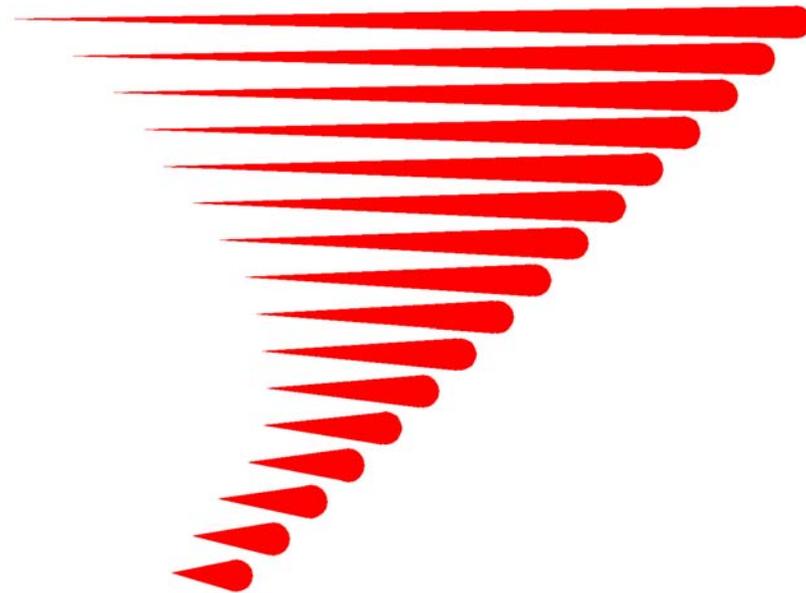


High Resolution Observations of Landfalling Hurricanes with the DOWs

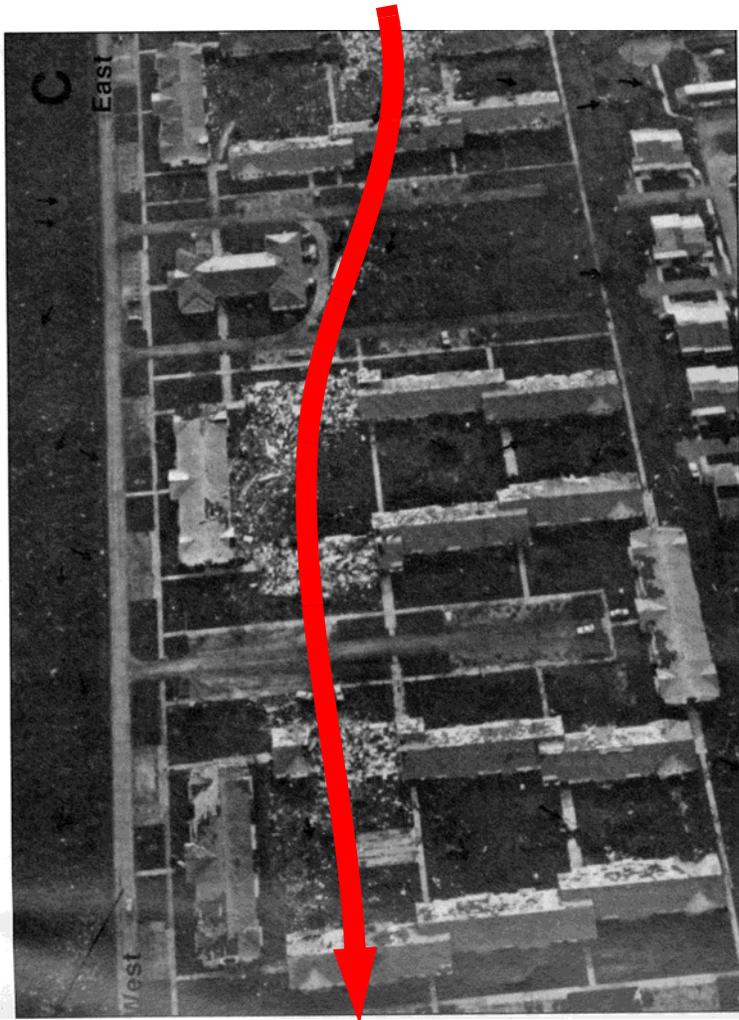
Joshua Wurman

Center for Severe Weather Research

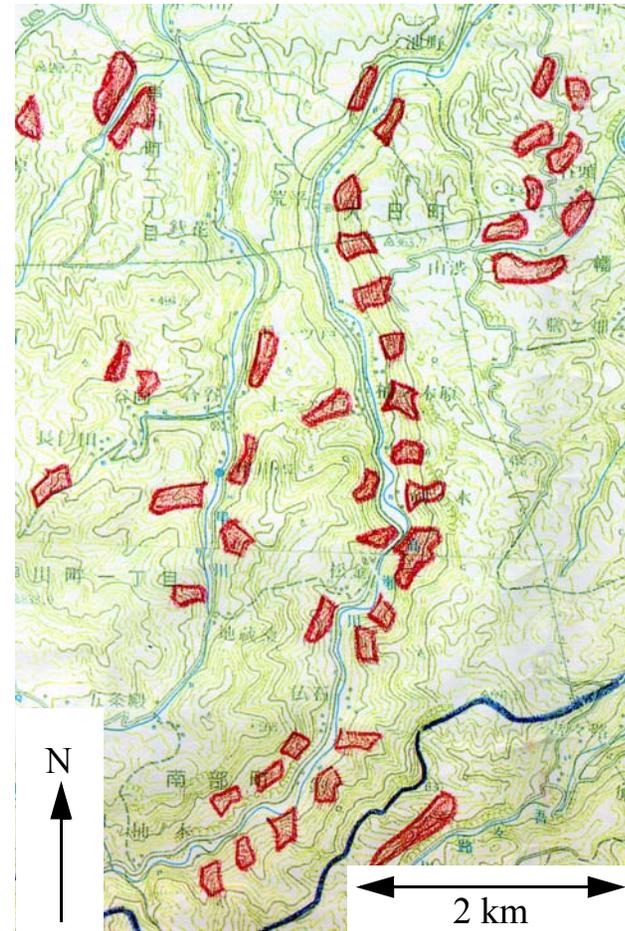


Center for Severe Weather Research

What Causes Modulation of Damage?



Andrew?



