## 17. Eye-eyewall Mixing Module

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**Significance**: Eyewall mesovortices have been hypothesized to mix high entropy air from the eye into the eyewall, thus increasing the amount of energy available to the hurricane. Signatures of such mesovortices have been seen in cloud formations within the eyes of strong TCs, in radar reflectivity signatures (Hurricane Fabian), and from above during aircraft penetrations (Hurricanes Hugo and Felix). Doppler radar was able to sample such features in Hurricanes Hugo and Felix, though interpretation with sparse observations through the small features has been difficult. Dropwindsondes released in very intense tropical cyclones, in conjunction with large-eddy simulations, have provided some thermodynamic data. However, the kinematic and thermodynamic structures of these features have never been directly observed. Observations within the eye near or below the inversion can allow for the study of the these mesovortices and improve knowledge of small-scale features and intensity changes in very strong TCs.

**Objective**: The objective is to directly observe the three-dimensional kinematic and thermodynamic structures of eyewall mesovortices for the first time. This would allow research into the impact these features have on subsequent intensity changes.

**Requirements:** A TC with a clearly defined visible eye, eyewall, and inversion and an eye diameter of at least 25 nm is needed. This should only be done during daytime missions. The inversion level is defined as the interface between cloudy air below and clear air above inside the eye. This can be done as a module during any other experiment.

**Hypothesis:** Eyewall mesovortices play an important role in tropical cyclone intensity change.

**Description:** Although this is not a standalone experiment in itself, it could be included within any missions during aircraft passage through the eye (Fig. 17-1). The P-3 will penetrate the eyewall at the altitude proposed for the remainder of the flight. Once inside the eye, the P-3 will descend from that altitude to a safe altitude below the inversion while performing a figure-4 pattern. The leg lengths will be determined by the eye diameter, with the ends of the legs at least 2 nm from the edge of the eyewall. Upon completion of the descent, the P-3 will circumnavigate the eye about 2 nm from the edge of the eyewall in the shape of a pentagon or hexagon. Time permitting; another figure-4 will be performed during ascent to the original flight level. Depending upon the size of the eye, this pattern should take between 0.5 and 1 h.

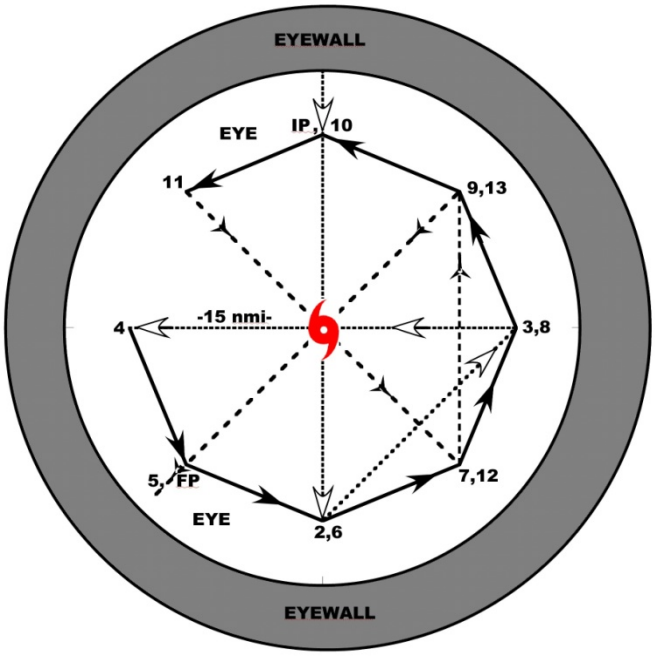


***Figure 17-1***. *The P-3 approaches from the north, penetrates the eyewall into the eye, and descends below the inversion while performing a figure-4 (dotted line) in the eye. The P-3 circumnavigates the eye in an octagon or pentagon (solid line), and then ascends while conducting another figure-4 (time permitting) rotated 45 degrees from the original (dashed line).*