MODULE DESCRIPTION

15. Air-Sea Surface Fluxes Module

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

Air–sea exchanges of heat and momentum are important elements in understanding and skillfully predicting hurricane intensity, but the magnitude of the corresponding wind-speed dependent bulk exchange coefficients is uncertain at hurricane force wind speeds. Since direct turbulent flux measurements in these conditions are extremely difficult, the momentum and enthalpy fluxes can be alternatively deduced via angular momentum and total energy budgets (Fig. 15-1). This module was successfully executed during the CBLAST field campaign with good results from the methodology reported by Bell (2010). Further research with data from additional hurricanes would add to the confidence in the derived exchange coefficients. This module could be performed by either of two existing flight patterns. The first would be to repeat the original CBLAST flight pattern with high frequency dropwindsonde deployments through the eyewall region (Fig. 15-2). This would allow for an axisymmetric budget calculation derived from azimuthally averaging the dense dropsonde data and tail Doppler radar derived winds. A second option (Fig. 51-3) could be executed using the Ocean Winds experiment flight pattern. This consists of a series of pie-shaped wedges originating in the eye and extending outward to just beyond the eyewall and high wind inner core nominally 50 km (37 nm), and which rotate downwind with time. These pie slices will be concentrated in the high wind right and front quadrants of the storm and be flown with the two WP-3D aircraft flying 'in trail', maintaining same lateral and vertical spacing. This would enable the budget calculation to be performed without the axisymmetric assumption, and include an estimate of the wind and energy tendency terms from the lagged aircraft measurements. The Ocean Winds pattern would require extra drops on the outer edge of the pie wedge in order to complete the budget around the entire circuit.

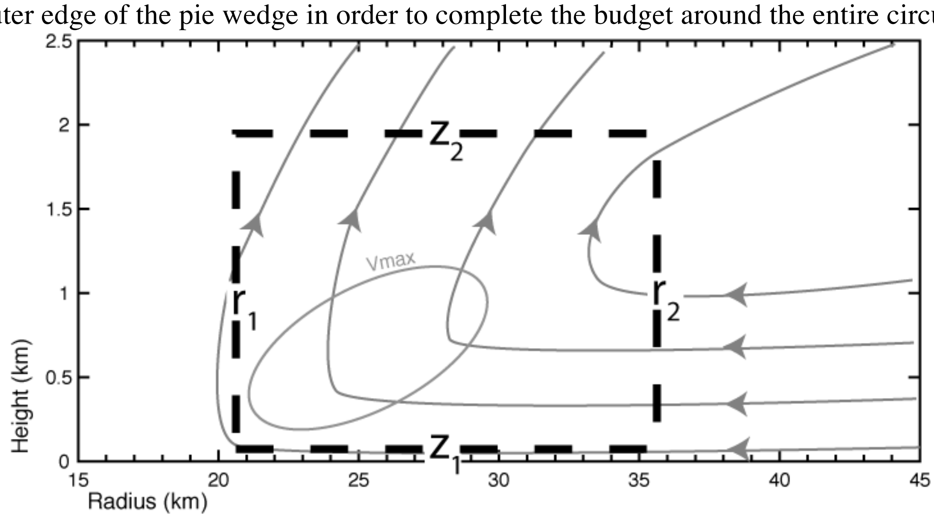

Figure 15-1. Schematic illustrating hypothetical control volume (black dashed line) used for the budget methodology. A simplified secondary circulation (gray streamlines) and region of maximum wind (v_{max}) are shown to indicate the control volume encompasses the eyewall region.