Kyushu

Small-Scale Vortices, Downbursts,
other structures

Evolution of Boundary Layer

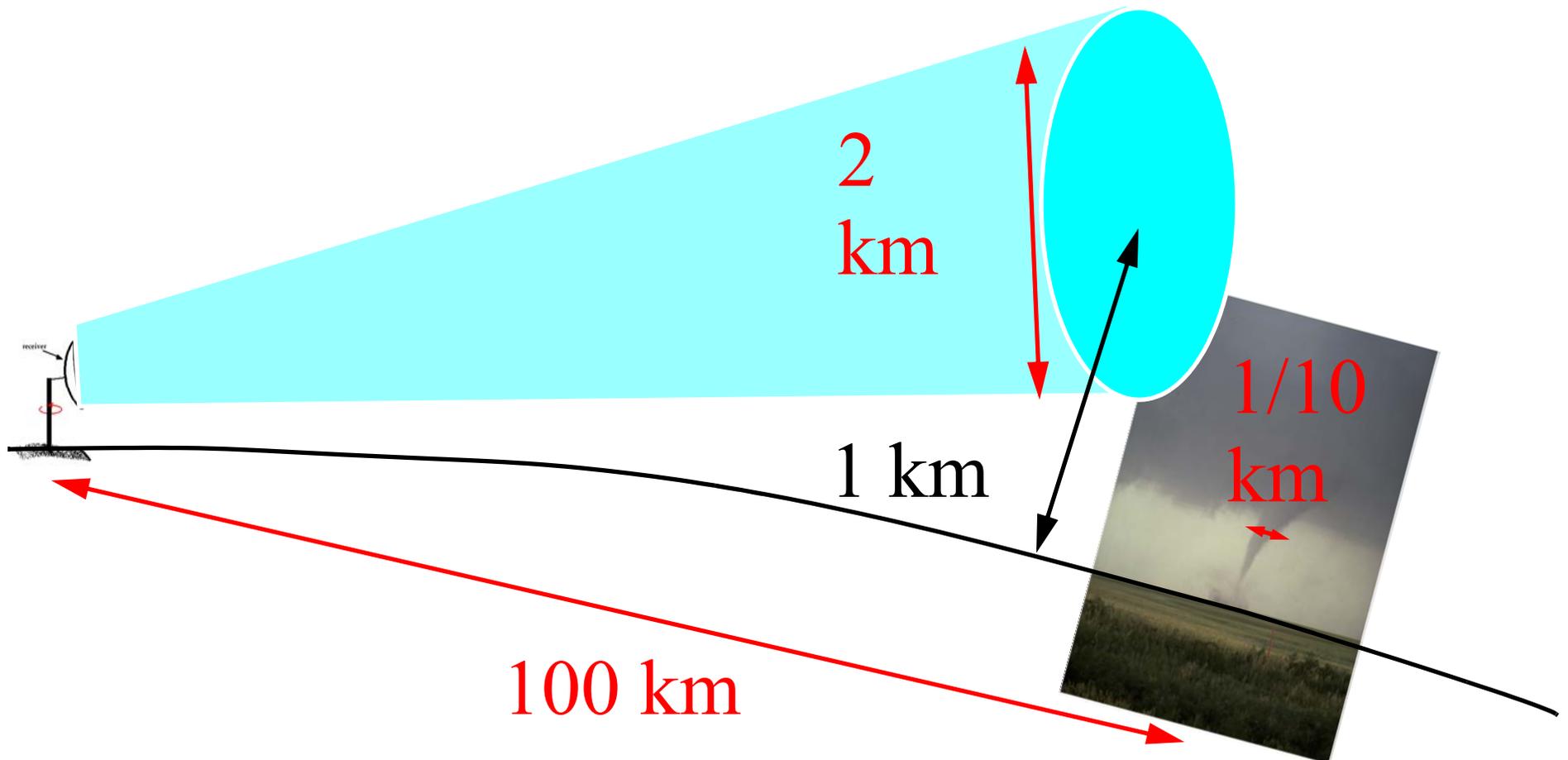
Small-Scale Eyewall and Band
Dynamics

The Bad news...

Normal Radars Can't See Tornadoes

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

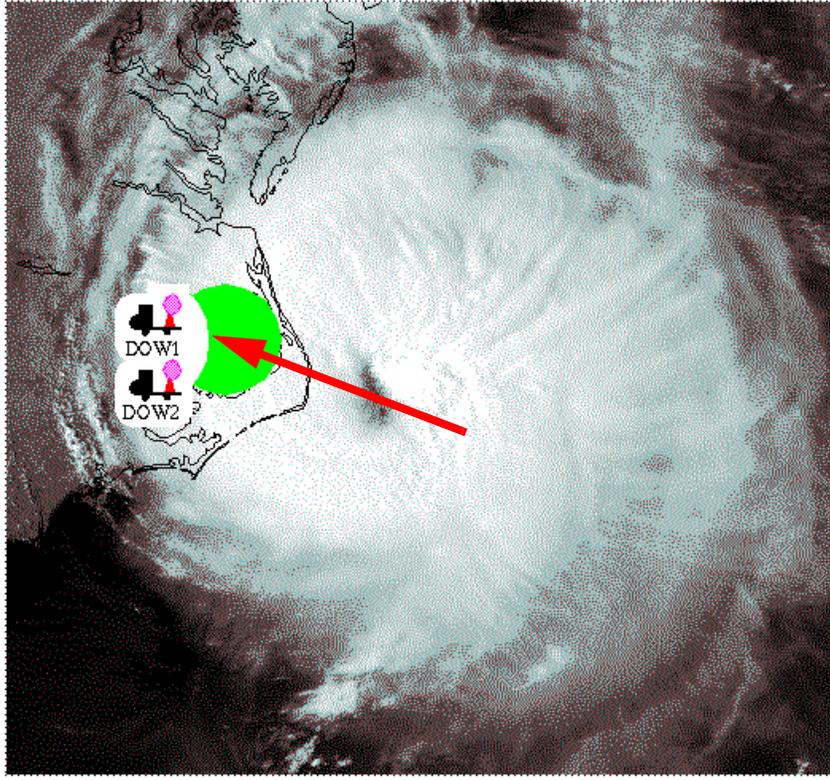
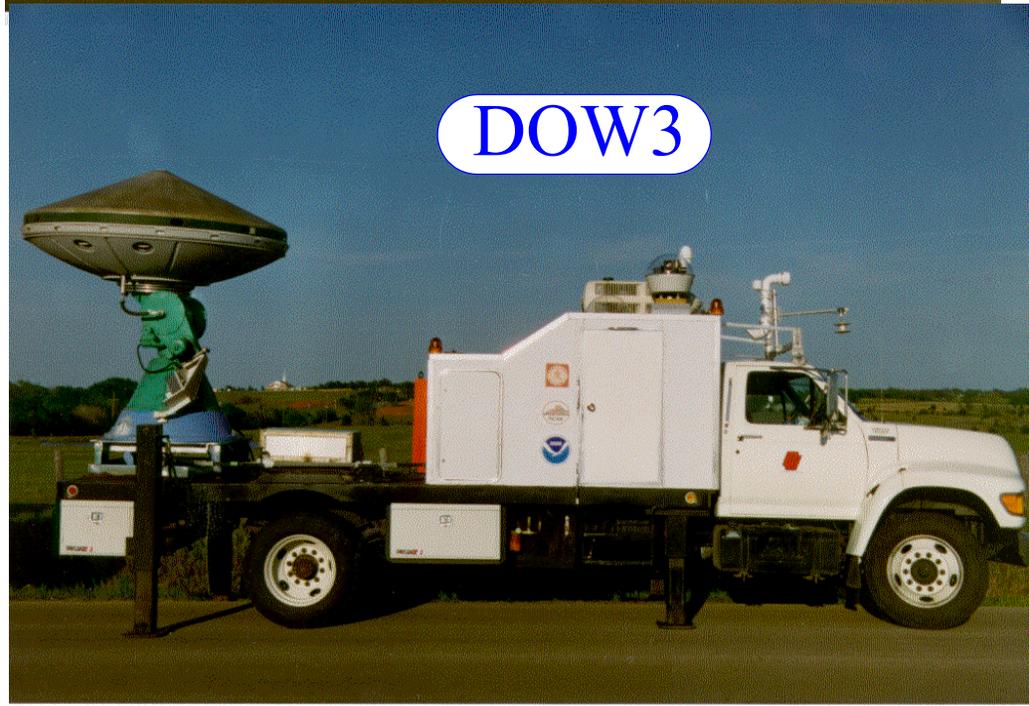


