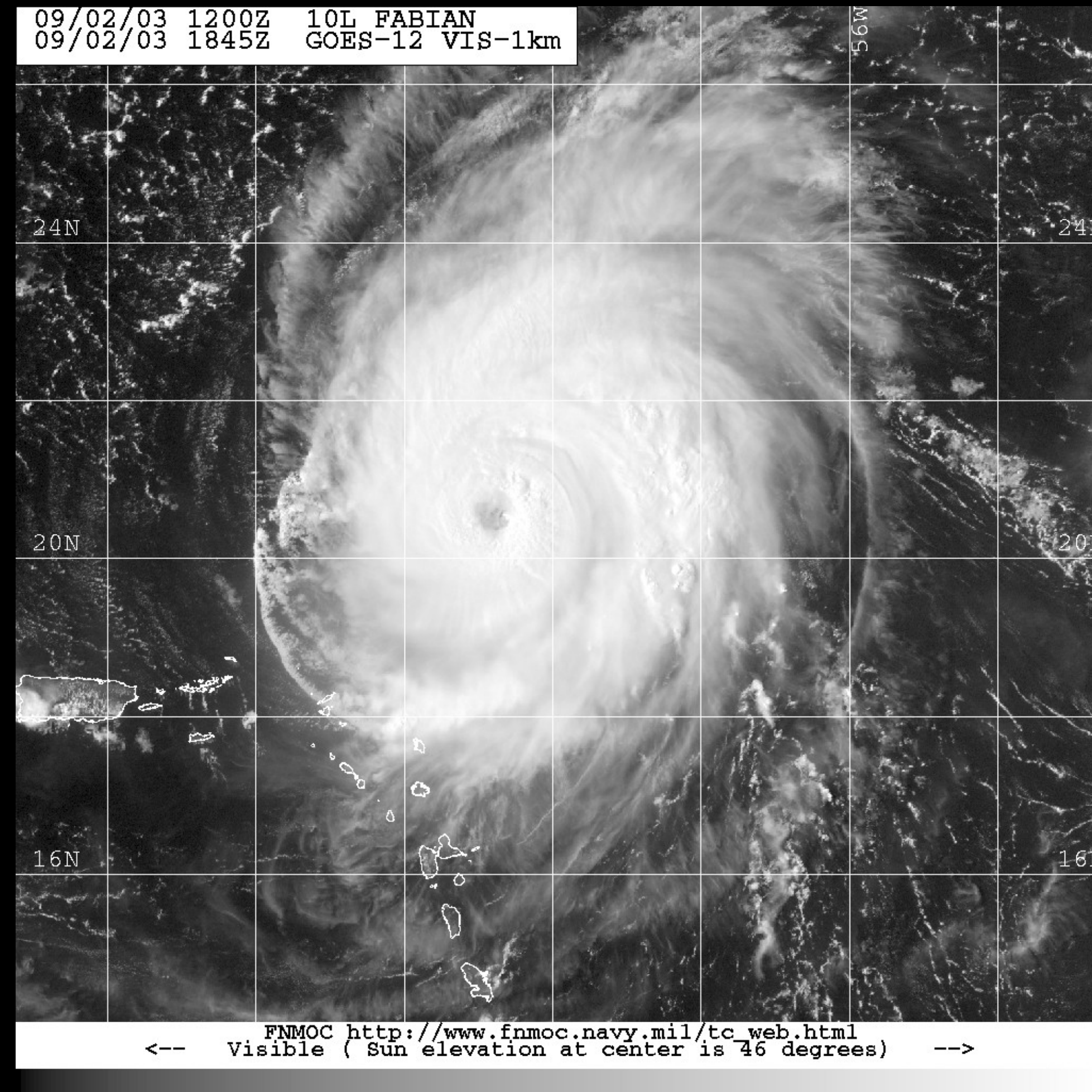


Polygonal eyewalls and mesovortices in Hurricane Fabian



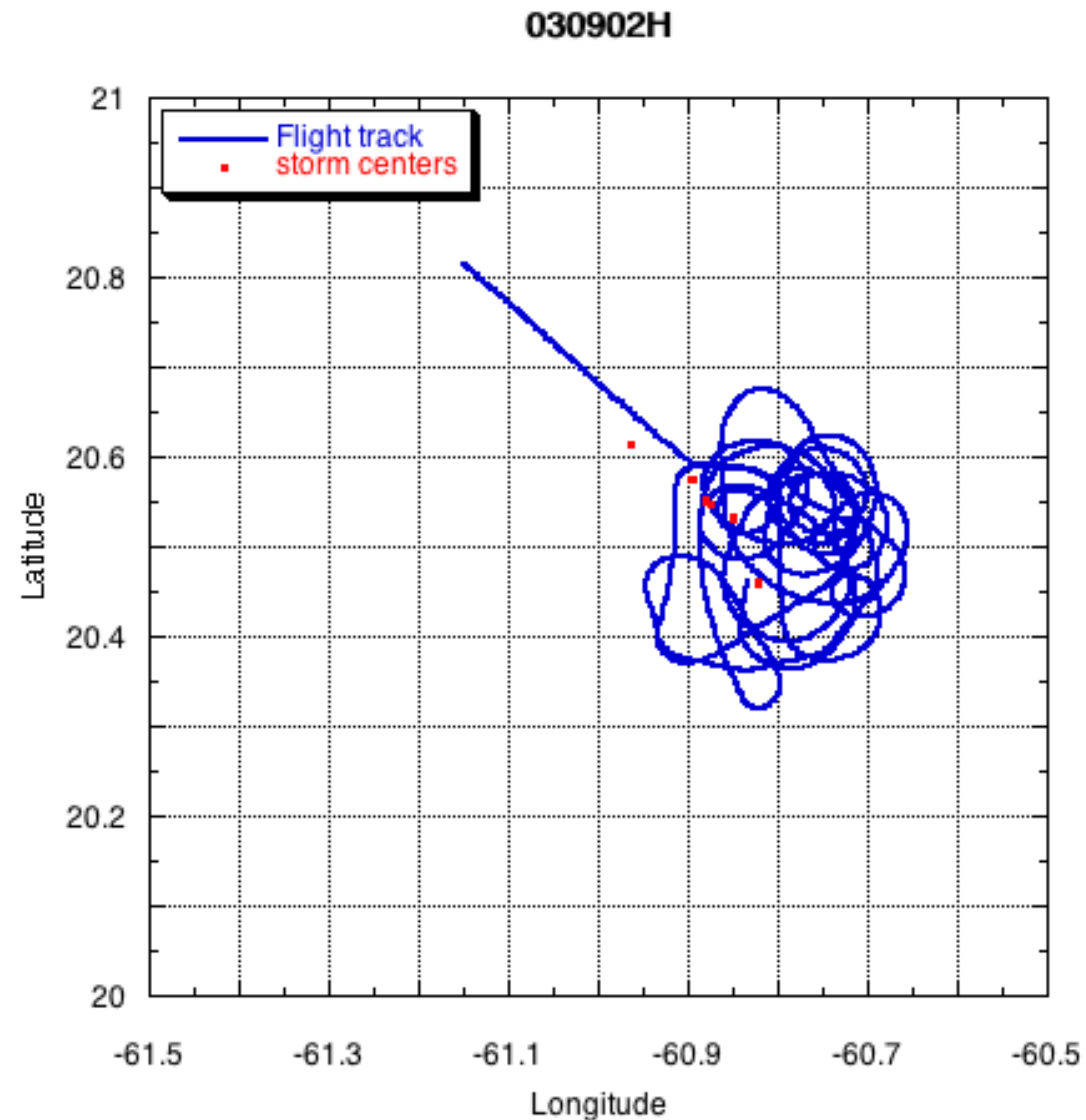
Sim Aberson

NOAA/Atlantic Oceanographic and Meteorological Laboratory

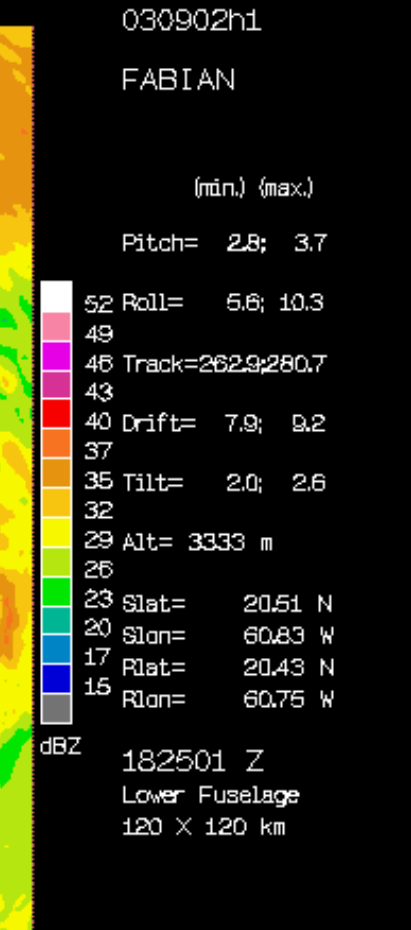
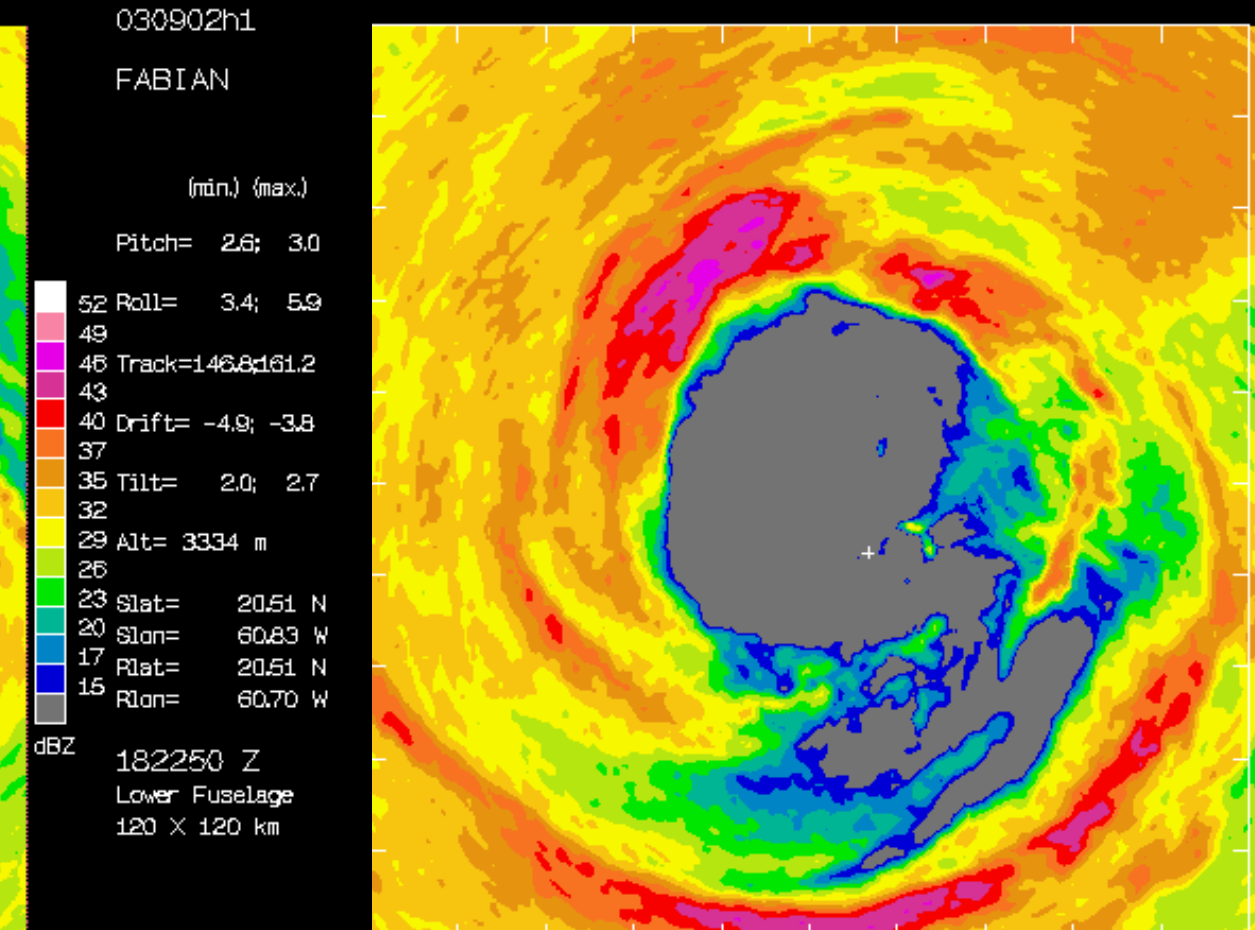
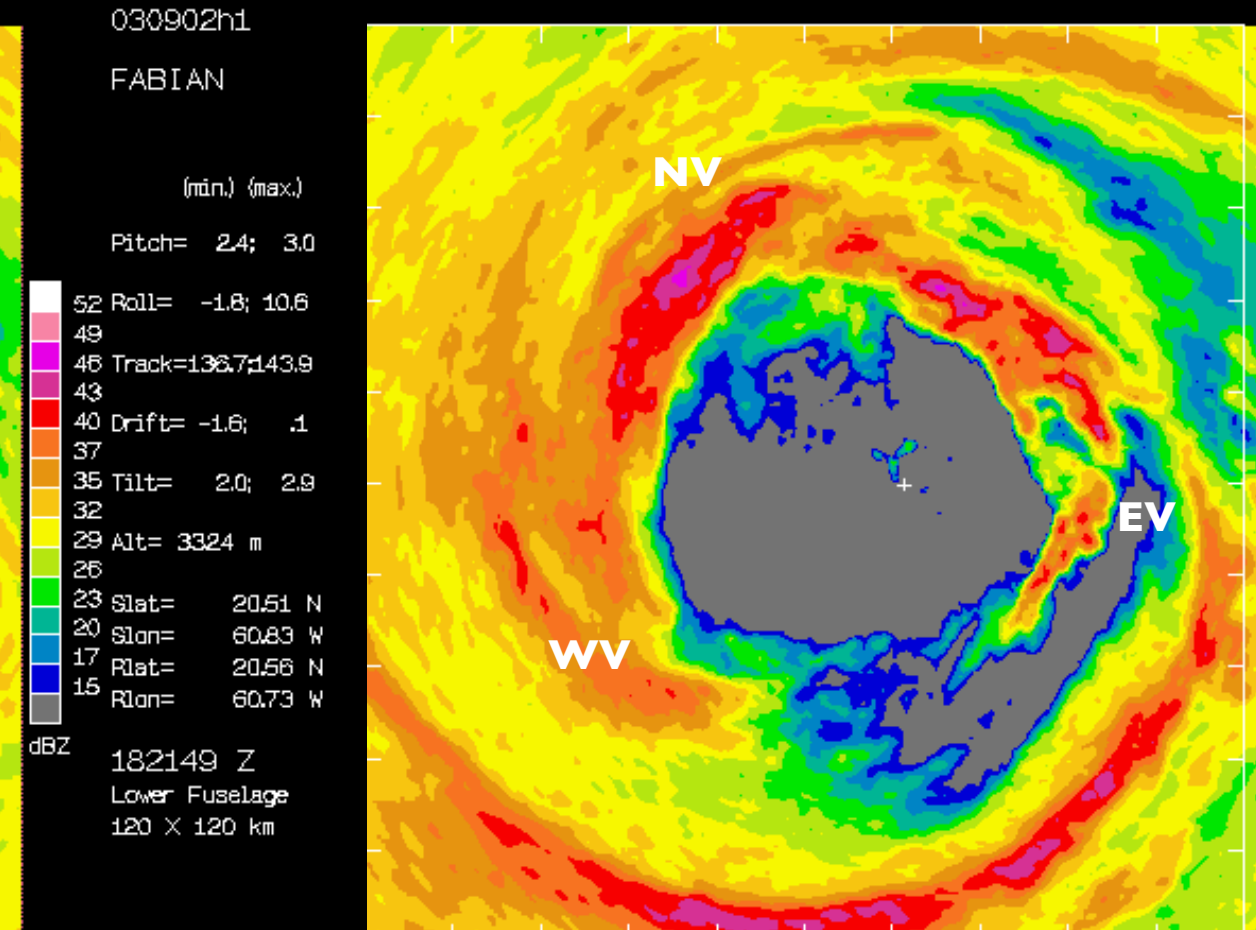
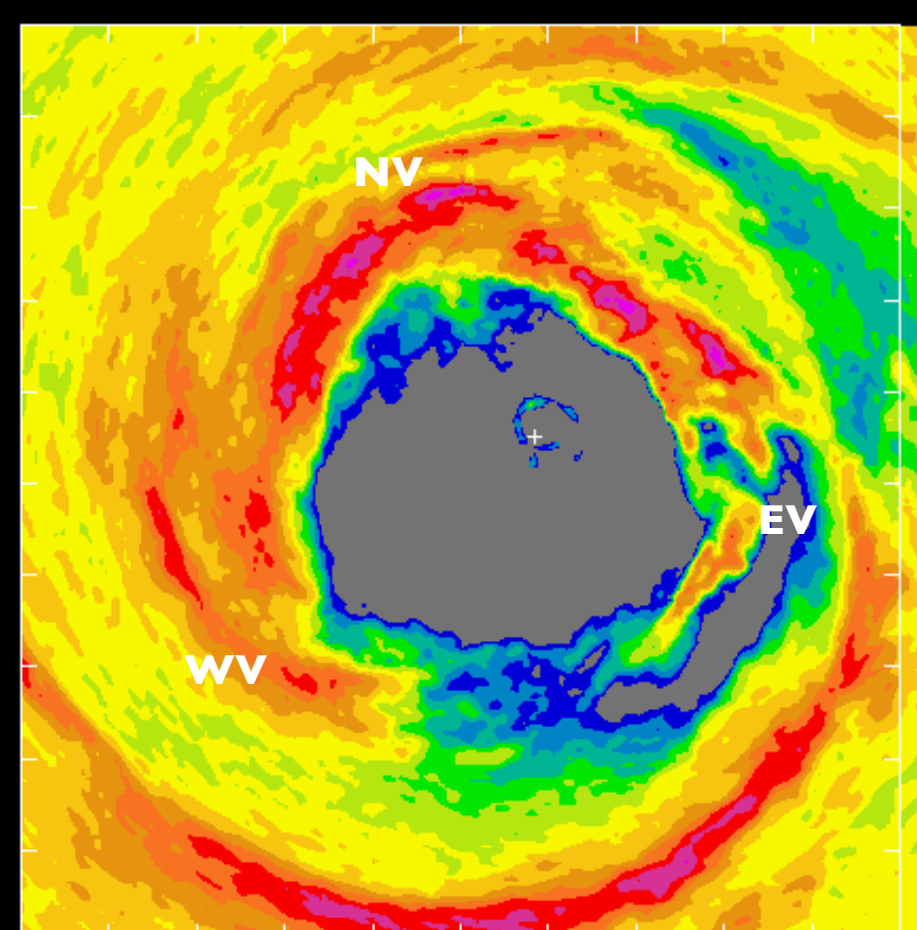
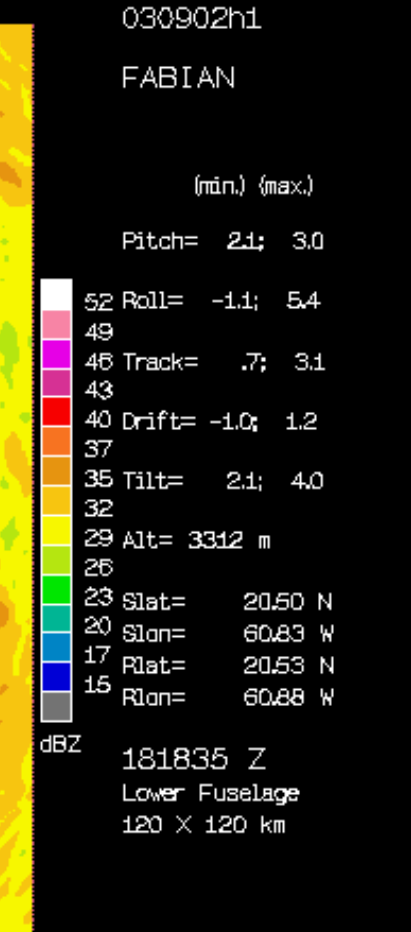
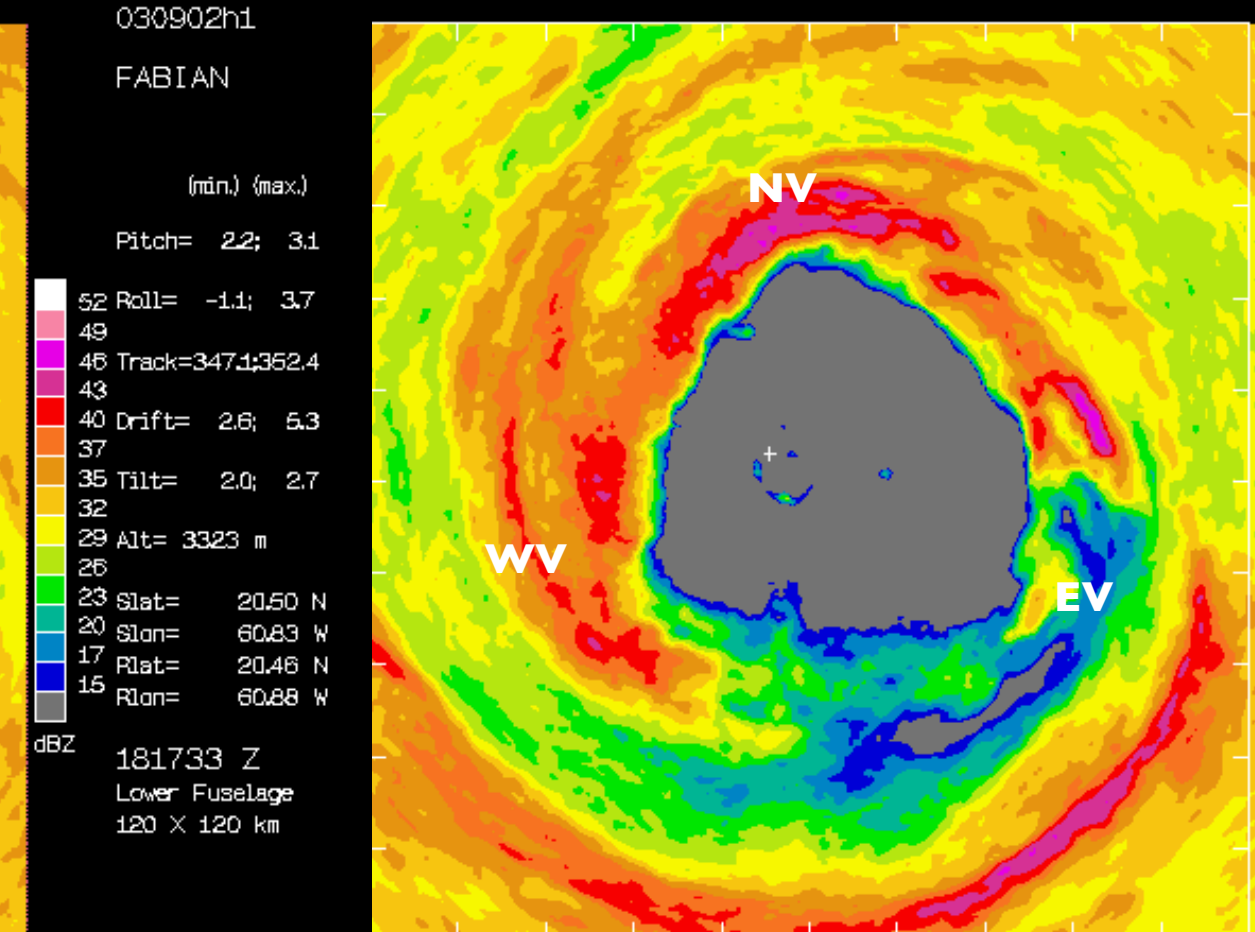
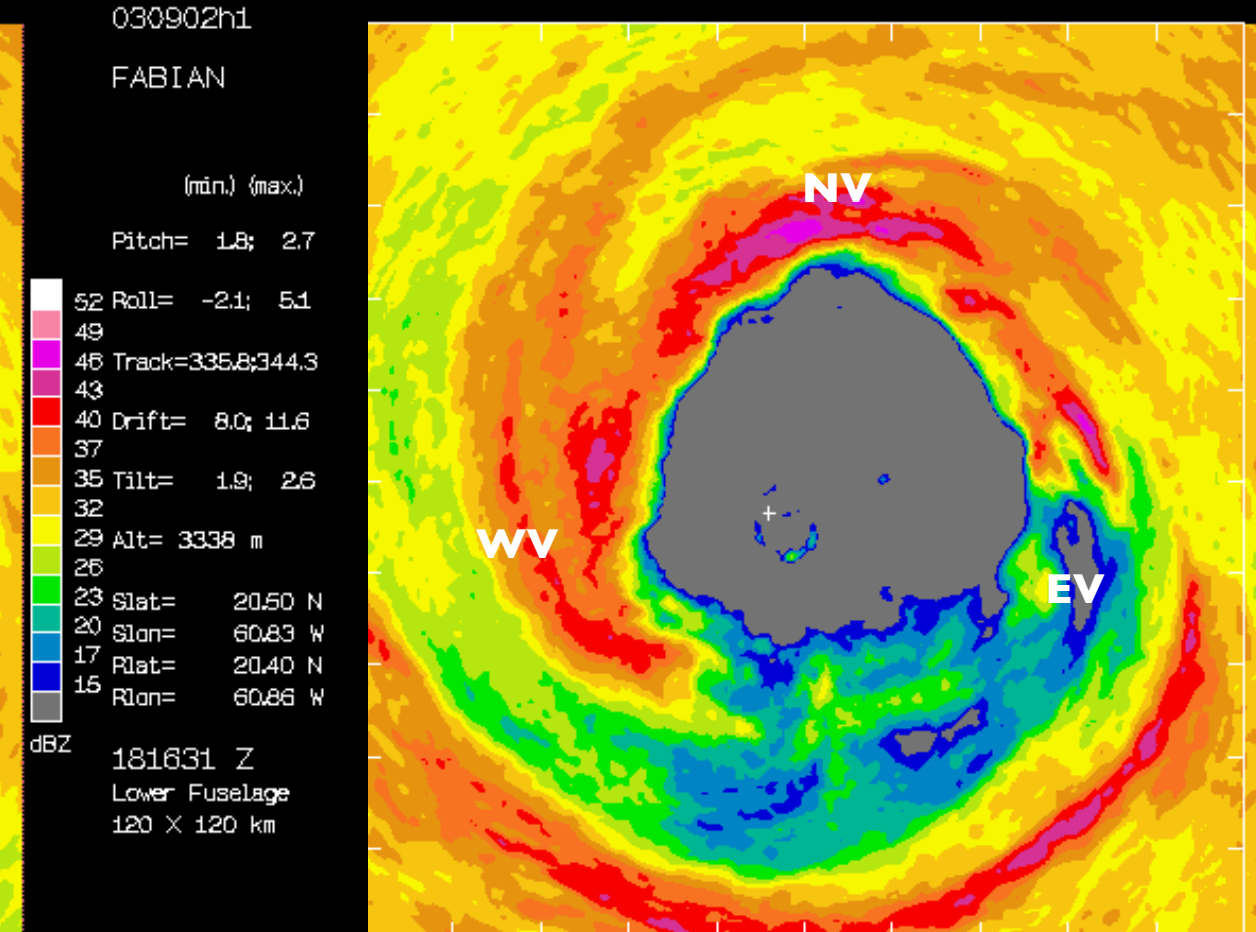
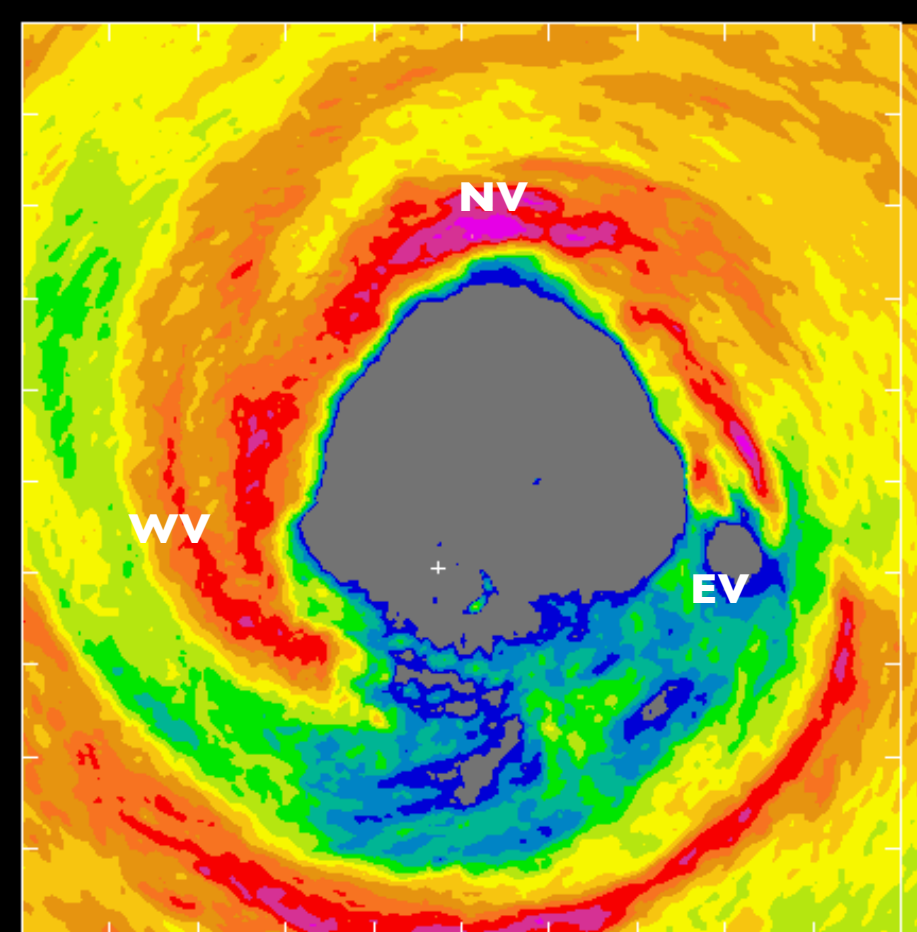
