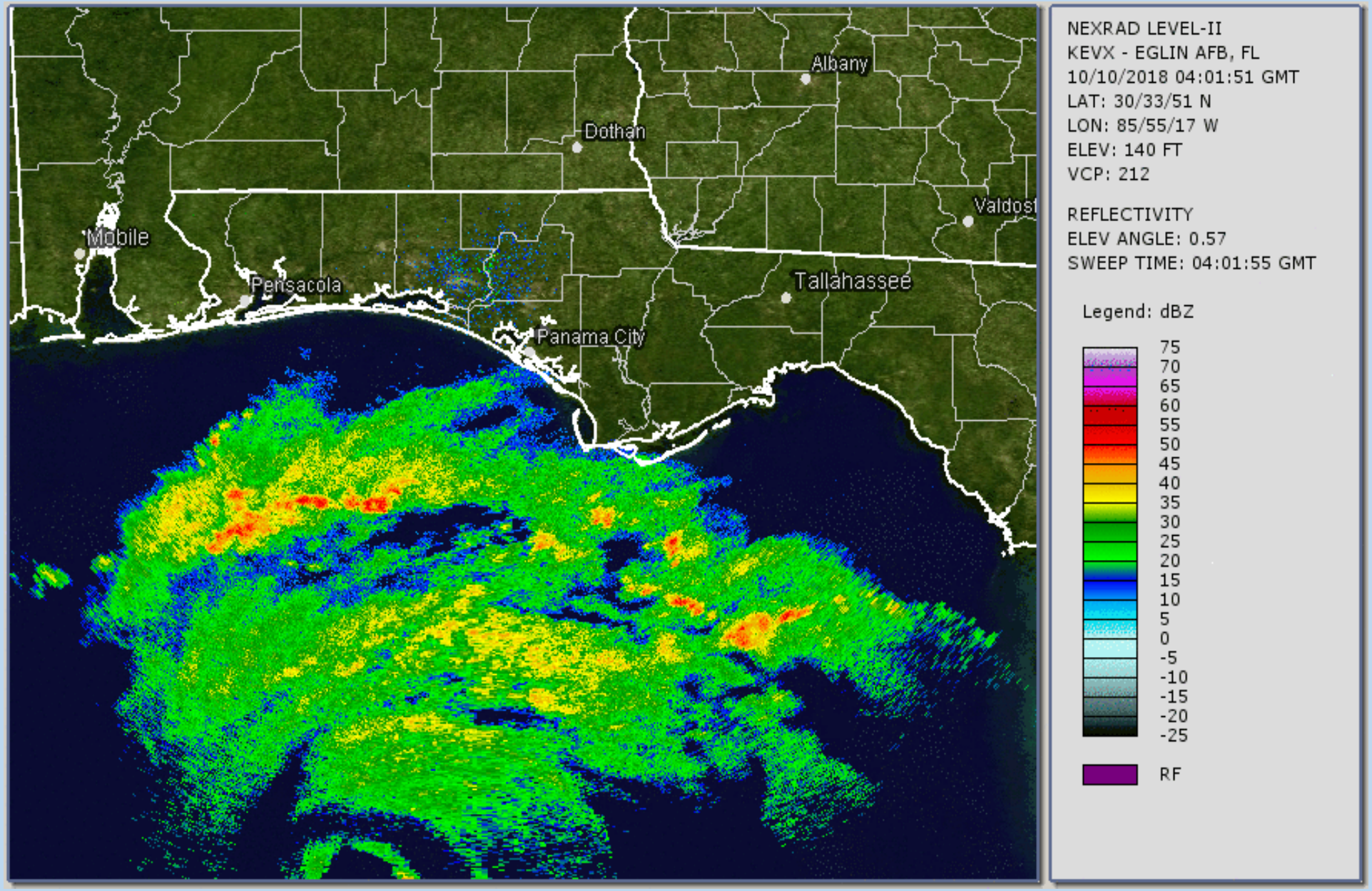
WSR-88D Doppler Weather Radar Analysis of Hurricane Michael

