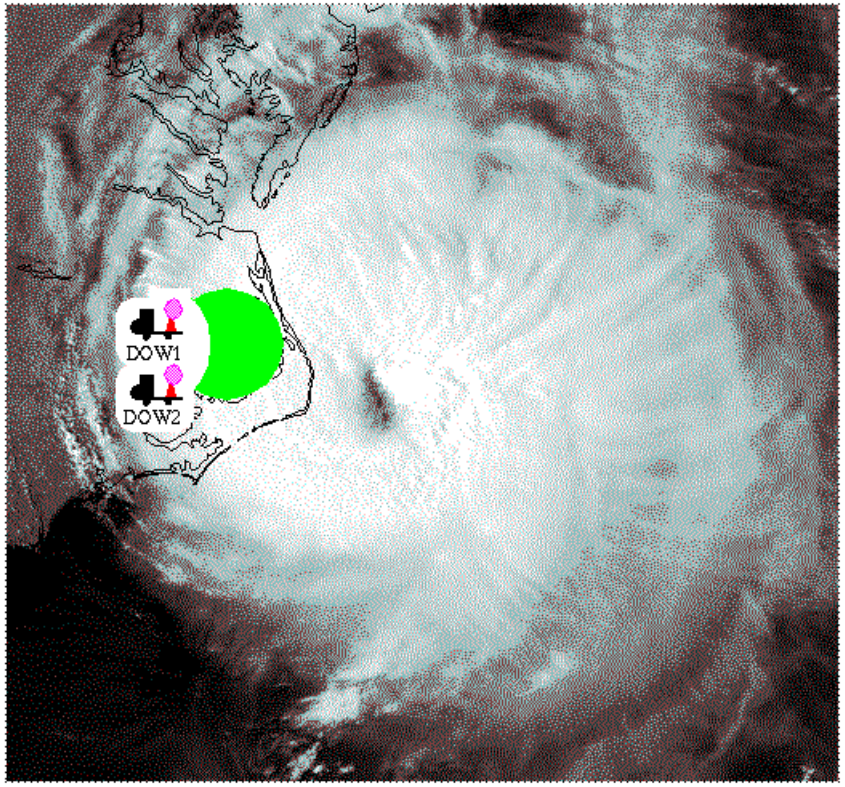

Center for
Severe
Weather
Research
Hurricane Studies
Photo by Herb Stein

DOW Hurricane Studies



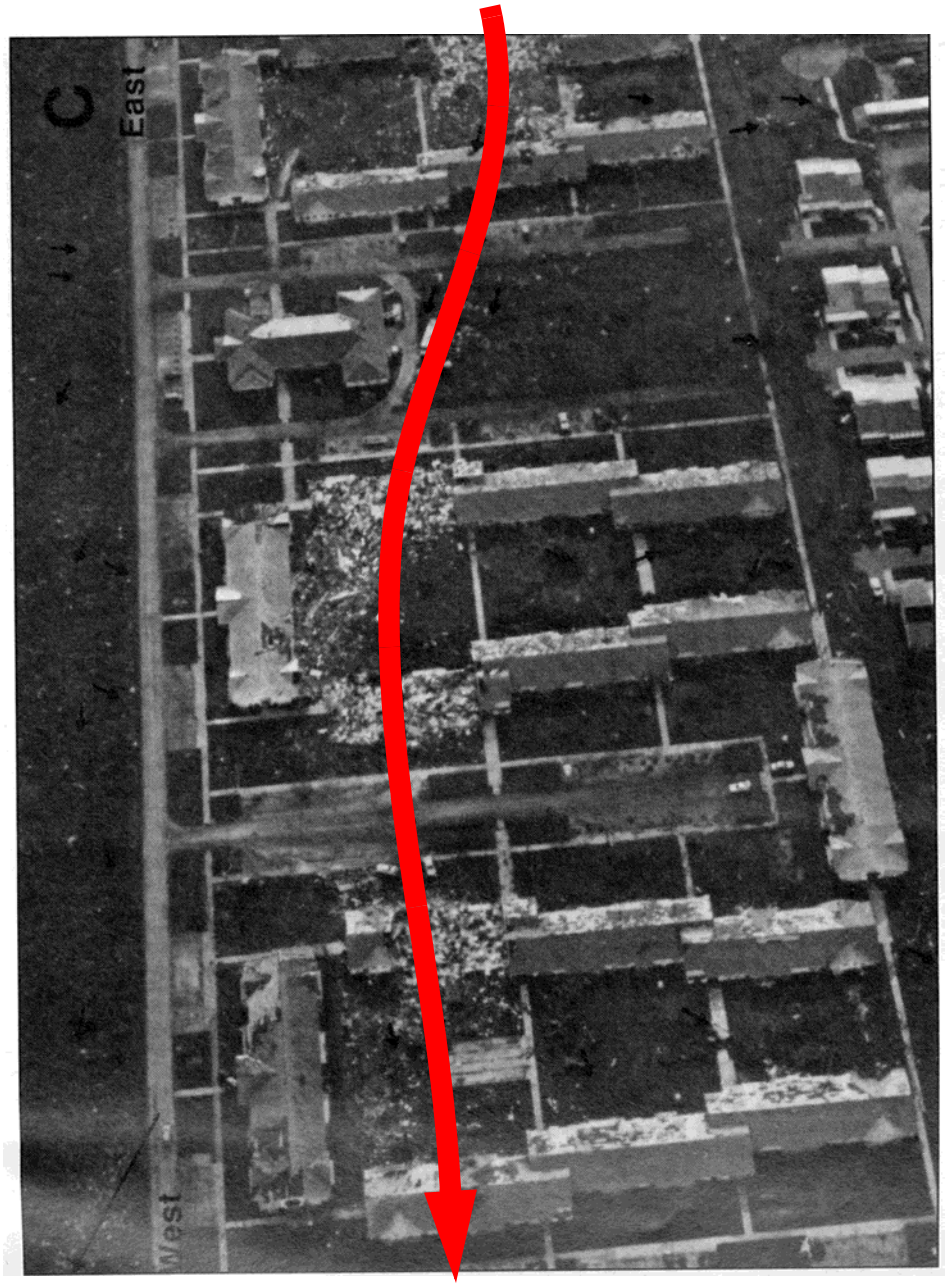
(or, what the DOWs do
after tornado season is over)

Missions are very
challenging compared
to tornado intercepts.

Deploy Inside Looking In

Inside can have 100+ mph winds
trees, debris, surge

8 eye intercepts
Fran, Bonnie,
Floyd, Georges,
Lili,, Isabel
Frances, Ivan

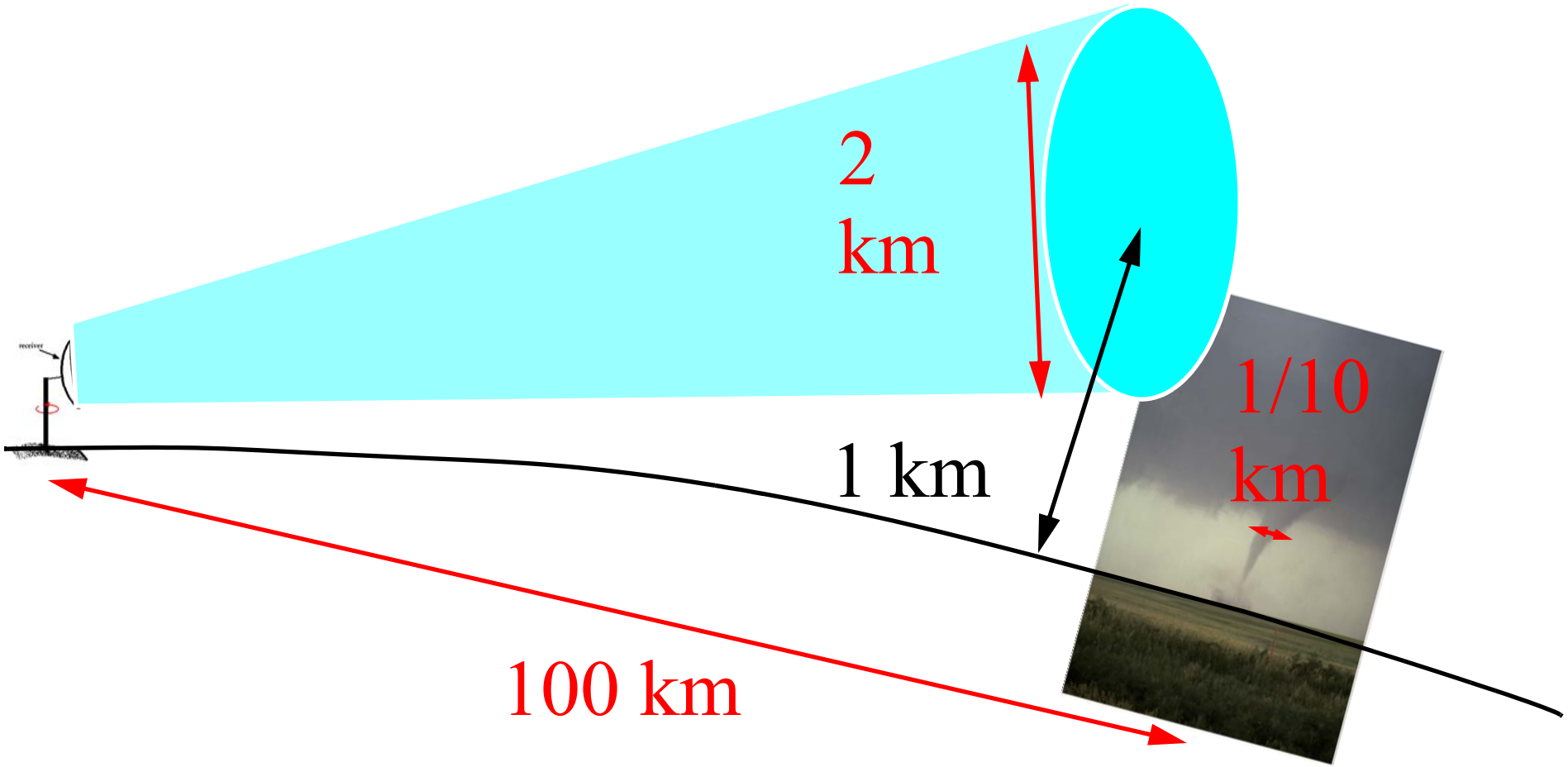


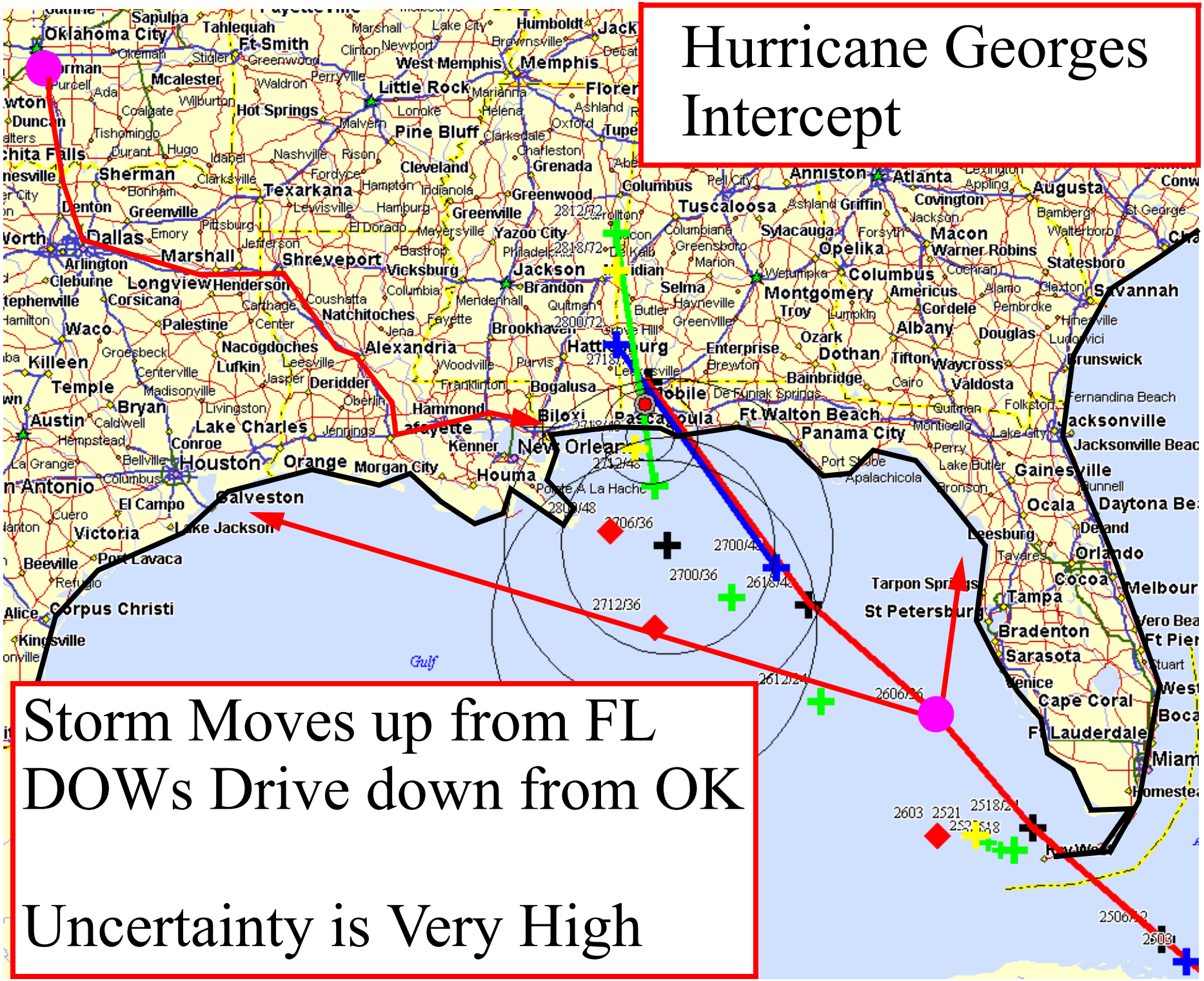
Some Neighboorhoods/Houses have
Much More Destruction from Winds: Why?