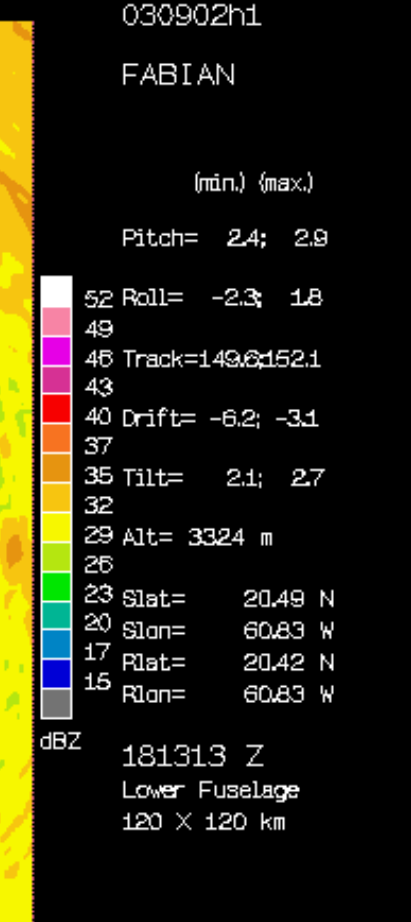
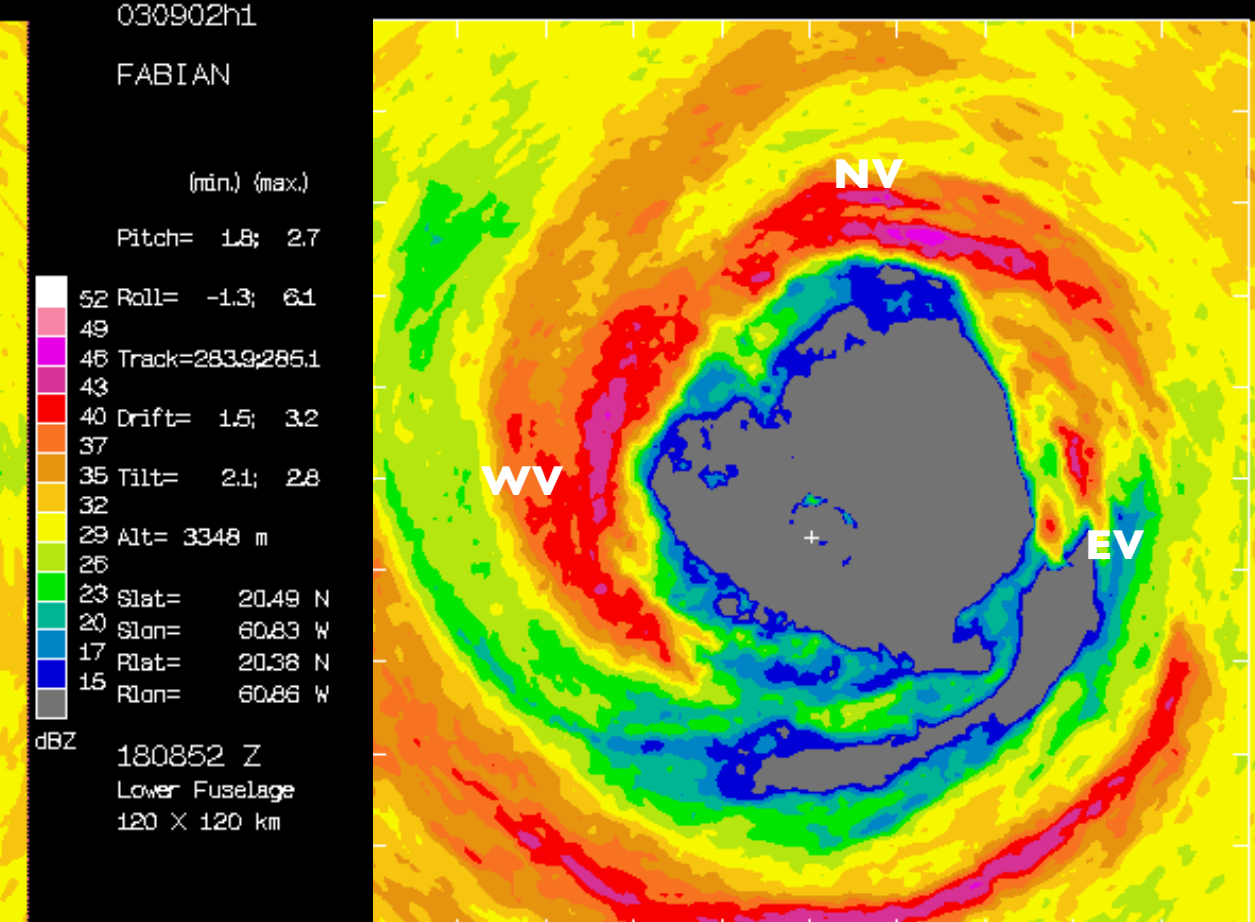
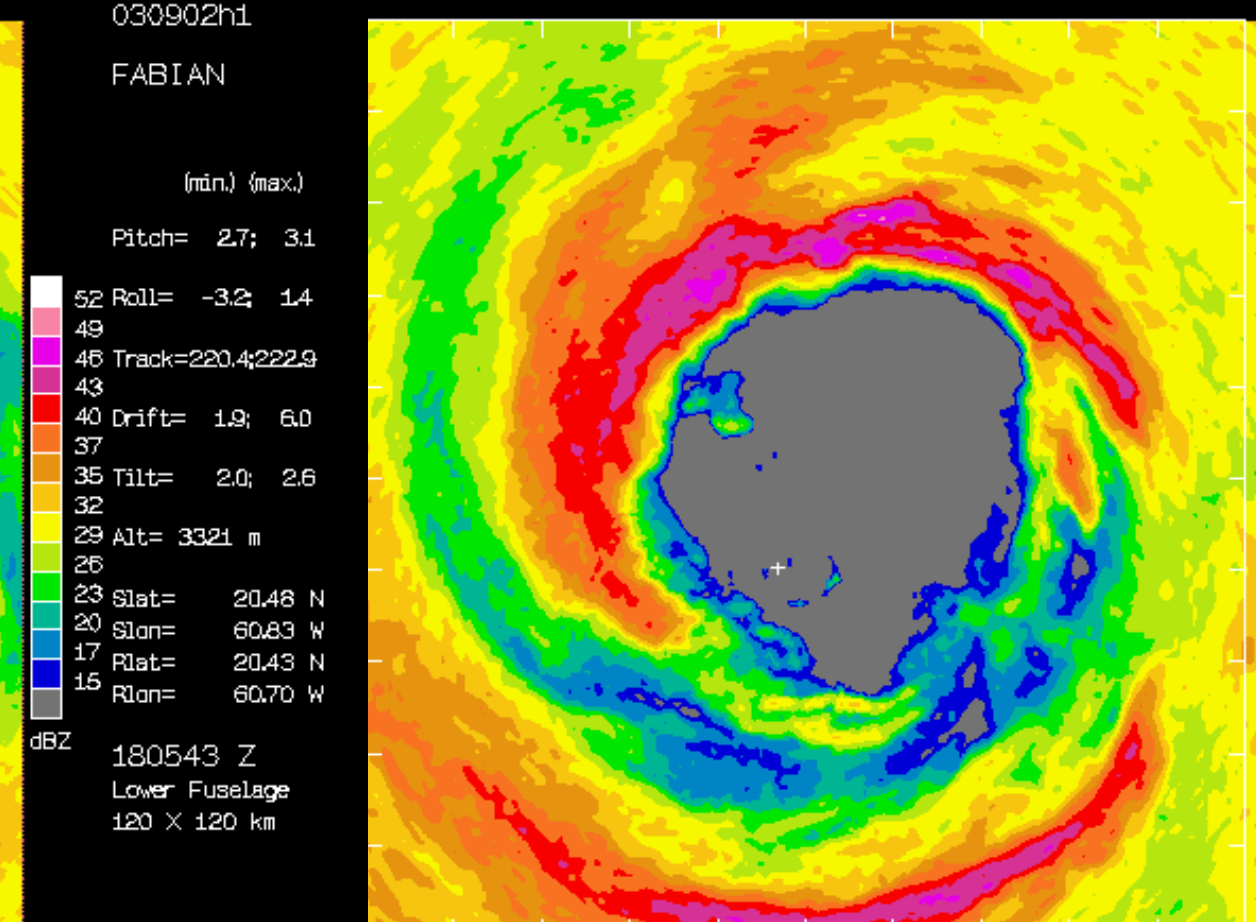
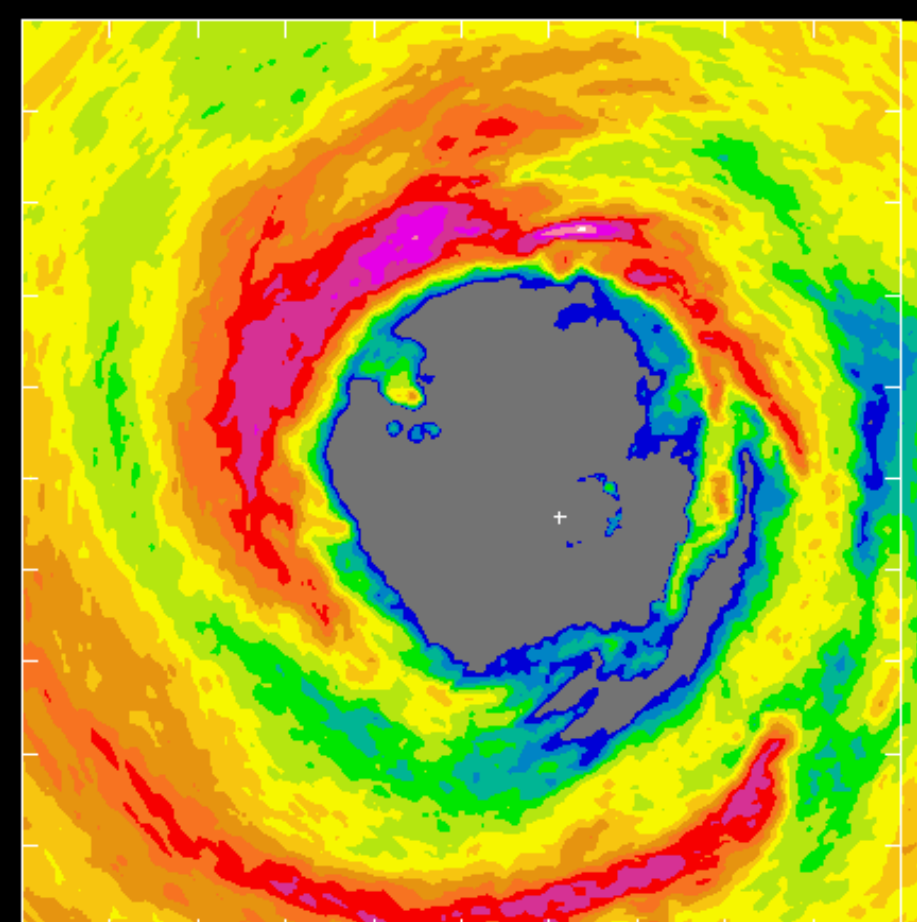


Hurricane Fabian (02 September 2003) 120 kt

Both 42 and 43 circled in the eye for up to two hours



During this time, the eyewall shape changed from circular to triangular (1813 UTC) and back (1823 UTC). The P-3s made three circles in the eye during that time, allowing for unprecedented coverage of the eyewall on short timescales with Doppler radar..



