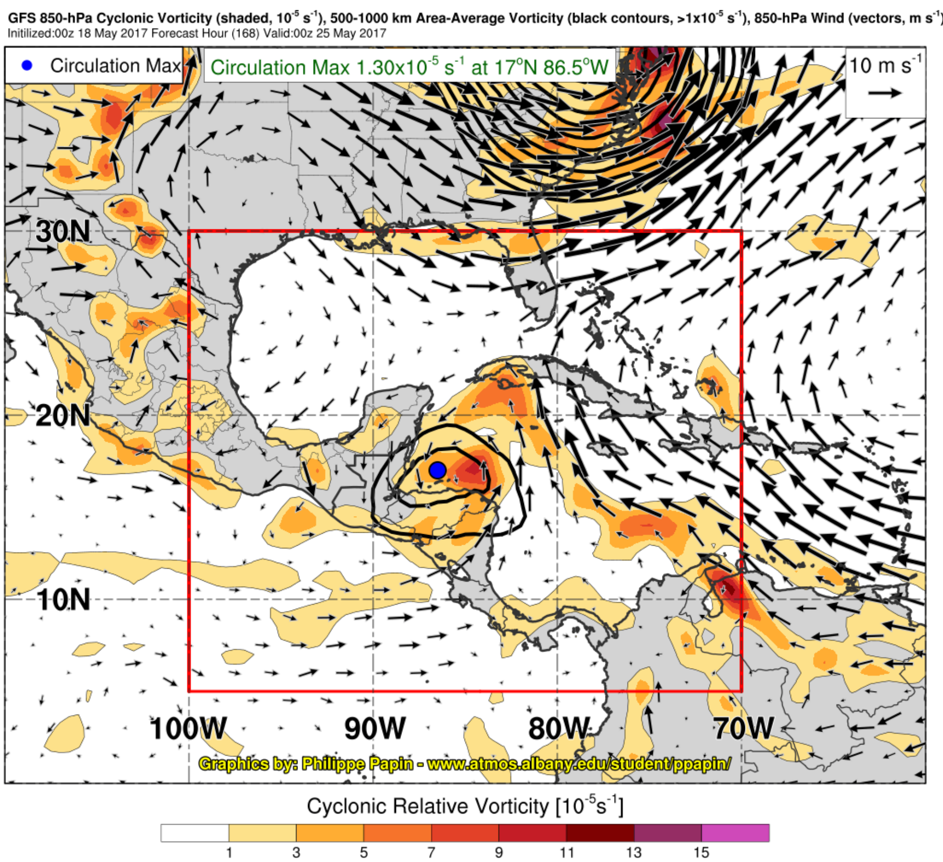
Central American Gyre Diagnostics: A README

For more detailed information describing how the Central American Gyre (CAG) algorithm was developed and how these diagnostics for the algorithm were chosen, please see the manuscript on CAGs below:

Papin, P., R. D. Torn, L. F. Bosart, 2017: A Climatology of Central American Gyres. *Mon. Wea. Rev.,* 145, 1983–2000. http://journals.ametsoc.org/doi/pdf/10.1175/MWR-D-16-0411.1

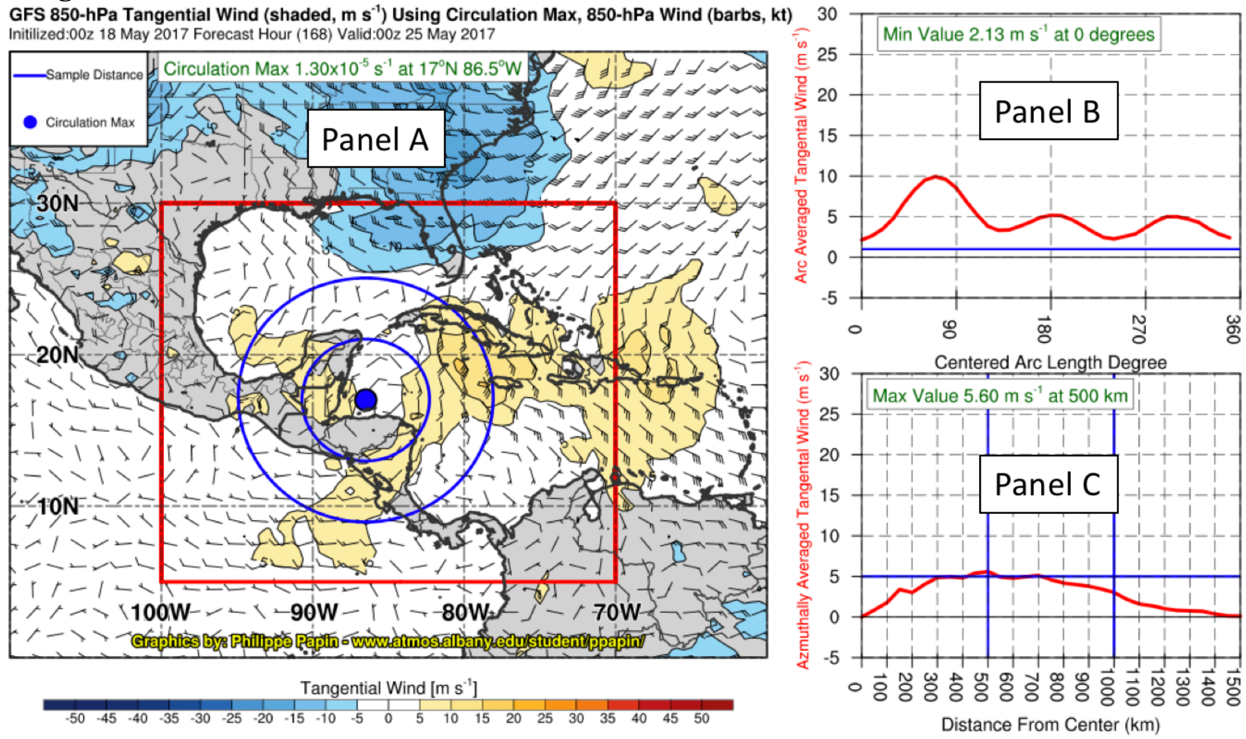
Explanation of Graphics for each diagnostic test:

500-1000 km Area-Averaged Vorticity Test – Test for Circulation Magnitude

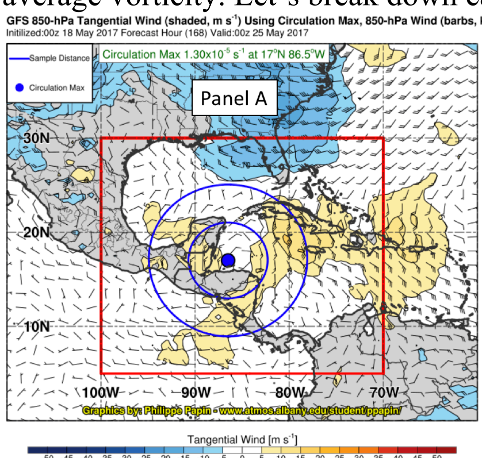


This first plot illustrates the area-average cyclonic vorticity (black contours), and how it compares to the distribution of grid point measured 850-hPa cyclonic vorticity (color shading). The top middle text box shows what the max area-average cyclonic vorticity is and its latitude and longitude (within the red area outlined in the image). **If this value exceeds $1x10^{-5}$ s^{-1}**, a CAG event is possible if additional criteria shown in the next diagnostic image are also met.

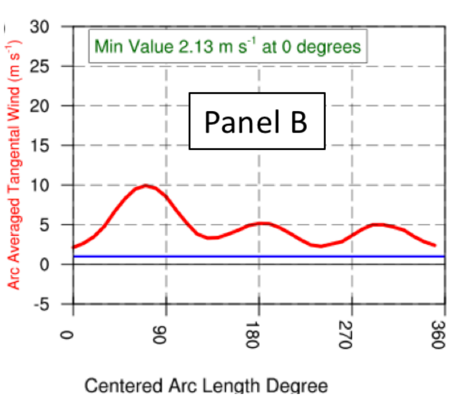
Tangential Wind Tests – Tests for Broad and Closed Earth-Relative Circulation



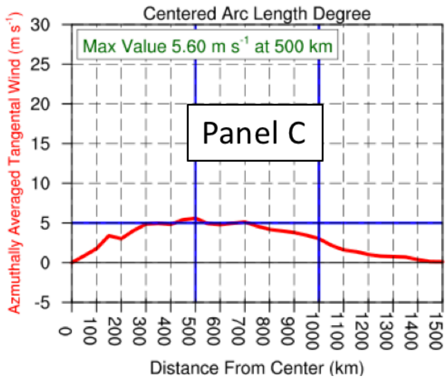
The second diagnostic plot illustrates different tangential wind tests using the maxima in area-average vorticity. Let's break down each panel.



Panel A is used to spatially show the distribution of tangential wind relative to the circulation max. 500 and 1000 km blue range rings are included to show the distribution of tangential wind within them that will be used for the subsequent diagnostic tests. This map is used to confirm that the line plot values in panels B and C are working as advertised (spatial confirmation).



Panel B shows the average tangential wind between 500-1000 km in a 60-degree arc (red line) that is centered on its mean direction (i.e., 0 degrees is due north). **All arcs from 0 to 350 degrees must exceed +1 m s^{-1}** (blue line) for this diagnostic to indicate the broad circulation has closed cyclonic flow. This minimum value is shown at the top of the line plot.



Panel C shows the azimuthally averaged tangential wind (red line) relative to the center of the circulation max (in km away from center). If this value exceeds +**5 m s^{-1} more than 500 km away from the center** (note blue lines), this indicates that the circulation is strong and board enough to be classified as a CAG. This maximum value at the reference distance is shown at the top of the line plot.

The area-average vorticity magnitude and tangential wind tests, in combination, help determine if a forecast case is a possible CAG candidate (possessing a strong circulation that is both broad and closed). In Papin et al. (2016), these criteria are required to persist for at least 48 consecutive hours using 6 hourly data for a CAG case to be identified. This time requirement is strict, and often there are disturbances that exhibit CAG like structures that exist for smaller time periods which still result in significant societal impacts (i.e., Heavy Rainfall and Flooding over Central America and Caribbean). Reanalysis data is used at the end of each season to determine the total number of cases, and the number of CAGs that occur in each year may be sensitive to the data sources chosen to conduct this analysis.

For any additional questions, feel free to contact me at ppapin@albany.edu