Solution: Go To Storm

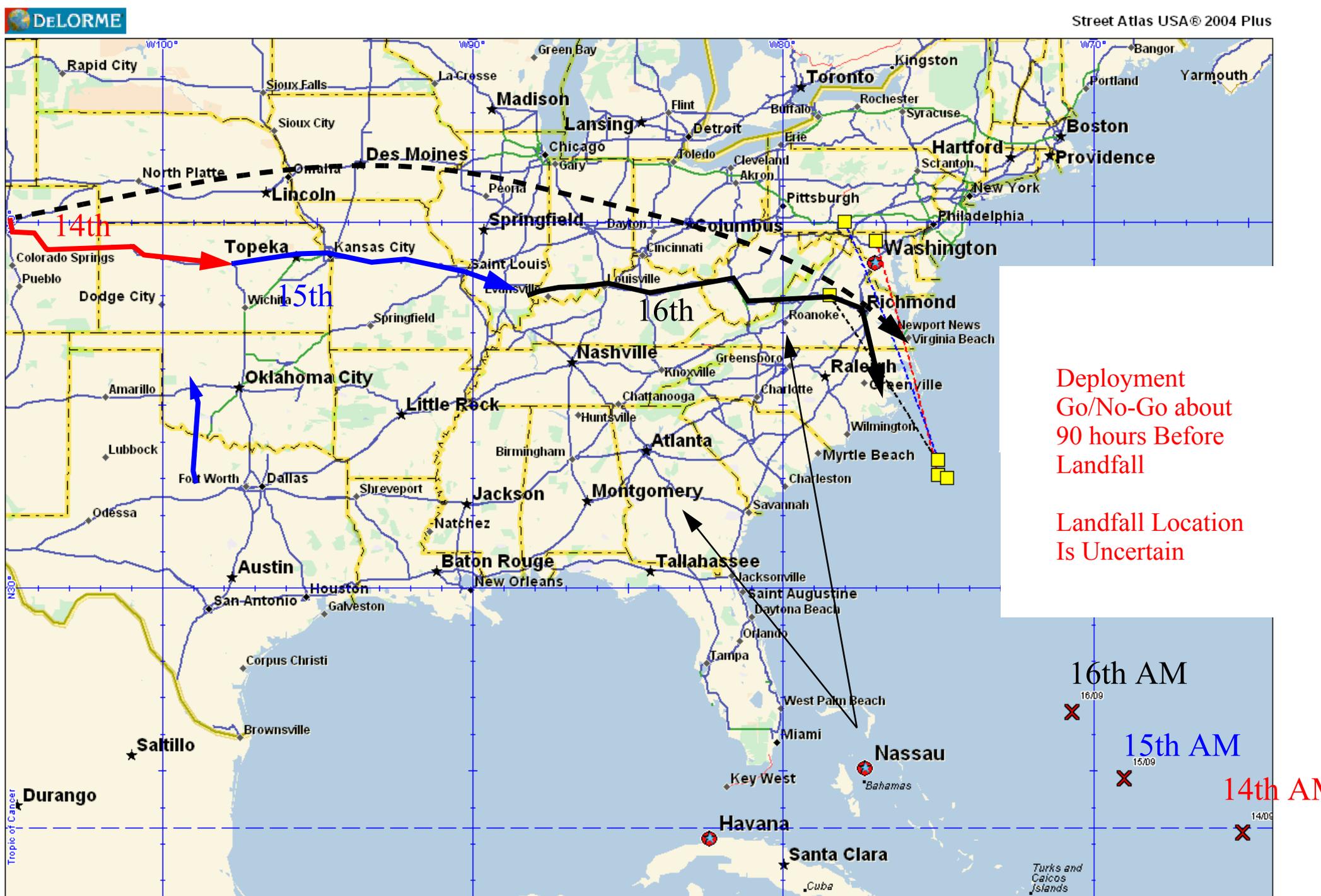
Basic Mission:



Get two or more DOWs near point of landfall

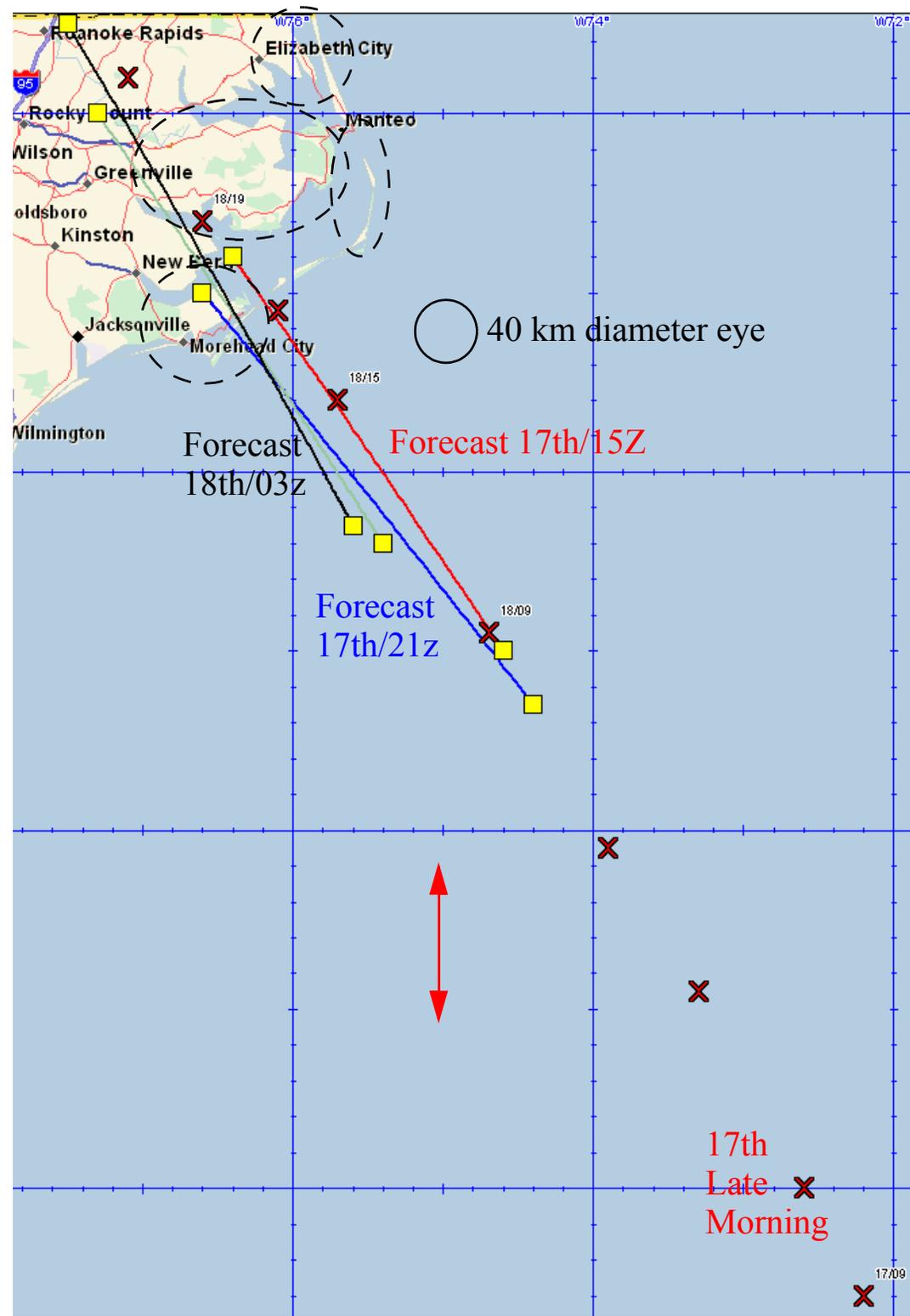


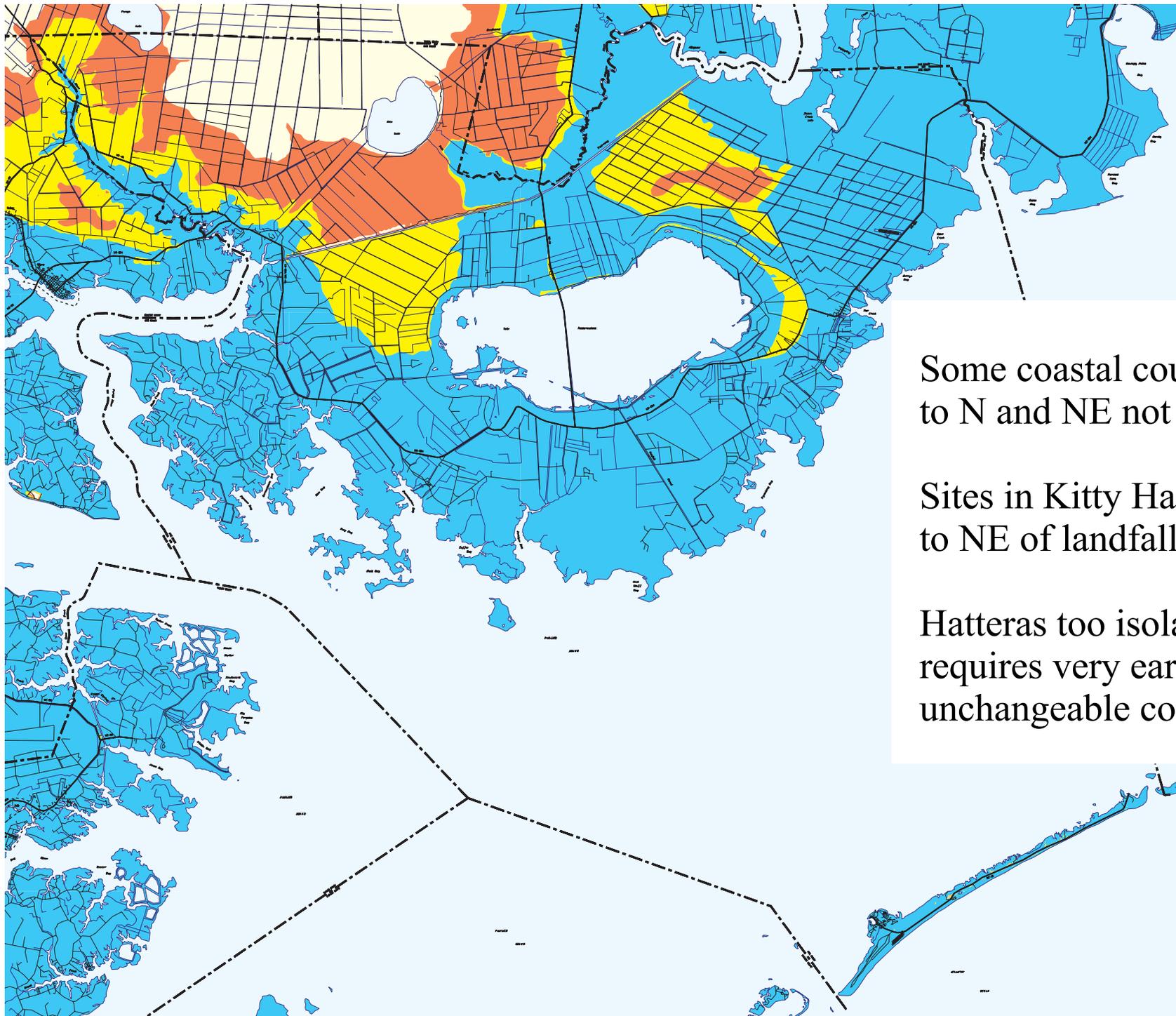
Challenging Logistics: Up to 2000 mile deployments



Biggest Challenge is
Choosing Exact Final Deployment
Based on 24 hour forecast.

With “fractal” NC coastline,
once regional decision is made,
(i.e which peninsula)
DOWs are committed