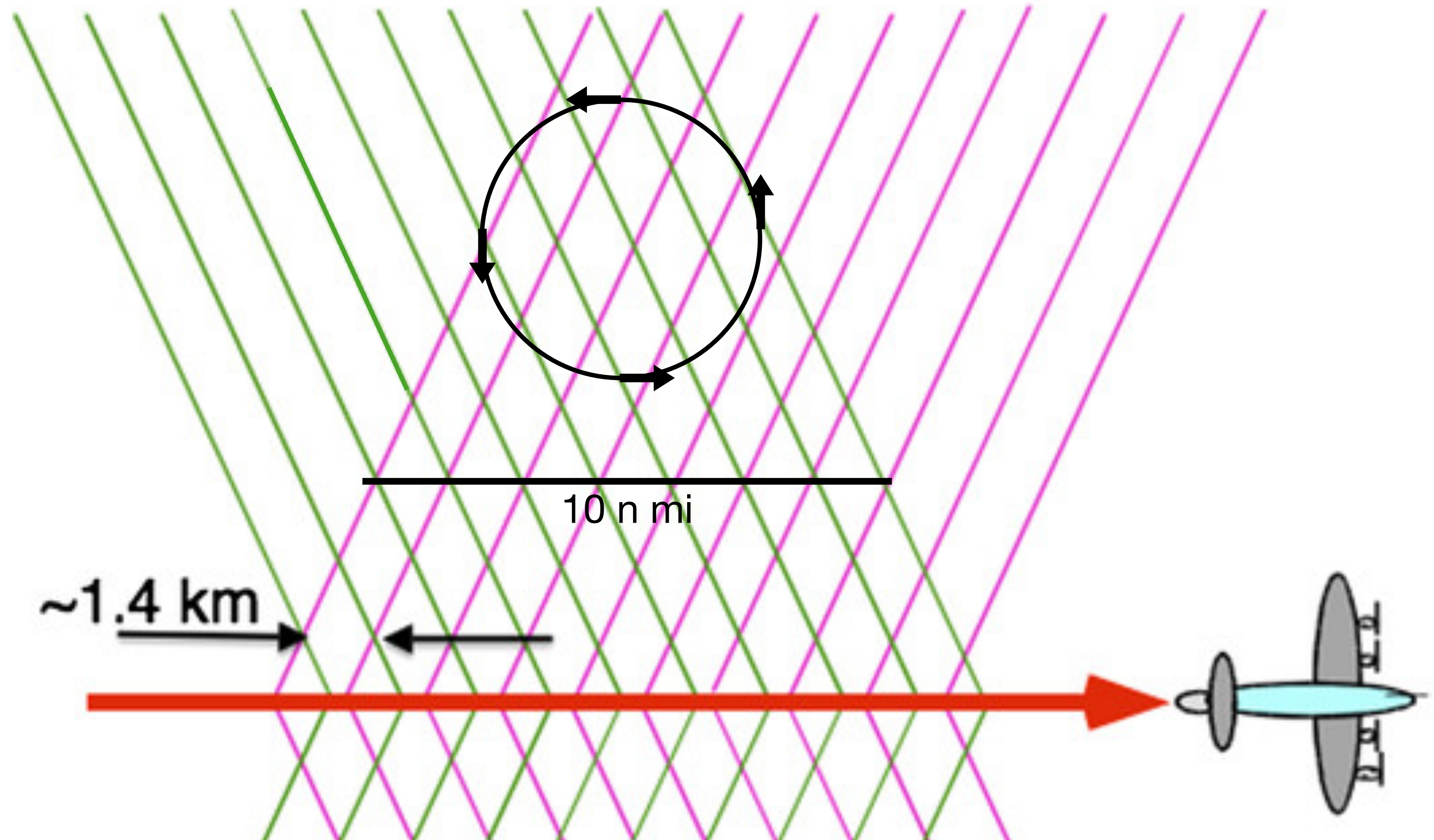
Two of the vertices moved 40 degrees around the center during that time; the other moved 50 degrees. This corresponds to approximately 4.5 degrees per minute, or a rotation period of about **80 minutes**.

The theoretical speed of waves c is given by

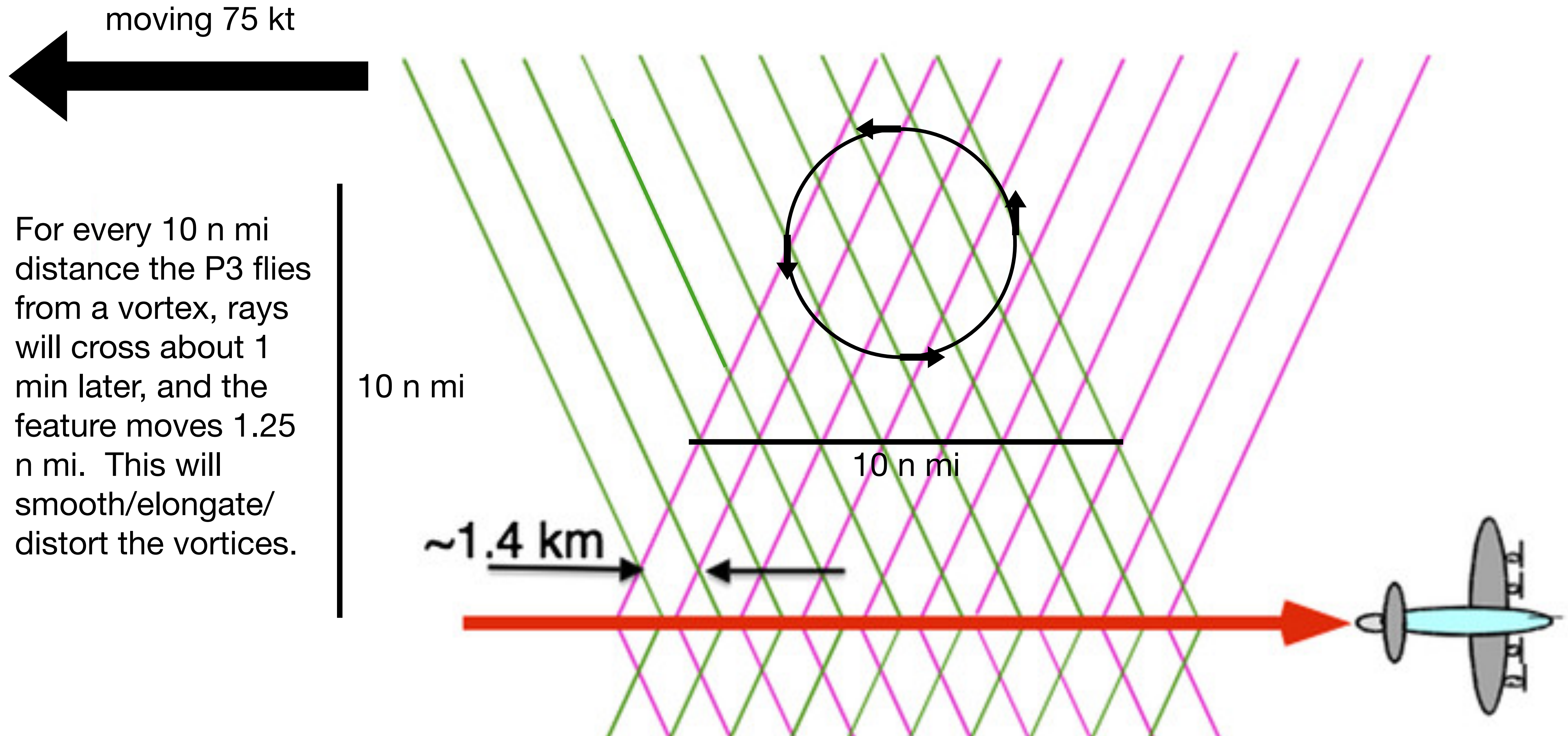
$$c = v_{\max}(1 - 1/m)$$

where v_{\max} is the tangential speed of the mean flow, and m is the wavenumber (Thomson 1880, Lamb 1932 and by Guinn and Schubert 1993). At the approximate altitude of the radar observations (~ 3 km), the mean flow was about 110 kt (57 ms^{-1}), giving a theoretical speed of 72 kt (37 ms^{-1}). At the radius of these features (~ 27 km), this translates to a rotation period of **76 minutes**.

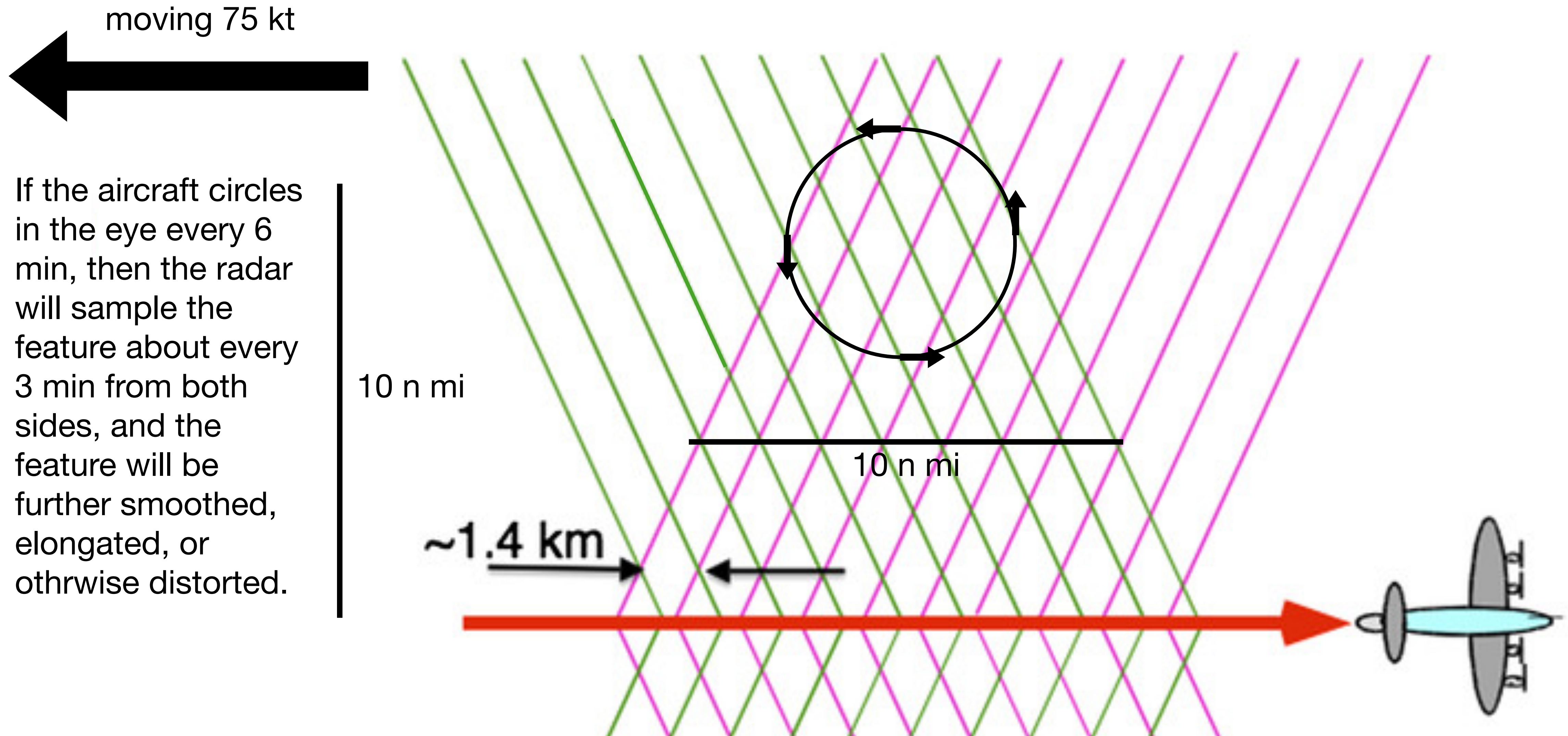
Can we see these small-scale features with airborne Doppler radar?



Can we see these small-scale features with airborne Doppler radar?

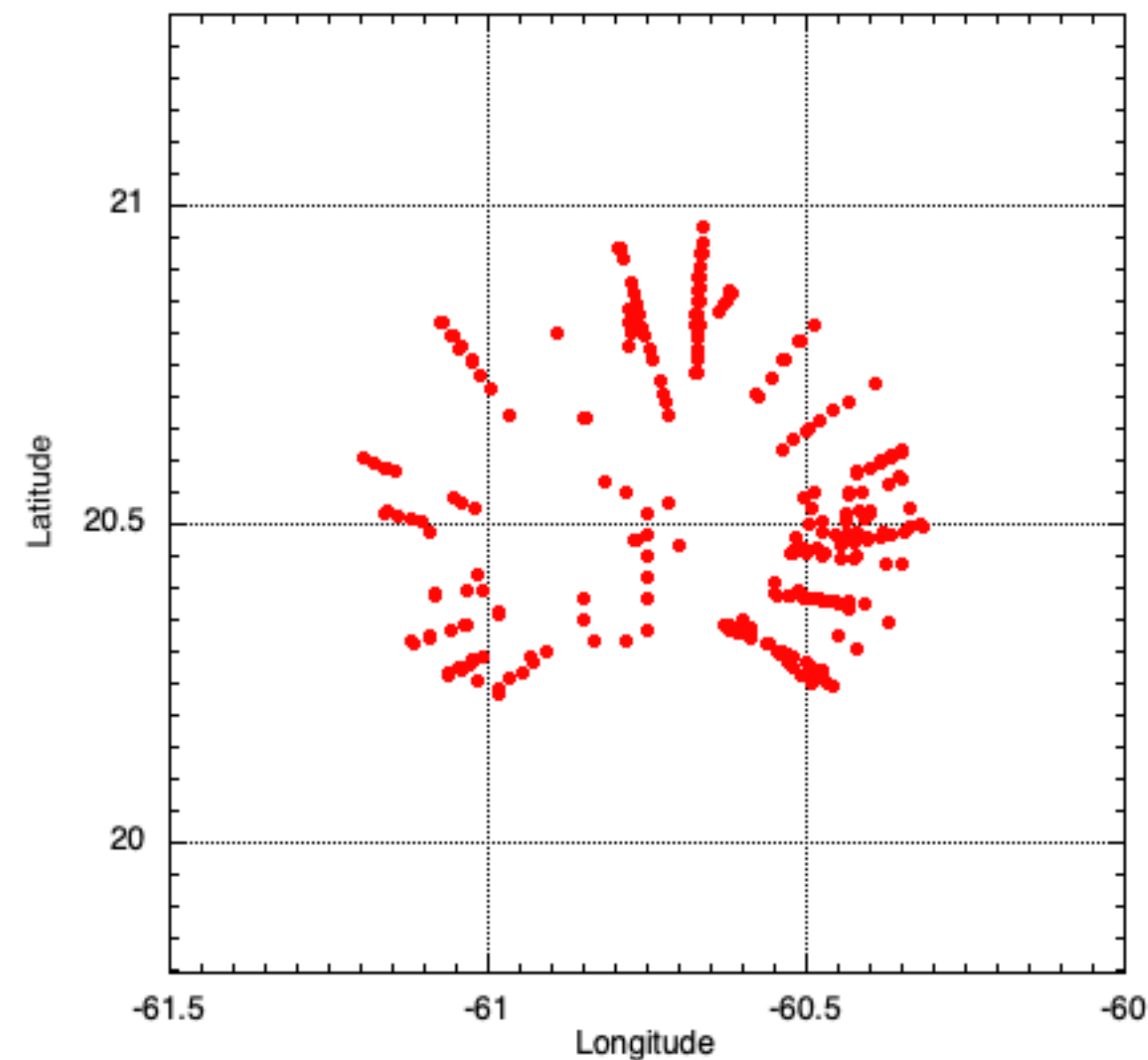


Can we see these small-scale features with airborne Doppler radar?

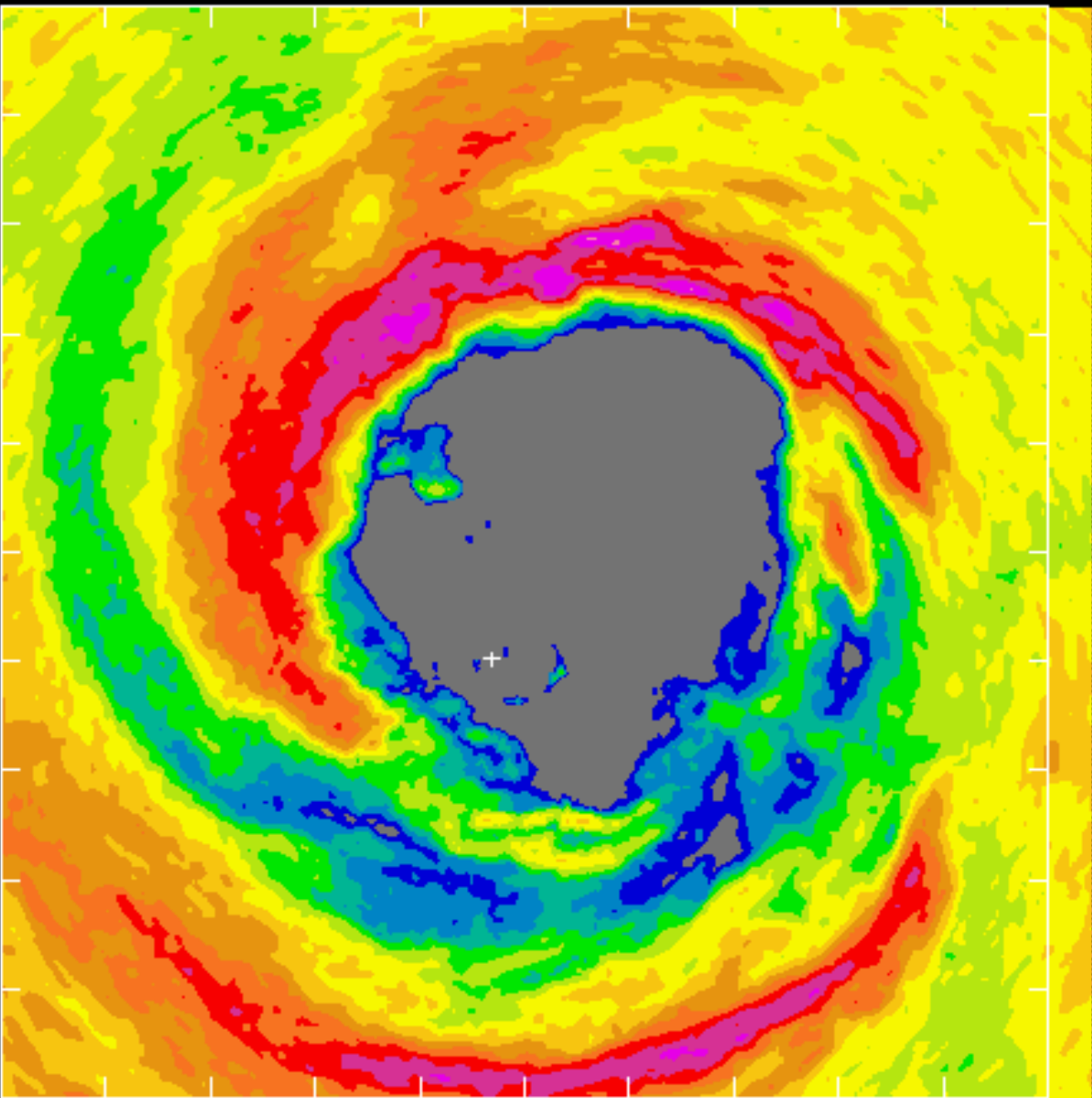


In an attempt to alleviate this problem, we limit the eyewall to be sampled once every time the aircraft circles the eye (every ~5 min) and using data only to the side of the aircraft closest to the eyewall, and only either fore or aft scans (much of the time, the radar was running in non-F/AST mode).