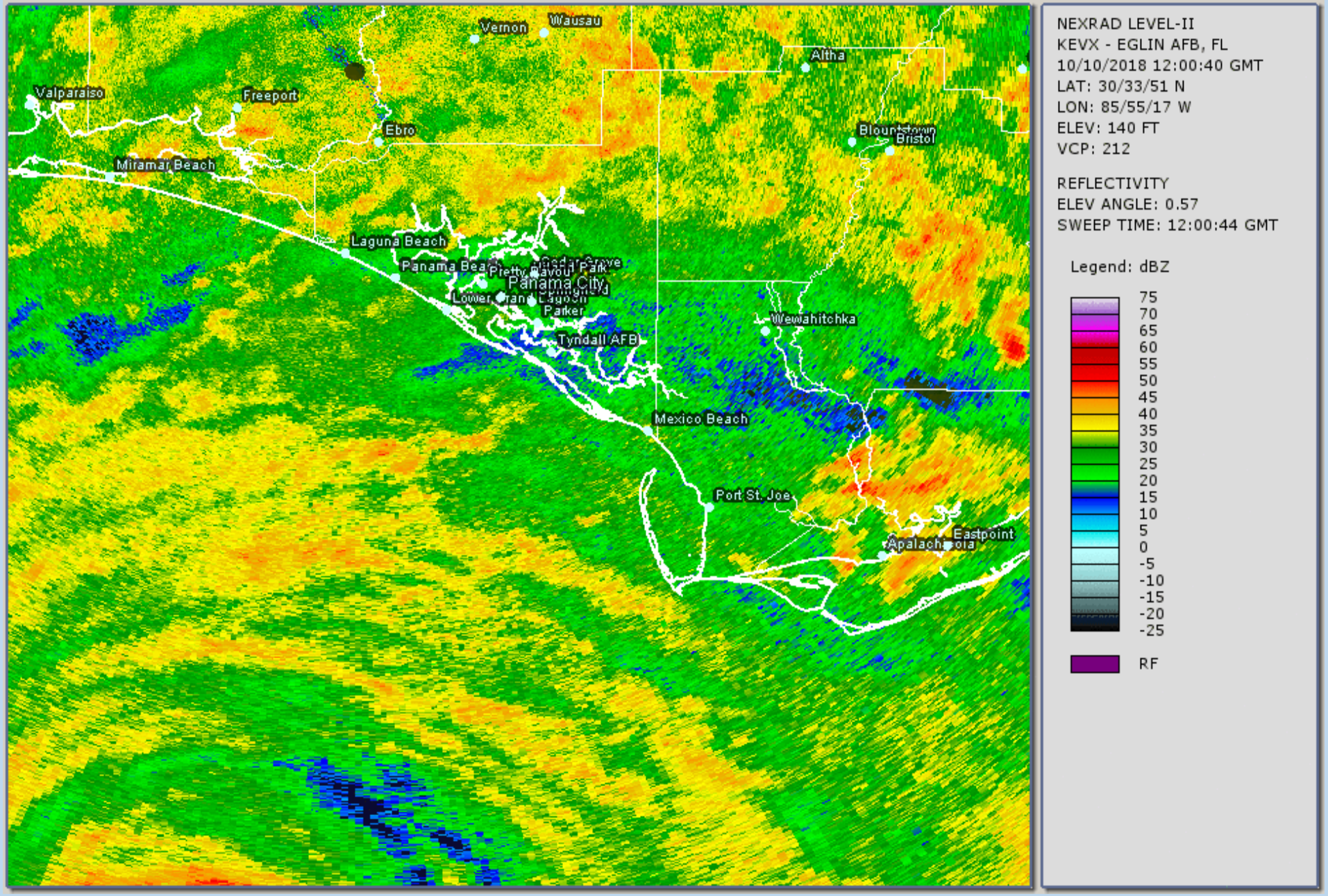
10 October 2018

Stacy Stewart – NWS/NHC