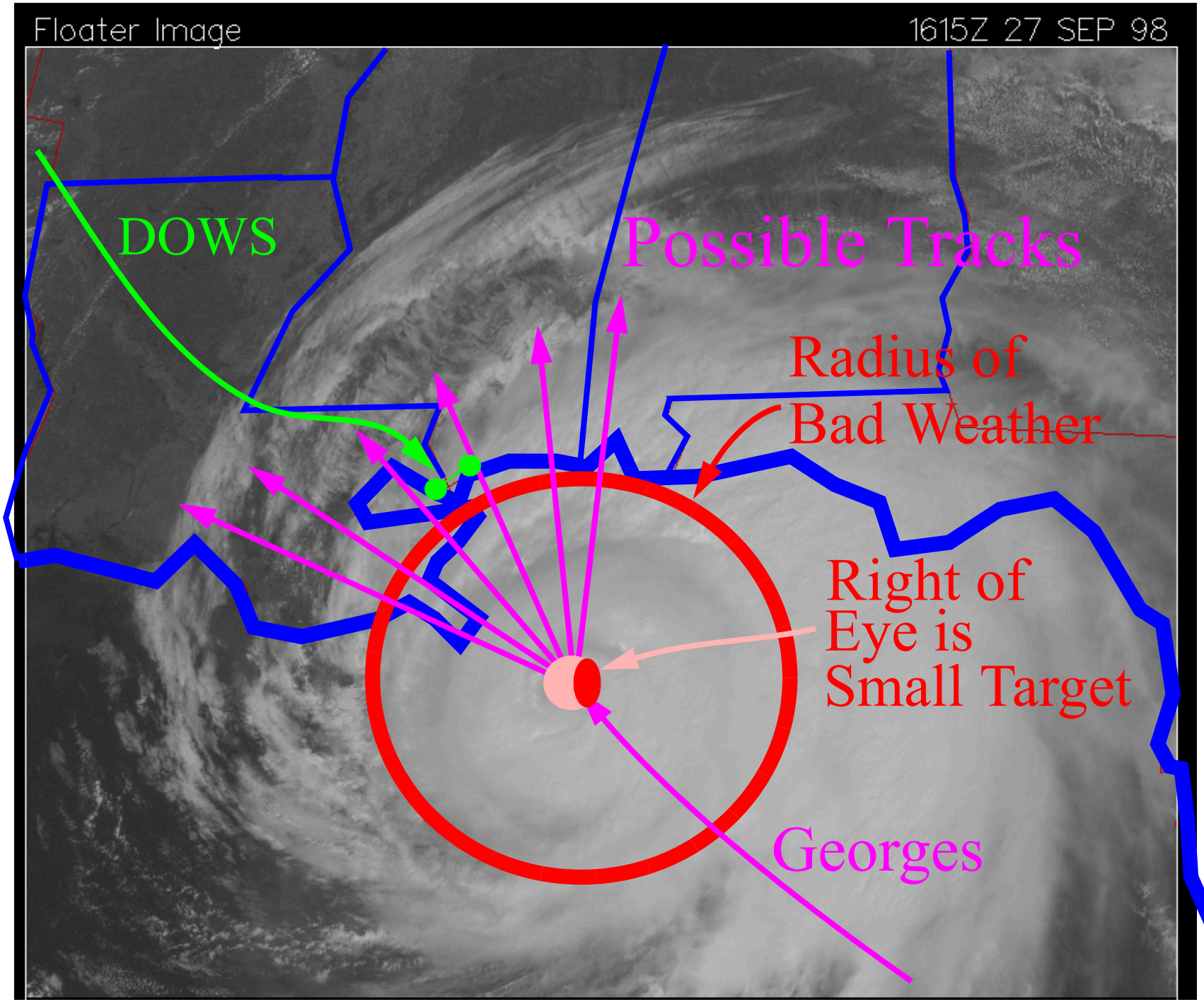
Normal Radars Can't See Small Things
(tornadoes or othe small boundary layer things)

Radar beams spread with distance and are much bigger than tornado

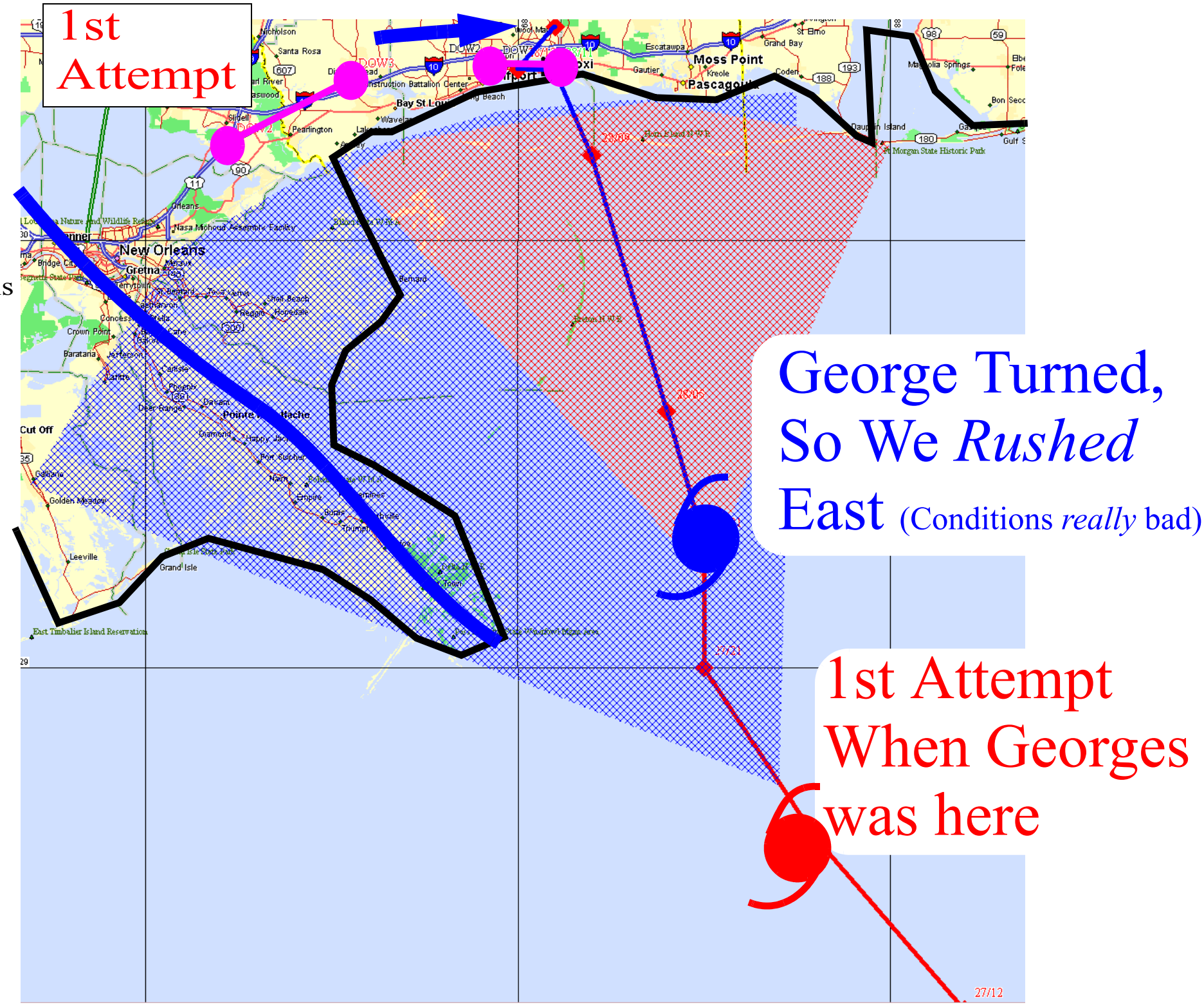
Earth curves, but beams go straight and radar can't see near the surface



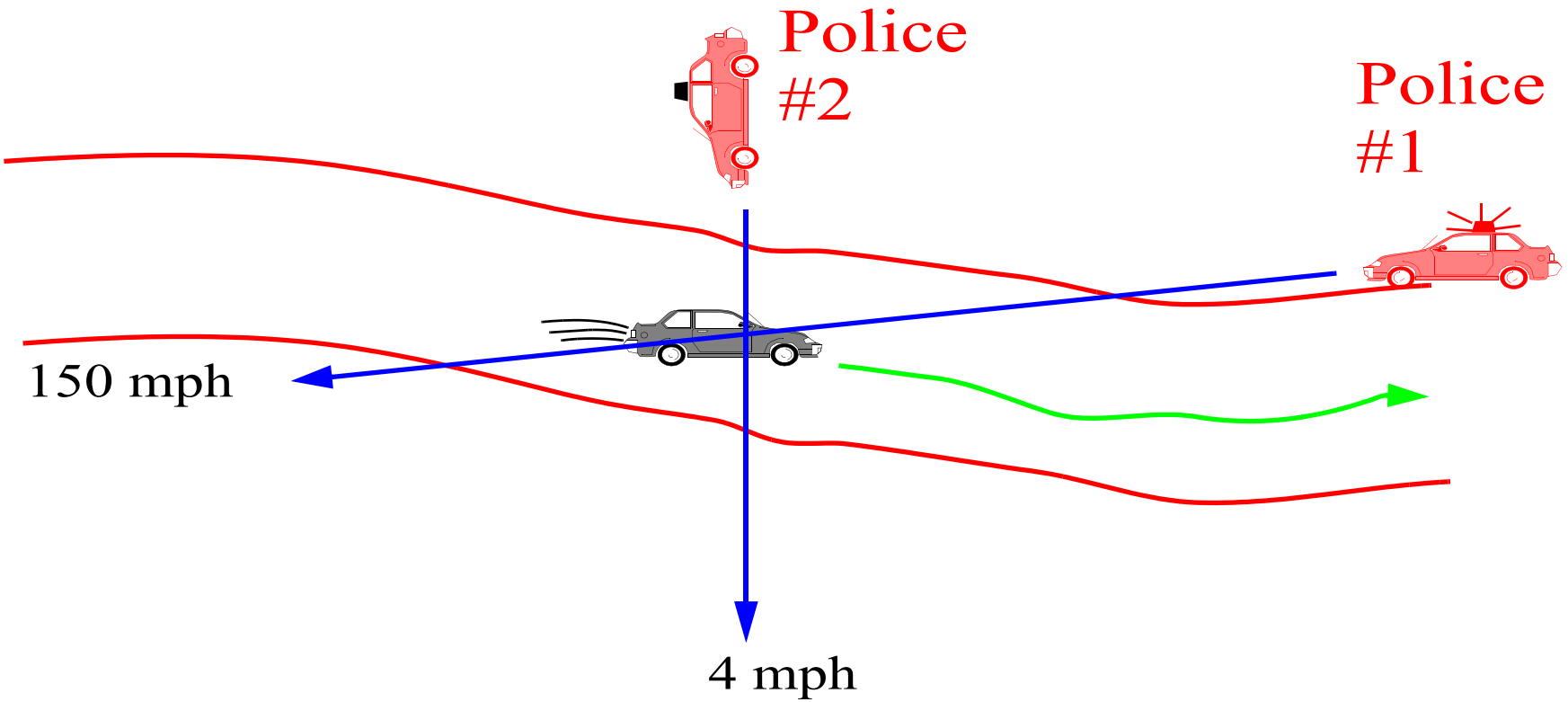

Hurricane Georges
Intercept
Storm Moves up from FL
DOWs Drive down from OK
Uncertainty is Very High
Oklahoma City
Dallas
Houston
Shreveport
Little Rock
Memphis
Jackson
Mobile
New Orleans
Atlanta
Tuscaloosa
Montgomery
Columbus
Savannah
Jacksonville
Tampa
Orlando
Miami
Gulf



We have to pick our spot before red circle comes onshore


1st Attempt
New Orleans
George Turned, So We *Rushed* East (Conditions *really* bad)
1st Attempt When Georges was here

Doppler gives towards and away motion.
But equations of motion are vector equations.



Why try to use 2-3 radars?

2 is 10x better than 1

Dual-Doppler Observations give Vectors

05 June 2001, Sumner County Kansas

(from Dowell et al. 2003)

