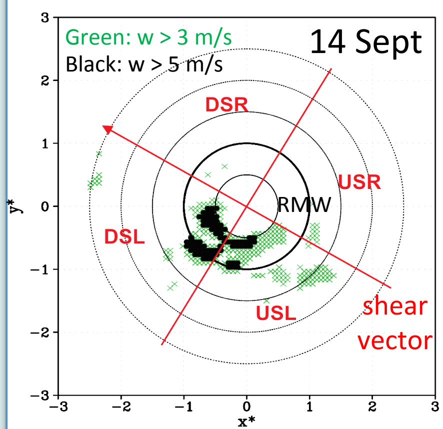
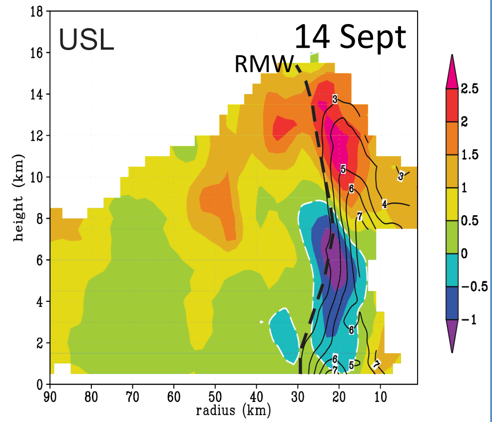
Kinematic and Thermodynamic Structure of Hurricane Edouard (2014) as seen by the NASA HS3 Global Hawk Dropsonde Data and NOAA Airborne Doppler Radar

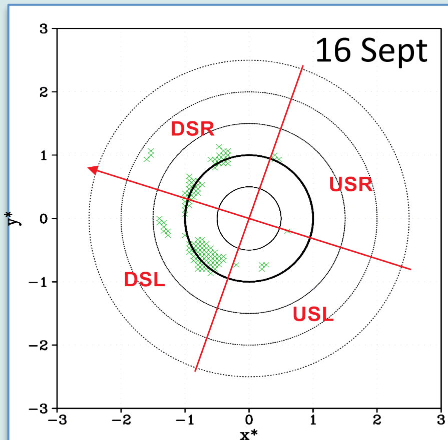
KINEMATIC STRUCTURE FROM NOAA IFEX AIRBORNE DOPPLER

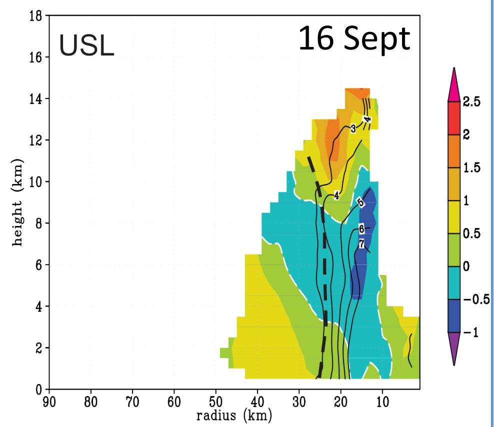
Locations of strong upper-level (8-16 km) updrafts relative to shear vector and RMW



Vertical motion (shaded) and inertial stability (contour) in upshear left (USL) quadrant