Mature Storms Experiment

CBLAST MODULE

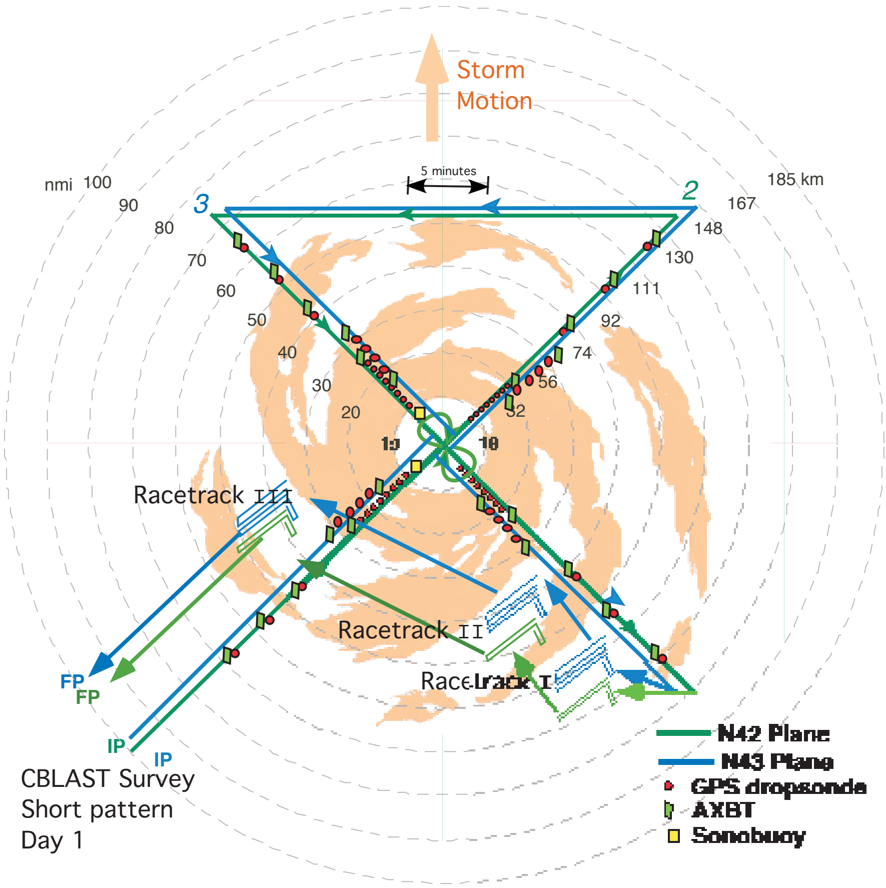

Figure 15-2. CBLAST eyewall sonde module.

• Note 1.	The pattern should be aligned 45° from storm heading. Preferred **IP** is in left-rear quadrant, but can be in any quadrant.
• Note 2.	The two WP-3Ds fly 'in trail' with high plane at 7,000 ft RA (12,000 ft in CAT 4 or 5) and low plane at 5,000 ft RA from **IP** to **2**, 2,500 ft RA thereafter, conditions permitting (8,000 ft for CAT 4 or 5). The lower WP-3D will lead the upper WP-3D.
• Note 3.	Aircraft should reach their respective **IP's** as simultaneously as possible, with the **IP** for upper WP-3D at a radius of 120 nm, and the **IP** for the lower WP-3D at a radius of 108 nm.
• Note 4.	The lower WP-3D will commence a sequence of four near-eyewall drops on inbound legs at approximately $2R_{MAX}$ or twice the eyewall thickness radially-outward. High-level aircraft should commence series of 8 eyewall drops 30 s after end of low plane drops, ending at inner edge of eyewall. Orbit in the center until all drops have cleared. Reverse the sequence on the outbound legs.
• Note 5.	Operate NOAA 43 Tail Doppler in continuous mode on all coordinated legs.