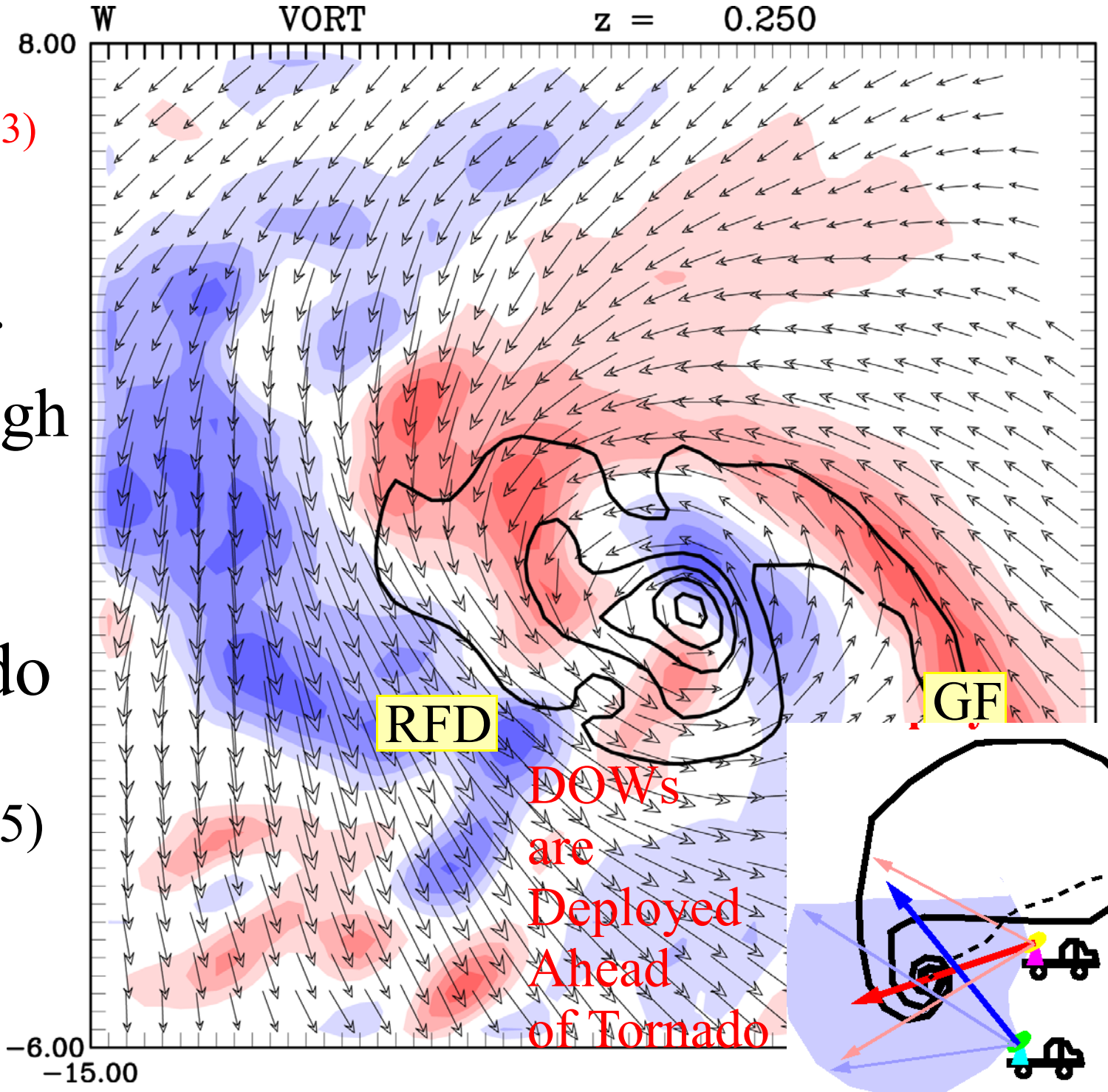
Dual-Doppler Genesis through Death

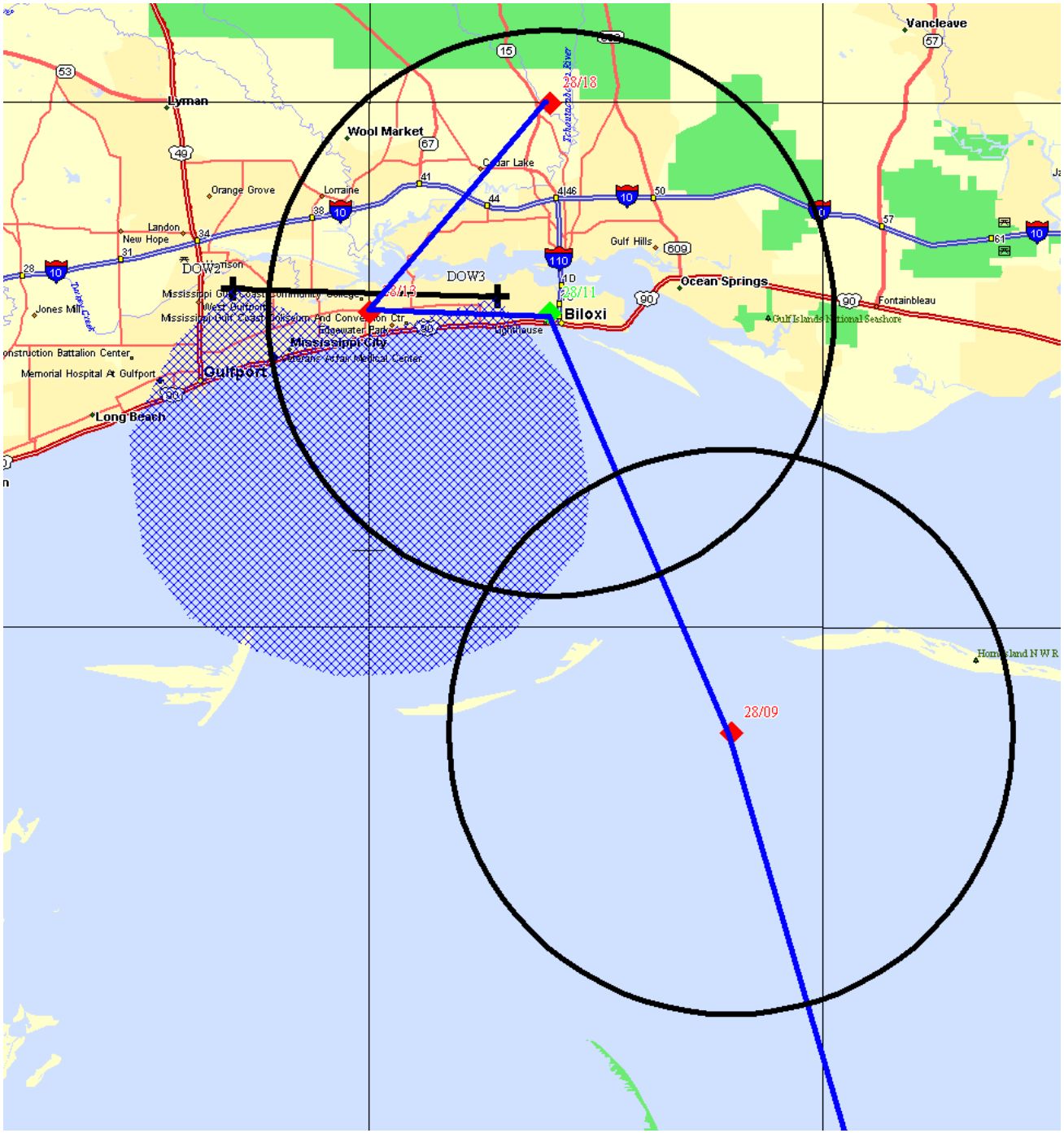
Weak Tornado

Black Contours of vorticity (0.05)

Blue = W down

Red = W up

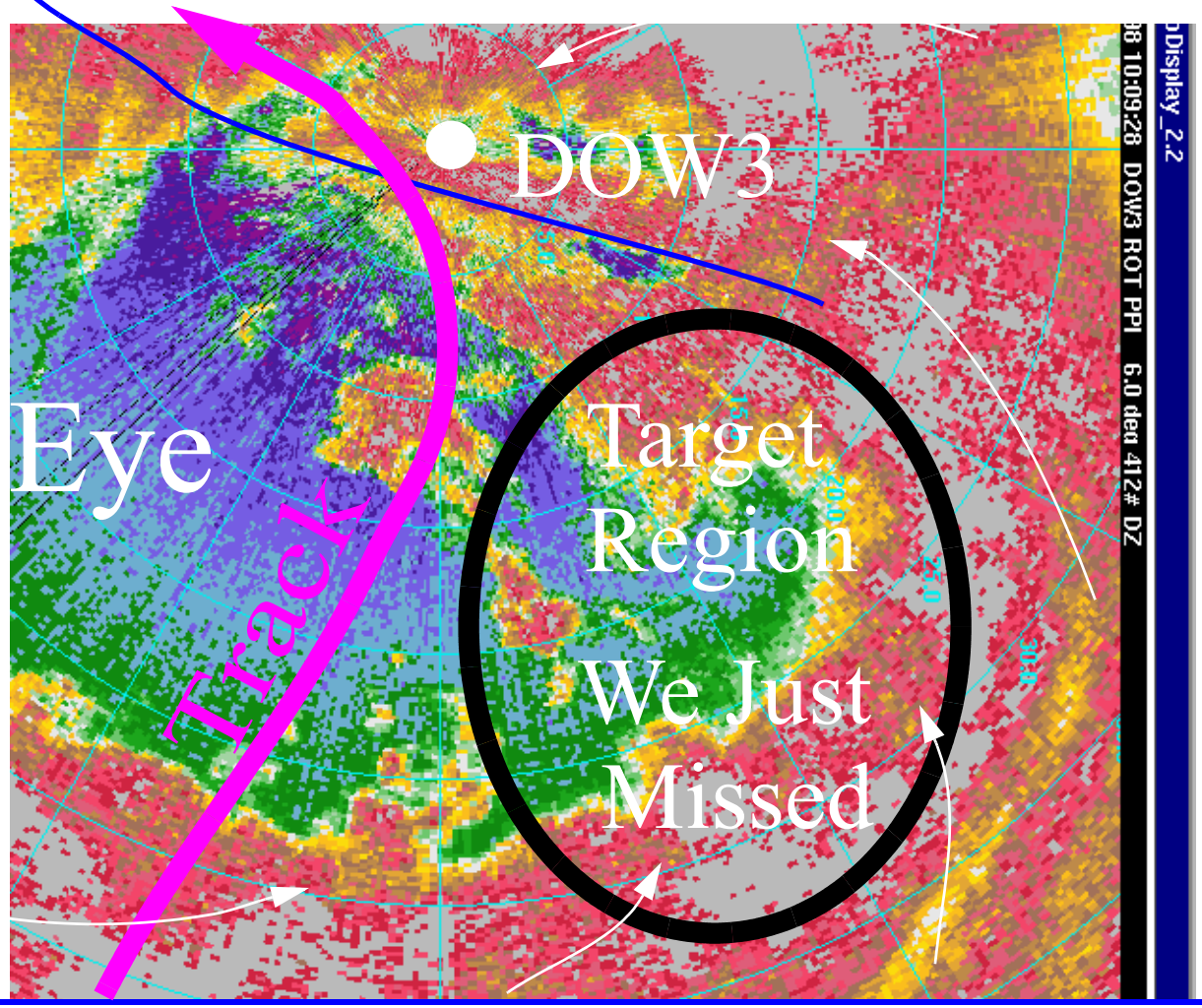




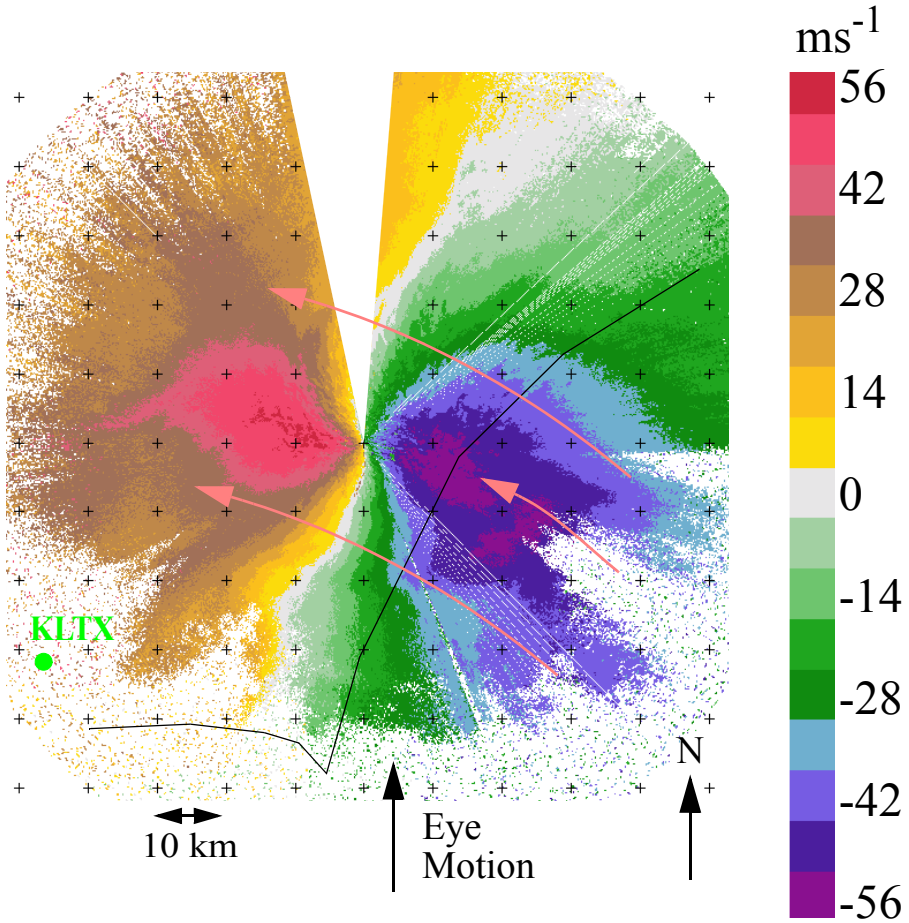
Final Deployment just 9.4 km apart.

Eye moved over DOW3 then over DOW2

Peak observed winds 61 m/s



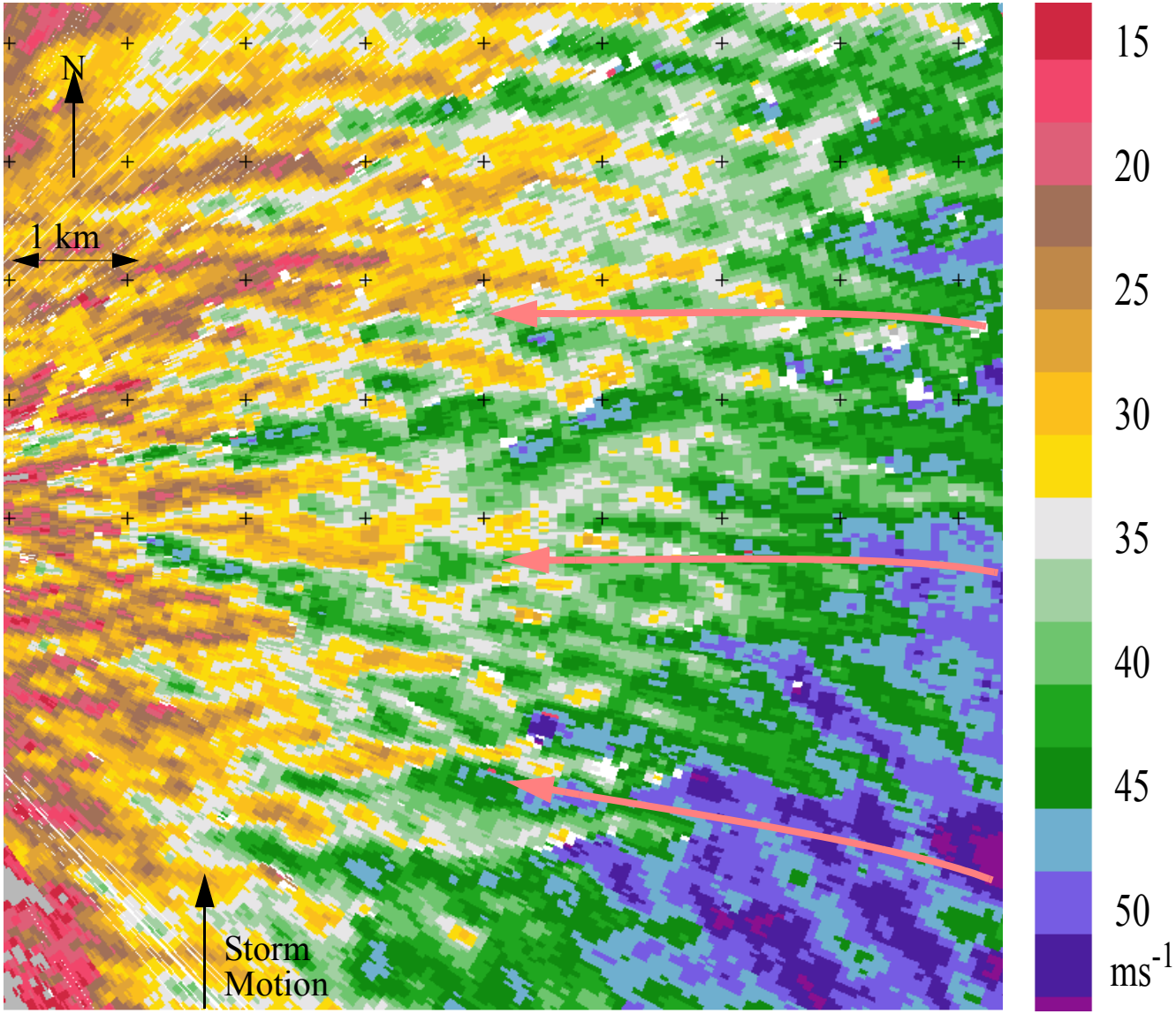
DOW2 and DOW3 in eye of Georges
Newly Revealed Fine-Resolution Detail