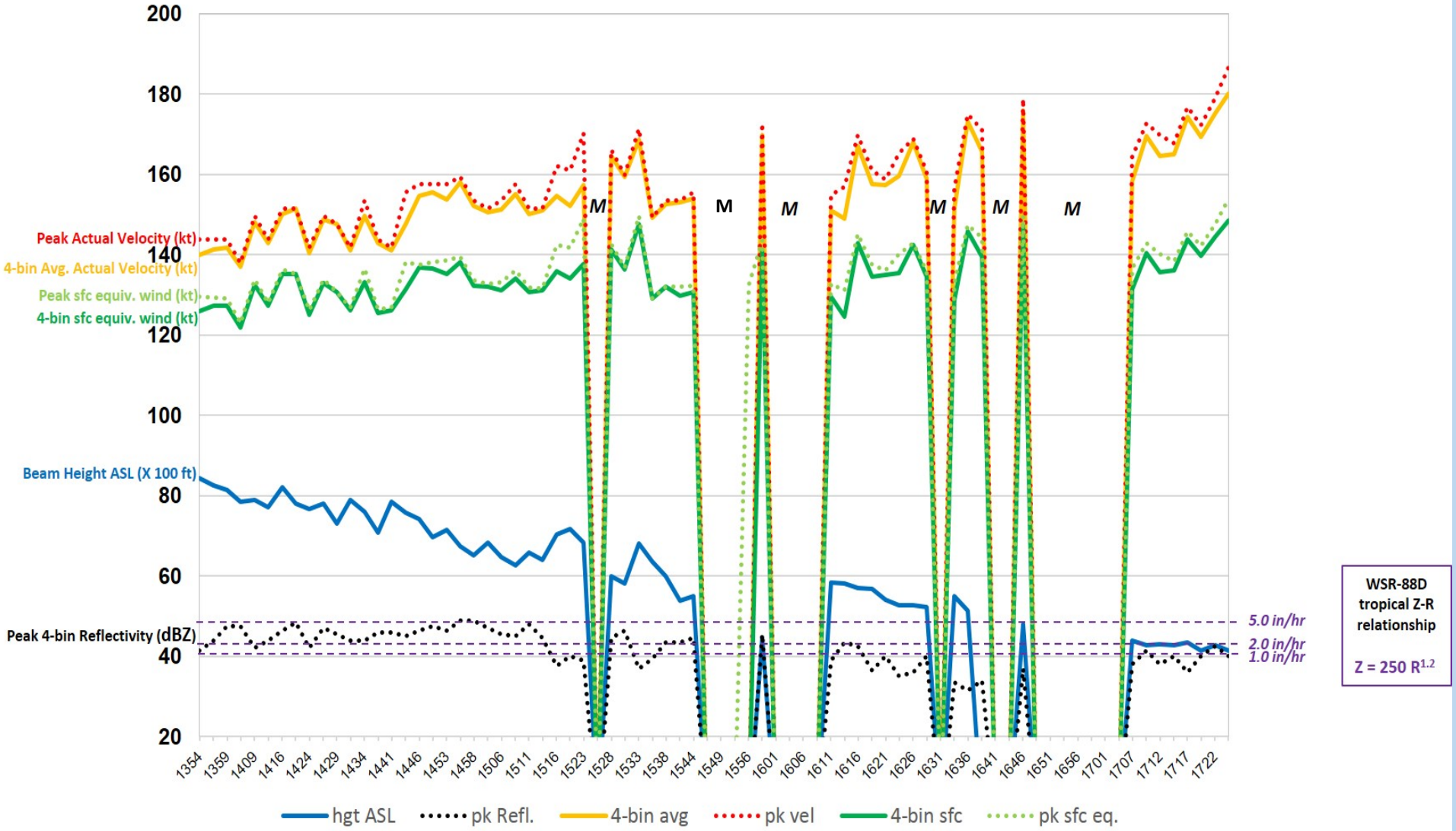
Hurricane Michael, 10 October 2018 (long range)