Mature Storms Experiment
OCEAN WINDS EXPERIMENT/MODULE

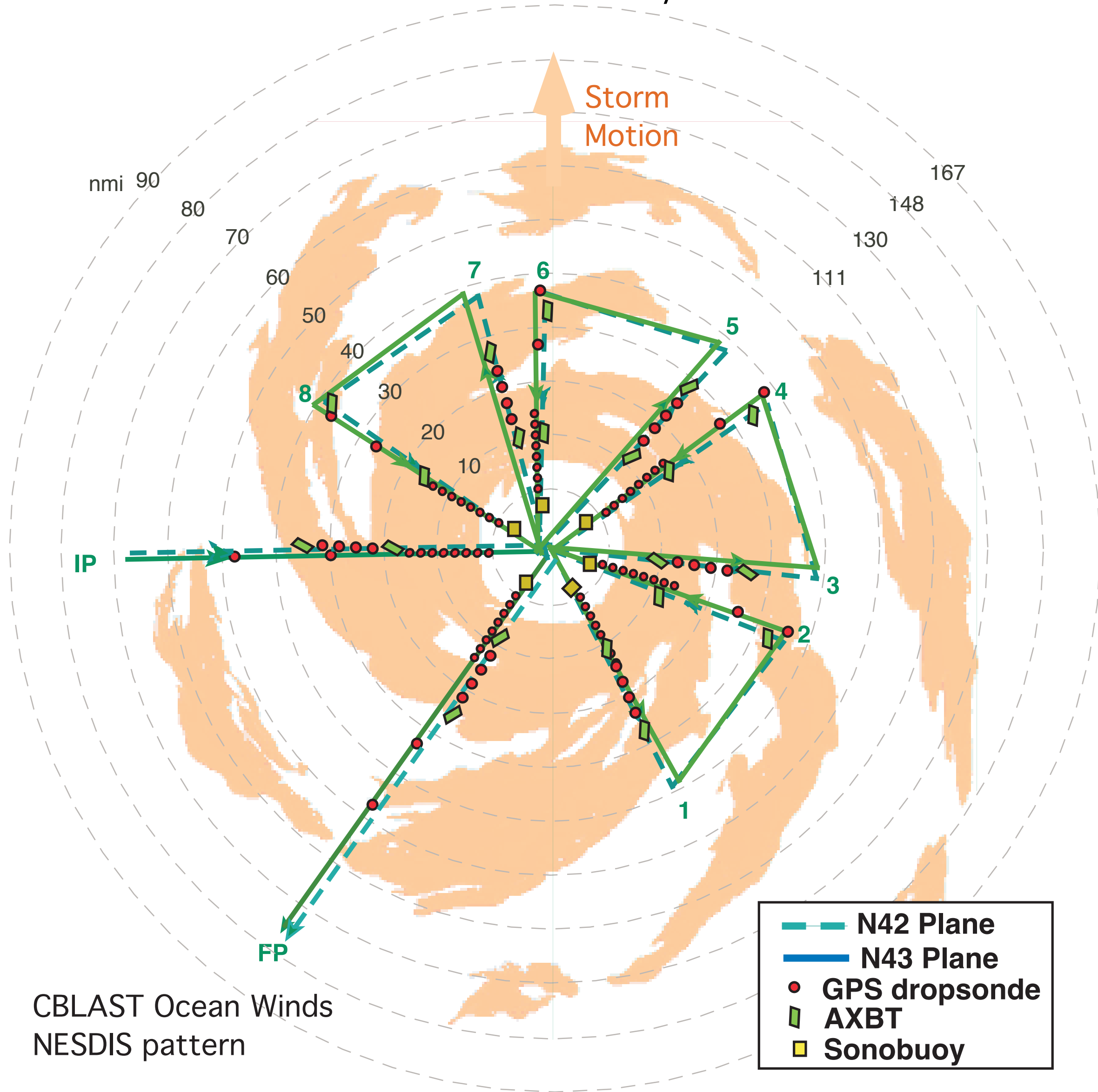

Figure 15-3. Ocean Winds Pattern

- Note 1. Preferred **IP** is in west quadrant, but can be in any quadrant.
- Note 2. The two WP-3Ds fly 'in trail' with high plane at 7,000 ft RA (12,000 ft in CAT 4 or 5) and low plane at 5,000 ft RA from **IP** to **2**, 2,500 ft RA thereafter, conditions permitting (8,000 ft for CAT 4 or 5). The lower WP-3D will lead the upper WP-3D.
- Note 3. Aircraft should reach their respective **IP's** as simultaneously as possible, with the **IP** for upper WP-3D at a radius of 108 nm, and the **IP** for the lower WP-3D at a radius of 97 nm.
- Note 4. The high WP-3D will commence a sequence of six eyewall drops on inbound legs at approximately 1.5RMAX or near the outer edge of the eyewall, ending at inner edge of eyewall. Reverse the sequence on the outbound legs.
- Note 5. NOAA 43 TA radar should be operated in continuous mode (**not** F/AST) while flying coordinated legs with NOAA 42.