2023 NOAA/AOML/HRD Hurricane Field Program - APHEX

EARLY STAGE EXPERIMENT
Flight Pattern Description

Experiment/Module: Convective Burst Structure and Evolution Module (CBM)

Investigator(s): Rob Rogers (PI), Trey Alvey, Robert Black, Hua Leighton, Xuejin Zhang, Michael Bell (CSU), Anthony Didlake (PSU), Jim Doyle (NRL), Dan Stern (NRL), Josh Wadler (ERAU)

Requirements: TD, TS, Category 1

Early Stage Science Objective(s) Addressed:

1) Obtain a quantitative description of the kinematic and thermodynamic structure and evolution of intense convective systems (convective bursts) and the nearby environment to examine their role in TC intensity change [*APHEX Goals 1, 3*].

P-3 Pattern #1

What to Target: An area of vigorous, deep convection occurring within the circulation of a tropical cyclone (TC)

When to Target: When deep convection is identified either by radar or satellite during the execution of a survey pattern at or near the radius of maximum wind (RMW) of a tropical depression, tropical storm, or Category 1 hurricane. Particular attention should be paid when a developing area of deep convection can be detected on the downshear (shear direction inferred by real-time SHIPS analyses) side of the storm prior to propagation upshear, though this module is also desired in weaker TCs where the vortex may be tilted and downshear to upshear propagation of a CB is limited.

When possible, coordination with a ground scientist should be used to improve situational awareness, as they may have better access to satellite loops, lightning data, etc. that aid identification of convective evolution. Additionally, it is recommended that the onboard scientists use radar (lower fuselage, i.e. MMR) looping features and/or storm ID tracks if available.

Pattern: Series of inbound/outbound radial penetrations / bowtie pattern: Repeated sampling can allow for a following of the burst around the storm, or if the burst remains confined downshear.

- Repeat penetrations as long as time permits within the 1–2 h window
- When a high-altitude aircraft is present, efforts should be made to coordinate the pattern with the high-altitude aircraft, so that the two aircraft are as close to vertically stacked as possible.

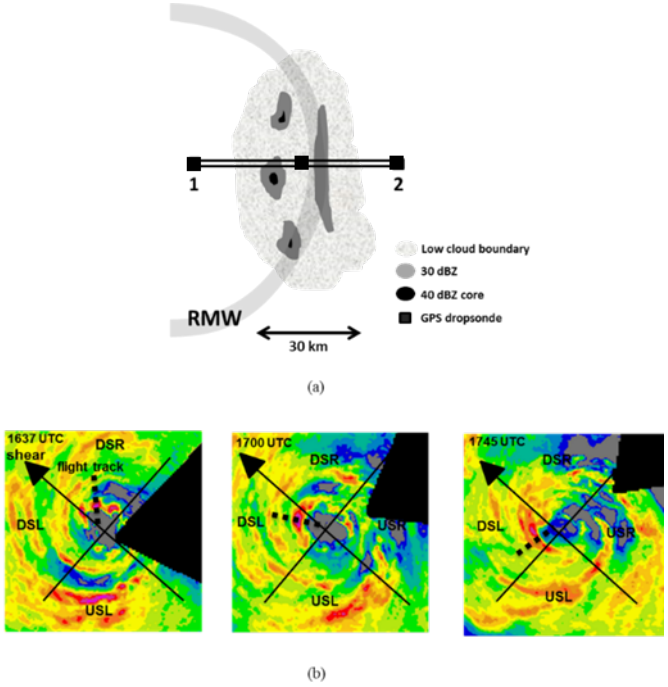

Figure CBM1: P-3 Convective burst module: (a) Radial penetrations / bowtie pattern. Black squares denote locations of GPS dropsondes from P-3. This pattern should be repeated multiple times as time allows, following the CB around the storm (or in place if the CB remains confined downshear). (b) Example of sampling strategy following CBs around the storm, beginning downshear right (DSR) and into the upshear quadrants. Each radial pass is separated by ~30 minutes.

Flight altitude: A constant altitude of 10–12 kft (radar or pressure altitude) is preferable

Leg length or radii: Variable depending on size of CB, but should extend at least 10 n mi (19 km) inside and 10 n mi (19 km) outside radar-defined edges of CB. Total leg length should last no less than 6 minutes in duration (~25 n mi/48 km).

Estimated in-pattern flight duration: 1–2 h added to the mission

Expendable distribution: Dropsondes at turn points 1 and 2, and within the CB, provided it is not released in heavy rain. No more than 15 dropsondes needed for this module. If AXBTs are available, drop one AXBT paired with a dropsonde in each shear-relative quadrant sampled during the module.

Instrumentation Notes: Every effort made to fly the aircraft level for optimal Doppler radar sampling during the radial penetrations and bowtie patterns.

Dual P-3: This is not a requirement for the module but can be treated as an add-on. If multiple P-3 aircraft are available and sampling simultaneously, one aircraft should perform the radial penetrations as described above. The other aircraft should attempt to complete a box pattern or circumnavigation,

preferably at the maximum allowable altitude ($\geq$ 18,000 feet) and centered on the CB but outside the precipitation shield. Dropsondes should be released at turn points of the circumnavigation of the CB.

G-IV Pattern #1: G-IV is not an explicit platform used with the module. However, science objectives of the module will be enhanced if G-IV is flying coincident with P-3 and releasing dropsondes in close spatial and temporal proximity to the P-3 during CB module.