Hurricane Michael, 10 October 2018 (short range)



H. Michael -- KEVX 0.5 deg elev. pre-landfall Doppler radar analysis, 10 OCT 2018 – se quadrant



WSR-88D tropical Z-R relationship

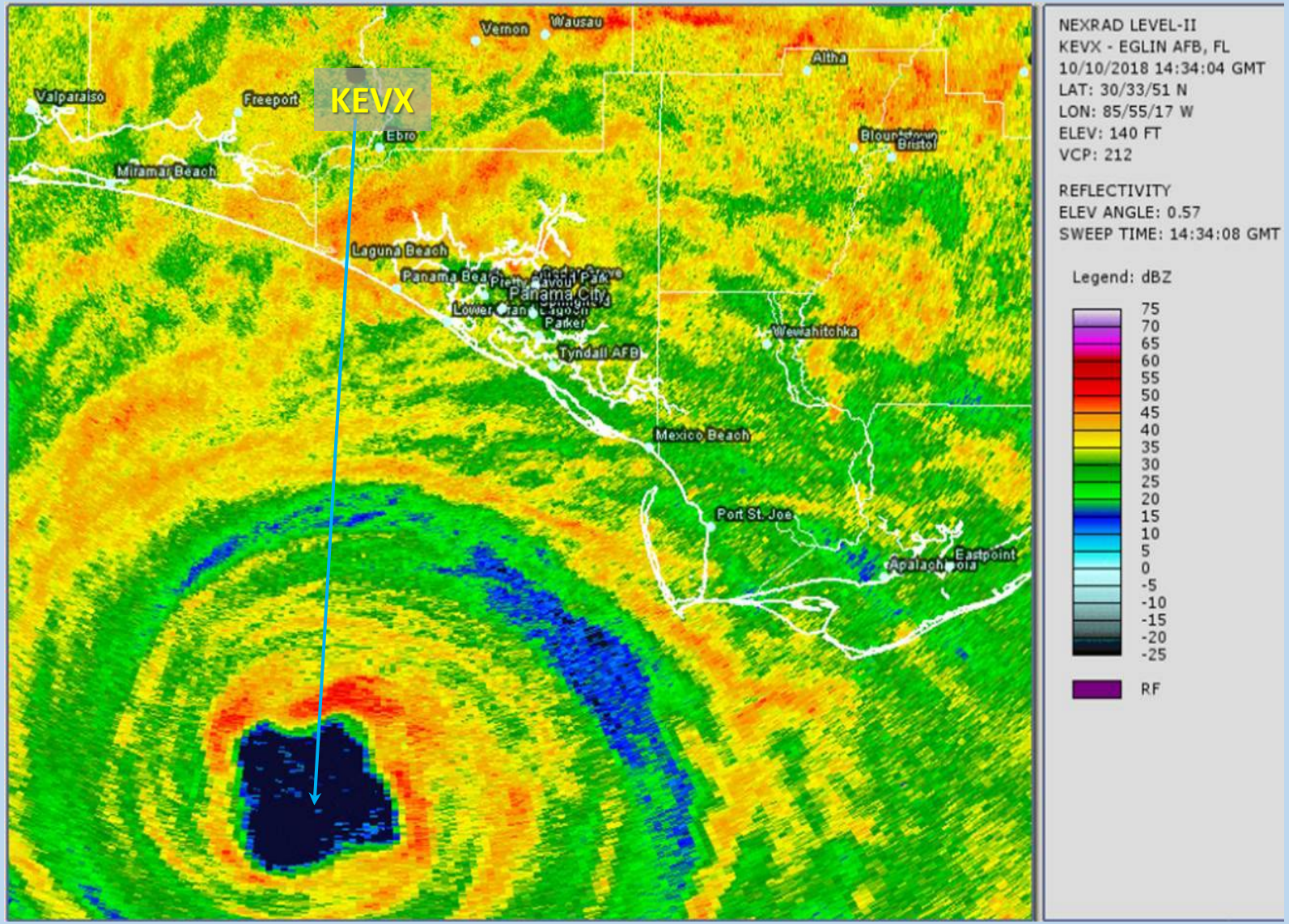
$Z = 250\ R^{1.2}$

The KEVX WSR-88D Doppler radar data analysis and associated equivalent surface wind speed conversions of the ***undisturbed tangential wind flow*** in the southeastern quadrant (090-150^{O} true) leading up to landfall indicate that Hurricane Michael was strengthening right up until landfall occurred at approximately 1730 UTC 10 OCT 2018.

