2022 NOAA/AOML/HRD Hurricane Field Program - IFEX

MATURE STAGE EXPERIMENT
Flight Pattern Descriptions

Experiment/Module: Rainband Complex Module (RCM)

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Requirements: Categories 2–5

Mature Stage Science Objective(s) Addressed:

1) Collect observations targeted at better understanding internal processes contributing to mature hurricane structure and intensity change. [*IFEX Goals, 1 3*].

2) Collect observations targeted at better understanding the response of mature hurricanes to their changing environment, including changes in vertical wind shear, moisture and underlying oceanic conditions [*IFEX Goals 1, 3*].

P-3 Pattern #1

What to Target: Mature TC with clear quasi-stationary rainband complex. Particular focus on convective-to-stratiform transition region and stratiform region of organized rainband complex. Typically in downshear to left-of-shear halves of storm (in sufficient shear), or downmotion (front) to left-of-motion halves of storm. Shear direction is estimated from real-time SHIPS analyses.

When to Target: Microwave satellite imagery or radar indicates presence of rainband complex

Pattern: As part of a figure-4, butterfly, or rotated figure-4 pattern, the straight, downwind leg between radial passes is replaced with a curved, downwind leg following the curve of the rainband complex. If safety permits, fly the pattern near the center of the rainband complex for microphysics measurements. If not, fly along the inside edge of the rainband complex with a 10-km offset for radar coverage. The option of executing a microphysics spiral (see description in Stratiform Spiral Module) would be considered in this case if there is a stratiform shield (likely on the downwind end of the band). The module can be performed multiple times in a mission.

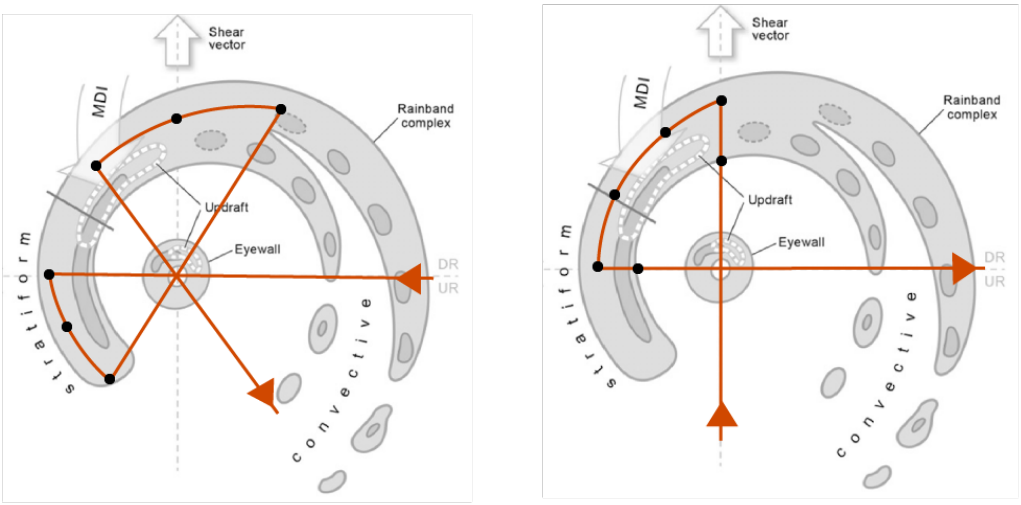

Figure 1. Rainband Complex modules in Figure-4 (left) and Butterfly (right) survey patterns. The module targets the stratiform and transition regions of a mature rainband complex. The downwind straight legs of a regular survey pattern are replaced with along-band curved legs, and the radial leg lengths are adjusted to meet the endpoints of the module leg. The "optimal" dropsonde (black dots) strategy is in the right panel, and the "acceptable" dropsonde strategy is in the left panel, for each RCM. (Figure adapted from Didlake et al. 2018.)

Flight altitude: 10-12 kft preferable, radar or pressure altitude.

Leg length or radii: Depends on the radial location of the rainband complex. Ideally, the radial legs are long enough to connect endpoints of the curved track that best follows the rainband complex. The along-band leg length depends on whether the survey pattern is a figure-4 or butterfly. An optimal configuration would extend the curved leg further down the band. This is preferable if it does not disrupt the survey pattern too significantly. If RCM is flown during an operationally-tasked mission, module will be executed in a manner that does not shorten the radial leg lengths of the vortex survey pattern. For example, curved downwind leg could be started at radial distance from the center beyond the specified vortex survey radial leg length. If end of curved downwind leg is within the radial length of the survey pattern, aircraft will return outbound to begin the next inbound radial leg of the survey.

Estimated in-pattern flight duration: ~45 min per leg

Expendable distribution: Acceptable deployment strategy is 3 dropsondes – 1 at each endpoint and 1 at midpoint of along-band leg (as shown in left figure panel). The optimal deployment strategy is 6 dropsondes – 1 at each endpoint, 2 evenly spaced on the along-band leg, and 1 deployed along each adjacent radial leg on the radially inside edge of the rainband (as shown in right figure panel).

Instrumentation Notes: Fly the curved leg at the smallest possible aircraft bank angle to minimize loss of radar data due to aircraft banking.

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G-IV Pattern #1:

What to Target: Sample the environment of a TC right outside of the rainband complex.

When to Target: Proposed flight pattern should take place when microwave satellite imagery indicates the presence of a rainband complex.

Pattern: G-IV Circumnavigation; fly pattern such that the innermost circumnavigation (octagon or hexagon) is as close to the outer edge of the rainband complex as is safely allowed. Standard circumnavigation (octagon or hexagon) would work as long as the inner radius is close to the outer edge of the rainband complex.

Flight altitude: 41–45 kft preferable

Leg length or radii: Deploy dropsondes at all turn points. The octagons are all turn points and could also be staggered rather than aligned to achieve better azimuthal sonde coverage.

Expendable distribution: Deploy dropsondes at all turn points. The octagons are all turn points and could also be staggered rather than aligned to achieve better azimuthal sonde coverage.

Instrumentation Notes: N/A