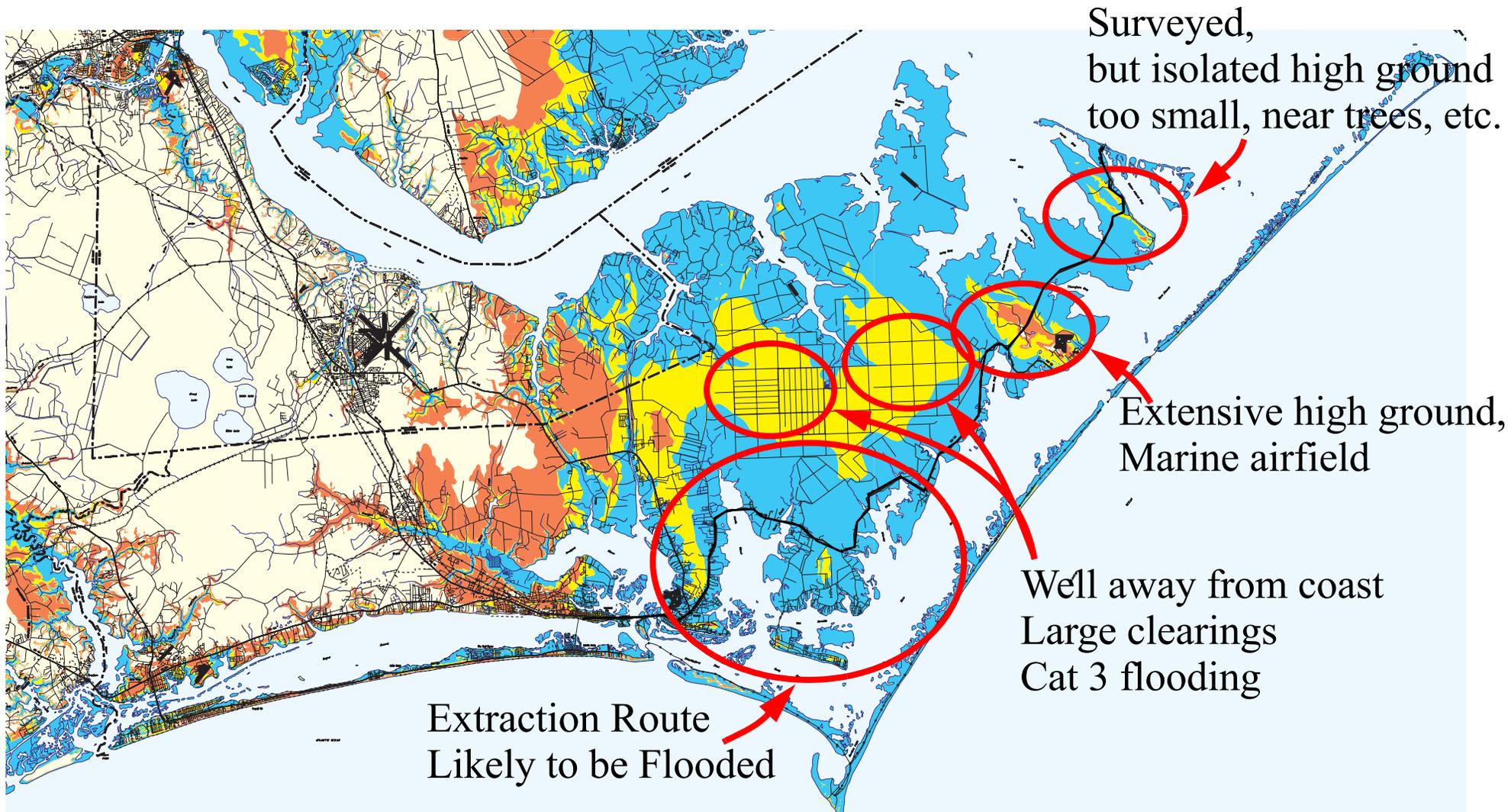


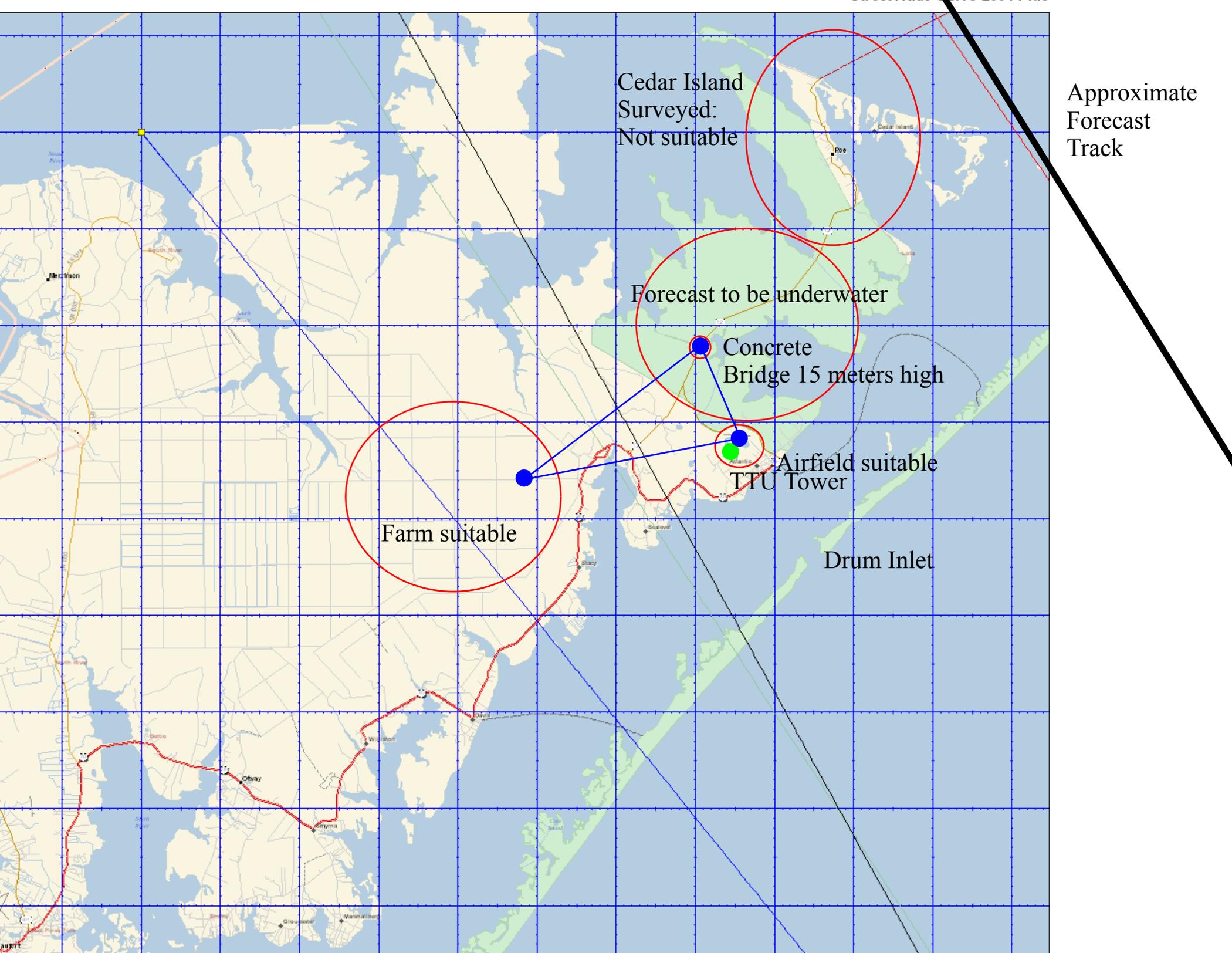
Some coastal counties
to N and NE not suitable.

Sites in Kitty Hawk well
to NE of landfall.

Hatteras too isolated and
requires very early and
unchangeable committment.

Worst case surge maps tell us that, even in swampy, coastal NC, there are havens of high ground, even for intense hurricanes. (Isabel was not, nor likely to be, intense, at landfall.)





