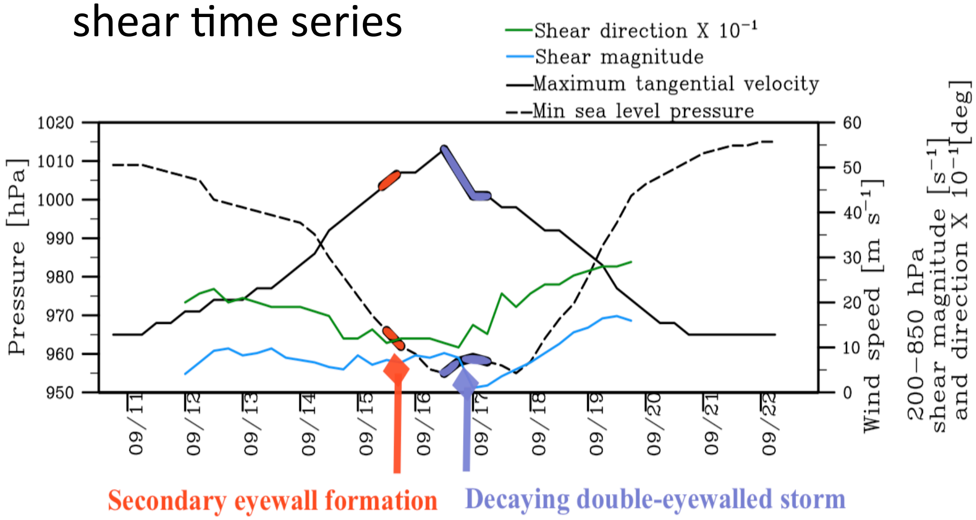
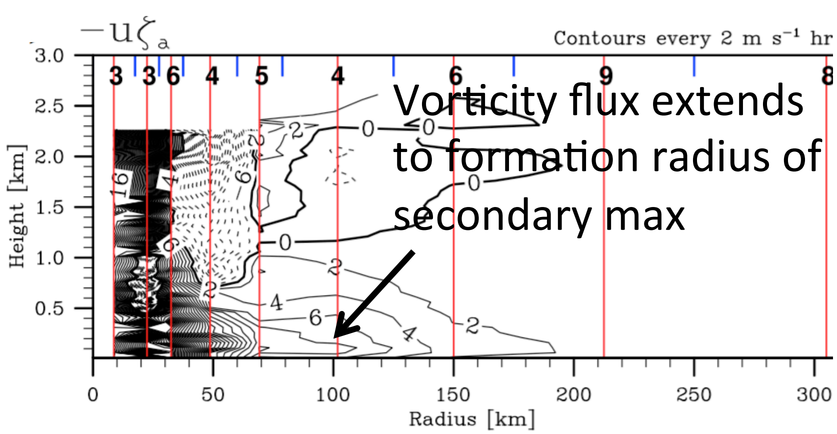
Secondary Eyewall Formation In Hurricane Edouard (2014)

Edouard's intensity and environmental shear time series

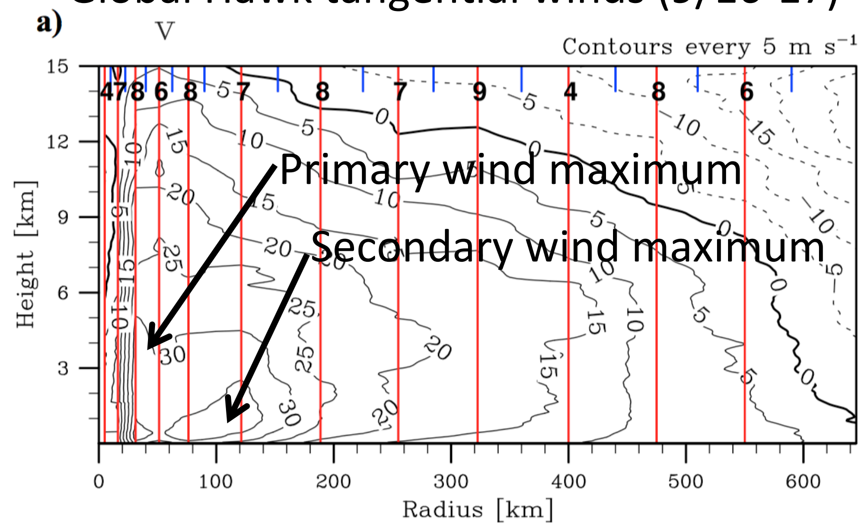


- Data from NASA HS3 and NOAA IFEX captured the formation of a secondary wind max and eye wall replacement cycle
- NOAA P-3 dropsondes found high radial vorticity flux and agradient force near formation radius of secondary wind max
- HS3 dropsondes showed location of resulting secondary wind max at radius of satellite observed secondary eye wall.

P-3 derived mean radial vorticity flux (9/15)



Global Hawk tangential winds (9/16-17)



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Data sources: Dropsondes from the NASA Global Hawk during HS3 and dropsondes from the NOAA P-3 during their Intensity Forecast Experiment (IFEX). P-3 data from flight into Hurricane Edouard on 15 September, 2014. Global Hawk data from 16-17 September flight over Edouard.

Technical Description of Figures:

Top left: Intensity (both minimum central pressure and maximum wind speed) time series over the lifetime of Hurricane Edouard. Also shown are time series of vertical wind shear magnitude and direction (blue and green lines). The time of the P-3 and HS3 flights are indicated by red and blue, respectively.

Lower left: Low-level vertical cross section of radial vorticity flux (the product of the radial velocity and absolute vorticity), which is the primary source of acceleration of the tangential velocity. P-3 dropsonde data from 15 September were placed into radial bins centered at the red vertical lines and the number of sondes averaged are shown at the top of each line. Radial vorticity flux is strongest in the eye wall, as expected, but extends radially outward in the lowest kilometer beyond 100 km radius. Note that the secondary wind maximum formed shortly thereafter at 100 km.

Lower right: Tangential velocity derived from HS3 dropsondes on 16-17 September. Red lines and numbers are as in the lower-left figure. The figure shows the primary wind maximum (somewhat difficult to see due to poor radial resolution resulting from the binning of dropsonde data) near 20-km radius. A clear secondary wind maximum is found at 100 km and was coincident with a satellite observed secondary eye wall. This secondary wind maximum formed in the region of strong radial vorticity flux where the agradient force (tangential velocity acceleration associated with departures of the flow from gradient wind balance) was maximum.

Scientific significance, societal relevance, relation to future missions: The Global Hawk provides a valuable capability for mapping out large regions of the storm and its environment. Combining data from the NOAA P-3 and NASA Global Hawk allowed a description of the formation process for a secondary wind maximum and secondary eye wall. This is one of the first studies to observationally describe this process. Secondary eye wall formation is important because it impacts the intensity of storms. Typically, secondary eye walls form in intense storms. After formation, the secondary eye wall chokes off the inflow of the primary eye wall, causing a decrease in storm intensity. In some cases, the secondary eye wall then contracts, leading to renewed intensification (although this did not happen in Edouard).