2020 NOAA/AOML/HRD Hurricane Field Program - IFEX

MATURE STAGE EXPERIMENT
Flight Pattern Descriptions

Experiment/Module: Surface Wind Speed and Significant Wave Height Validation

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Requirements: Categories 2–5

Mature Stage Science Objective(s) Addressed:

1) Collect Test new (or improved) technologies with the potential to fill gaps, both spatially and temporally, in the existing suite of airborne measurements in mature hurricanes. 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 [*IFEX Goal 2*]

P-3 Pattern #1

What to Target: Surface wind speeds ≥ 100 kts, most likely in the eyewall

When to Target: This module can be flown during any pass through the storm center.

Pattern: This module can be flown with any of the standard in-storm flight patterns. The eye must be ≥ 25 n mi in diameter, and for asymmetric or non-circular eyes, the narrowest cross section from eyewall to eyewall must be 25 n mi. Additionally, a 2 n mi standoff should be maintained from the radar displayed inner eyewall. The primary option for this module consists of flying inbound, releasing a dropsonde, or rapid sequence of 3 dropsondes (targeting the surface wind speed maximum), entering the eye, waiting for the dropsonde(s) to splash to determine the splash location(s), and flying outbound to overfly the exact splash location(s). A second option is to estimate the dropsonde drift after launch and fly outbound from the eye ~30–40° azimuthally downwind of the inbound leg to overfly the estimated splash location(s) of the dropsonde. For this second option, it may be necessary to adjust the azimuthal separation of the inbound and outbound legs to account for eye size, storm strength, and flight altitude.

Flight altitude: 7–12 kft radar

Leg length or radii: Any

Estimated in-pattern flight duration: ~10–15 min. The time separation between releasing the dropsonde and the outbound pass over the estimated splash location should be as close as possible to the time it takes for the dropsonde(s) to fall to the surface (~5-6 min) or the time it takes to obtain the dropsonde(s) splash locations(s) (~10–15 min).

Expendable distribution: Release a dropsonde targeting the surface wind speed maximum on the inbound leg. If possible, release 3 dropsondes in rapid succession through a tight gradient to increase the chances of observing the surface wind speed maximum with a dropsonde.

Instrumentation Notes: Use standard SFMR set-up. Important to maintain as constant of a roll angle, pitch angle, and altitude as possible.

P-3 Pattern #2

What to Target: Surface wind speeds ≥ 100 kts, most likely in the eyewall
When to Target: This module can be flown during any mission using both P-3s and during any pass through the storm center.

Pattern: This module can be flown with any of the standard in-storm flight patterns. The module consists of one P-3 (preferably NOAA43 with the USFMR and WSRA) flying inbound and releasing a dropsonde targeting the surface wind speed maximum or a sequence of 3 dropsondes released in rapid succession to increase the odds of observing the surface wind speed maximum. The second P-3 (preferably NOAA42 with IWRAP) will fly inbound ~30–40° azimuthally downwind of the first P-3 and approximately 5-6 min later (or the closest temporal spacing possible for safe operations) to overfly the splash location of the dropsonde(s). The two aircraft can be at different altitudes. It may be necessary to adjust the azimuthal separation of the two P-3s to account for eye size, storm strength, and flight altitude or to identify the actual splash location of the dropsonde(s).

Flight altitude: 7–12 kft radar

Leg length or radii: Any

Estimated in-pattern flight duration: ~10–15 min. The time separation between the two P-3s should be as close as possible to the time it takes for the dropsonde to fall to the surface (~5-6 min) or the time it takes to obtain the dropsonde(s) splash locations(s) (~10–15 min) while maintaining safety of flight.

Expendable distribution: The first P-3 will release a dropsonde targeting the surface wind speed maximum on the inbound leg. If possible, release 3 dropsondes in rapid succession through a tight gradient to increase the chances of observing the surface wind speed maximum with a dropsonde.