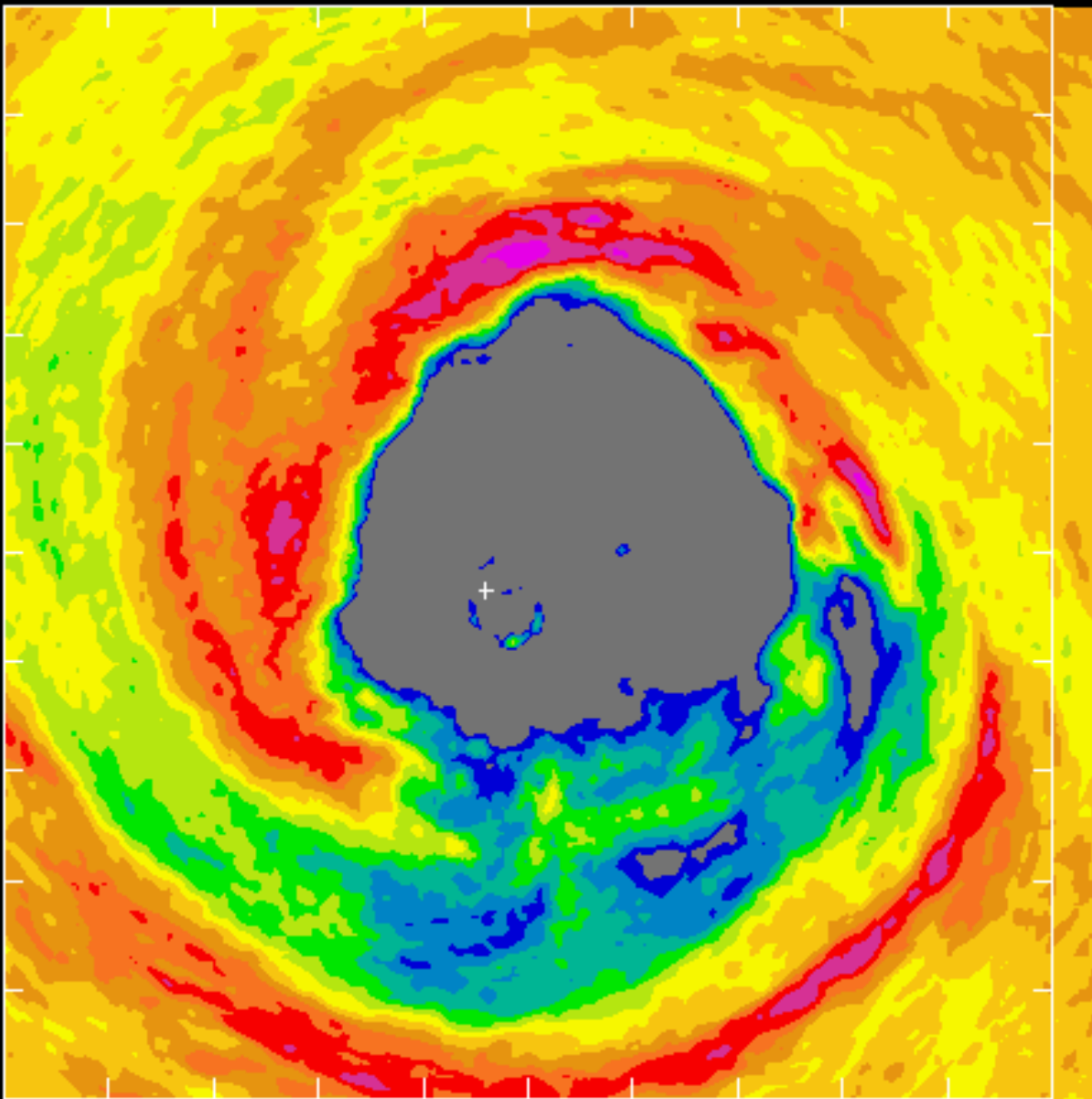
Data assimilated for 1830 UTC analysis
(1827-1833 UTC)