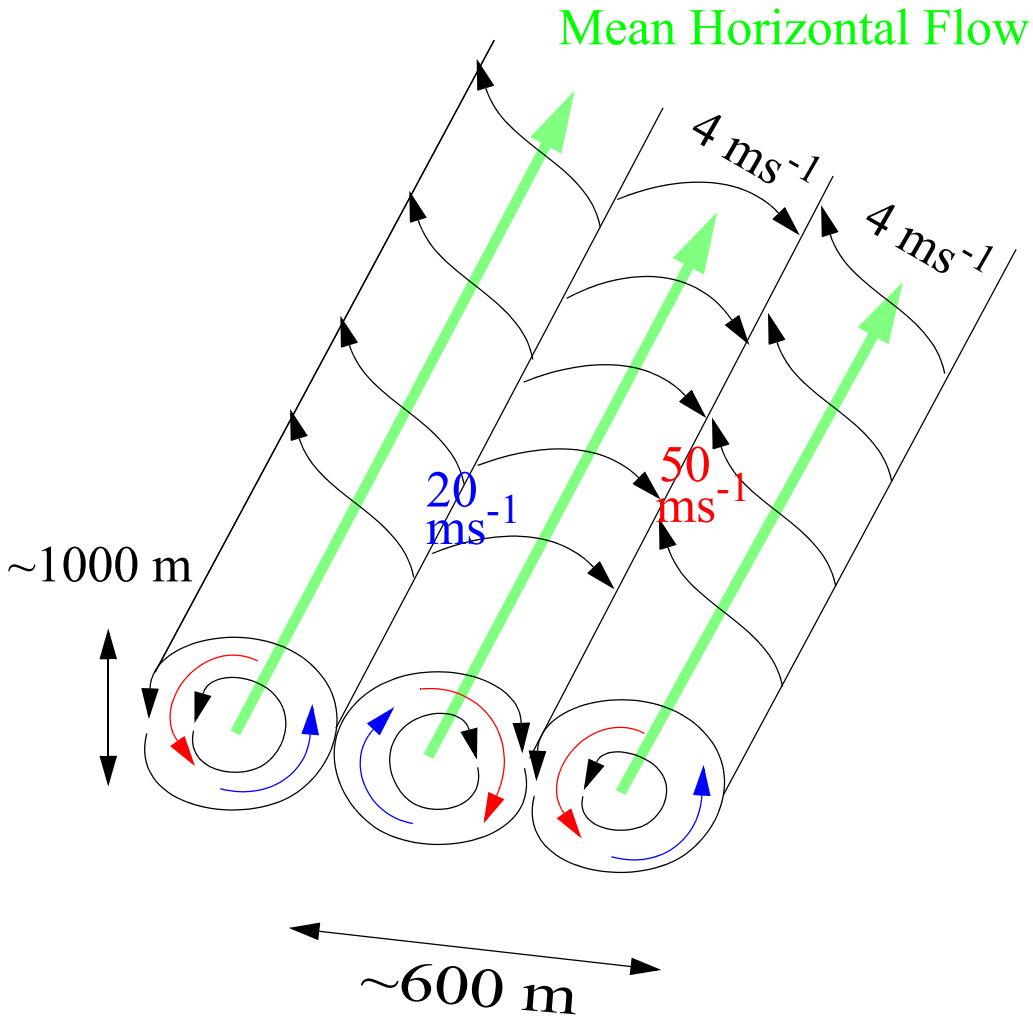
Hurricane Fran 1996

Basic windflow is onshore at 50-60 m/s

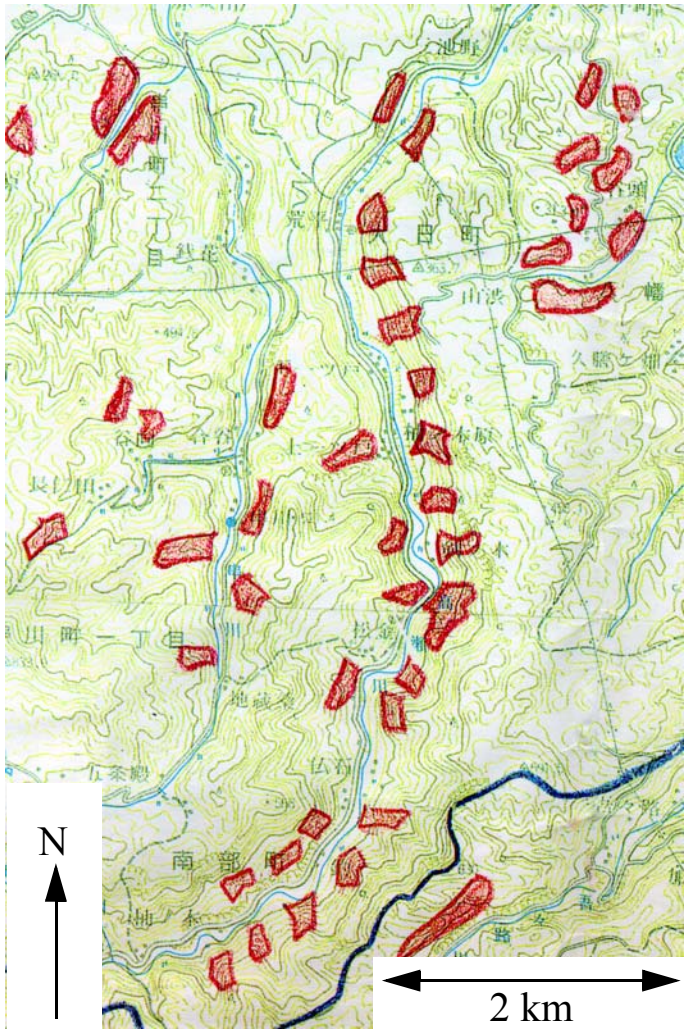
It is windy and rainy. So What



But, small-scale streaks alternate with 60 m/s in peaks and 30 m/s in troughs



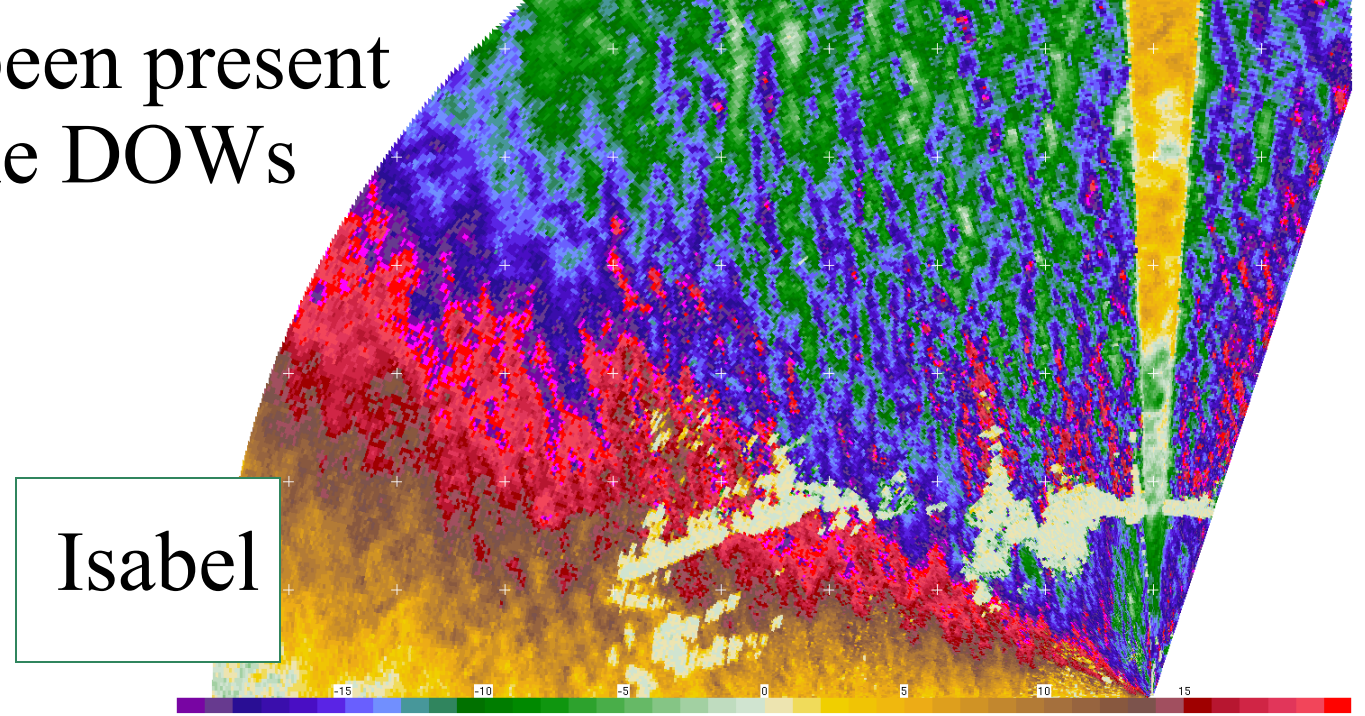
Horizontal Rolls bring high velocity air from aloft