Cedar Island
Surveyed:
Not suitable

Approximate
Forecast
Track

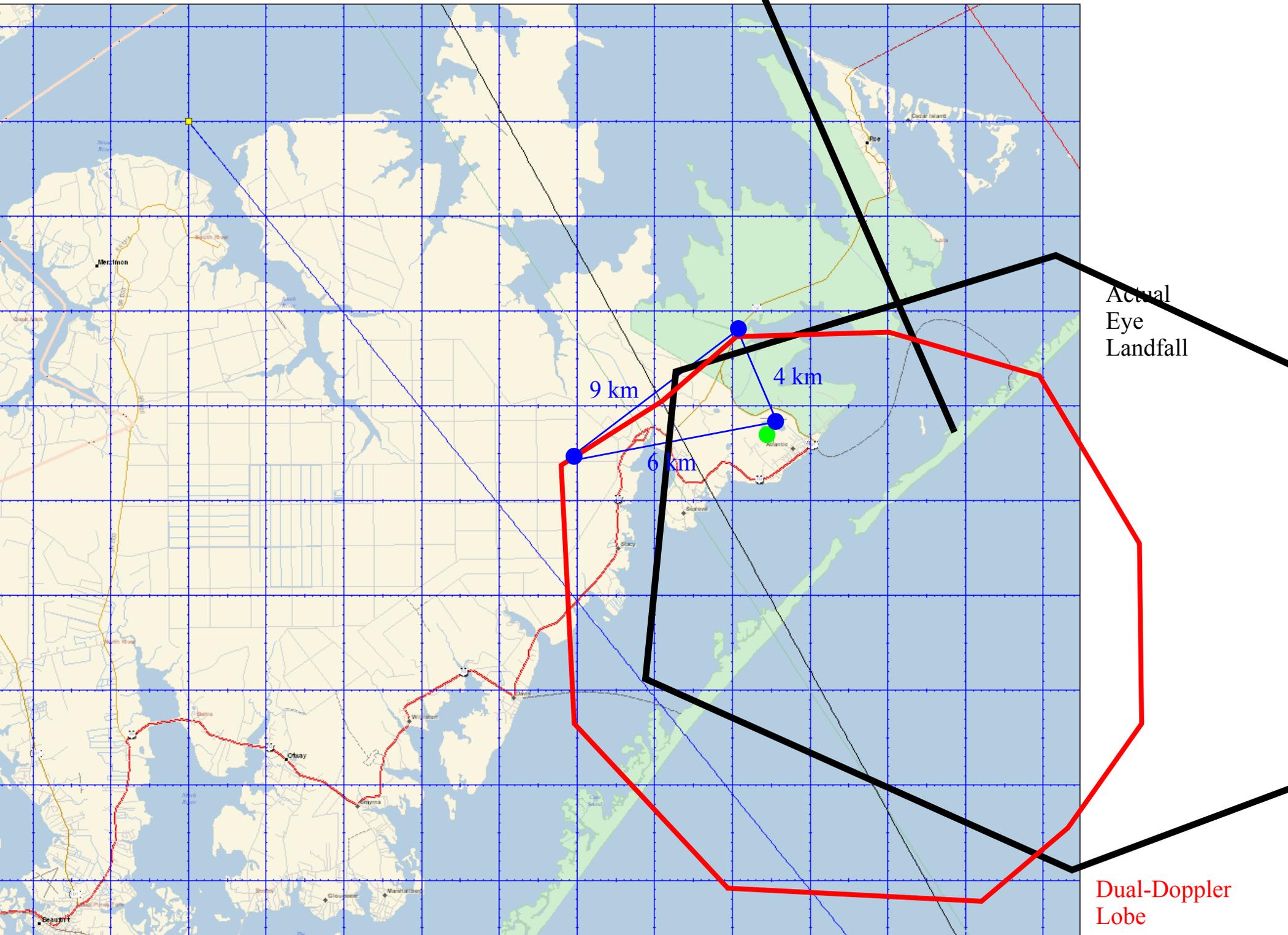
Forecast to be underwater

Concrete
Bridge 15 meters high

Airfield suitable
TTU Tower

Farm suitable

Drum Inlet



Actual
Eye
Landfall

Dual-Doppler
Lobe

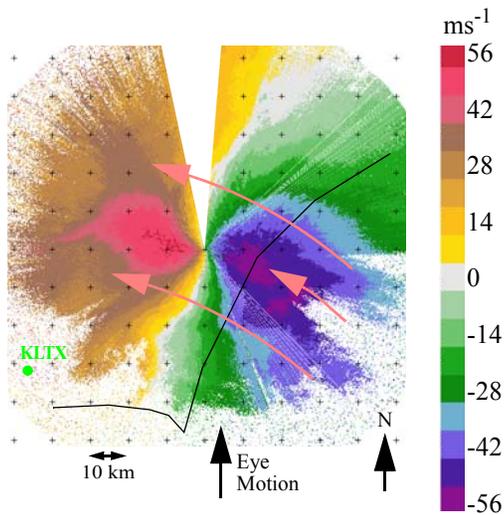
9 km

6 km

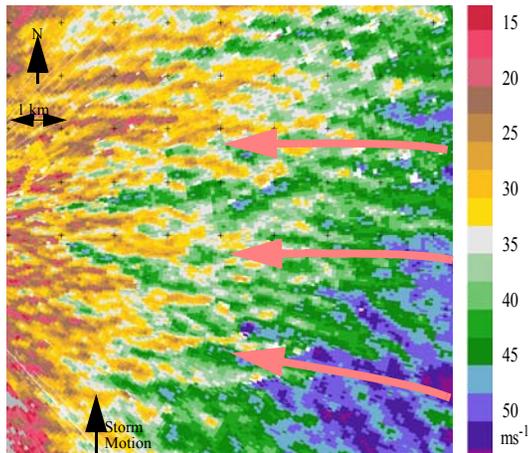
4 km

Hurricane Fran 1996