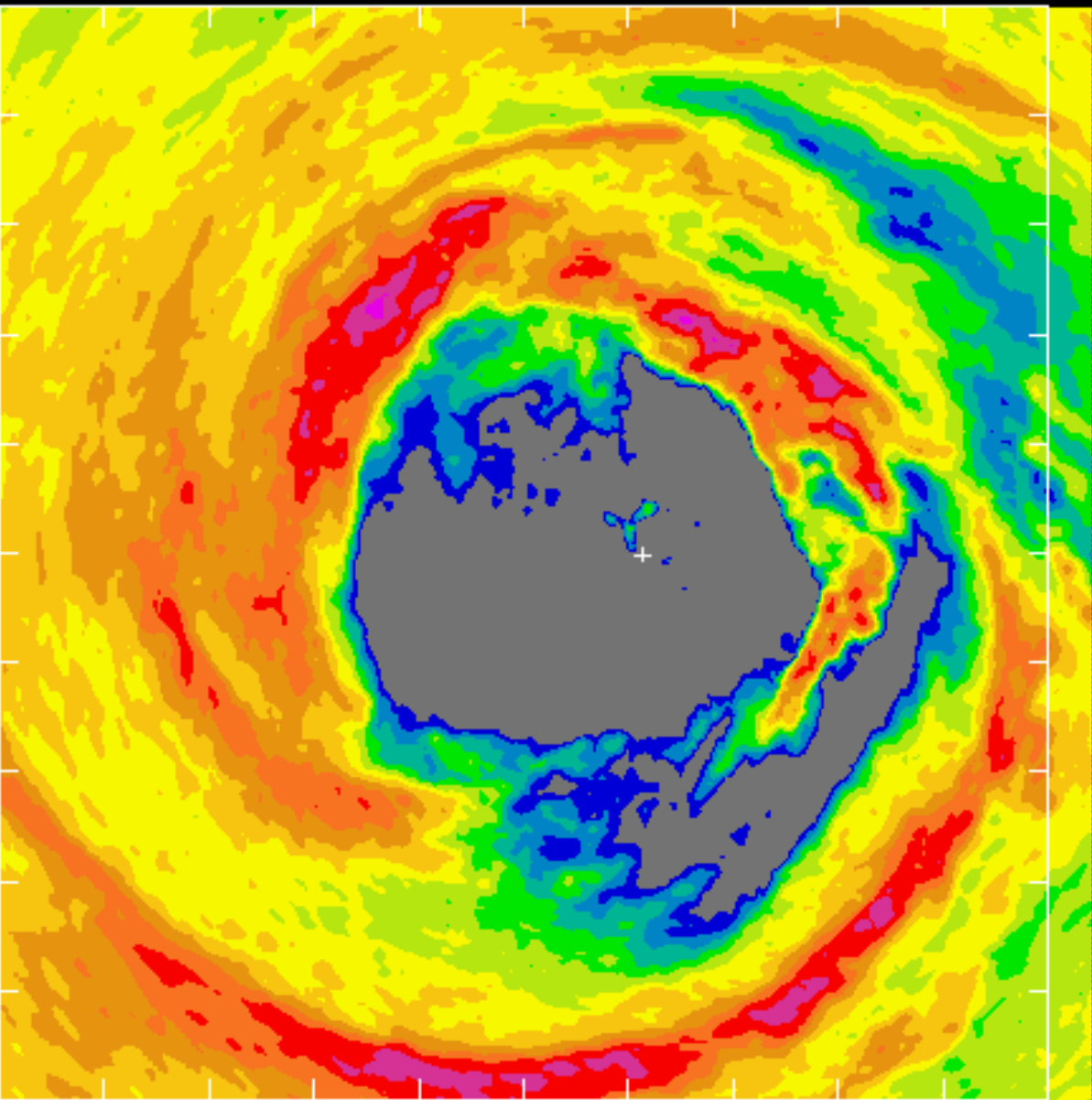
1812 UTC



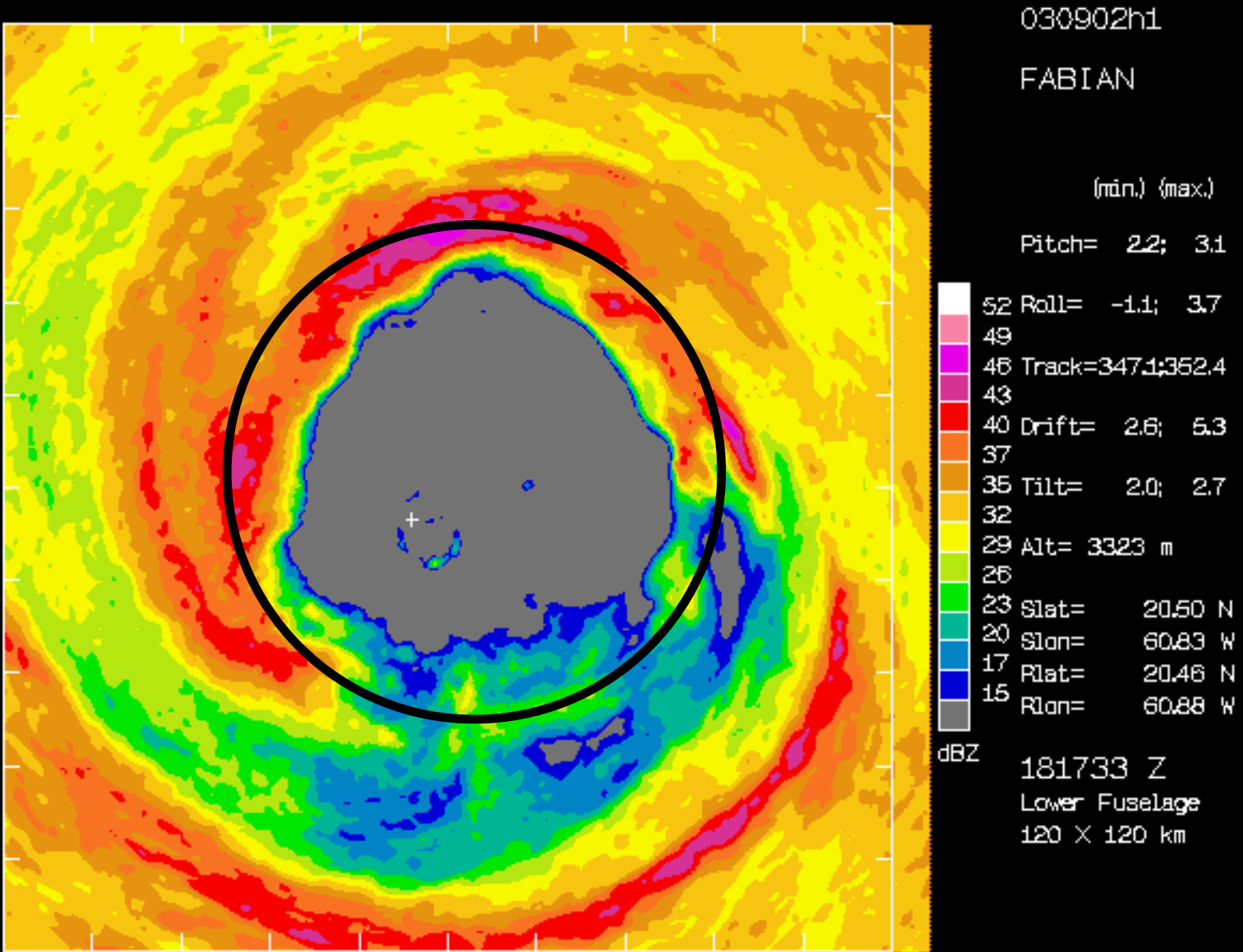
1818 UTC



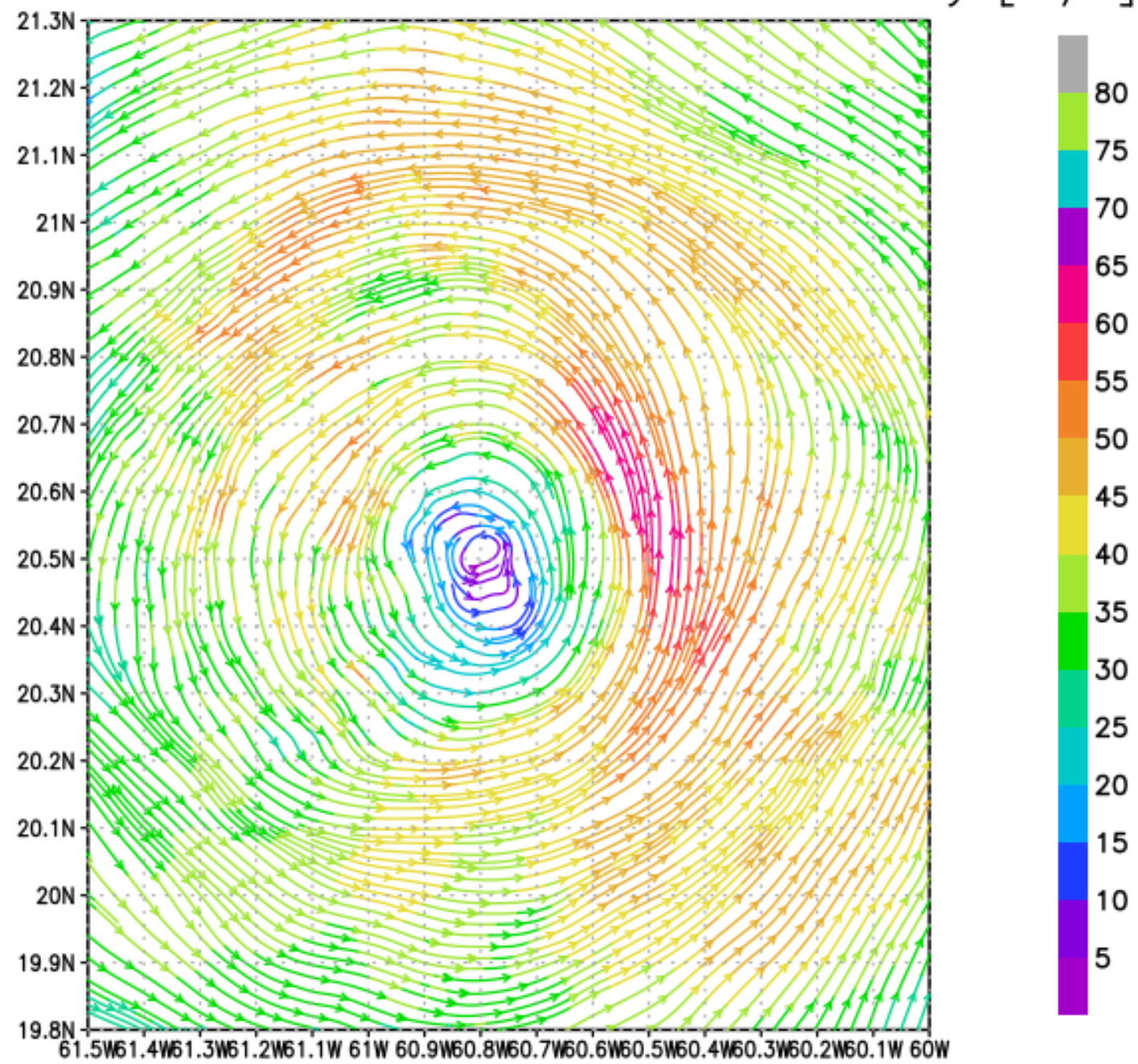
1824 UTC



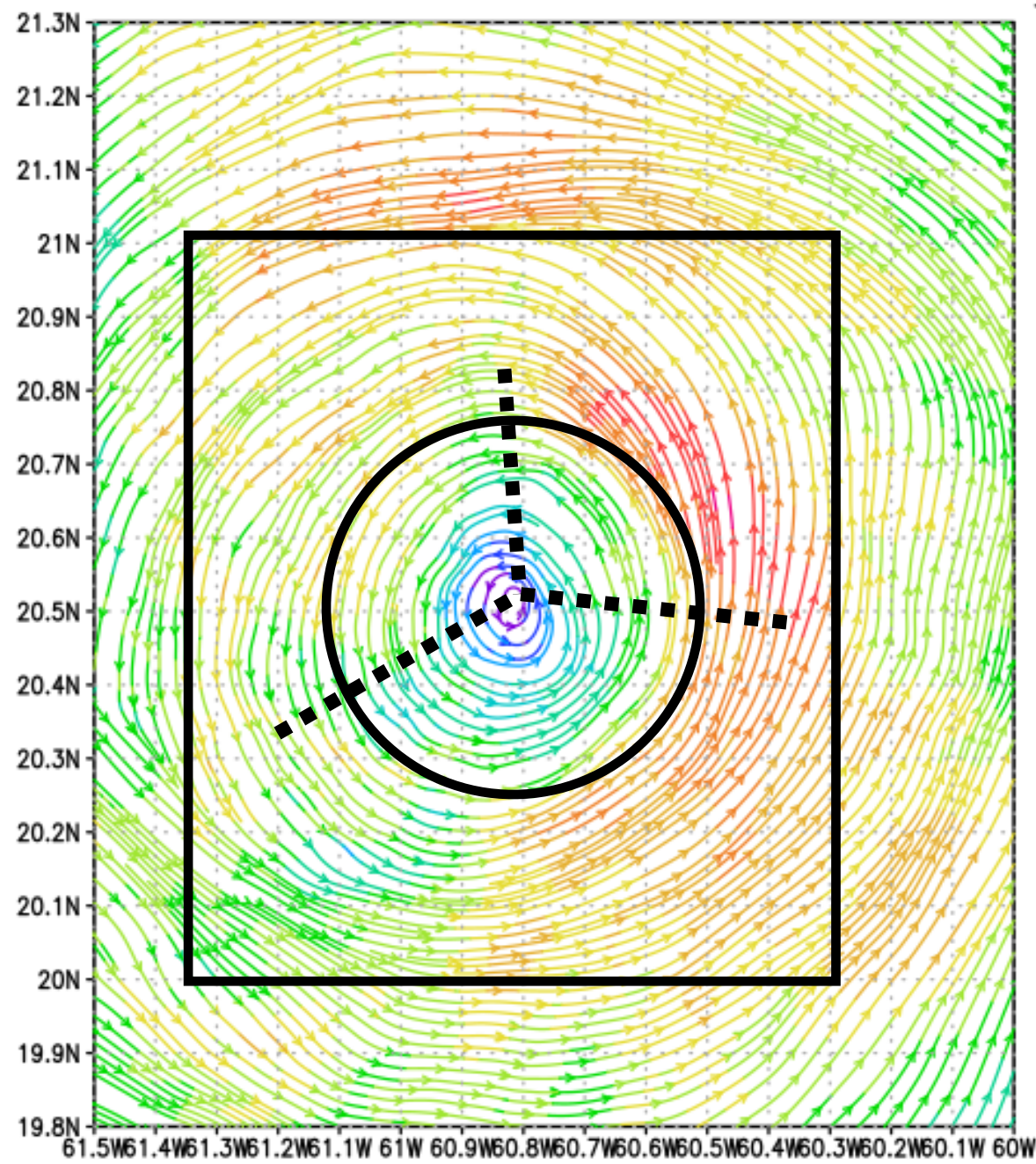
No small-scale vortices



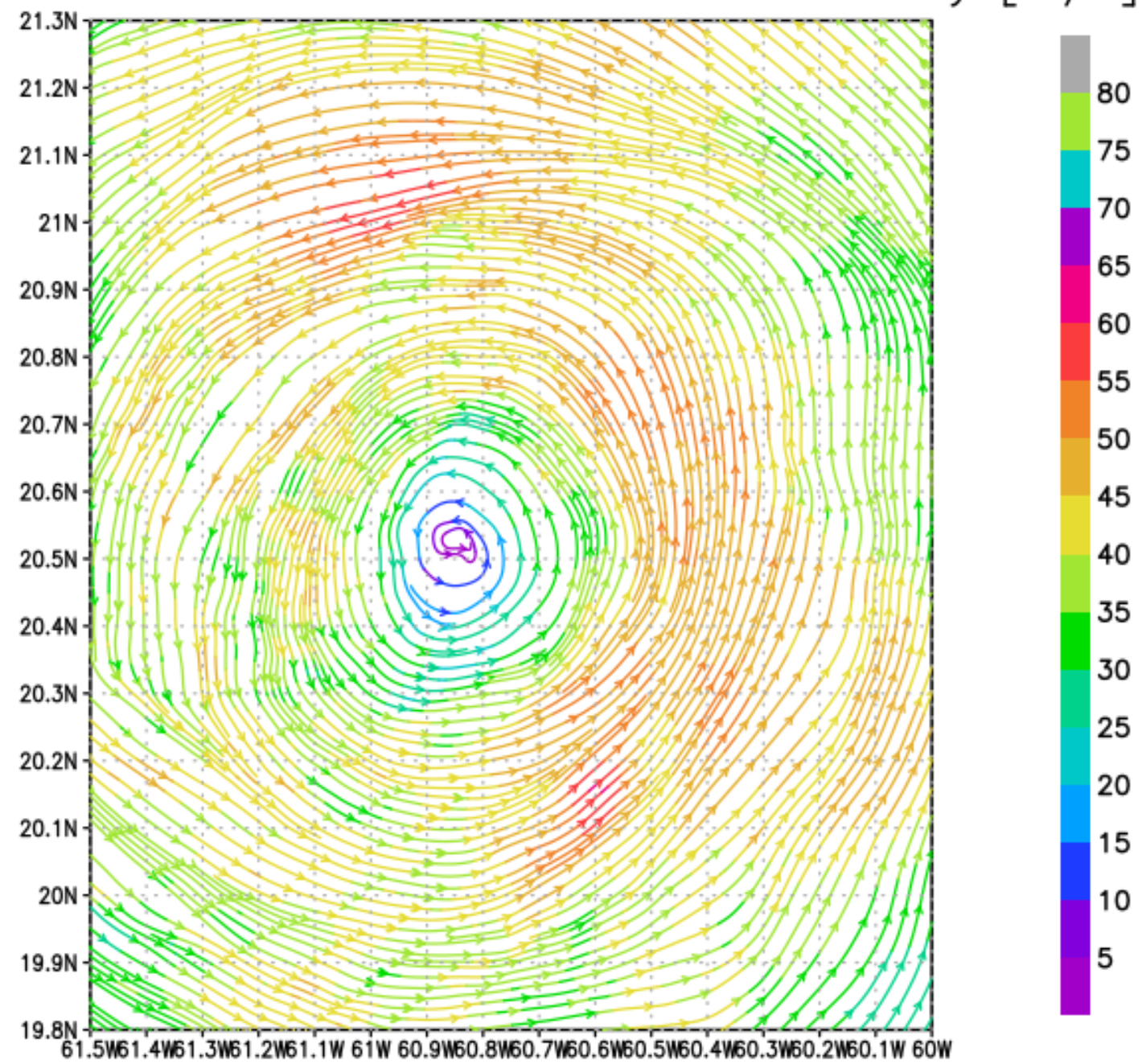
Fabian 20030902 1812 700 hPa Wind Velocity [m/s]



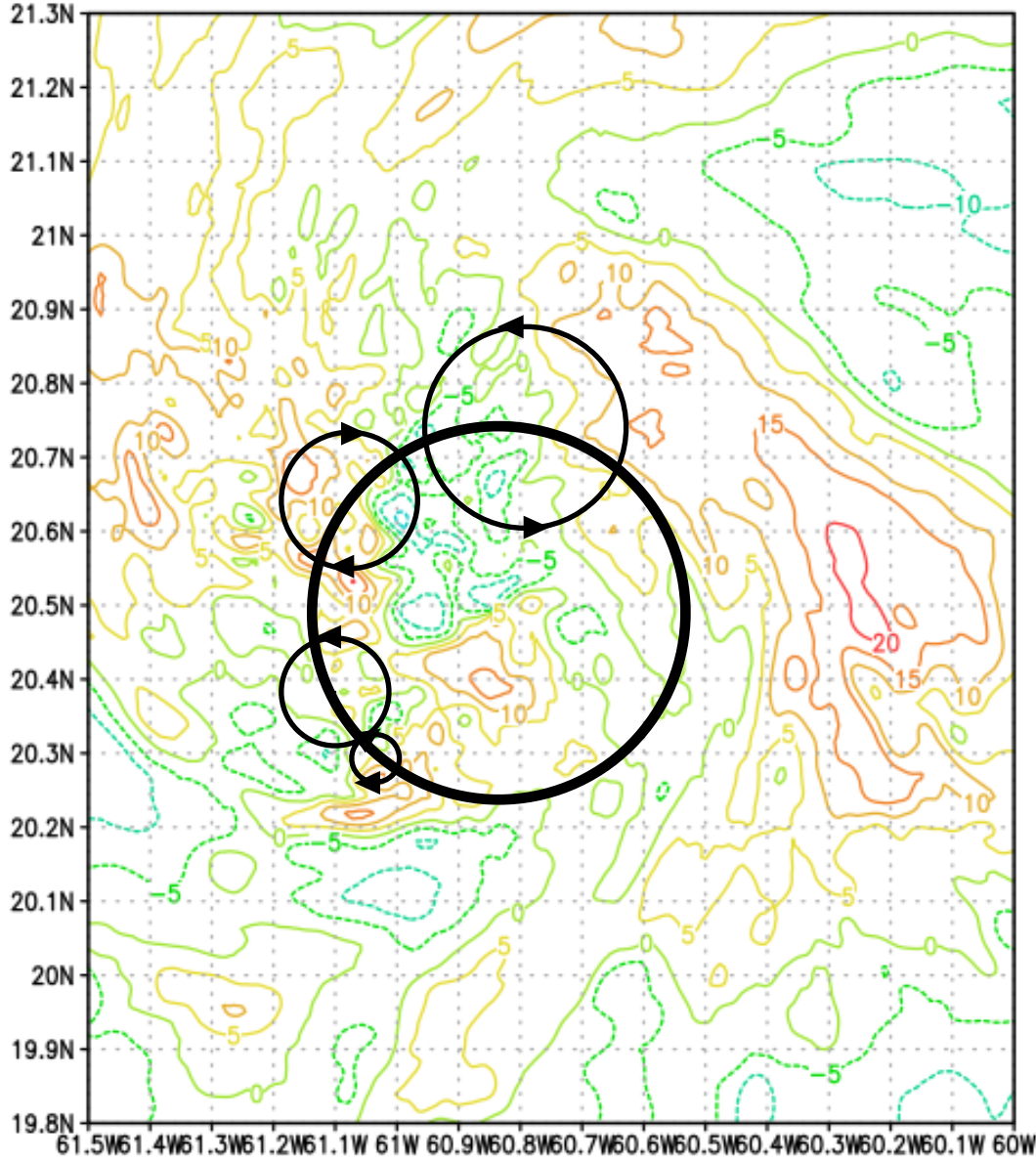
Fabian 20030902 1818 700 hPa Wind Velocity [m/s]



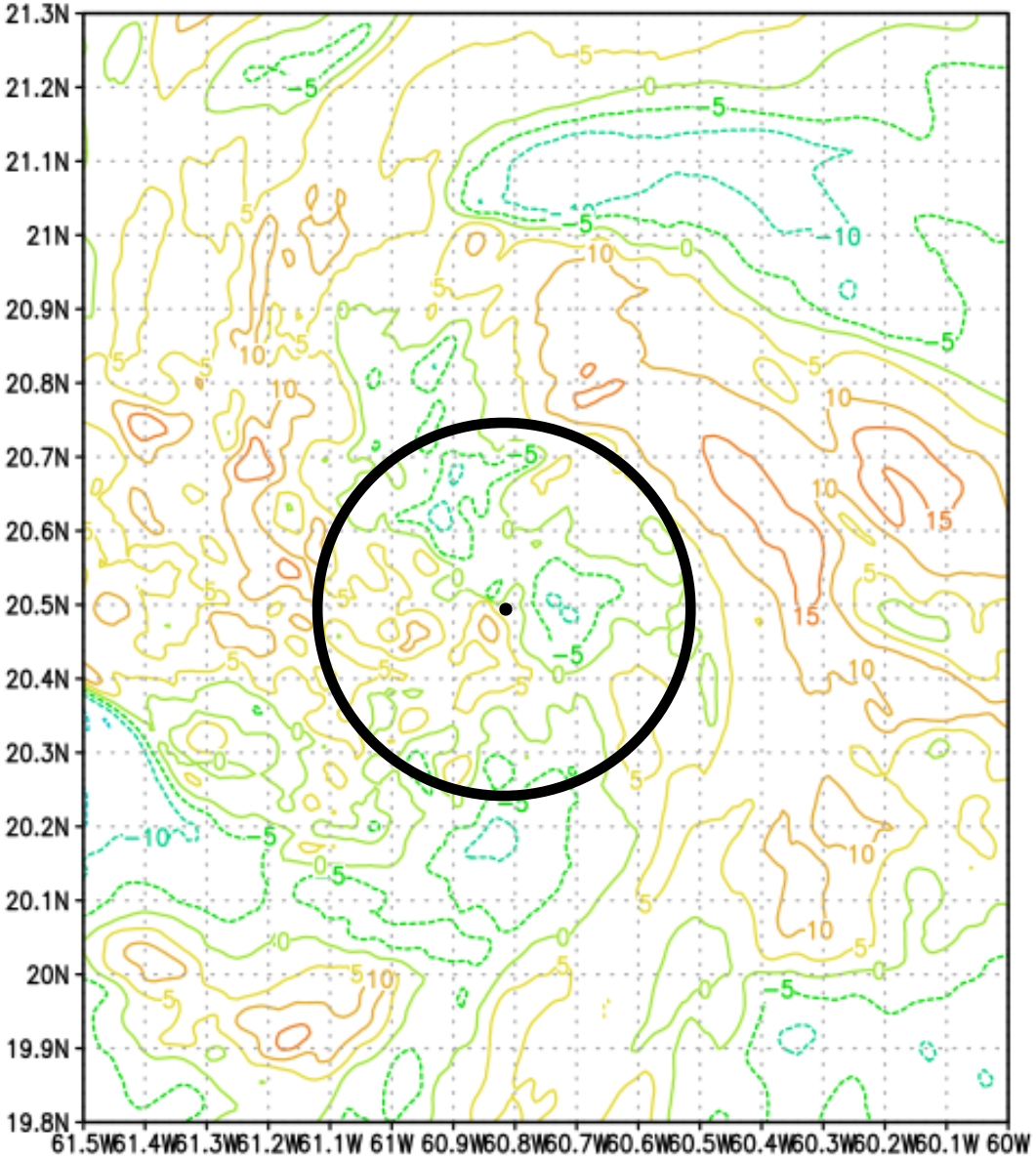
Fabian 20030902 1824 700 hPa Wind Velocity [m/s]



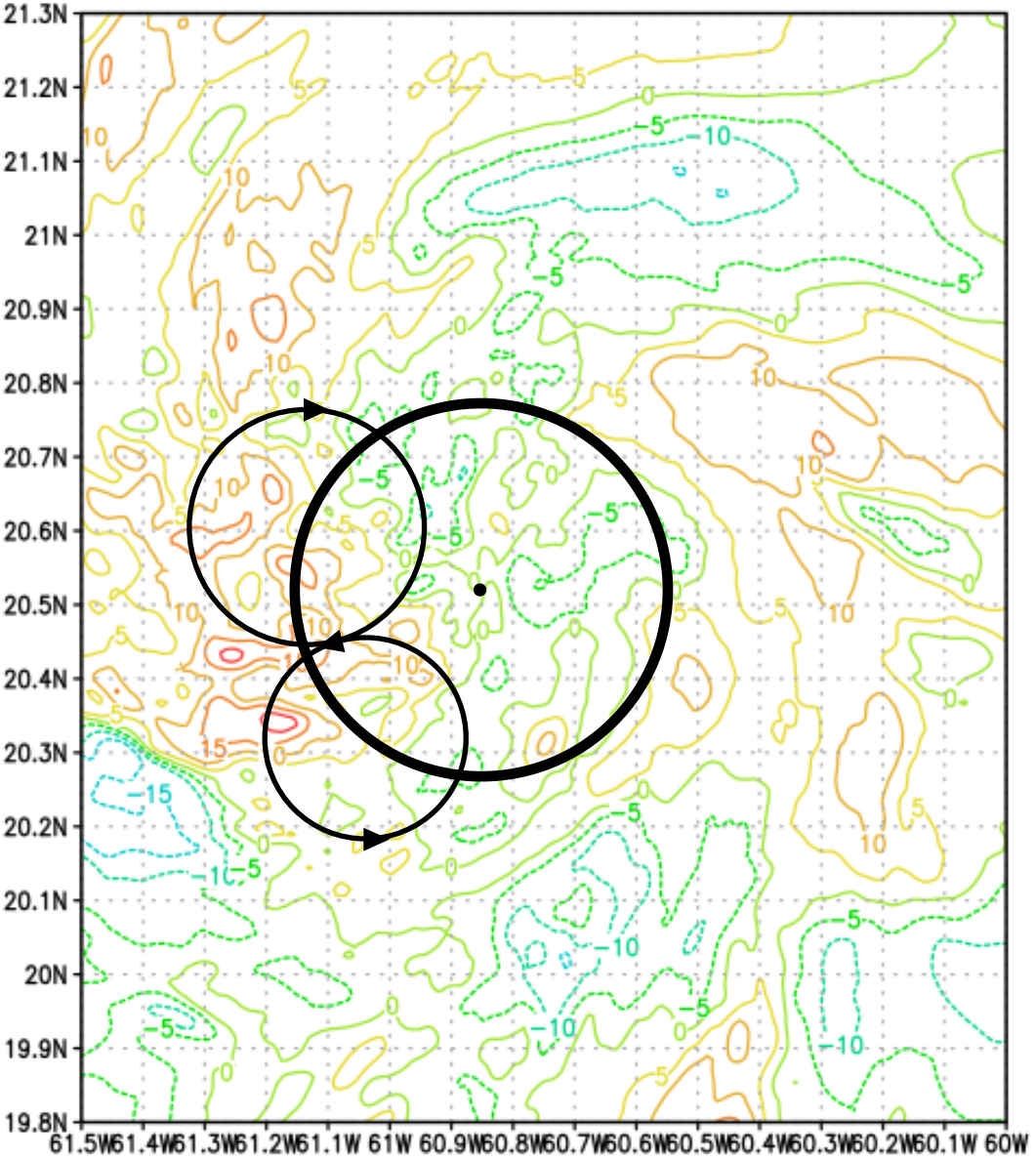
Fabian 20030902 1812Z 700 hPa Radial Wind Velocity [m/s]



Fabian 20030902 1818Z 700 hPa Radial Wind Velocity [m/s]

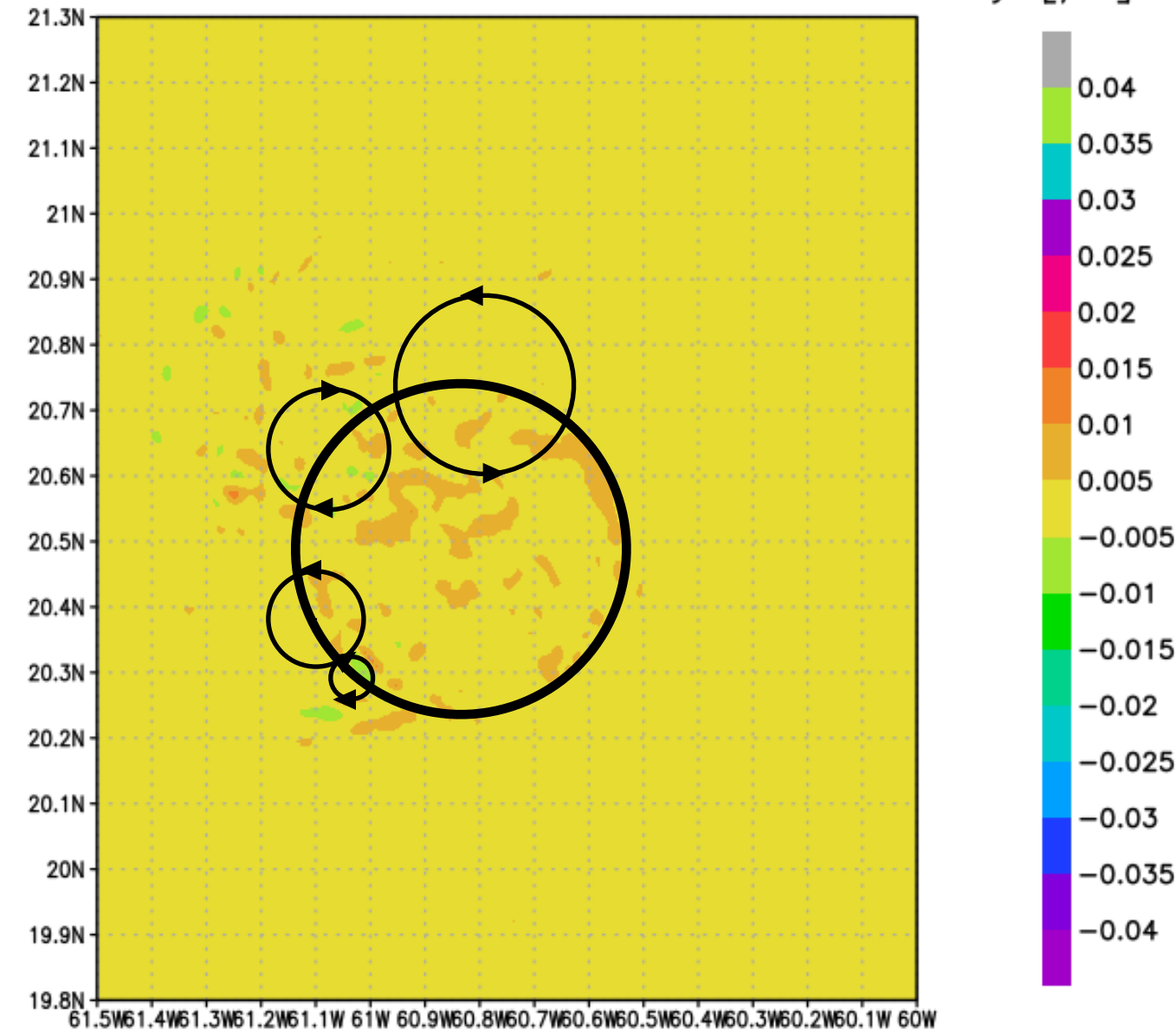


Fabian 20030902 1824Z 700 hPa Radial Wind Velocity [m/s]

