 AXBTs

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

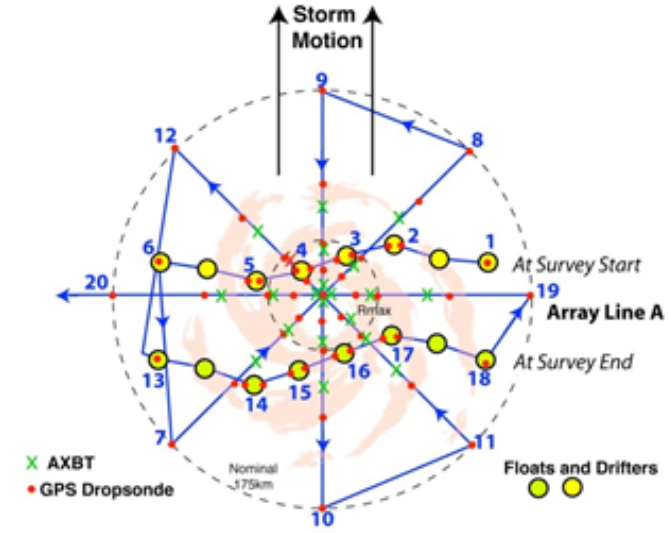


Figure OC-6: P-3 pattern over float and drifter array. The array has been distorted since its deployment on the previous day and moves relative to the storm during the survey. The pattern includes two legs along the array (waypoints 1–6 and 13–18) and an 8 radial line survey. Dropsondes are deployed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

**P-3 Pattern # 7: Ocean Survey (Saildrone and Glider coordination)**

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

**When to Target:** In or near a storm, no constraint. Any P-3 flight patterns with a radial leg or downwind leg overpassing the locations of saildrones and gliders will be good.

**Pattern:** Straight line

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

**Leg length or radii:** 5-30 n mi

**Estimated in-pattern flight duration:** 5-30 min

**Expendable distribution:** 2 dropsondes and 2 aircraft ocean expendables with the option for additional A-Sized DWSTM wave drifters if indicated.

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