

MODULE DESCRIPTION

16. Boundary Layer Inflow Module

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Primary IFEX Goal 3: Improve understanding of the physical processes important in intensity change for a TC at all stages of its lifecycle.

Summary: This module is designed to complement standard operationally-tasked P-3 Tail Doppler Radar (TDR) missions by obtaining near-surface wind vector data from GPS dropwindsondes where Doppler winds are not readily available.

Background: The near-surface inflow is a crucial region of a tropical cyclone (TC), since it is the area of the storm in direct contact with the ocean moisture and heat sources which power the storm. Recent composite analysis of near-surface wind data has led to a more accurate description of general TC inflow characteristics, including asymmetries (Zhang and Uhlhorn 2011). However, it has also become clear that there are few individual cases that contain sufficient observations to develop an accurate synoptic view and comprehensive understanding of boundary layer inflow evolution as a TC intensifies or weakens, changes motion, experiences eyewall/rain-band cycles, and is impacted by shear to varying degrees. To fill this data gap, the proposed modular experiment is developed to augment wind vector observations from Doppler radar that are routinely obtained by NOAA WP-3D aircraft.

Synopsis: The flight pattern is consistent with a typical rotated “alpha” (Figure-4) pattern flown for TDR missions. (Fig. 16-1). The rotated pattern (as opposed to the repeated alpha pattern) is preferable to better resolve higher (than 1) wavenumber asymmetric wind field structure. In addition, it is requested to fly the pattern as orthogonal pairs of radials, rather than rotating radials by 45 deg. as the flight proceeds. The initial (IP) and final (FP) points of the pattern are arbitrary. Required instrumentation consists of expendable probes (34 dropwindsondes and 16 AXBTs) as depicted in Fig. 16-1. Note that in particular, high-resolution sampling (3 sondes spaced ~1 min apart) is requested across the radius of maximum wind (RMW) on a pair of orthogonal radii to help better estimate boundary layer gradient winds. Center drops are requested on the first and last pass through the eye.

Research plan: The optimal successful experiment will yield a synoptic view of near surface inflow over a series of consecutive missions to document the evolution of boundary layer inflow as a TC progresses through its life cycle. Our research goal is to better understand details about environmental impacts on BL inflow which is not adequately described by the composite analysis constructed from data obtained from numerous independent cases. Specific questions we wish to answer are: 1) How might environmental shear modulate the expected, frictionally-induced, inflow asymmetry? 2) What is the relationship between near-surface inflow and inflow above the BL as depicted by Doppler wind analysis? 3) How are near-surface inflow and thermodynamic fields (temperature and moisture and associated fluxes) inter-related?

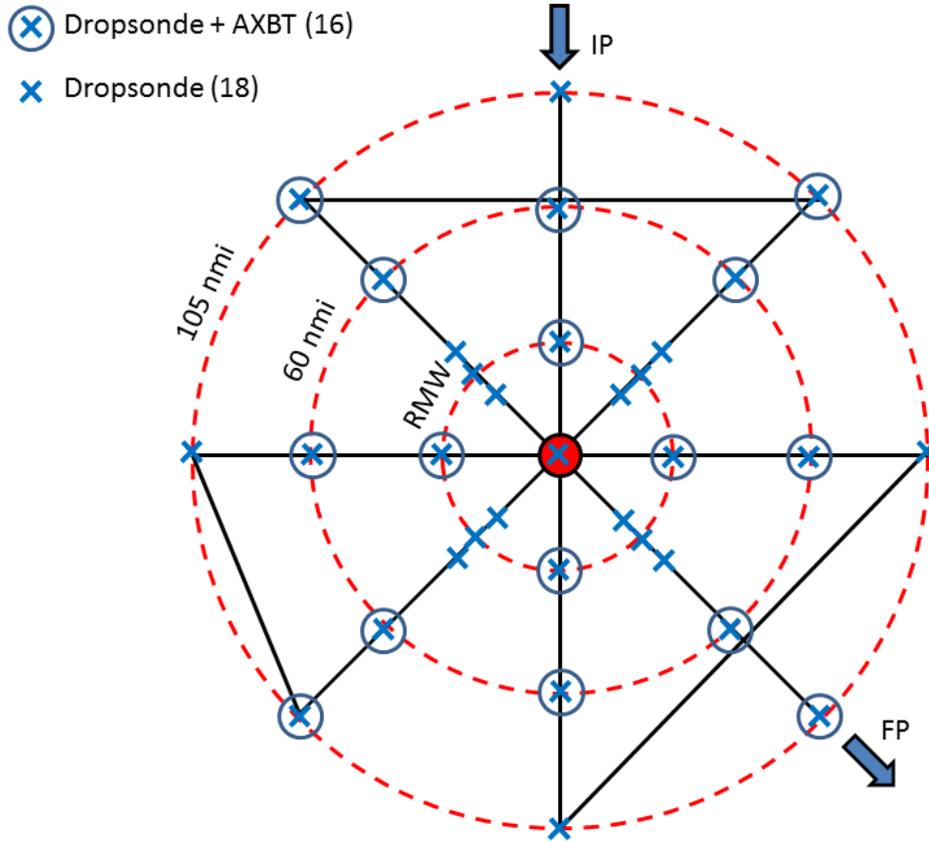


Figure 16-1: Boundary Layer Inflow Module. GPS dropwindsondes (34 total) are deployed at 105 nmi and 60 nmi radii and at the radius of maximum wind along each of 8 radial legs (rotated alpha/figure-4 pattern). On 4 of the 8 passes across the RMW, rapid deployment (~1 min spacing) of 3 sondes is requested. Center drops are requested on the initial and final pass through the eye. AXBT (16 total) deployments are paired with dropsondes at the indicated locations. Flight altitude is as required for the parent TDR mission, and initial and final points of the pattern are dictated by these same TDR mission requirements.