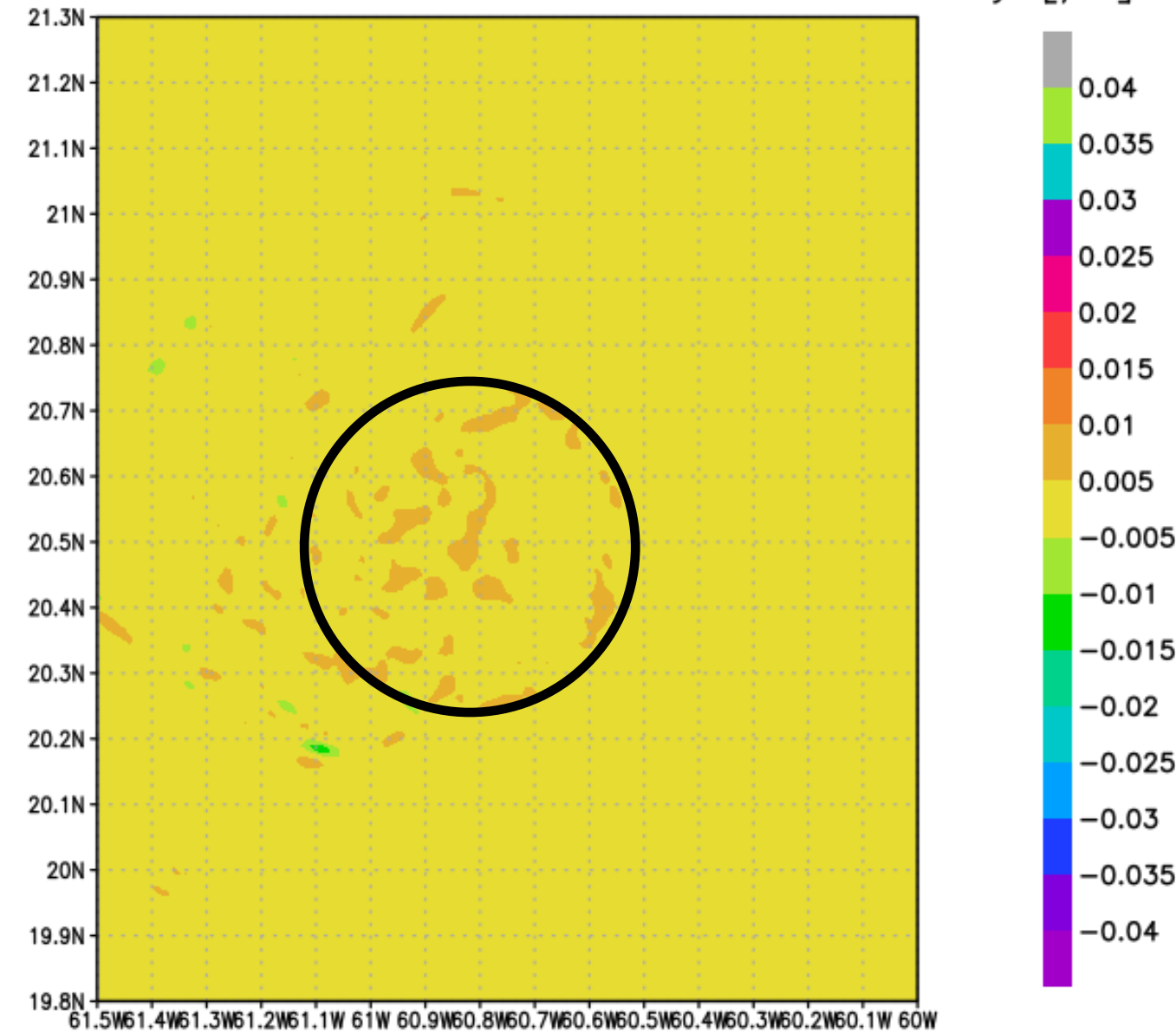


No large vorticity maxima suggesting vortices

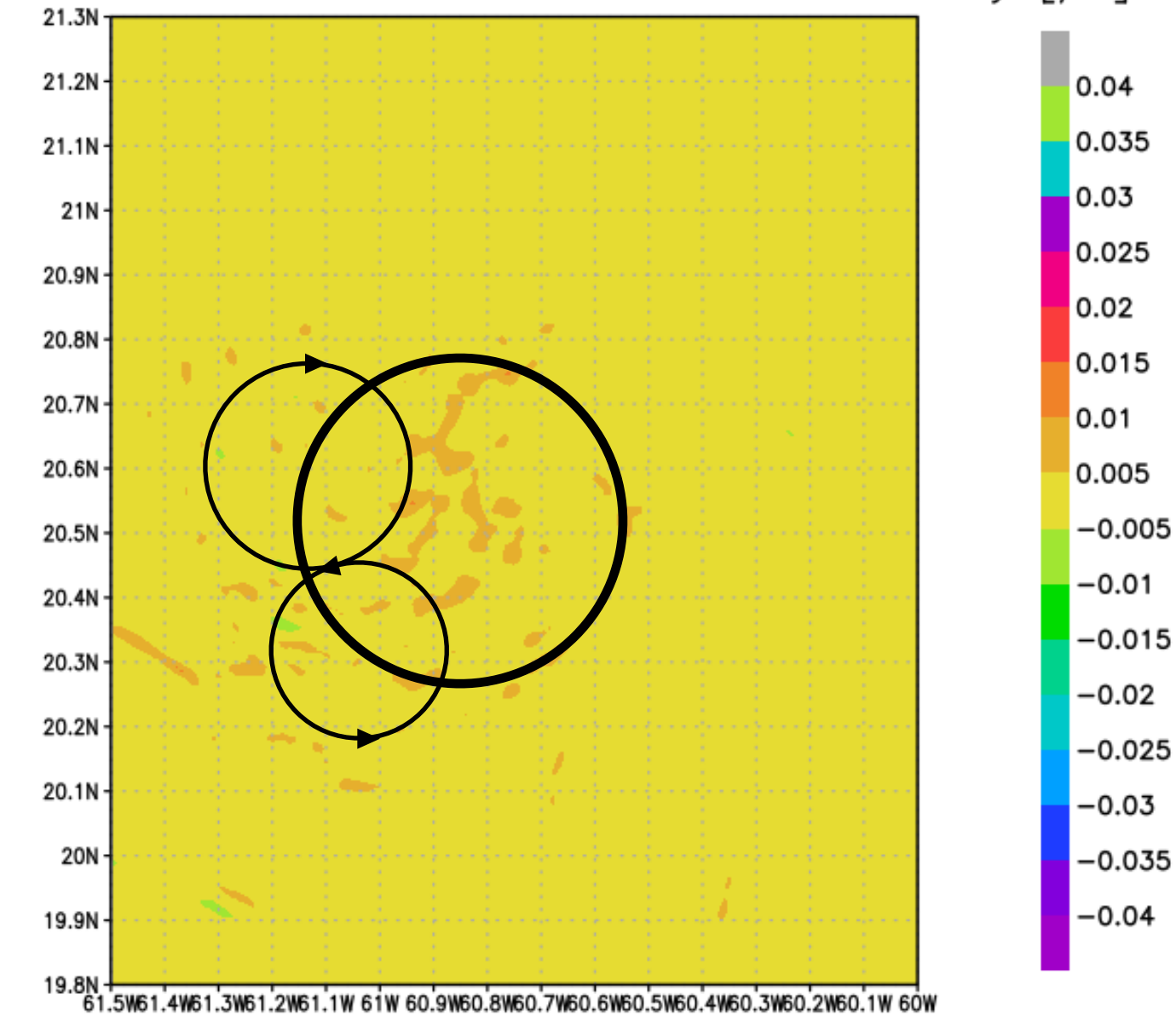
Fabian 20030902 1812 700 hPa Vertical Vorticity [1/s]



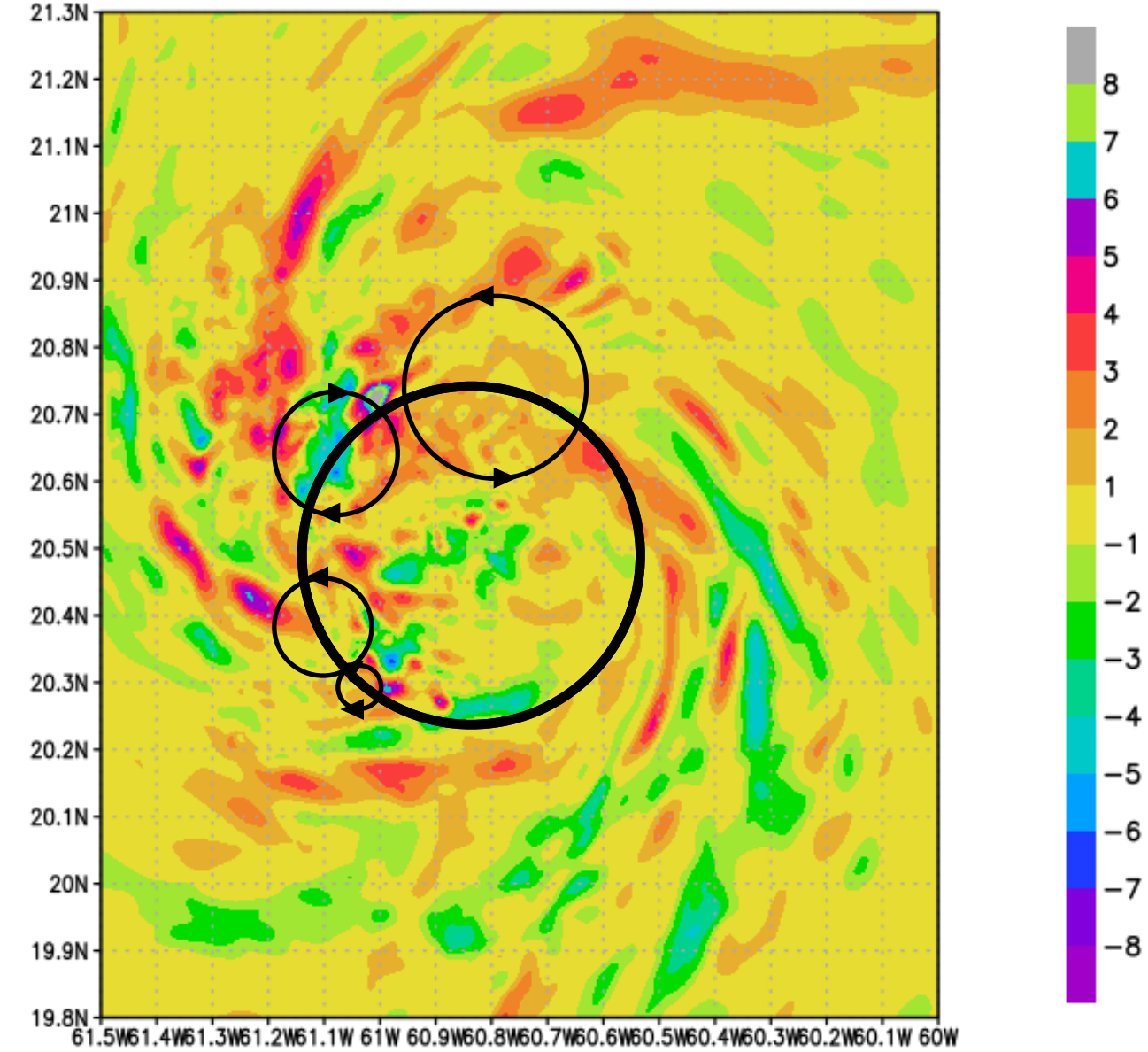
Fabian 20030902 1818 700 hPa Vertical Vorticity [1/s]



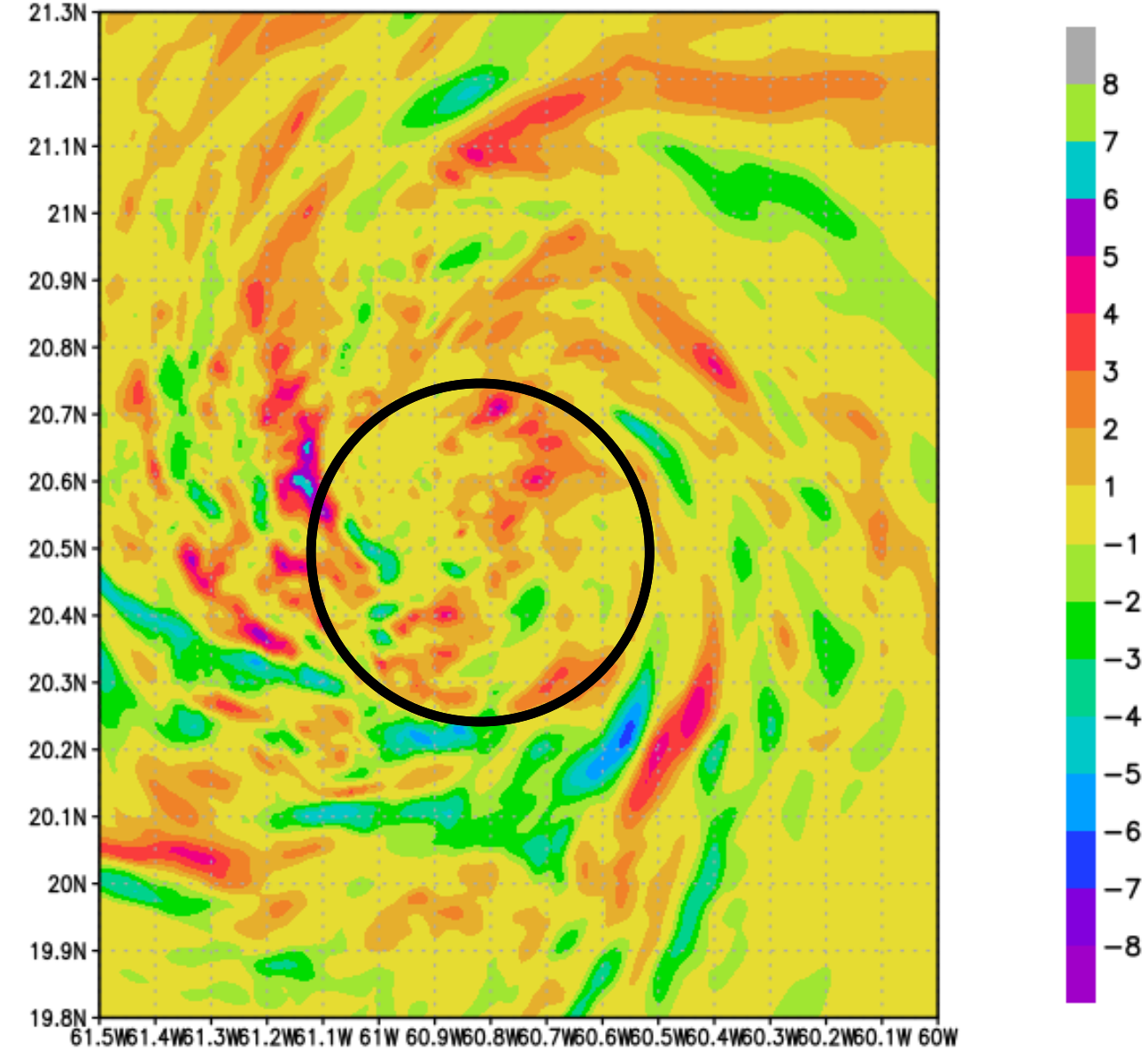
Fabian 20030902 1824 700 hPa Vertical Vorticity [1/s]



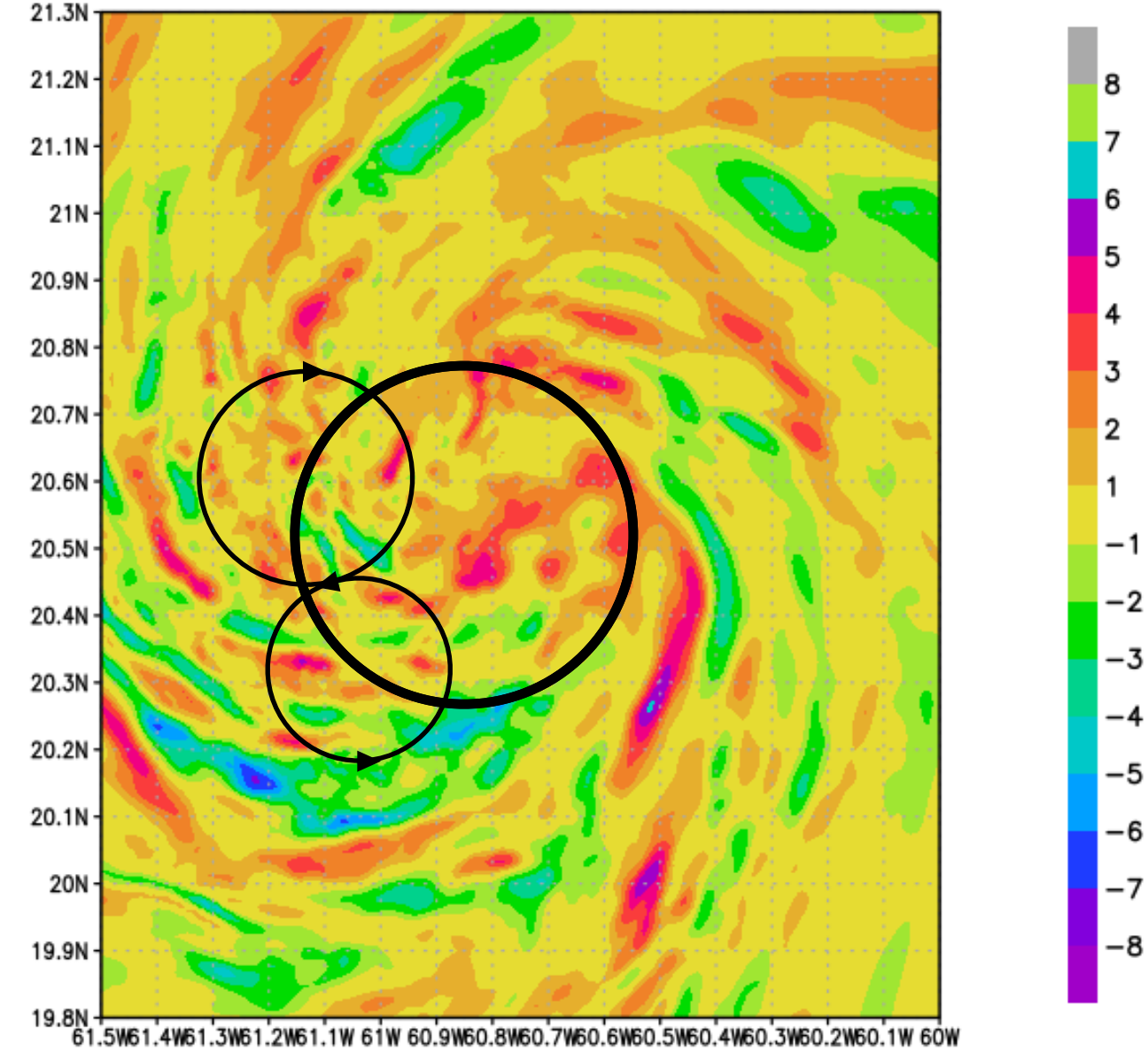
Fabian 20030902 1812 700 hPa Vertical Velocity [m/s]



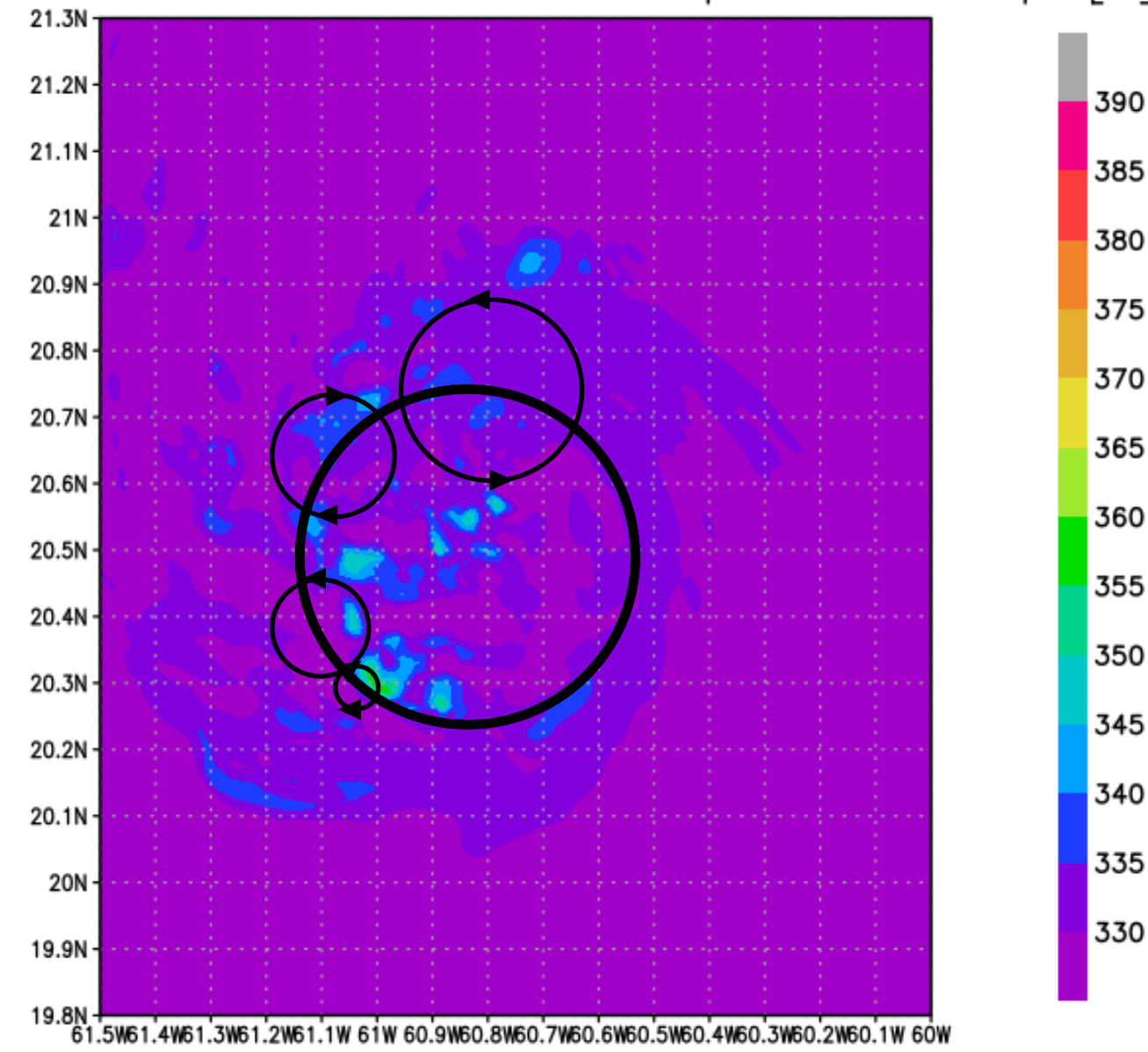
Fabian 20030902 1818 700 hPa Vertical Velocity [m/s]



