2025 NOAA/AOML/HRD Hurricane Field Program - APHEX

SATELLITE VALIDATION EXPERIMENT
Flight Pattern Description

Experiment/Module: Synthetic **A**perture **R**adar **W**ind **I**nspection with **N**OAA P-3 **D**ata (SARWIND)

Investigator(s): Philippe Papin, Lisa Bucci, Eric Blake, Brad Reinhart (NHC/NWS/NOAA), Jason Dunion (HRD/NOAA), Jim Doyle (NRL), Victoria Pizzini (University of Miami), Christopher Jackson, Tyler Ruff (NOAA-STAR).

Requirements: No requirements: flown at any stage of the TC lifecycle and including Pre-genesis

Genesis/Early/Mature Stage Science Objective(s) Addressed:

1) Test new (or improved) satellite 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 and thermodynamic structure and more accurate measurements of ocean surface winds and underlying ocean conditions [APHEX Goal 2]

P-3 Pattern #1

What to Target: Sample the largest mesoscale convective burst area within a disturbance (aka. "Invest"), a formative TC, or a TC with pronounced wind asymmetry. Should the convection persist and show signs of organization (i.e. mid-level circulation), center the subsequent transects as best as possible to that location (adjusting for translation speed, if possible). Additional interest to target overshooting tops within mesoscale burst occasionally make SAR wind retrievals prone to overinflation, hypothesized to be ice scattering effects (Fig. 1).

When to Target: The aircraft should be within the mesoscale convective burst as the SAR data are collected. P-3 take-off times and/or flight patterns will be adjusted (when possible) to coordinate temporal and spatial overlap with overpasses by various SAR satellites. GPS dropsonde and P-3 tail-Doppler radar (TDR) sampling should be timed to be ≤15 min and ≤200 n mi (370 km) from satellite nadir. NASA's MTS aircraft software should be used to coordinate the underflight with SAR overpasses.

Pattern: Single Figure-4 (or rotated Figure-4 if time permits). Other standard patterns are also acceptable.

Flight altitude: Standard P-3 flight altitude (8-12 kft).

Leg length or radii: Standard P-3 flight radii (105 n mi). Legs may be truncated as needed once outside of precipitation.

Estimated in-pattern flight duration: 4-5 h

Expendable distribution: Dropsondes at end points and center points.

Instrument Notes: Use straight flight legs as safety permits. Inbound-outbound passes should be uninterrupted. Concurrent with the SAR overpass, an effort should be made to record surface roughness data from the MMR. Cloud microphysical data from the P-3 may also be useful in cases of deep convection with significant ice scattering notably affecting the SAR wind speed retrieval data.

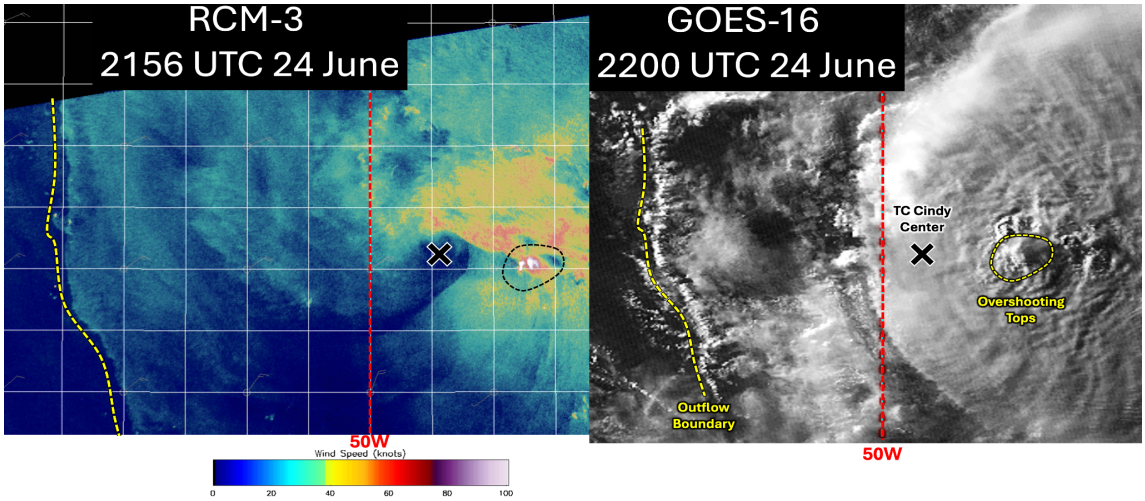

Figure 1. Comparison of an RCM-3 SAR pass at 2156 UTC 24 June with GOES-16 satellite imagery within 5 minutes of the pass over TC Cindy. Note the noisy peak in wind speed retrievals from SAR near the circled region associated with a substantial convective burst. P-3 Pattern #1 could potentially target this region east of the TC Cindy's center.

P-3 Pattern #2

What to Target: Maximize coverage of the surface wind field (maximum extent of the 34-, 50-, 64-kt wind radii in each quadrant, RMW). For reference, 34-kt winds extend out up to 125 n mi (230 km) from the center in an average sized tropical cyclone.

When to Target: For hurricanes, the aircraft needs to be in close proximity to the RMW as the SAR data are collected. P-3 take-off times and/or flight patterns will be adjusted, when possible, to coordinate temporal and spatial overlap with overpasses by various SAR satellites. GPS dropsonde and P-3 TDR sampling should be timed to be ≤15 min and ≤200 n mi (370 km) from satellite nadir. NASA's MTS aircraft software should be used to coordinate the underflight with SAR overpasses.

Pattern: Any P-3 standard pattern (figure-4, butterfly, or rotated figure-4)

Flight altitude: Standard P-3 flight altitude (TC stage dependent). Pressure altitude is preferable.

Leg length or radii: Standard P-3 flight radii (105 n mi) with the possibility of extension to fully map the extent of TS wind field limited to **125** n mi.

Estimated in-pattern flight duration: Extension of legs should add no more than **1 hour** to flight time, and ideally none at all in cases where mission is flying the RMW anyway, but there is an opportunity of adding modules to allow for proper arrival time at the RMW coinciding with SAR overpass.

Expendable distribution: In the area of the suspected maximum wind, release 1-2 additional dropsondes across the radius of maximum wind. Otherwise, release dropsondes at standard locations (center, RMW, mid-point, end point).

Instrument Notes: A center fix should be made during the transect concurrent with the SAR overpass. Concurrent with the SAR overpass, an effort should be made to record surface roughness data from the MMR. Also worth noting rain-rate data from the SFMR to see if similar low wind-speed derived areas show up on SAR wind retrievals near or in eyewalls like that seen from some recent SFMR missions in high rain rate eyewall regimes.