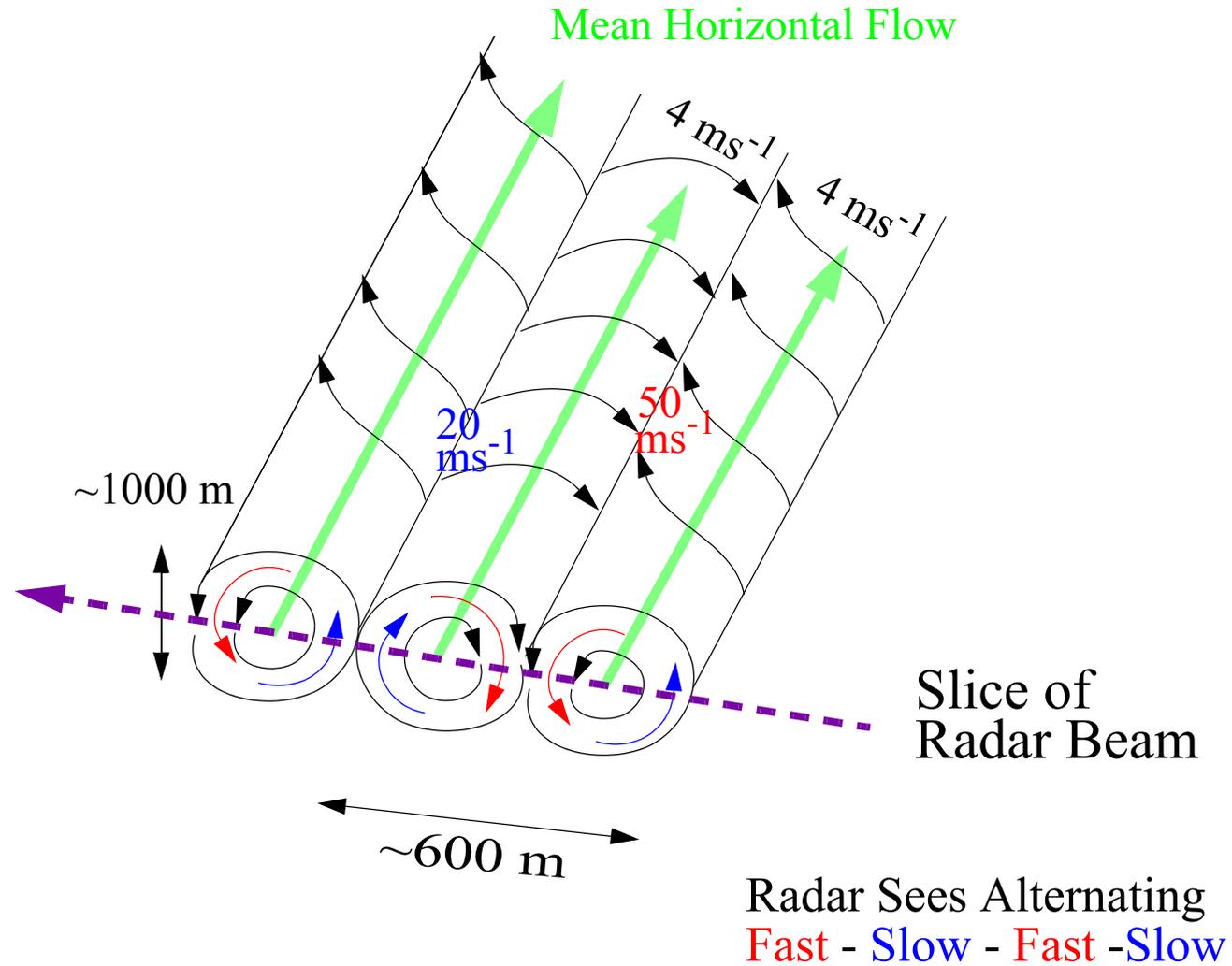
Basic windflow is onshore at 50-60 m/s

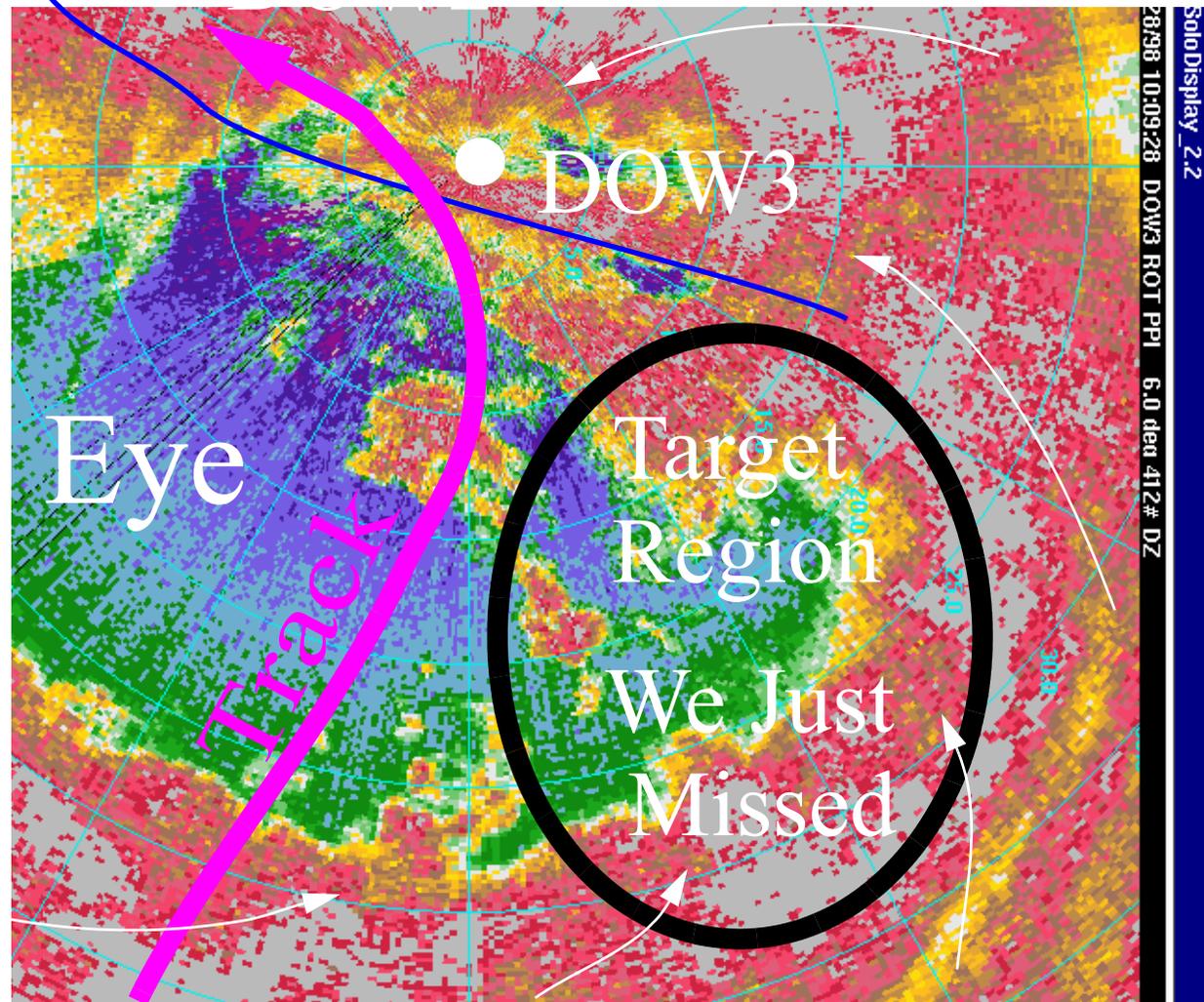


But, small-scale streaks alternate with 60 m/s in peaks and 30 m/s in troughs

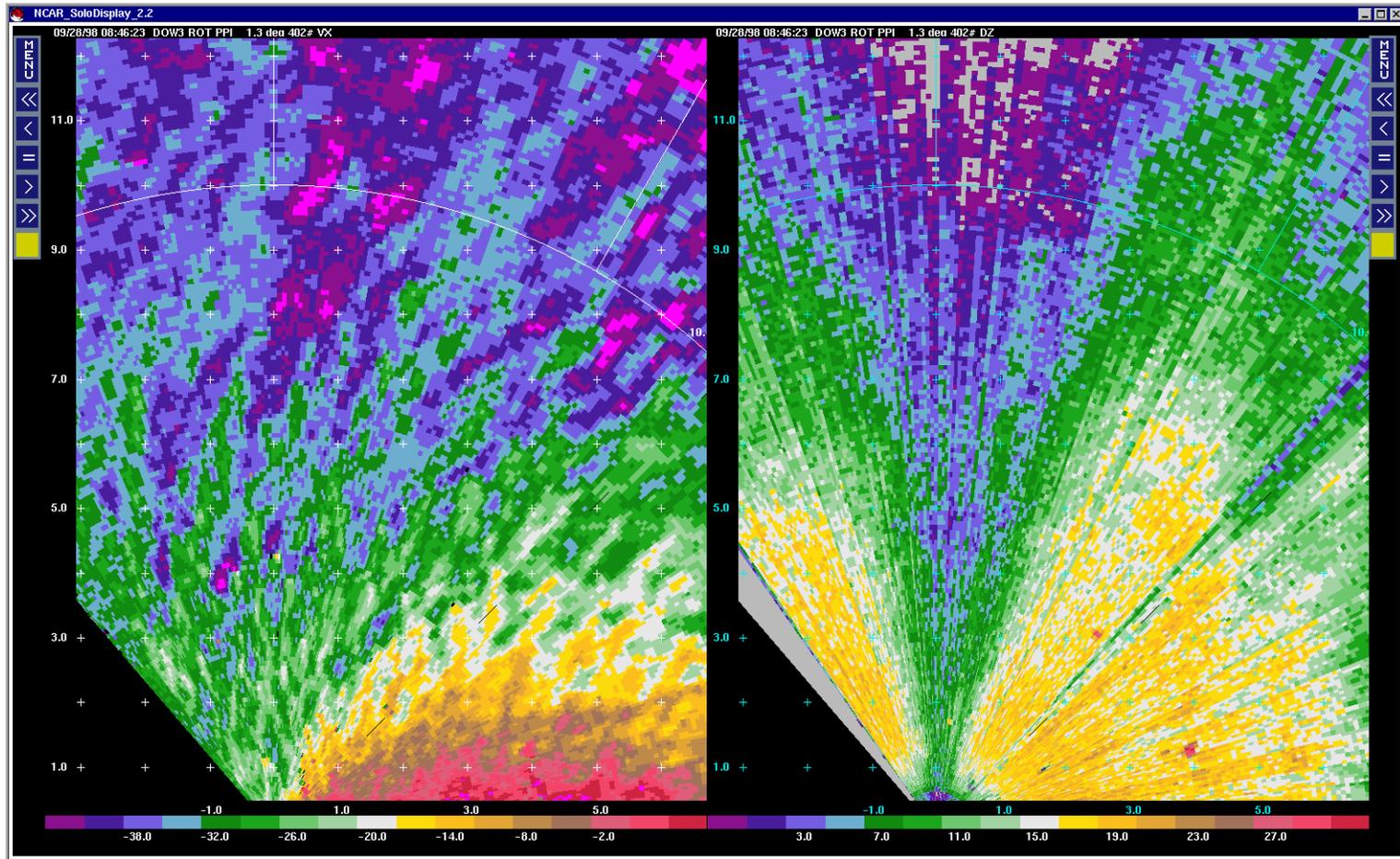


Horizontal
Rolls bring high
velocity air from
aloft



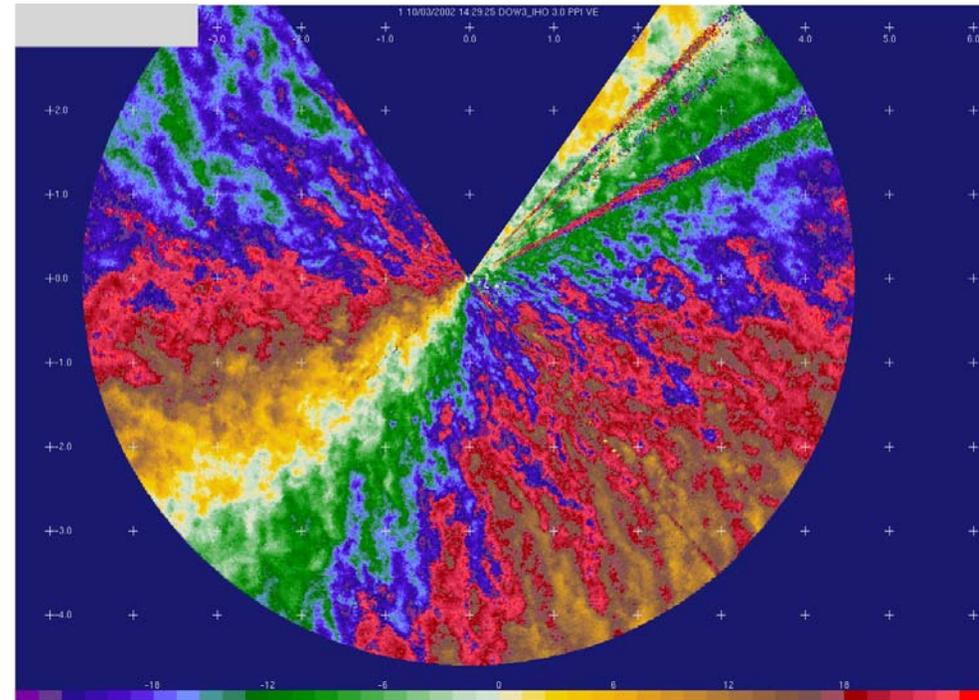
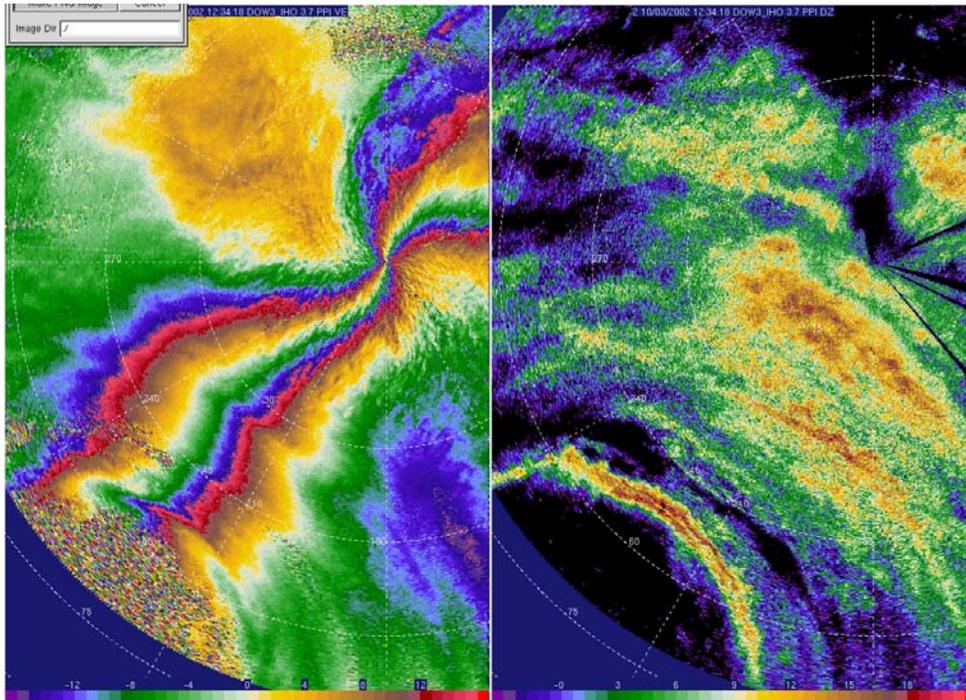