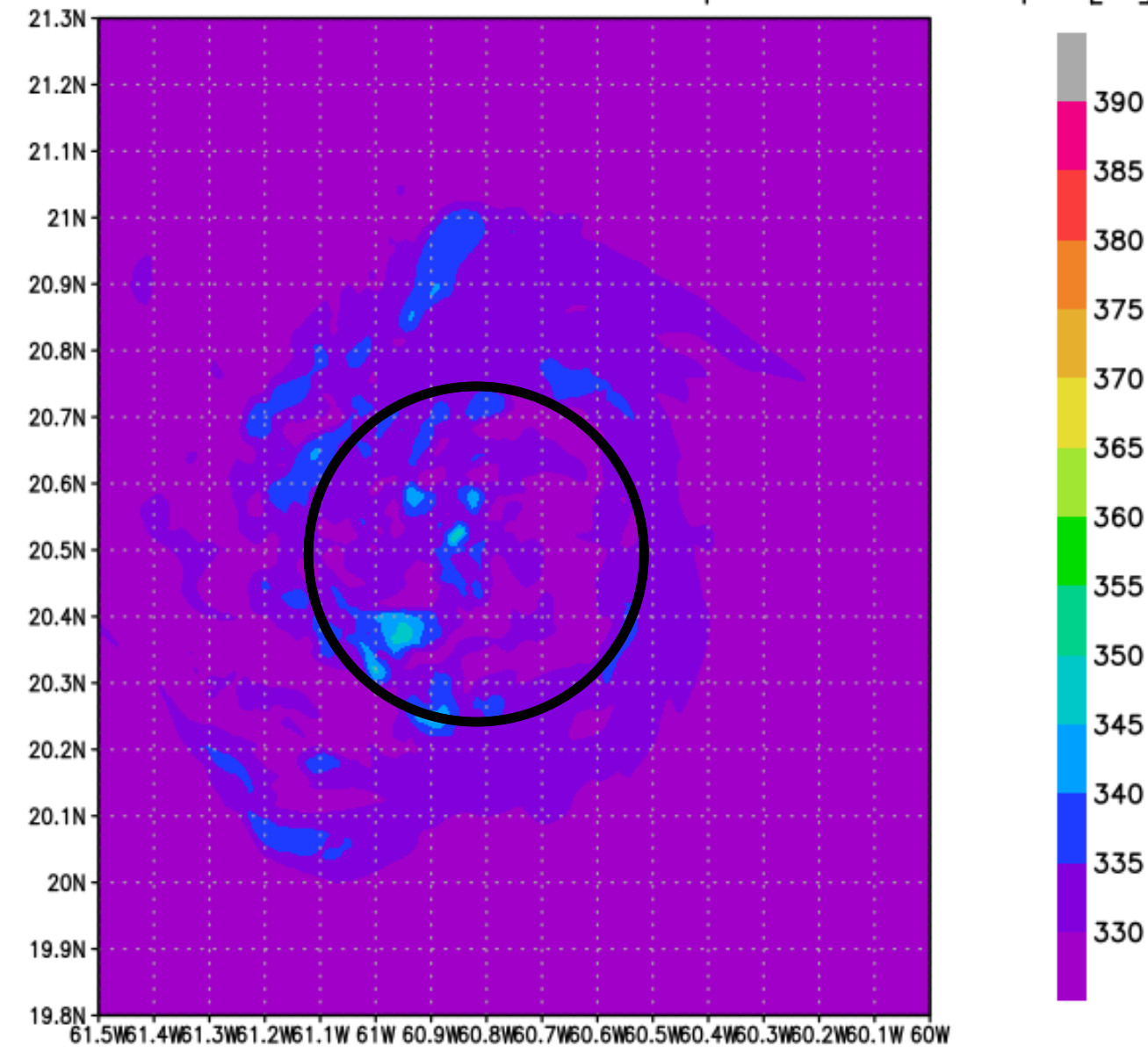
Fabian 20030902 1824 700 hPa Vertical Velocity [m/s]



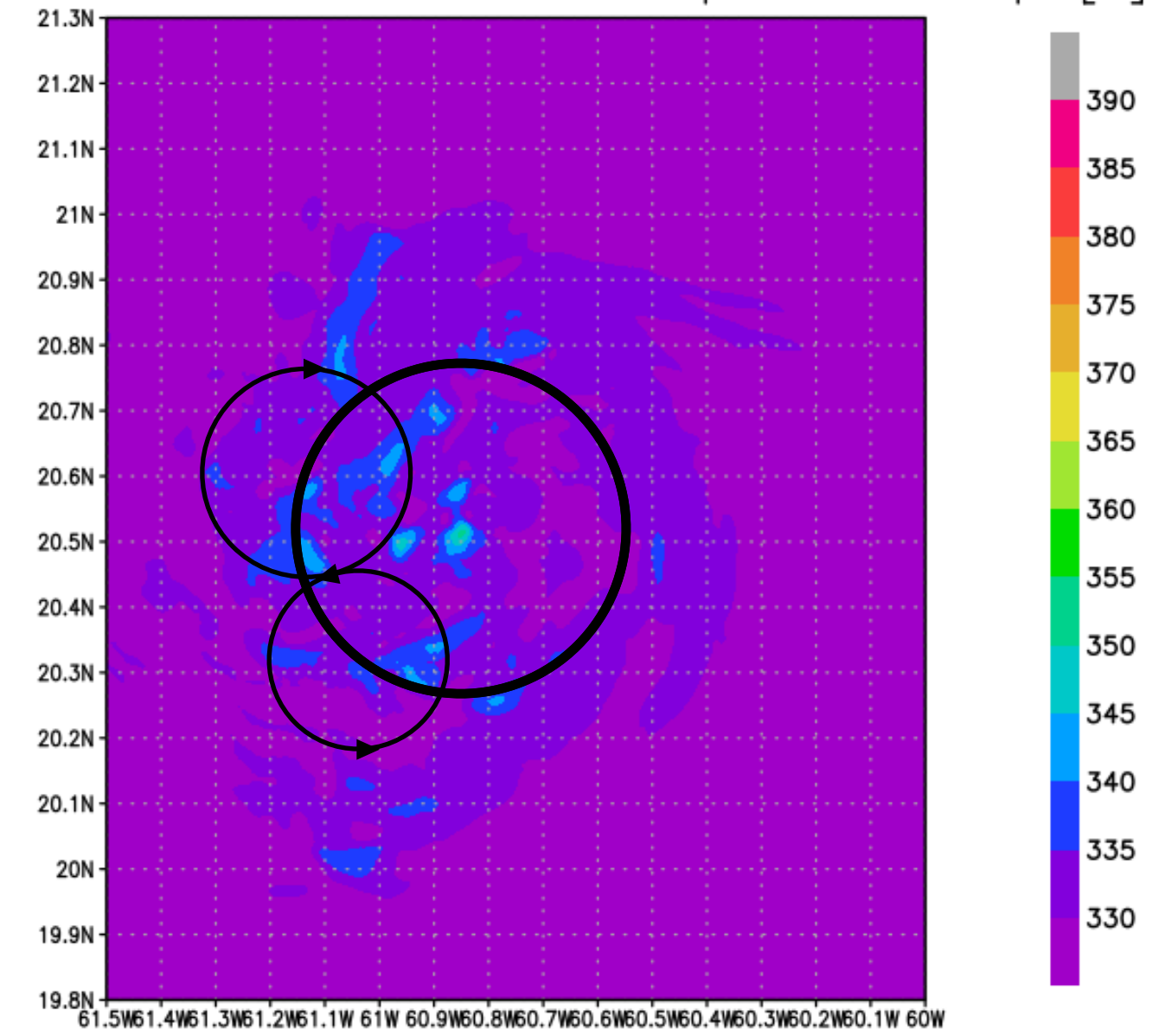
Fabian 20030902 1812 700 hPa Equiv. Pot. Temp. [K]



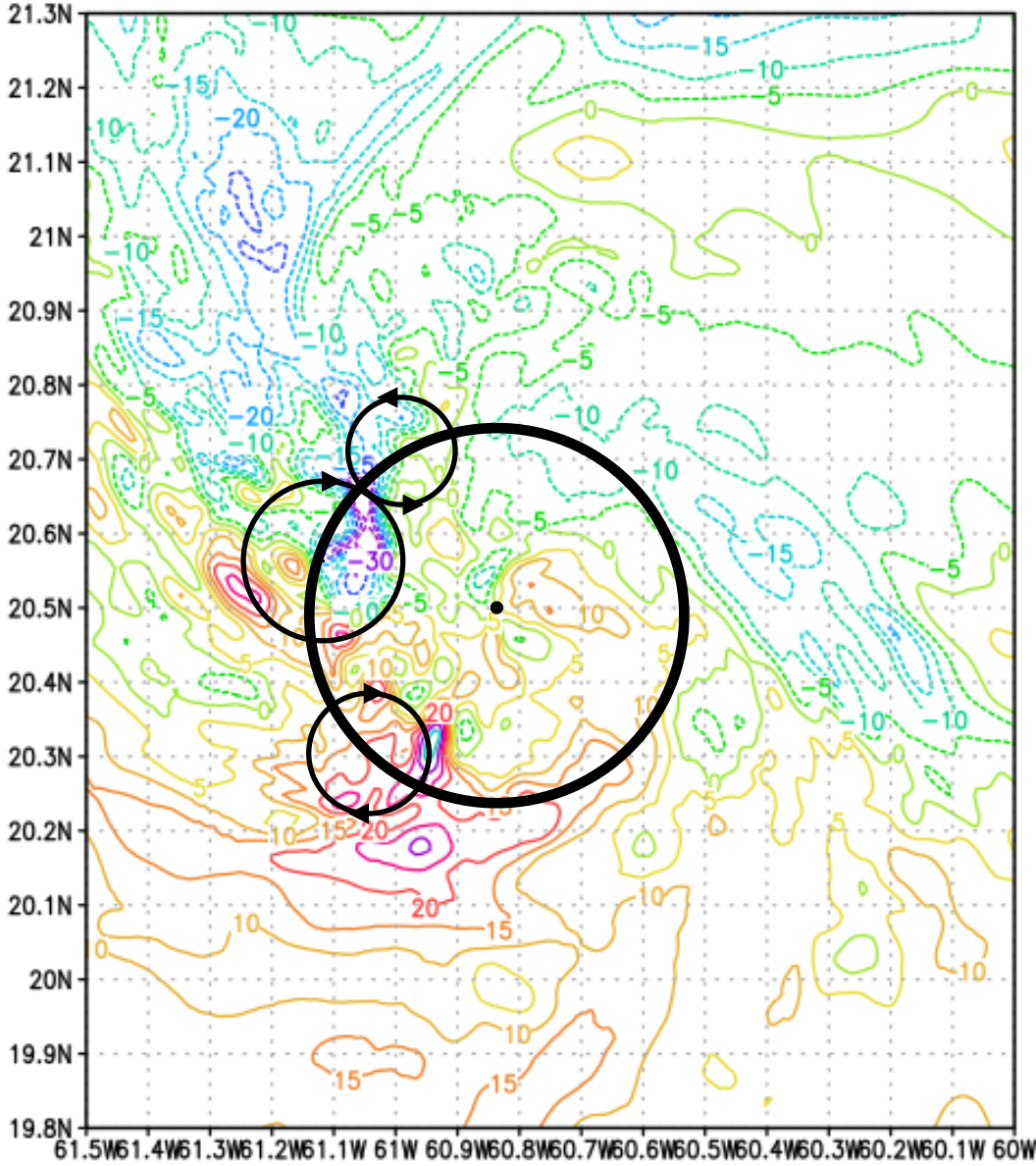
Fabian 20030902 1818 700 hPa Equiv. Pot. Temp. [K]



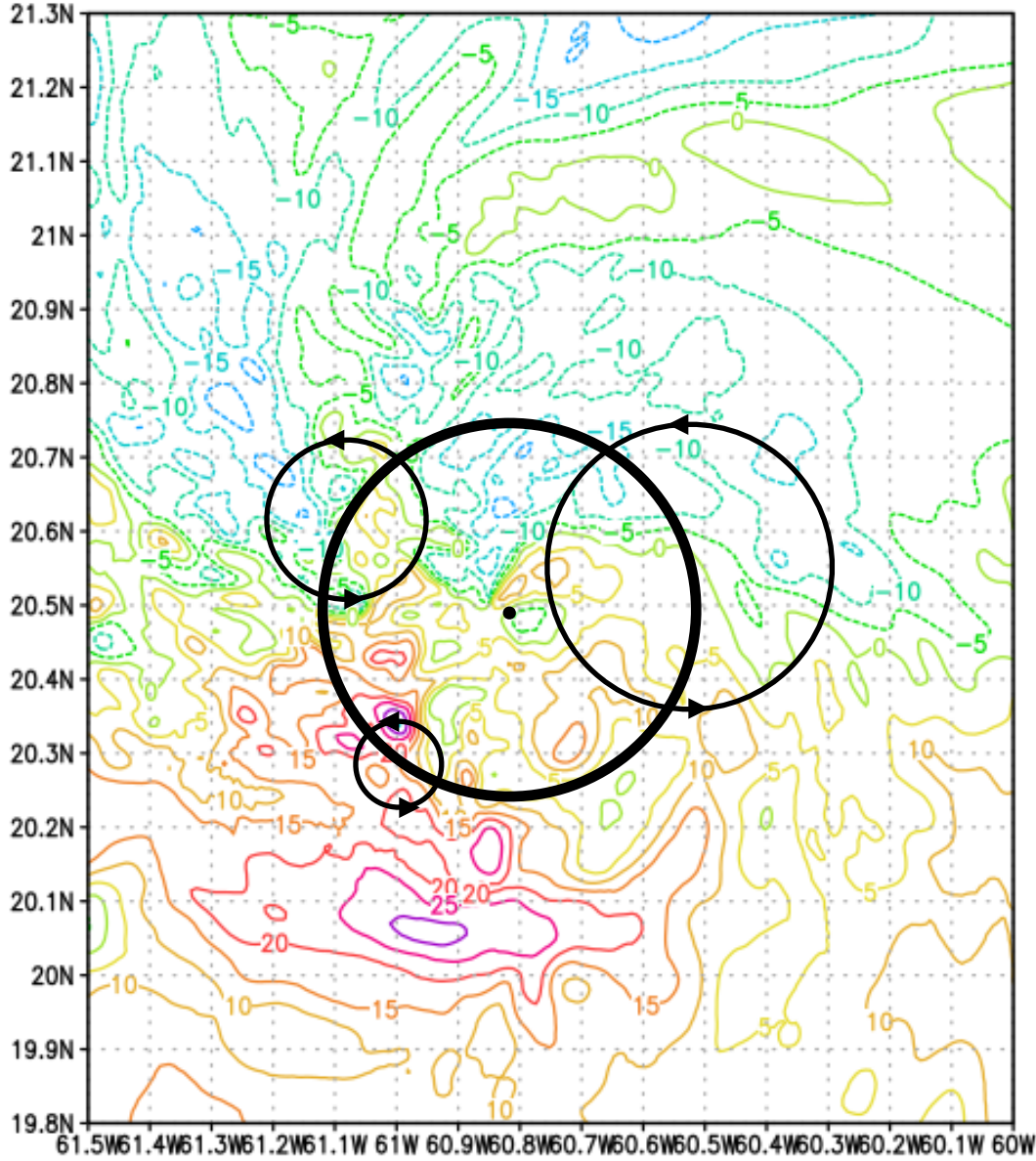
Fabian 20030902 1824 700 hPa Equiv. Pot. Temp. [K]



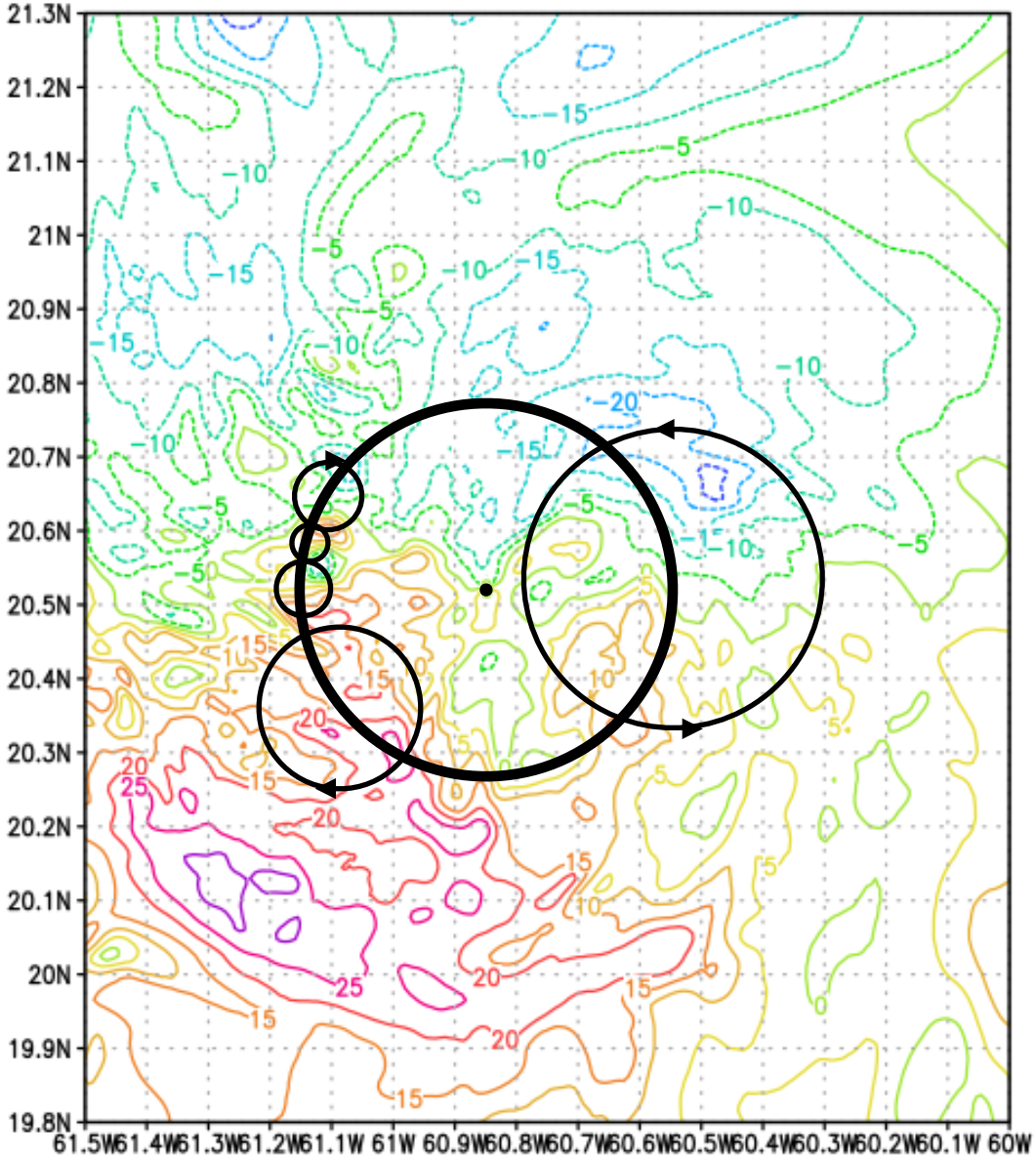
Fabian 20030902 1812Z 900 hPa Radial Wind Velocity [m/s]