The red-shaded area indicates the time period where original $V_{Doppler}$ values were not converted to V_{actual} values due to AWIPS-II data ingest and display issues; this time period will eventually be converted in the future. However, the wind speeds shown will ***likely be lower than*** the converted V_{actual} values.

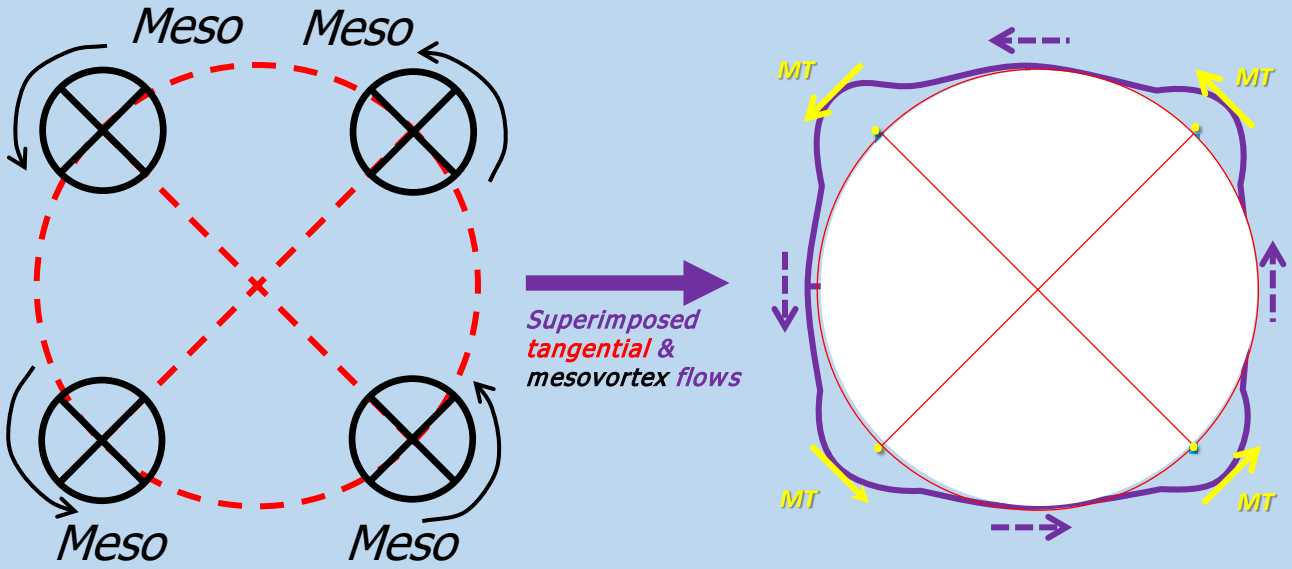
No $V_{Doppler}$ and V_{actual} values were obtained time periods where the tangential wind flow was perturbed by eyewall mesovortices (labeled "M") and, thus, making the values there unrepresentative.

The V_{actual} values over the last ~1 h prior to landfall suggest that Michael had sustained surface wind speeds of at least ***140 kt***.



Real-Time example of the combined tangential and four mesovortex flows (MT) associated with Hurricane Michael at 1434:04 UTC 10 OCT.

Some of the MT flows indicated V_{actual} values of 180-200 kt, which correspond to *equivalent surface wind speeds of 153-165 kt* using recon adjustment values ranging from 0.825 to 0.850 for the corresponding altitudes of the $V_{Doppler}$ radar bins.



