EARLY STAGE EXPERIMENT
Science Description

Experiment/Module: Airborne Doppler Wind Lidar Module

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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*]

Motivation: Collect wind observations on the dry side of a TC with asymmetric precipitation distribution to provide symmetric coverage of its wind field.

Background: Currently there are limited continuous high-resolution wind observations in the TC boundary layer and in regions of low or no precipitation. The coherent-detection Doppler wind profile (DWL) system can collect wind profiles through the detection of aerosol scatters motion in areas of optically thin or broken clouds or where aerosols are ~2 micron or larger (Zhang et al. 2018). The DWL is capable of performing a variety of scanning patterns, both above and below the aircraft. Depending on the scanning pattern, the vertical resolution of the wind profiles is 50m and the horizontal resolution is 2-3km. Below the aircraft, the instrument can observe winds at or near the surface (~100m). When sampling above the aircraft, it can observe as high as ~14km (in the presence of high cirrus). However, in the presence of optically thick convection or within ~400m of the instrument, DWL is unable to collect measurements. Measurements from the DWL have been validated against other wind observing platforms onboard the NOAA P-3s and were found to be reliable and of good quality (Bucci et al. 2018).

Hypotheses:

1. Providing more continuous wind observations in data sparse regions to a data assimilation system will lead to a better analysis and forecast of a TC.

Aircraft Pattern/Module Descriptions: P-3 circumnavigation with single or rotated Figure-4

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Links to Other Early Stage Experiments/Modules: This module complements and mirrors the sampling strategies of AIPEX. The DWL is able to provide profiles of wind observations in the upshear region of a TC. The DWL Module can also be flown in conjunction with the following *Early Stage* experiments: TDR Experiment, Synoptic Flow Experiment, and NESDIS JPSS Satellite Validation Experiment.

Analysis Strategy: Exploration into the "real-time" transmission of a DWL profiles continues this season. Line of sight (LOS) observations and GPS/INS information are processed to create wind vector profiles in ASCII format that are pushed to the SEB website. The hardware used to complete this process has been simplified and will be tested this season.

In the post-season, observing System Experiments (OSEs) will be performed using both the LOS data and the post-processed vector wind data product to determine the impact of DWL observations on the analyses of TC structures, track, and intensity forecasts. Observations collected from the DWL in conjunction with other observing platforms will be used to evaluate the model representation of different aspects of a TC, such as the boundary layer, SAL intrusions, and sheared TCs. Multiple modeling frameworks are expected to be used. Options include the operational HWRF model, the cycling basin-scale HWRF, and the HEDAS-HWRF setup.

References:

Bucci, L.R., C. O'Handley, G.D. Emmitt, J.A. Zhang, K. Ryan, R. Atlas, 2018: Validation of an Airborne Doppler Wind Lidar in Tropical Cyclones. *Sensors*, **18**, 4288.

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