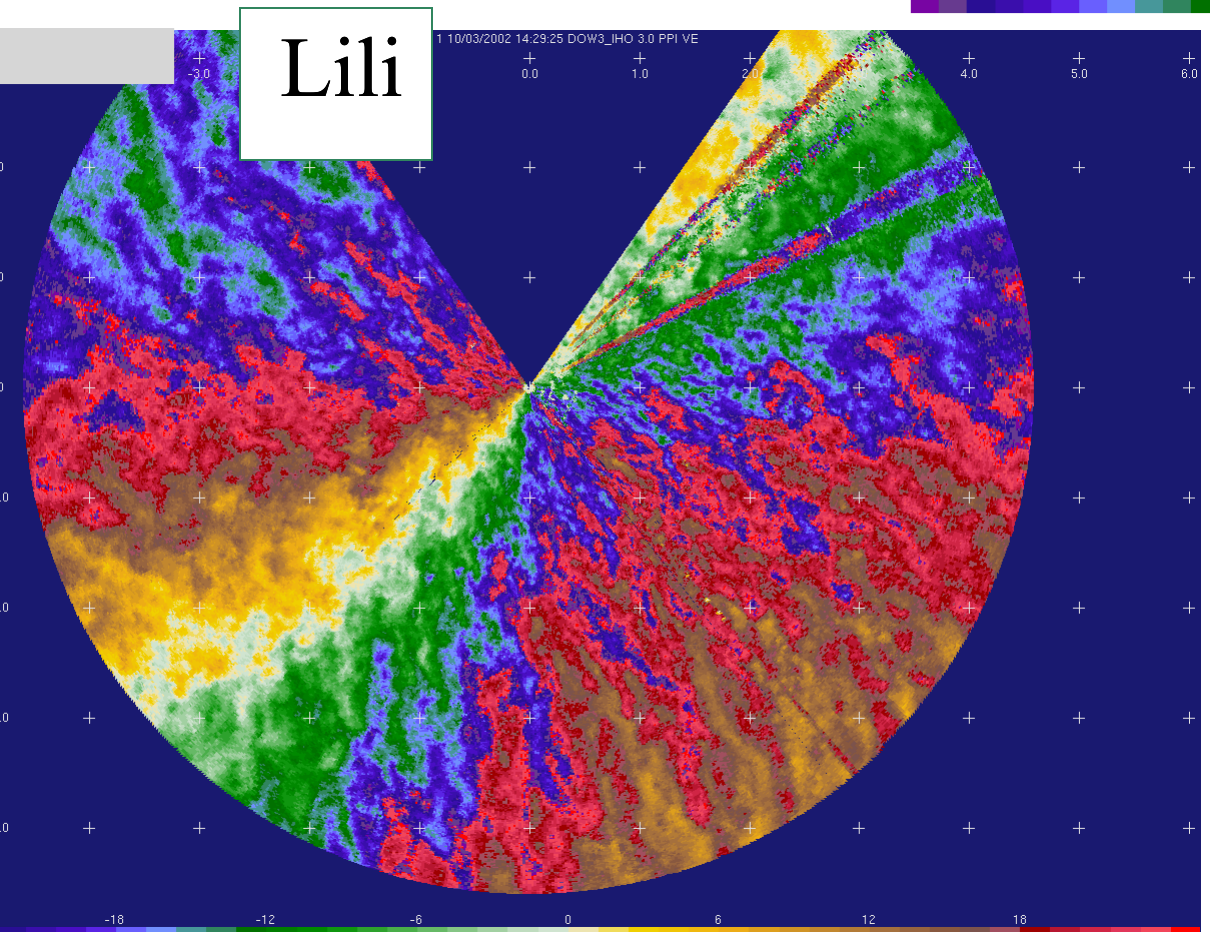


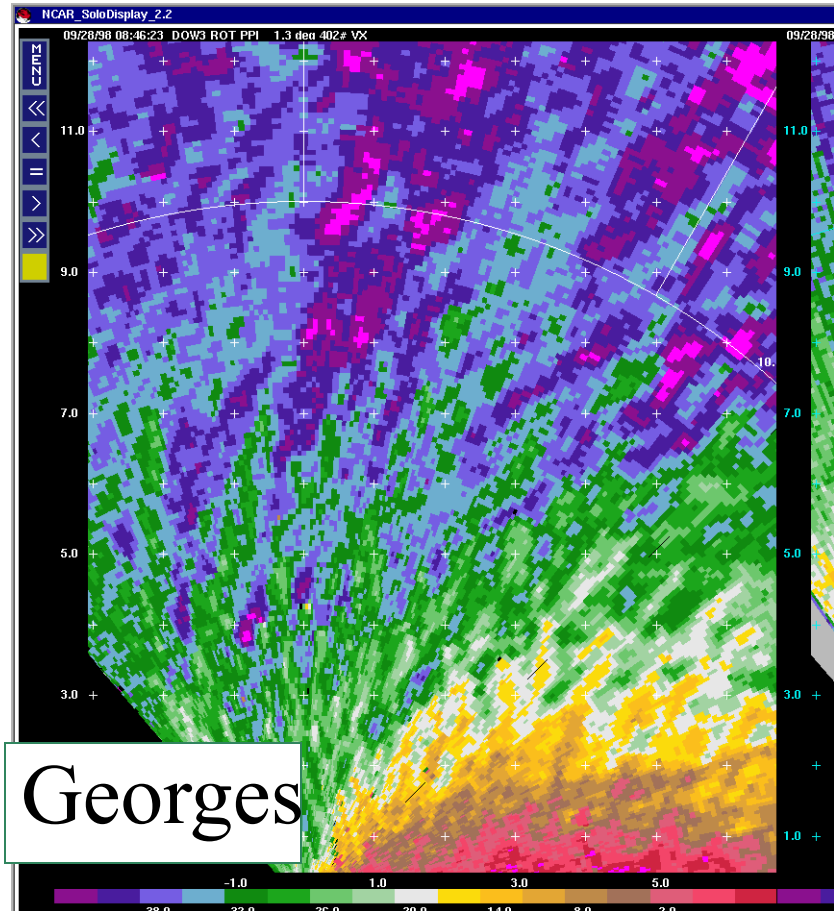
Quasi-periodic Damage in Kyushu Japan

Probably similar to laboratory-simulated hairpin vortices

Wind Streaks have been present in all 8 hurricanes the DOWs have intercepted

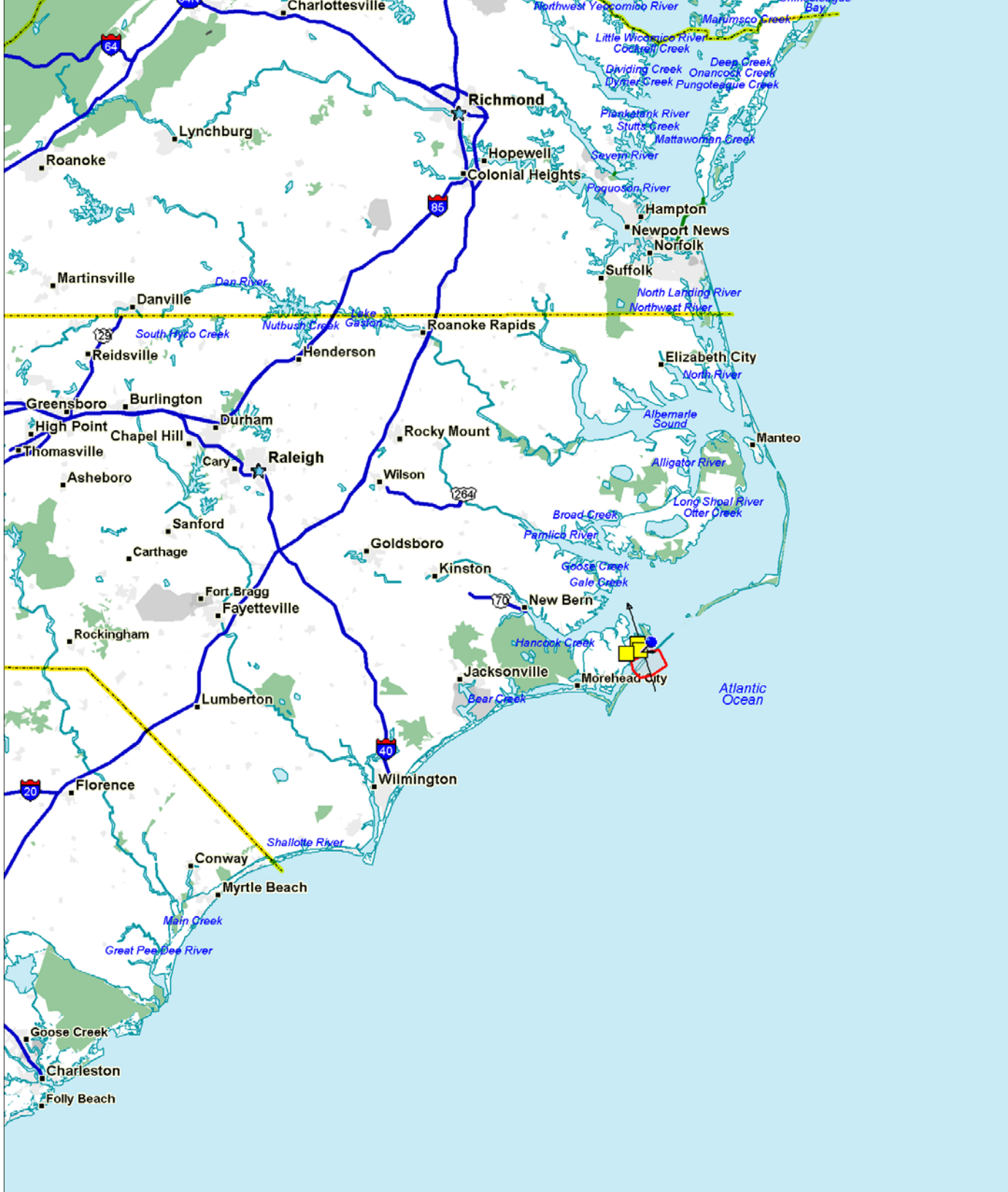


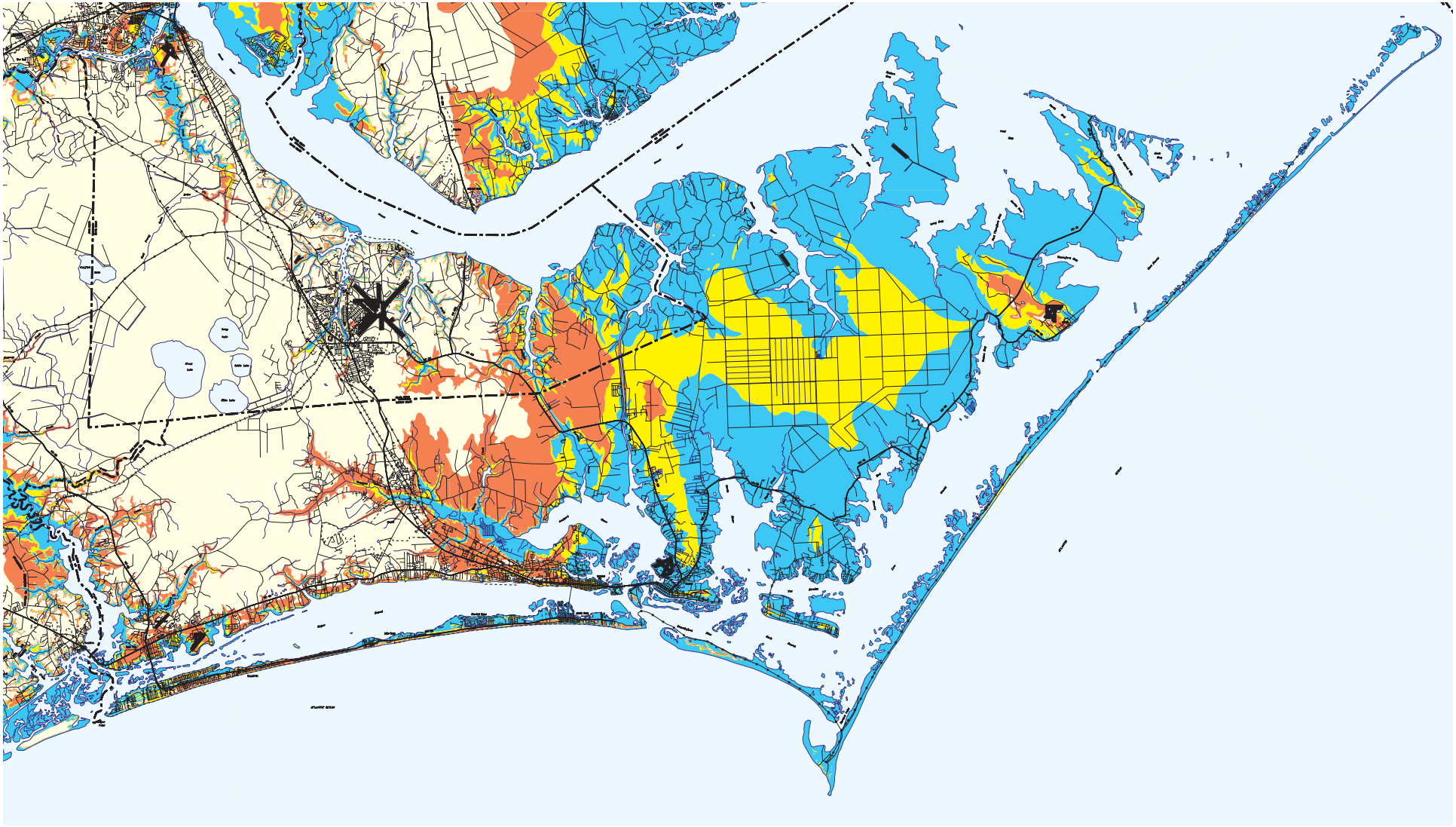




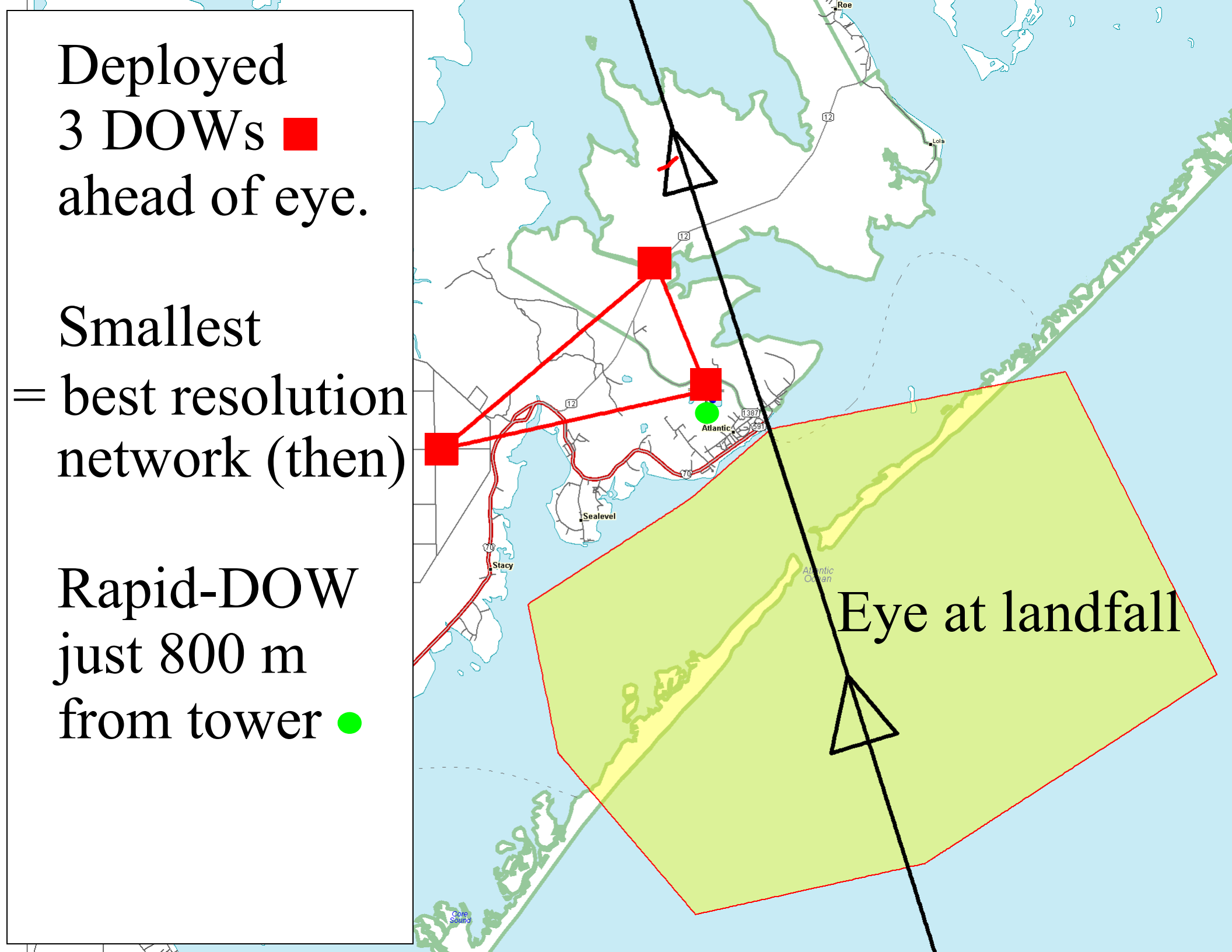
Isabel
2003

Landfall in generally low level East NC



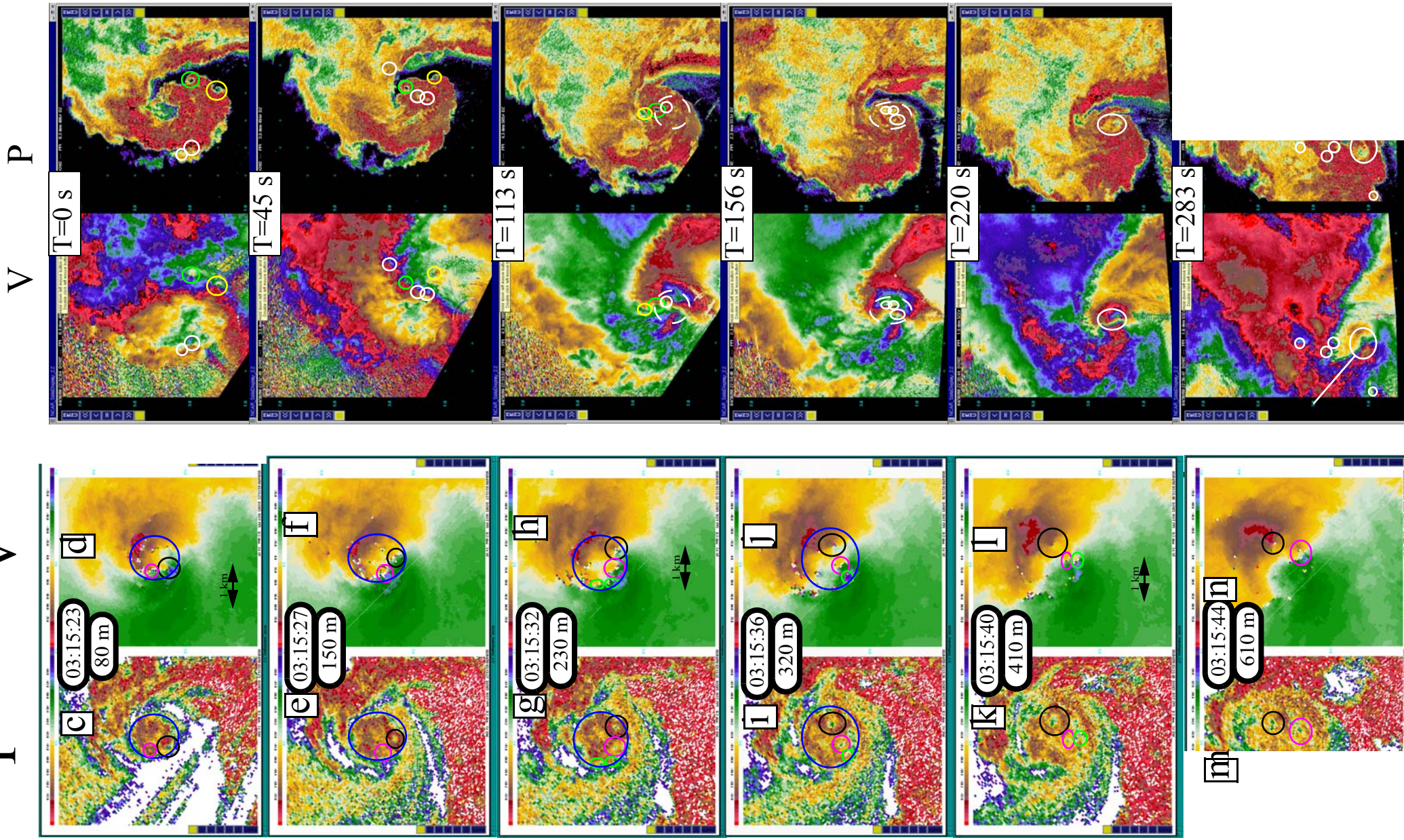


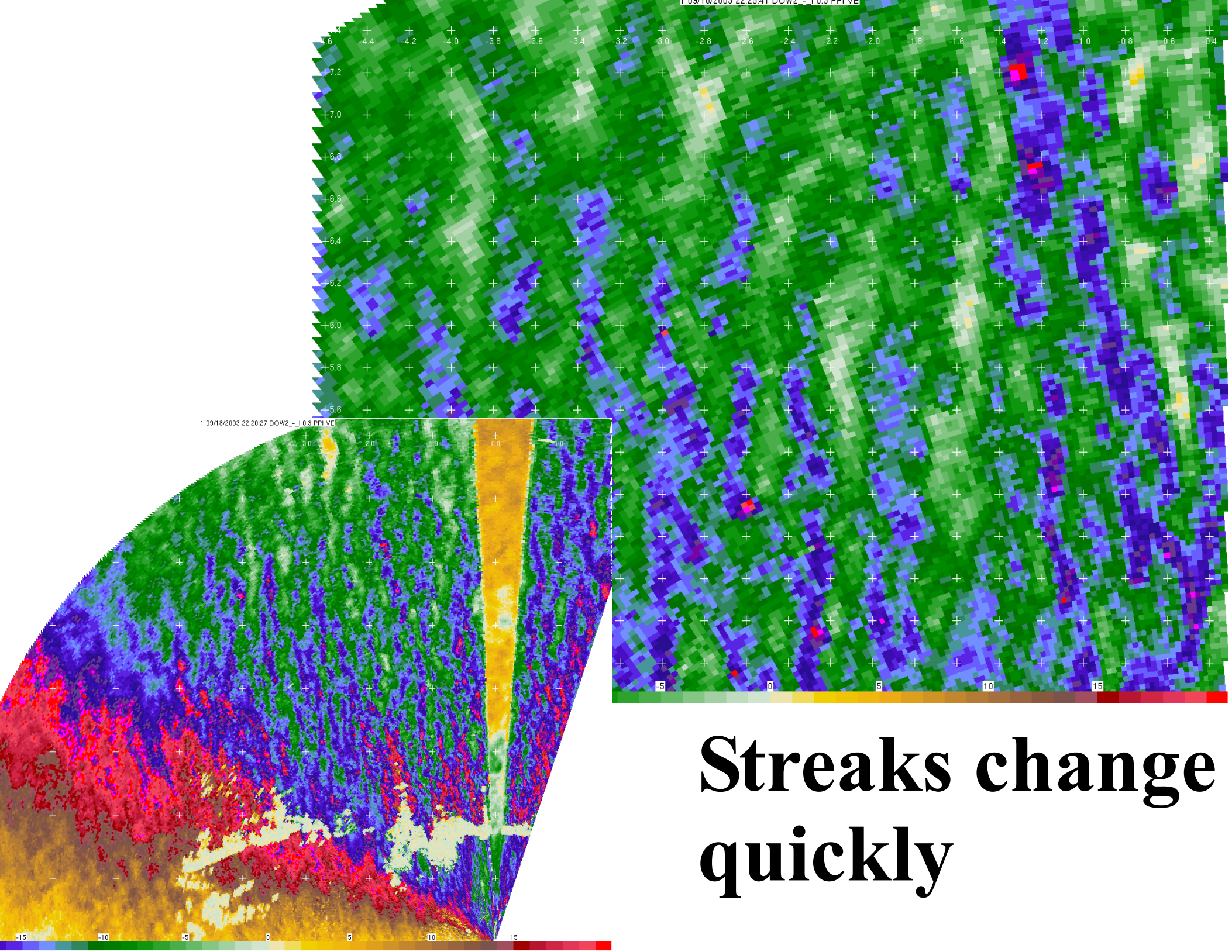
Data show where it is safe from Cat 1,2,3,4,5 surge


Deployed
3 DOWs ■
ahead of eye.
Smallest