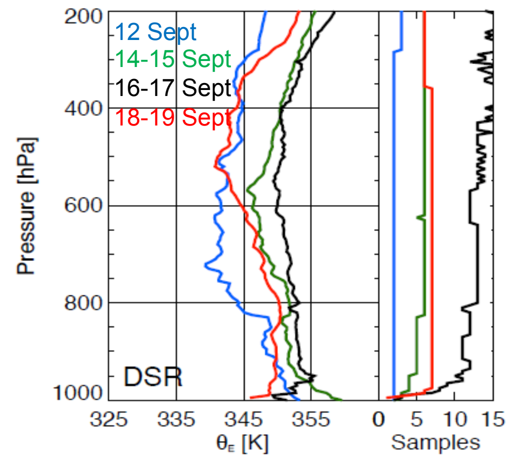




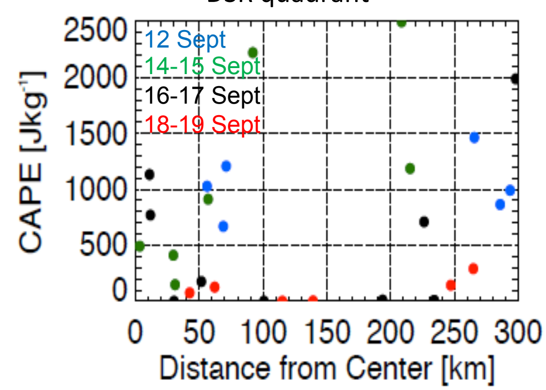


THERMODYNAMIC STRUCTURE FROM NASA HS3 DROPS

Inner-core mean vertical profiles of theta-e in downshear right (DSR) quadrant



Stability values for dropsondes in DSR quadrant



- **More** deep convection **USL, inside RMW** when intensifying (14 Sept), strong updrafts **USL** in efficient area for intensification
- **More unstable** lower troposphere on 14-15 Sept **DSR**, stable boundary layer and lower troposphere on 16-17 Sept
- Stable environment on 16-17 Sept associated with downdraft-cooled air unable to recover over storm-cooled sea surface

“Observations of the structure and evolution of Hurricane Edouard (2014) during intensity change. Part II: Kinematic structure and the distribution of deep convection”

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Highlights:

- Part 2 of this two-part paper focuses on the kinematic structure and distribution of deep convection observed within Hurricane Edouard (2014) during the two middle Global Hawk flights, when Edouard was nearly rapidly intensifying (14–15 September) and during the initial stages of weakening after reaching peak intensity (16–17 September)
- Synthesis of NOAA P-3 airborne Doppler observations (from coincident missions with the Global Hawk) for the kinematic structure and NASA Global Hawk dropsondes for the thermodynamic environment and boundary layer structure
- Edouard showed distinct differences in the distribution of deep convection during these two missions
- When Edouard was intensifying, there were significant areas of deep convection downshear left (DSL) and upshear left (USL), inside the RMW; when it was weakening, there was much less deep convection, and none USL
- Asymmetry in low-level inflow responsible for asymmetric distribution of precipitation, inflow maximized DSR, which served as initiation quadrant for convection
- Low-level inflow DSR penetrated further inward, stronger convergence, and less-stable environment on 14 Sept, leading to stronger convection that persisted USL, in a region of high inertial stability that is efficient for intensification
- Low-level inflow and convergence weaker DSR, convergence peaked outside RMW, and more stable boundary layer and lower troposphere on 16 Sept, leading to less deep convection that was not present USL, little heating coincident with high inertial stability

Description of Figures: The distribution of deep convection (defined as locations where peak updrafts > 3 and 5 m/s between 8 and 16 km) from airborne Doppler radar on 14 and 16 Sept are shown in left plots; center plots show vertical velocity and inertial stability (a measure of the efficiency of a vortex response to heating from convection) averaged within the USL quadrant on 14 and 16 Sept; upper-right plot shows vertical profiles of equivalent potential temperature from Global Hawk dropsondes averaged within 200 km of center on 12, 14-15, 16-17, and 18-19 Sept; lower right plot shows values of convective available potential energy (a measure of convective stability) for same four periods.

Scientific Significance and Relevance to Future Missions:

- The results shown in this two-part study emphasize the importance of symmetry in thermodynamic structure and precipitation, as well as the radial and azimuthal distribution of deep convection, in governing TC intensity change. Mechanisms to explain these azimuthal and radial distributions are also proposed.
- These results highlight the unique capabilities of the NASA Global Hawk – high altitude, extended range, and long duration. They also illustrate the value of synthesizing measurements from the NASA Global Hawk with NOAA aircraft – the ability to evaluate the kinematic and thermodynamic structures of the inner core and environment and provide a multiscale picture of the processes important in TC intensity change.