EARLY STAGE EXPERIMENT
Flight Pattern Descriptions

Experiment/Module: Tail Doppler Radar (TDR) Experiment

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Requirements: TD, TS, Category 1

Early Stage Science Objective(s) Addressed:

1) Collect datasets that can be used to improve the understanding of intensity change processes, as well as the initialization and evaluation of 3-D numerical models, particularly for TCs experiencing moderate vertical wind shear [*IFEX Goals 1, 3*]

2) Test new (or improved) technologies with the potential to fill gaps, both spatially and temporally, in the existing suite of airborne measurements in early stage TCs. These measurements include improved three-dimensional representation of the TC 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: Sample tropical cyclones and invests from the center out to maximum radius possible, while providing higher wavenumber coverage in invests, tropical storms and depressions.

When to Target: Sampling commences when tasked by EMC. Missions tasked for TDR assimilation purposes are carried out every 12 h

Pattern: While TDR data can be collected whenever the P-3 is flying, the standard patterns are best used during a tasked mission. For reconnaissance, the Alpha pattern is typically employed. For TDR assimilation purposes, the Lawnmower and Square-spiral patterns are appropriate for invests and tropical depressions. For systems having a more well-defined center of circulation, the Figure-4, Rotated Figure-4, Alpha, Butterfly, and P-3 Circumnavigation patterns (all these patterns are described in in “Standard Patterns and Expendable Locations” section) are all appropriate, depending on system size and distance from base of operations.

Flight altitude: TDR data for assimilation and analysis can be collected at most flight altitudes, since TDR analysis will work no matter what flight level is flown. Typical flight altitude is 10 kft. 12 kft will allow deeper coverage of dropsondes. Since much of the flight is within cloud and precipitation, the aircraft is flown low enough to avoid icing and strong electrification. Lower altitudes will allow a better determination of the center of poorly organized systems. Flight altitude might be determined by NHC, since these are tasked flights. Presence of Air Force Reserve aircraft may also require some compromise in flight-altitude choice.

Leg length or radii: The standard radial leg length for TDR missions is 105 n mi (195 km), but this can be adjusted as needed for land restrictions and ferry times. Legs may be shortened due to a lack of scatterers, but the HRD LPS should be consulted first to ensure that other scientific objectives are not adversely impacted.

Estimated in-pattern flight duration: See the listing of standard pattern figures in "Standard Patterns and Expendable Locations" section.

Expendable distribution: Expendables are not required; however, they can help to provide verification of HWRF, and to provide data in clear air. Dropsondes may also be requested by NHC. See section entitled "Standard Patterns and Expendable Locations" for a suggested pattern of dropsondes, if desired.

Instrumentation Notes: Single PRF, short/long random-phase pulse at PRF designed to give 25 m/s Nyquist velocity

P-3 Pattern 2 (Clear Air):

What to Target: Clear air over open ocean conditions in a low-wind region

When to Target: At the beginning of the season, preferably during a pre-season test flight

Pattern: Straight and level flight, reversing course (Fig. TD-1). The pattern should be flown upwind and downwind, defined by the flight-level winds.

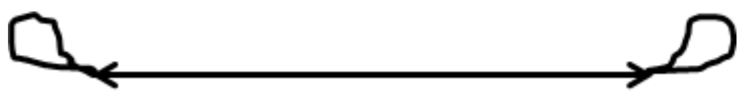

Fig. TD-1. Example of clear-air TDR pattern

Flight altitude: 15–20 kft is best if short/long pulse not working. If short/long pulse is working, this pattern is best repeated, if possible, at 5, 10, and 15 kft, since we do not know exactly what to expect from this new setup. It is possible that the data are required will be obtained if a P3 wind calibration flight has been flown.

Leg length or radii: 5 to 10-minute segments

Estimated in-pattern flight duration: 10–60 minutes

Expendable distribution: None

Instrumentation Notes: The purpose of this sea-surface module is to identify angle corrections to be applied in the P-3 TDR software for the season. The sea surface should be unobstructed by intervening scatterers and the winds should be light enough so as to yield a smooth sea state.

G-IV Pattern 1:

What to Target: Sample invests and tropical cyclones of interest to the NHC/EMC

When to Target: Sampling commences when tasked by EMC. Missions tend to follow the NHC synoptic surveillance schedule, typically with a takeoff time of 0530 and/or 1730 UTC. The ability to perform storm overflights at any time is desirable, but safety concerns (e.g., the impact of intense convection on flight and lack of visual) may restrict overflight to certain conditions and times of day.

Pattern: If the G-IV is tasked for synoptic surveillance, the flight pattern will be completely determined by NHC. It would be advisable to lobby for a 90 n mi (165 km) circumnavigation (see "Standard Patterns and Expendable Locations" section), if possible, unless a pass over the center is considered safe enough to fly. While TDR data can be collected whenever the G-IV is flying, the standard patterns are best used during a TDR-focused mission. For TDR assimilation purposes, the Lawnmower and Square-spiral patterns are appropriate for invests and tropical depressions. For systems having a more well-defined center of circulation, the Figure-4, Rotated Figure-4, Alpha, Butterfly, and G-IV Star and Star with Circumnavigation patterns (see "Patterns and Expendables" section for all these patterns) are all appropriate.

Flight altitude: TDR data for assimilation and analysis can be collected at most flight altitudes. Typical flight altitude is 40–45 kft to get the deepest sonde coverage.

Leg length or radii: In the unlikely event, that the G-IV can be flown through the center, the standard leg length for figure-4 and butterfly patterns in TDR missions is 105 n mi, but this can be adjusted as needed for land restrictions and ferry times. Legs may be shortened due to lack of scatterers, but the HRD LPS should be consulted first to ensure that other scientific objectives are not adversely impacted. For circumnavigations without a P-3 present, the radius of the innermost "circle" should be set to resolve the maximum wind region. Typically, winds can be retrieved out to 40–50 km from the aircraft.

Estimated in-pattern flight duration: See the listing of standard pattern figures in the section entitled "Standard Patterns and Expendable Locations" section.

Expendable distribution: Expendables are not required

G-IV Pattern 2 (Clear Air):

What to Target: Clear air over open ocean conditions in a low-wind region

When to Target: At the beginning of the season, preferably during a pre-season test flight

Pattern: Straight and level flight, reversing course (Fig. TD-1). The pattern should be flown upwind and downwind, defined by the flight-level winds.

Flight altitude: 15–20 kft is best

Leg length or radii: 5-minute segment (10 minutes for entire pattern)

Estimated in-pattern flight duration: 10–15 minutes

Expendable distribution: None

Instrumentation Notes: The purpose of this sea-surface module is to identify angle corrections to be applied in the G-IV TDR software for the season. The sea surface should be unobstructed by intervening scatterers and the winds should be light enough so as to yield a smooth sea state.