= best resolution
network (then)
Rapid-DOW
just 800 m
from tower ●
Eye at landfall
Roe
Lola
Atlantic
Sealevel
Stacy
Atlantic Ocean
Core Sound
12
70
1387
591

DOWs Scan Too Slowly

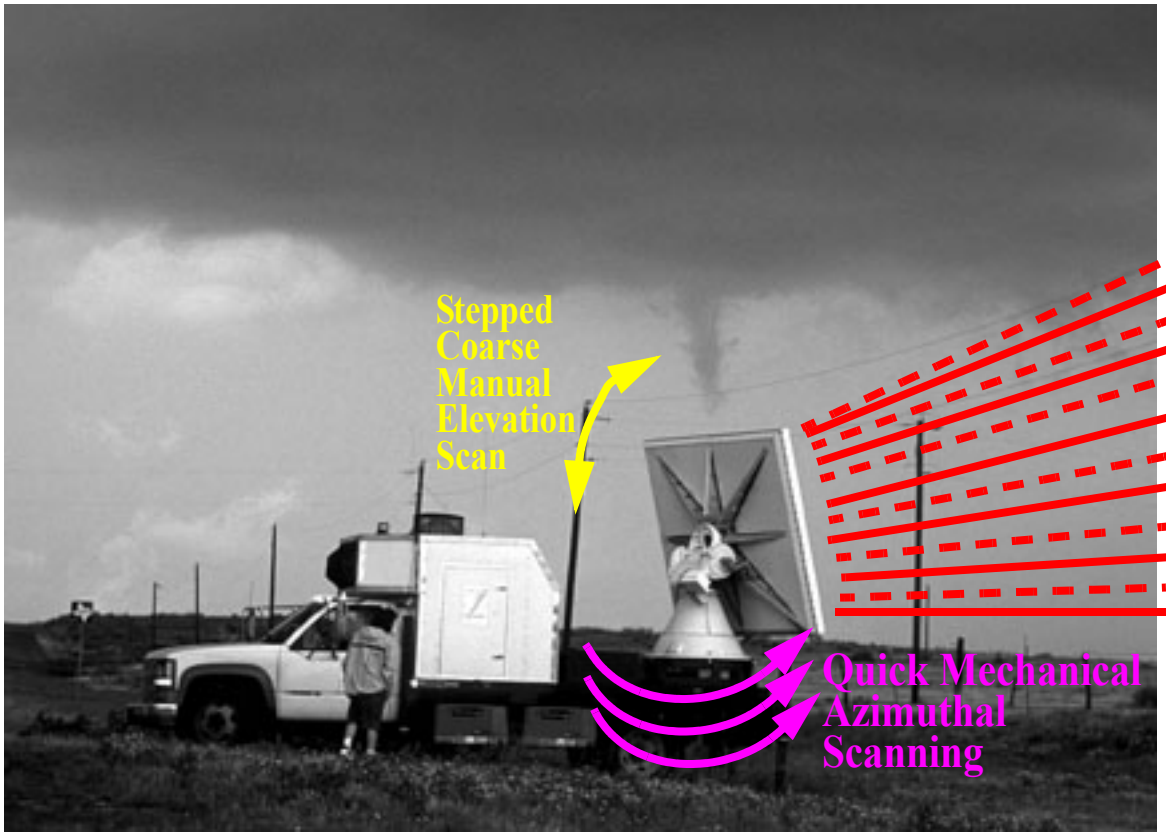
Sub-Tornado-Scale Vortices Move and Evolve on ~10 s Time Scale

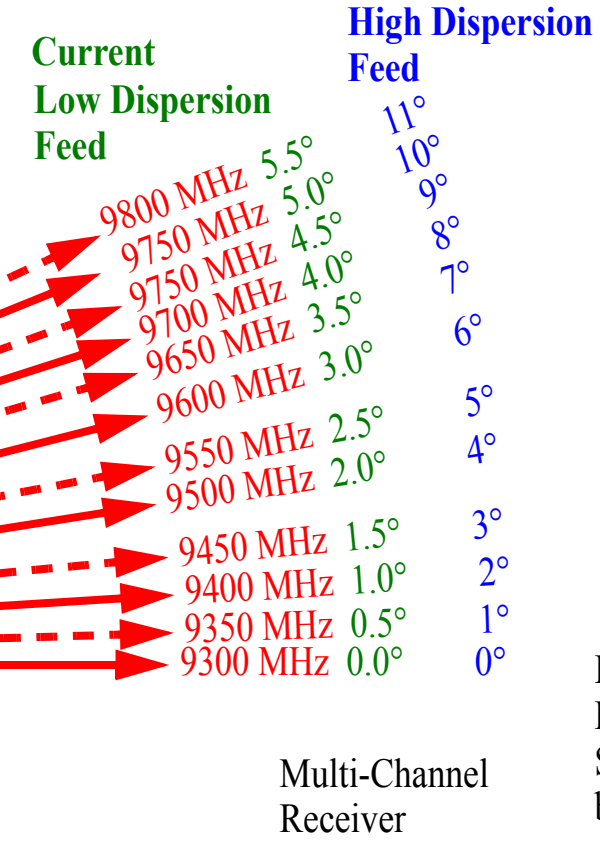




Streaks change quickly

Multiple-Simultaneous-Beams Tx and Rx

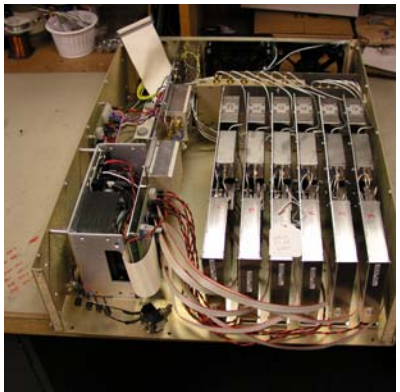




6 beams 2003 --- 12 beams 2004

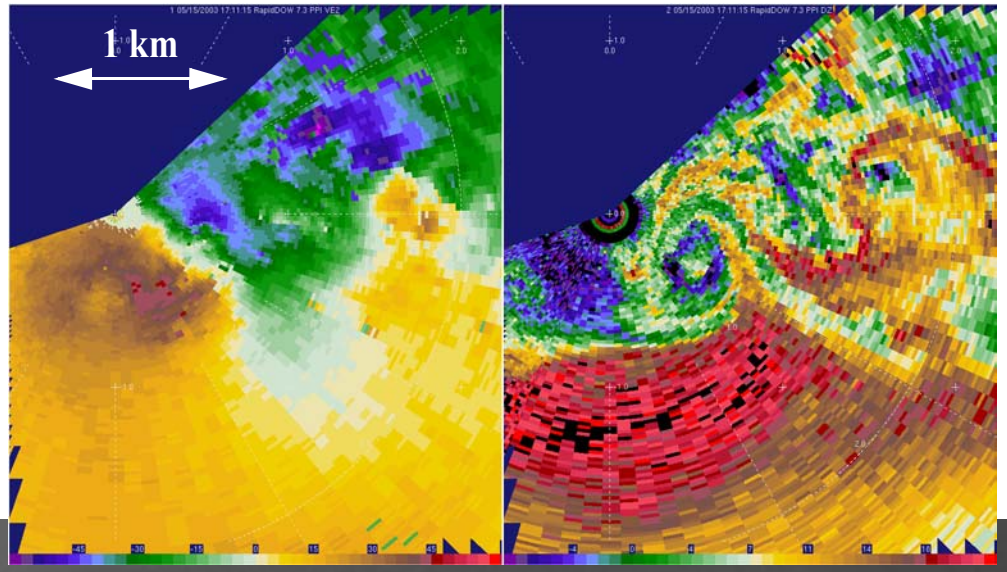
Design is very modular, so adding beams is simple

Feed is modular for easy switching from low to high dispersion.