The tangential & mesovortex combined flows can only be accurately assessed at locations *MT* where both flows directions *exactly* coincide, thus allowing for symmetrical/circular flow to be assumed at those points.

This allows for an accurate assessment of the Cosine of the Radar Viewing Angle (RVA) and, therefore, V_{actual} to be calculated.

Eyewall mesovortex wind speed data *were not included* in the computation of V_{actual} values.

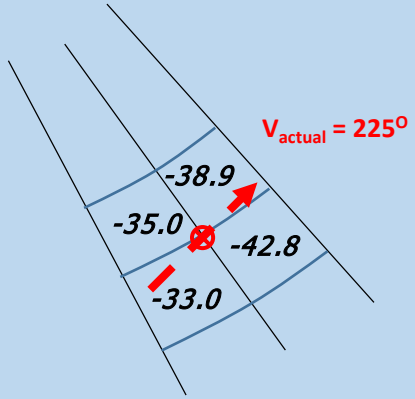
However, there were at least 5 cases where the wind direction of the tangential winds and the mesovortex winds coincided, allowing for the calculation of peak combined flows and V_{actual} values, which ranged from ~180-200 kt, resulting in equivalent surface wind speed estimates of 153-165 kt.

Some consideration and weight should be given to the equivalent surface wind speeds associated with the eyewall mesovortices (eddy flow) since the temporal and spatial scales of those features were very similar to scale of the undisturbed eyewall tangential flow between the mesovortices.

Recon Wind Data vs. WSR-88D ($V_{Doppler}$) & V_{actual} Direction

Reconnaissance Aircraft Data

AF301 1514A MICHAEL HDOB 27 20181010
171930 3000N 08534W 6970 02432 9177 +191 +097 194027 030 053 002 03
172000 2959N 08532W 6960 02446 9181 +191 +100 193030 031 /// /// 03
172030 2958N 08532W 6968 02435 9173 +197 +105 208032 033 049 002 00
172100 2956N 08531W 6963 02446 9171 +205 +121 229049 065 083 001 03
172130 2955N 08530W 6981 02466 9242 +168 +135 238107 122 099 001 00
172200 2954N 08528W 6967 02555 9327 +140 +139 231142 149 121 002 05
172230 2953N 08527W 6973 02621 9437 +137 +136 225150 152 123 005 03
172300 2952N 08525W 6977 02684 9527 +124 //// 218141 148 132 007 05
172330 2951N 08524W 6971 02747 //// +114 //// 219140 146 133 006 05
172400 2951N 08522W 6976 02789 9613 +128 +118 217132 136 101 002 03
172430 2950N 08521W 6971 02819 9641 +130 +106 219124 128 092 001 00
172500 2949N 08522W 6971 02829 9654 +126 +109 222122 123 092 001 00
172530 2948N 08522W 6967 02844 9667 +125 +109 224119 120 091 001 00
172600 2947N 08522W 6970 02853 9679 +123 +114 226116 118 088 003 00
172630 2946N 08522W 6968 02866 9699 +119 +117 229112 115 085 006 00
172700 2945N 08523W 6967 02875 9719 +118 +118 233108 110 085 007 00



Radar beam height = 8337 ft ASL
Aircraft altitude/height = 8599 ft ASL

Recon actual wind direction = 225°
Radar radial = 149°
Radar viewing angle = 76°
Cosine 76° = 0.2419

V_{actual} = $V_{Doppler}$ /Cosine of angle

$V_{Doppler}$ 33.0 kt => V_{actual} = 136.0 kt
$V_{Doppler}$ 35.0 kt => V_{actual} = 144.7 kt
$V_{Doppler}$ 38.9 kt => V_{actual} = 160.8 kt
$V_{Doppler}$ 42.8 kt => V_{actual} = 176.9 kt

4-bin V_{actual} average = 154.6 kt
Recon V_{actual} = 152.0 kt