Instrumentation Notes: Use standard SFMR set-up. Important to maintain as constant of a roll angle, pitch angle, and altitude as possible.

P-3 Pattern #3:

What to Target: Regions of wind speeds ≥ 15 m s^{-1} with homogenous rain rates (or no rain) and wind direction (e.g. not in eye). Avoid regions with large wind speed or rain rate gradients.

When to Target: This module can be flown at any point during the flight while in the storm. If the WSRA is on the plane collecting surface wave data then the preference is to fly this module at night or when the sun is low in the sky.

Pattern: This module can be flown with any of the traditional in-storm flight patterns. The module consists of flying at least 3 consecutive circles at a given roll angle (Figure 1). Roll angles to be sampled are 15°, 30°, and 45°. If time allows, it is preferable to fly 5 consecutive circles at 45°. Best to begin circles by turning upwind for station keeping.

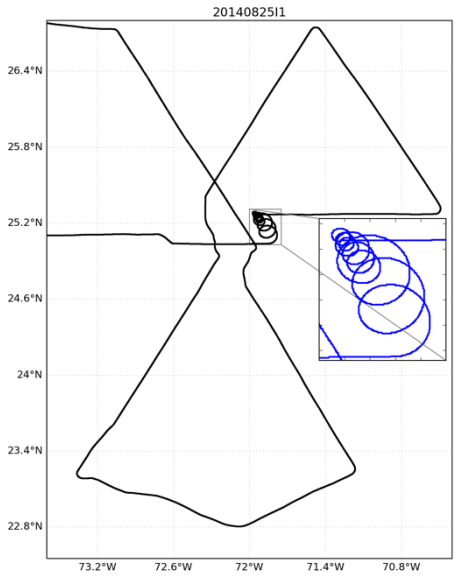

Figure 1: Example flight path (black) with SFMR high-incidence angle module. The inset zoomed in portion with the blue track displays the SFMR module in more detail.

Flight altitude: 7–12 kft radar

Leg length or radii: Any

Estimated in-pattern flight duration: 3 circles at 15° takes ~17 min., 3 circles at 30° takes ~7 min., and 3 (5) circles at 45° takes ~4.5 (~7) min. for a total time of ~28.5 (~31) min. If time is a concern, remove 15° circles for a total time of ~11.5 min for 3 circles each at 30° and 45° or ~14 min for 3 circles at 30° and 5 circles at 45°.

Expendable distribution: Release a dropsonde/AXBT combo at the beginning of the module. If no AXBTs are available, this module can still be flown while only releasing a dropsonde at the beginning of the module.

Instrumentation Notes: Use standard SFMR set-up. Important to maintain as constant of a roll angle, pitch angle, altitude, and rain rate as possible. Ideal to fly this module while the WSRA is also operating and gathering surface wave data. However, any data collected is useful as long as there is a dropsonde for comparison.

P-3 Pattern #4:

What to Target: Regions with significant wave heights of 8 ft and greater.

When to Target: Begin data collection when approaching significant wave heights of 8 ft on first inbound pass and continue data collection when significant wave heights are ≥ 8 ft.

MATURE STAGE EXPERIMENT
Flight Pattern Descriptions

Pattern: This module can be flown with any of the standard in-storm flight patterns. This pattern consists of extending standard flight legs, when necessary, to obtain WSRA significant wave height measurements in all regions with significant wave heights ≥ 8 ft. PIs will advise LPS prior to and during flight on the extent of waves with significant wave heights ≥ 8 ft.

Flight altitude: 8–12 kft radar

Leg length or radii: Out to radius of significant wave heights ≥ 8 ft.

Estimated in-pattern flight duration: Data collection will occur during the entire flight. Extension of legs could add 30-60 min to a flight.

Expendable distribution: No expendables required.

Instrumentation Notes: Use standard WSRA set-up. Important to maintain 8-12 kft radar altitude for WSRA data collection.