Tornado passes < 700 m from Rapid-DOW

Multiple Simultaneous Slices



North

11°

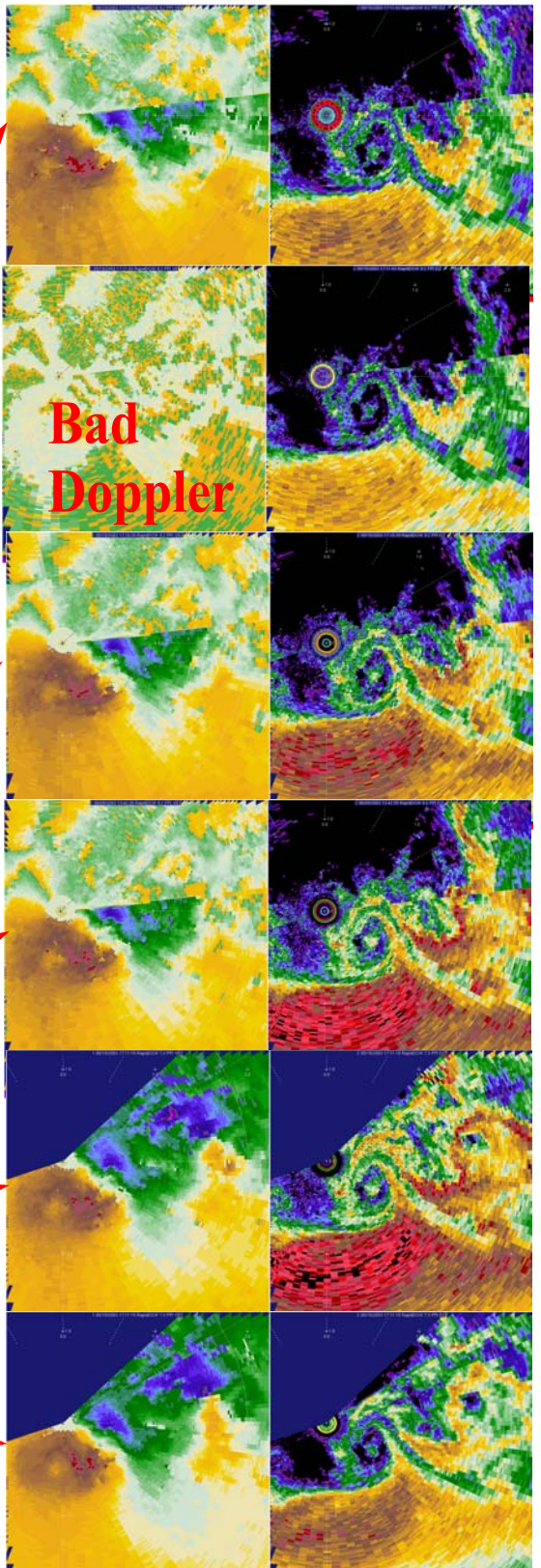
10°

9°

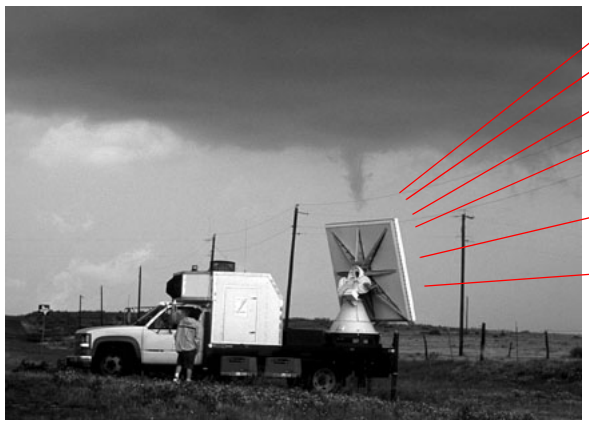
8°

7°

6°



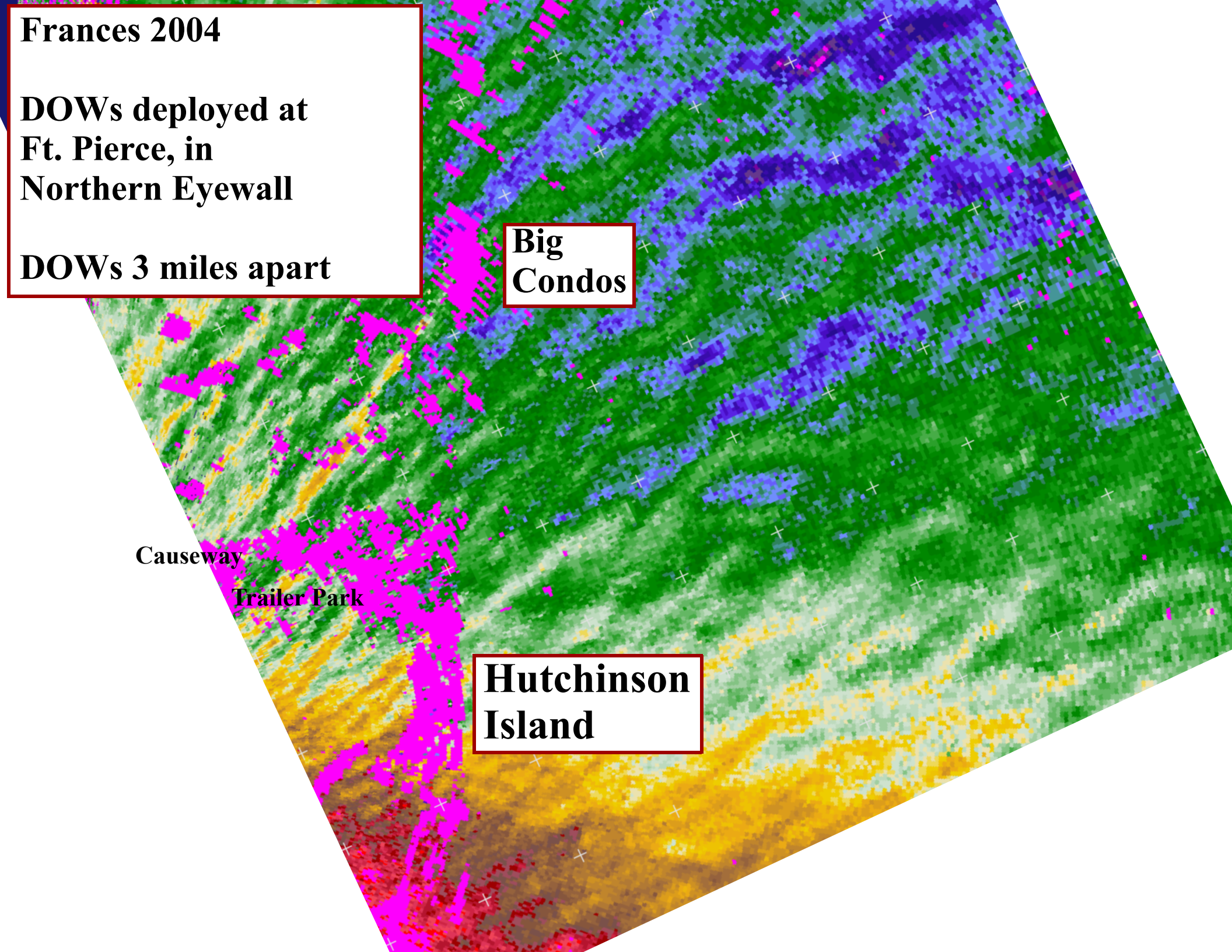
Multiple slices through and above instrumented towers

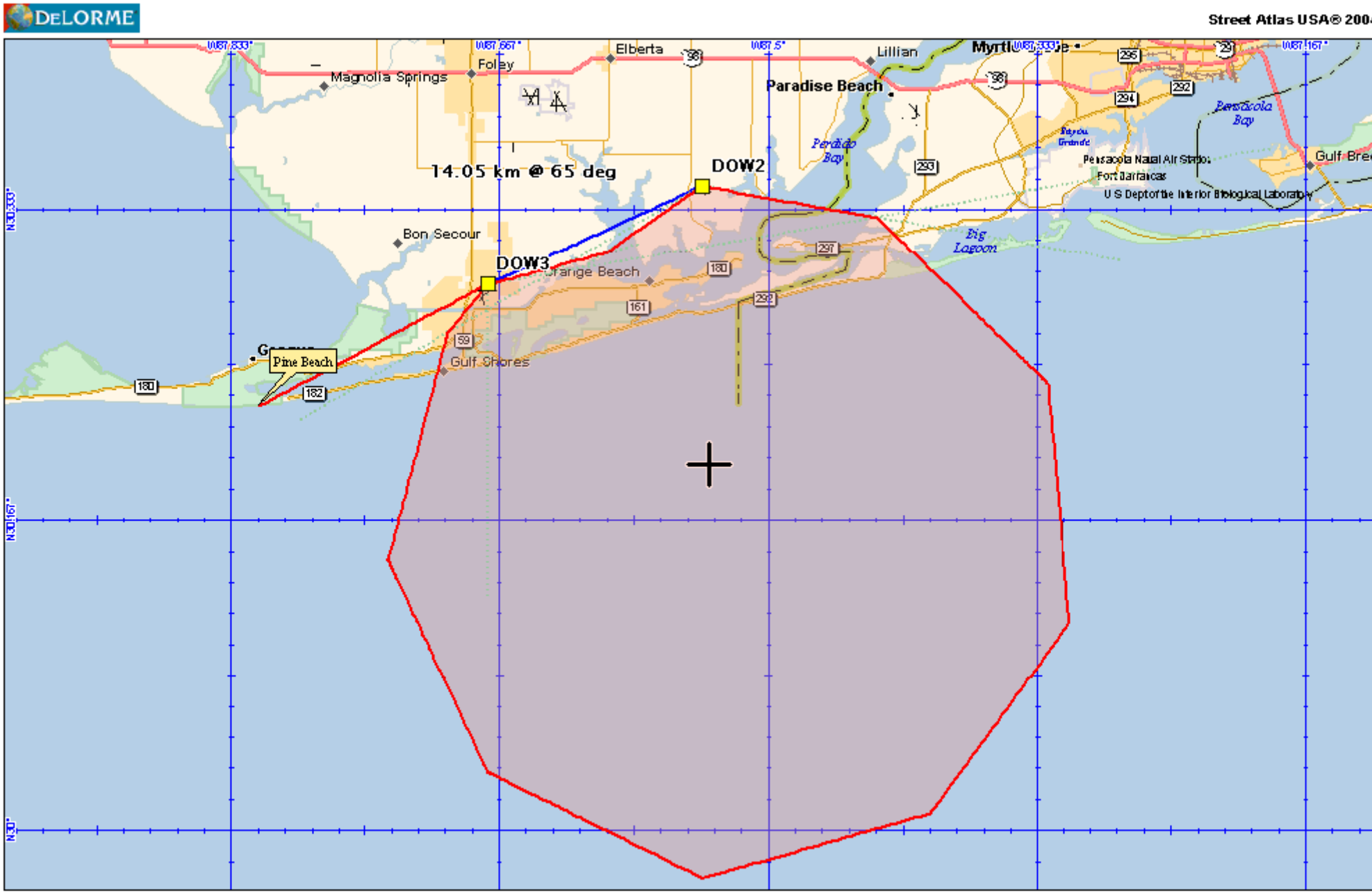


1.5° beam @ 15m

0.5° beam @ 5m

700 m


Frances 2004
DOWs deployed at Ft. Pierce, in Northern Eyewall
DOWs 3 miles apart
Big Condos
Causeway
Trailer Park
Hutchinson Island

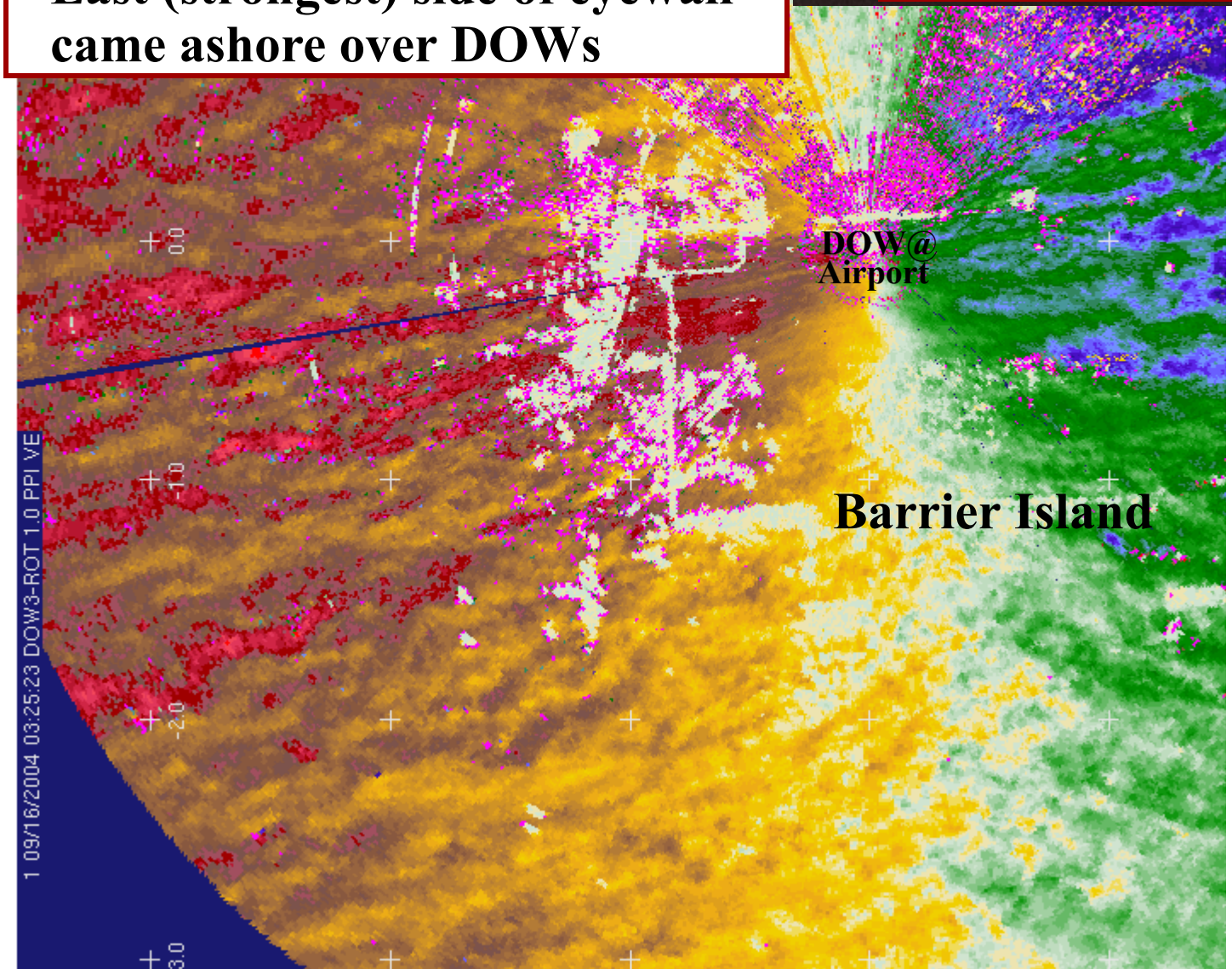

DELORME
Street Atlas USA® 200
Elberta
Foley
Magnolia Springs
Lillian
Paradise Beach
Perdido Bay
Pensacola Bay
Big Lagoon
Bayou Grande
Pensacola Naval Air Statio
Fort Barrancas
U S Dept of the Interior Biological Laboratory
Gulf Bre
14.05 km @ 65 deg
DOW2
DOW3
Bon Secour
Orange Beach
Gulf Shores
Pine Beach
W87.833'
W87.667'
W87.5'
W87.333'
W87.167'
N30.333'
N30.167'
N30'
© 2003 DeLorme
www.delorme.com
MN (1.2° W)
0 3 6 9 12 15
Data Zoom 9-3