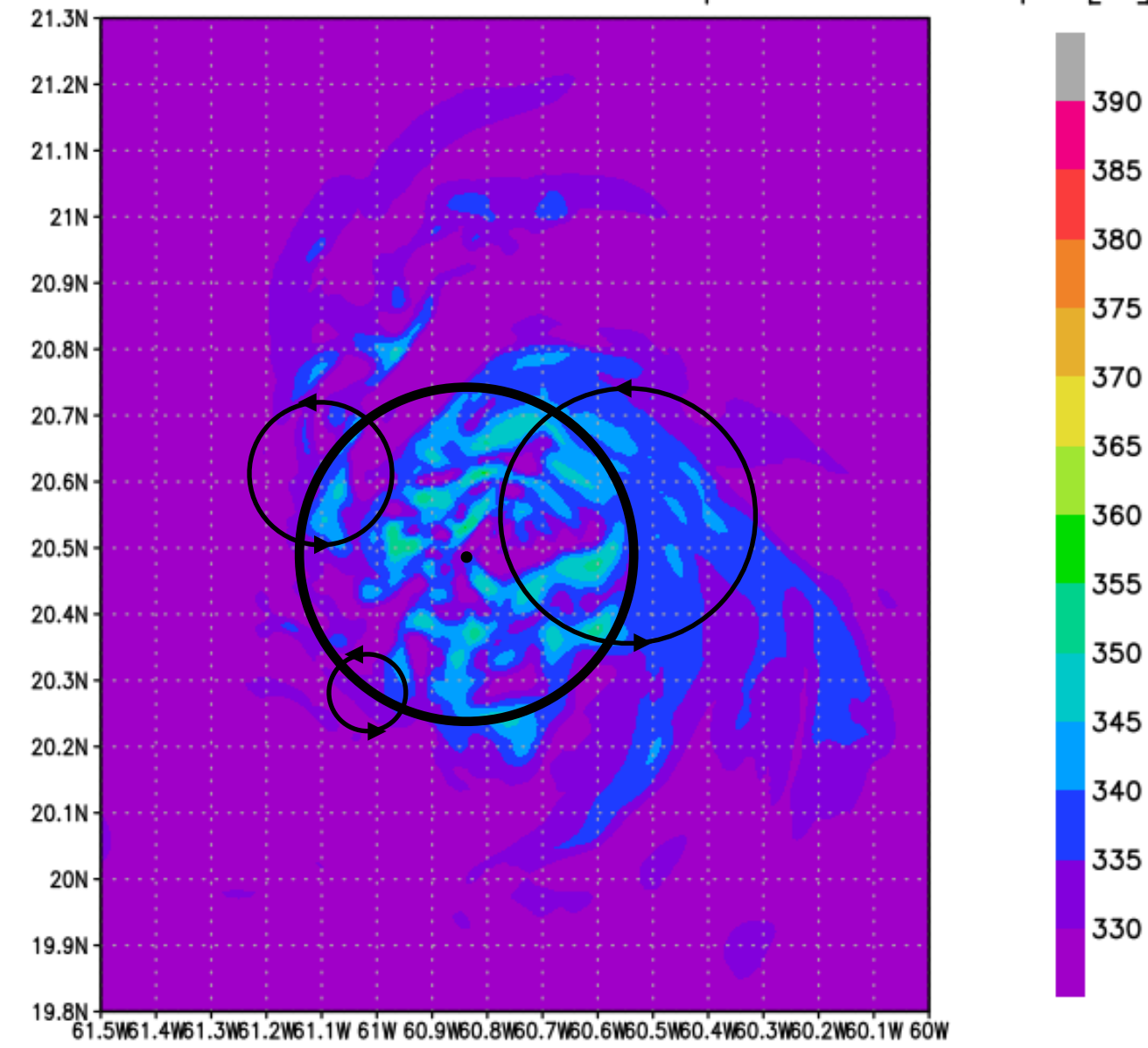
Fabian 20030902 1818Z 900 hPa Radial Wind Velocity [m/s]



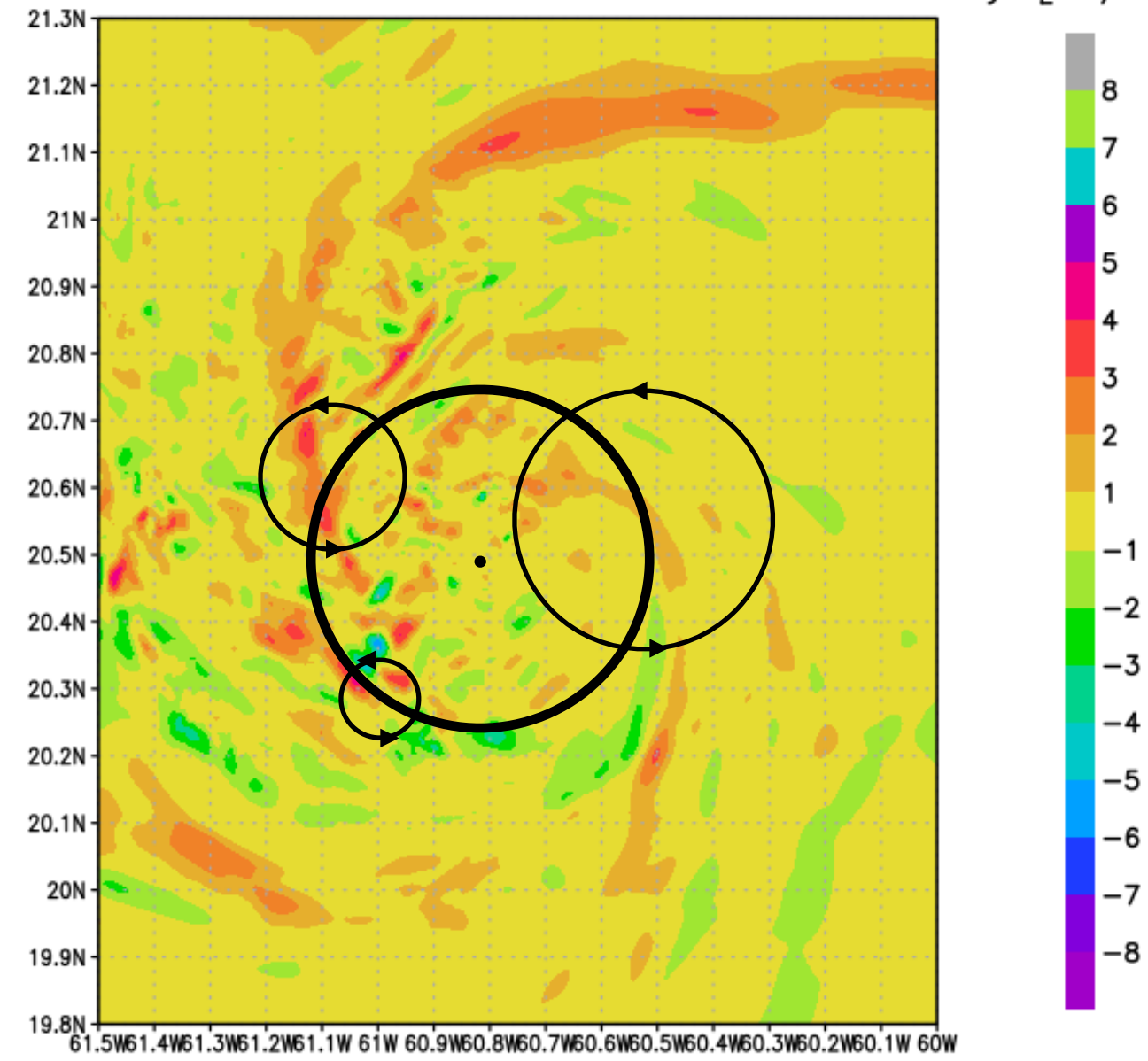
Fabian 20030902 1824Z 900 hPa Radial Wind Velocity [m/s]



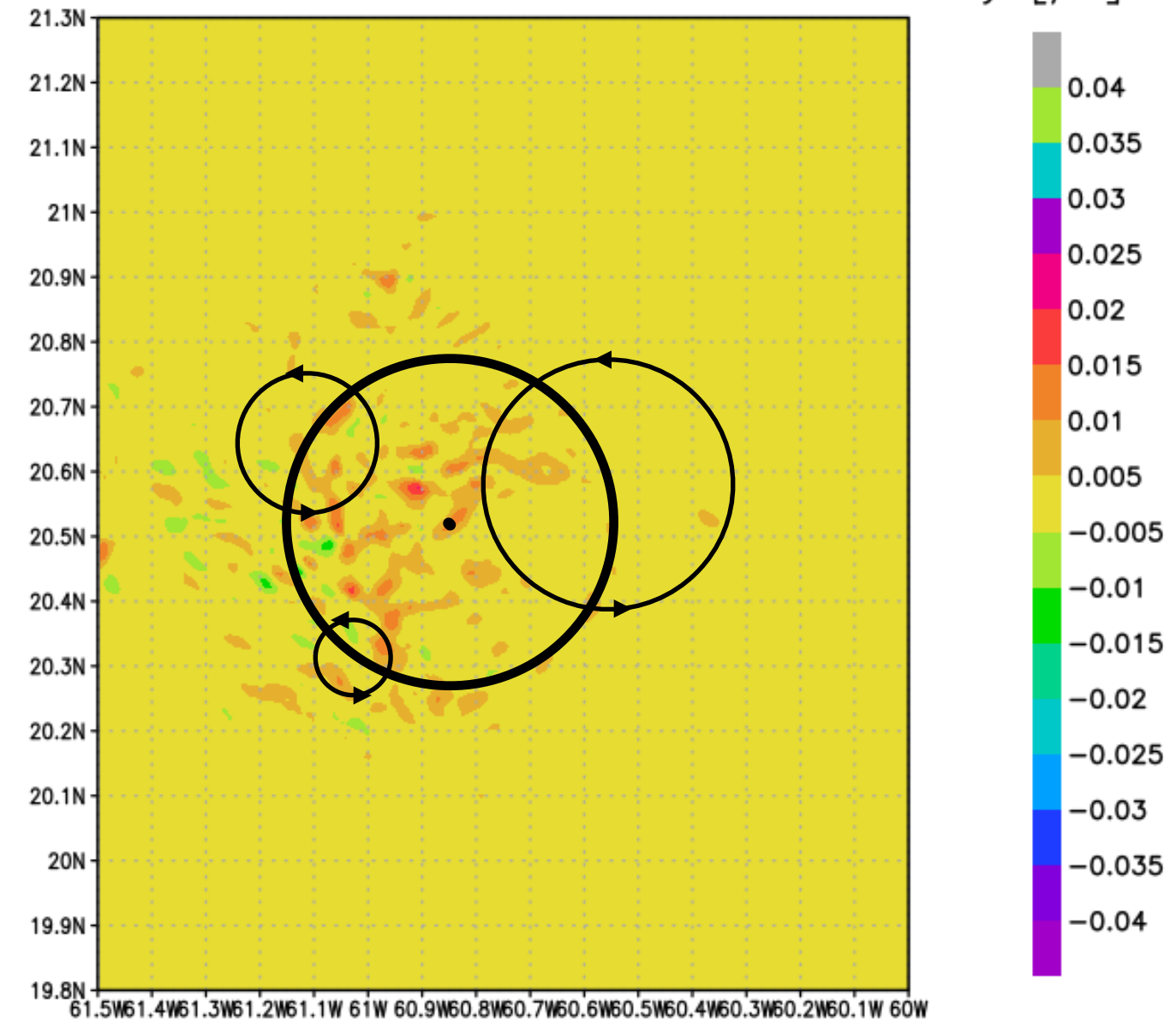
Fabian 20030902 1818 900 hPa Equiv. Pot. Temp. [K]



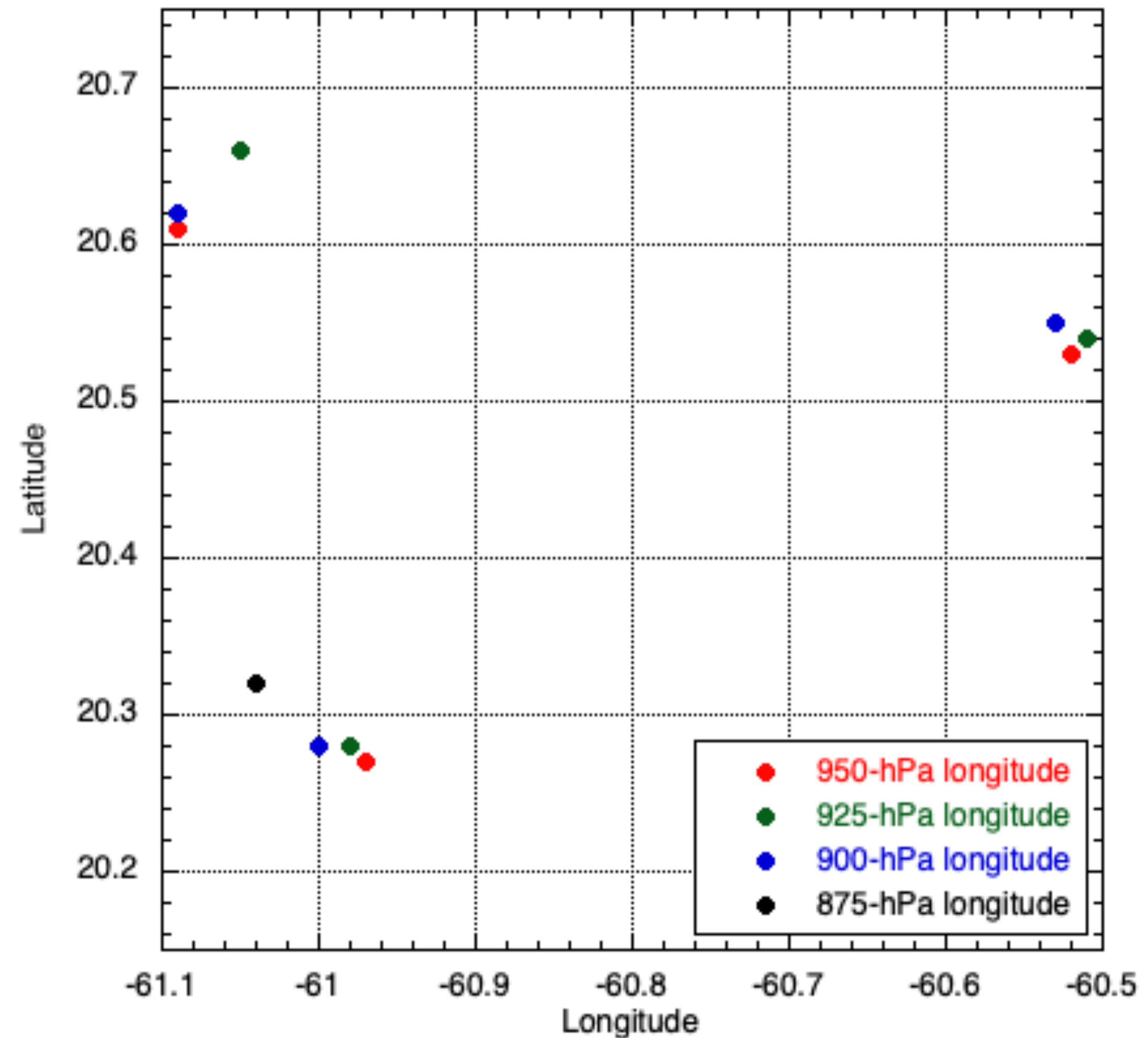
Fabian 20030902 1818 900 hPa Vertical Velocity [m/s]



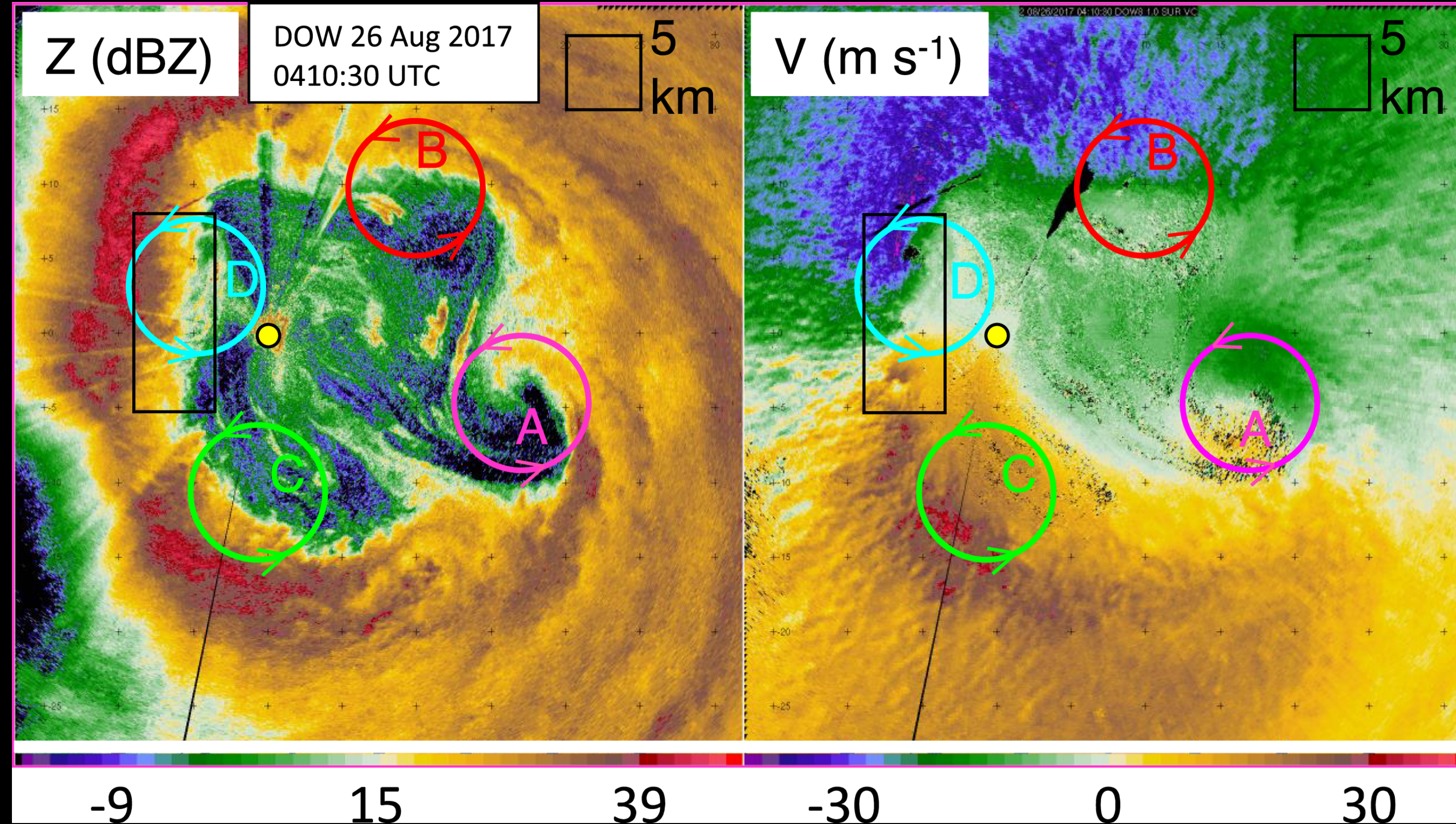
Fabian 20030902 1818 900 hPa Vertical Vorticity [1/s]



**Radial-wind dipole
centers tilt upwind with
altitude on the edge of
the eyewall**



“first direct evidence of MVs” and their role in enhancing surface winds



Finescale DOW radar imagery of hurricane eye and eyewall, including four MVs. (left) Radar reflectivity and (right) Doppler velocity measured from inside eye (DOW location indicated with yellow dot) at 0410:30 UTC 26 Aug 2017. Four MVs revolving about the eye are highlighted schematically with colored circles. Black rectangle is zoomed-in area shown in Fig. 6.

Wurman, J., and K. Kosiba, 2018: The Role of Small-Scale Vortices in Enhancing Surface Winds and Damage in Hurricane Harvey (2017). *Mon. Wea. Rev.*, 146, 713–722, <https://doi.org/10.1175/MWR-D-17-0327.1>.