Ivan 2004

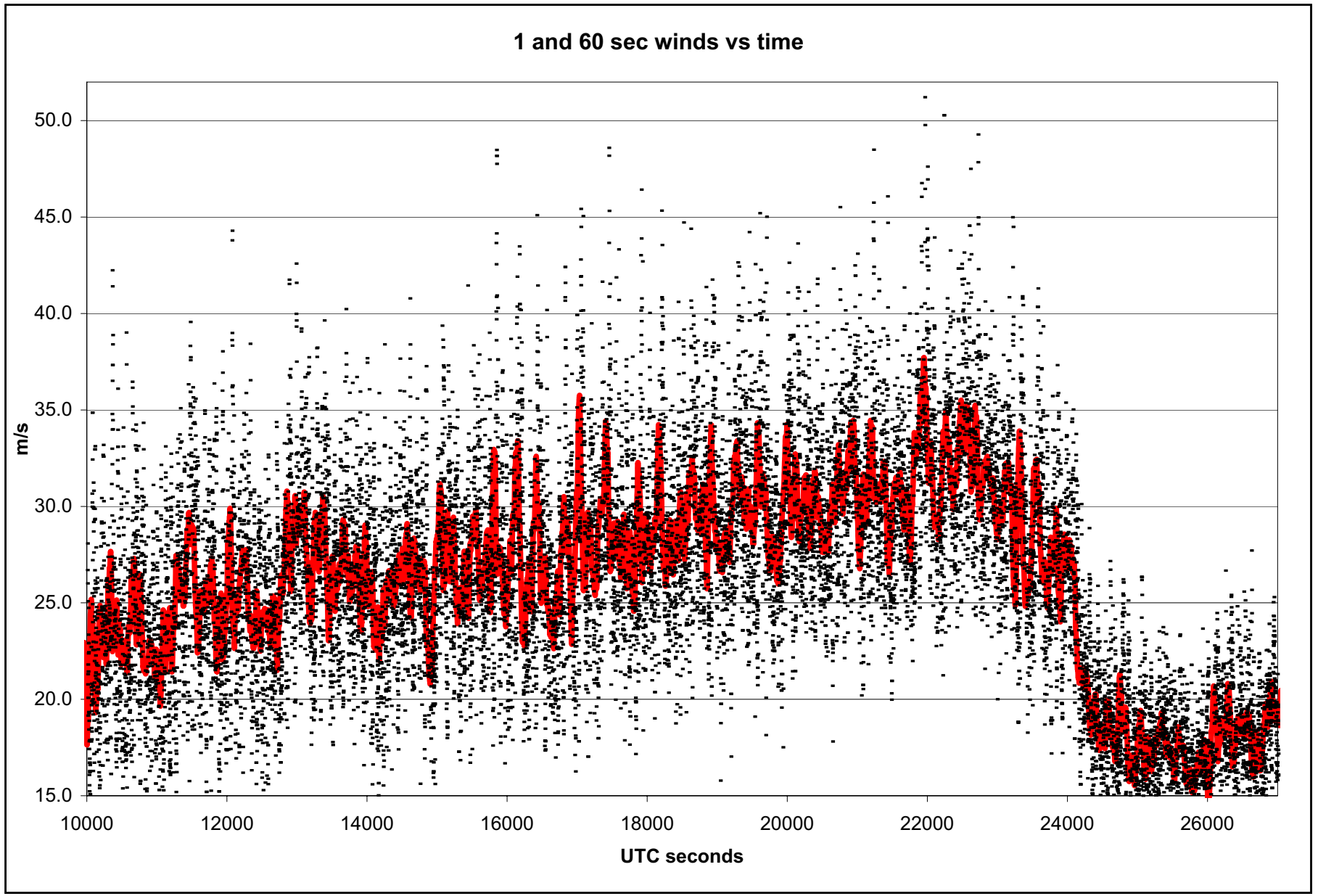
DOWs broke on way back to Boulder, so stayed in SE and deployed in Gulf Shores, AL

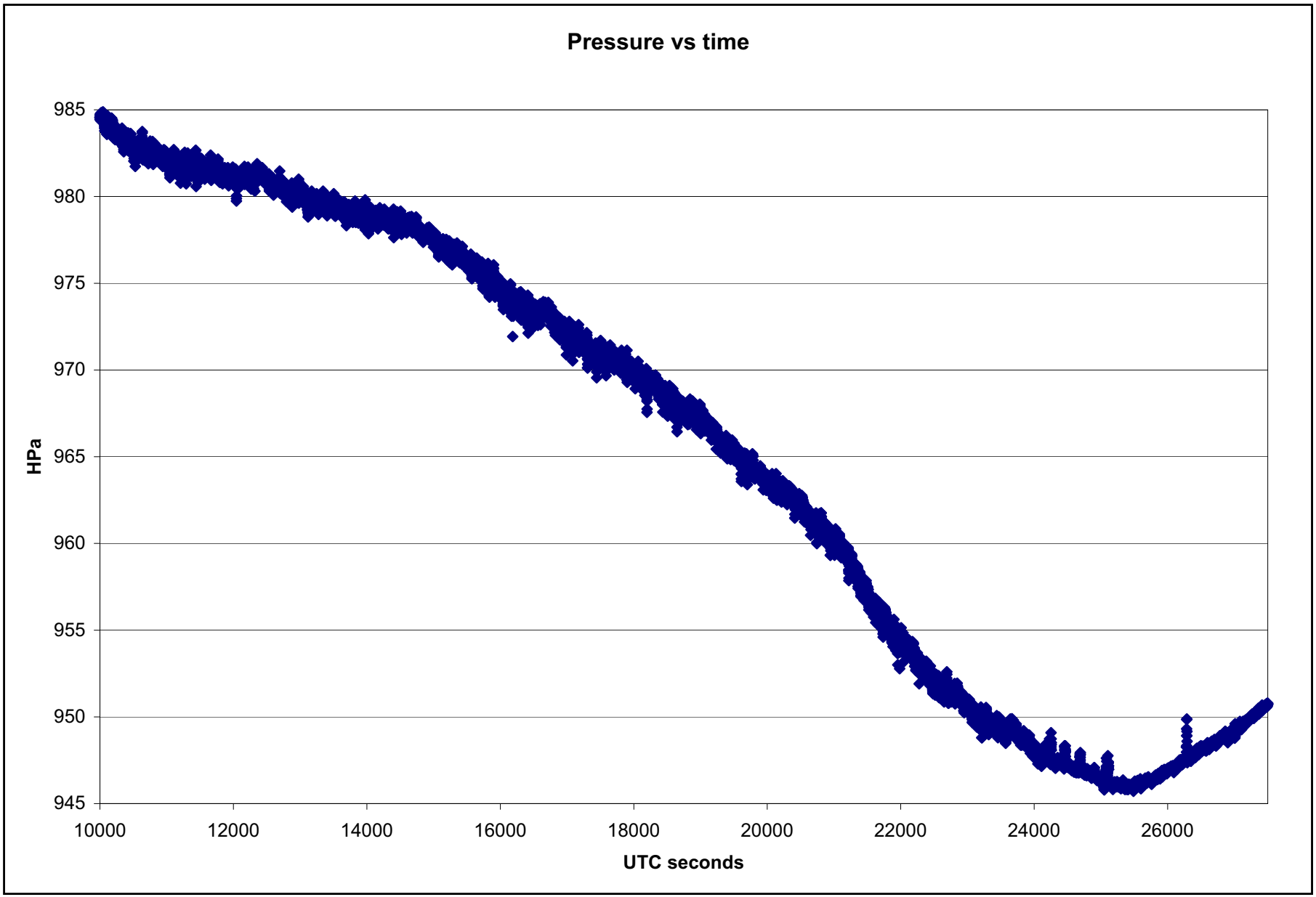
East (strongest) side of eyewall came ashore over DOWs

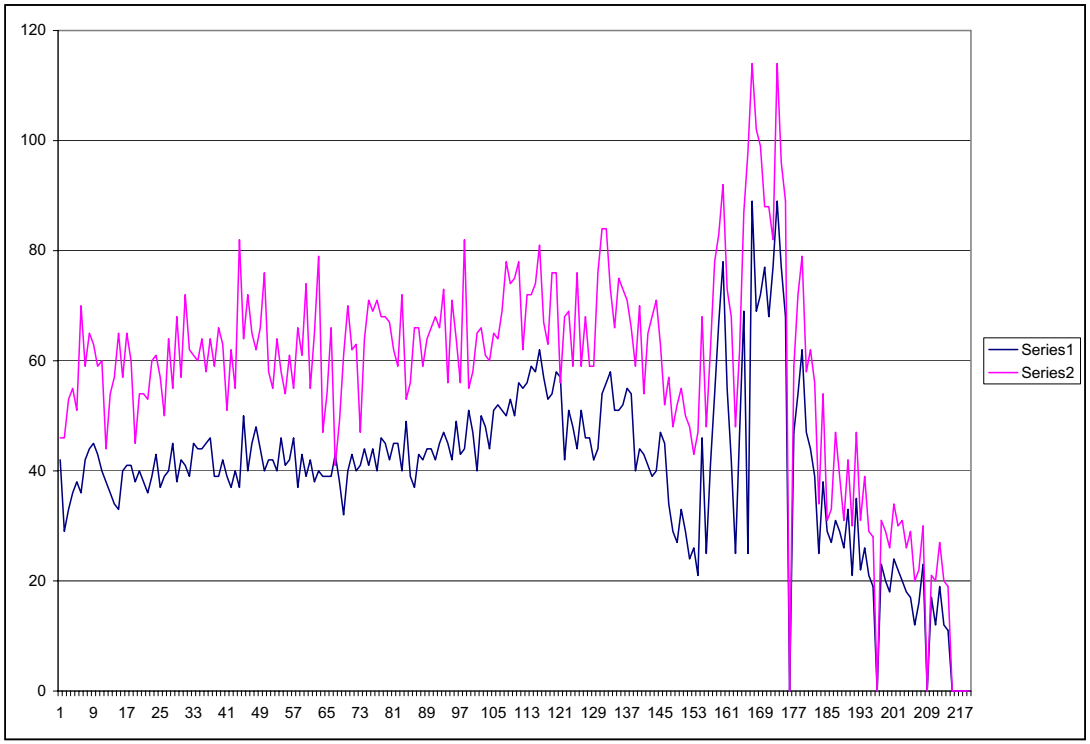
Needed 2 tow-trucks to get us out.

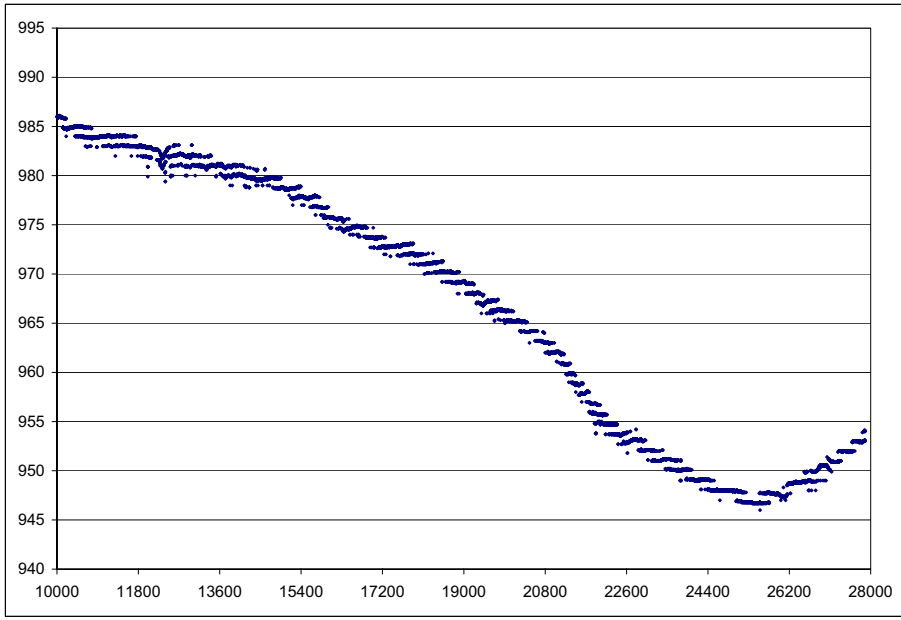


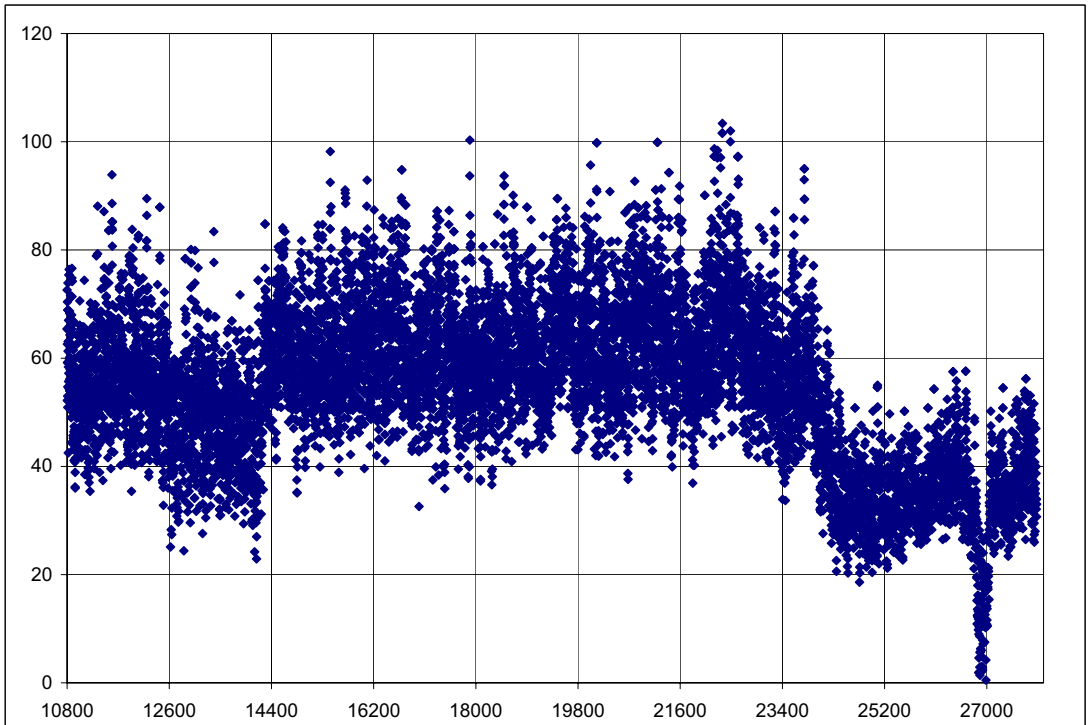

ROTATE
DOW3
DOPPLER ON WHEELS


1 and 60 sec winds vs time
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
m/s
10000
12000
14000
16000
18000
20000
22000
24000
26000
UTC seconds


Pressure vs time
985
980
975
970
965
960
955
950
945
HPa
10000
12000
14000
16000
18000
20000
22000
24000
26000
UTC seconds







Winds are Less than Advertised

Damage does not support high wind speed estimates in many hurricanes.

Windspeed measurements rarely as high as expected. Used to be blamed on sparseness of obs, but towers in Frances/Ivan barely over hurricane force sustained. Peak gusts in Ivan < 120 mph.

Charley: We've all seen these

The site of one of the dramatic videos in P.G. is virtually undamaged

Did 140 mph winds go through here?

Probably not.

Charley: An F1 event based on damage
Frances, Ivan: F0 based on damage
F1 peak wind gusts