DOW2 and DOW3 in eye of Georges
Newly Revealed Fine-Resolution Detail

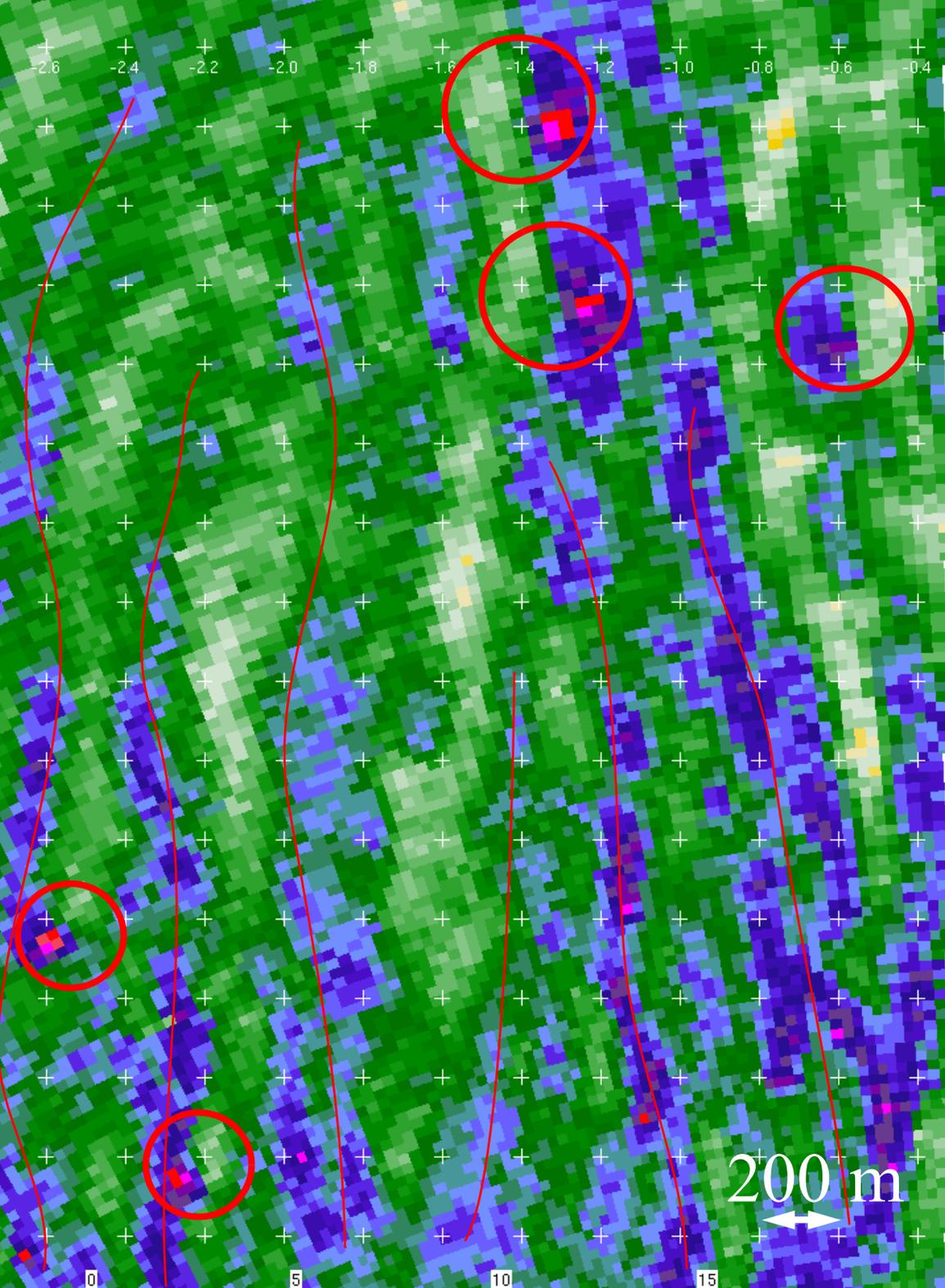


Wind Streaks have been present
in all 4 hurricanes the DOWs
have intercepted

Hurricane Lili (Louisiana 2002)



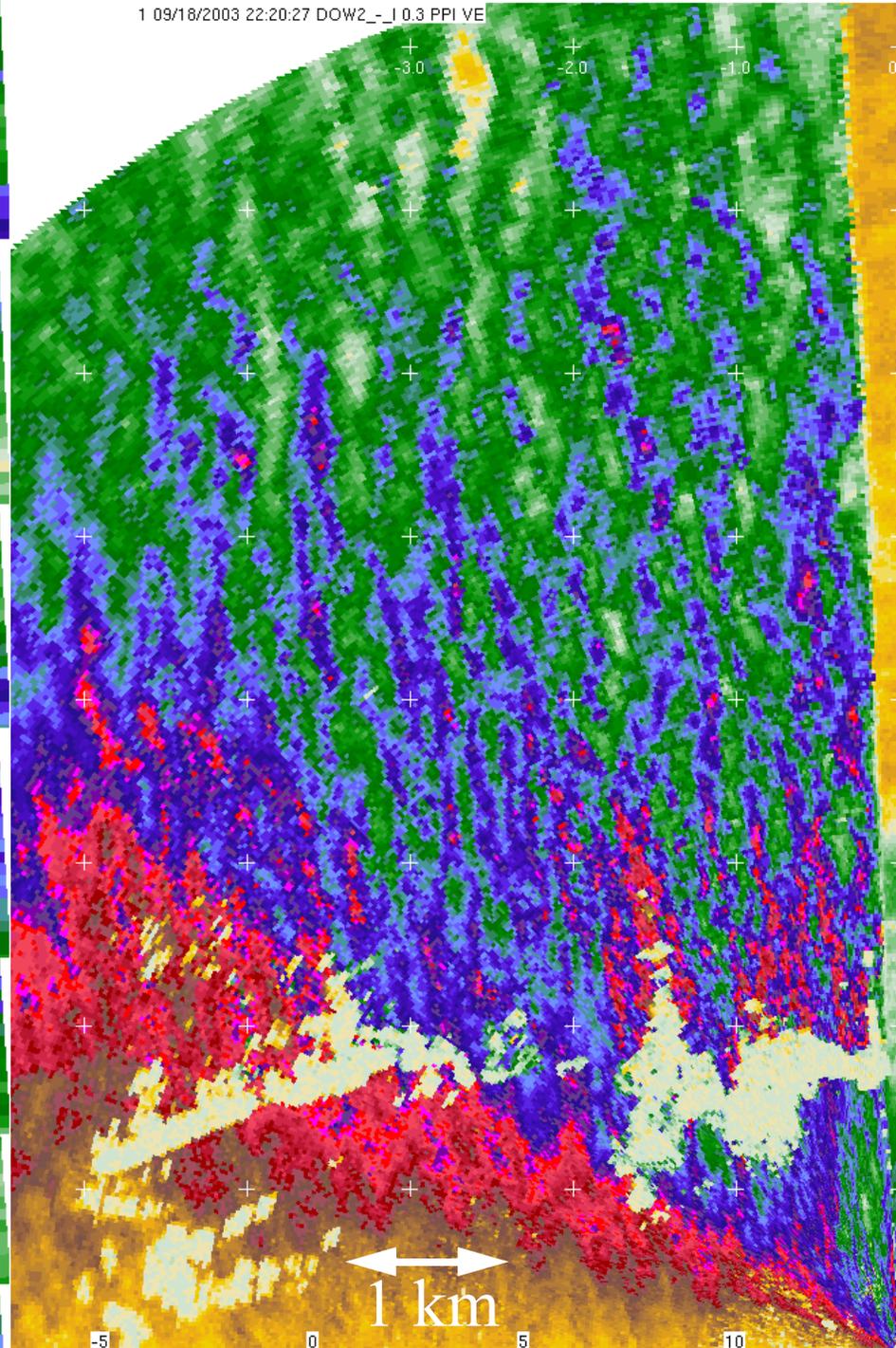
01 22:25:41 DOW2 - 1 0.3 PPI VE



Isabel from DOW3

Cedar Is Bridge NE of Atlantic

1 09/18/2003 22:20:27 DOW2_-1 0.3 PPI VE



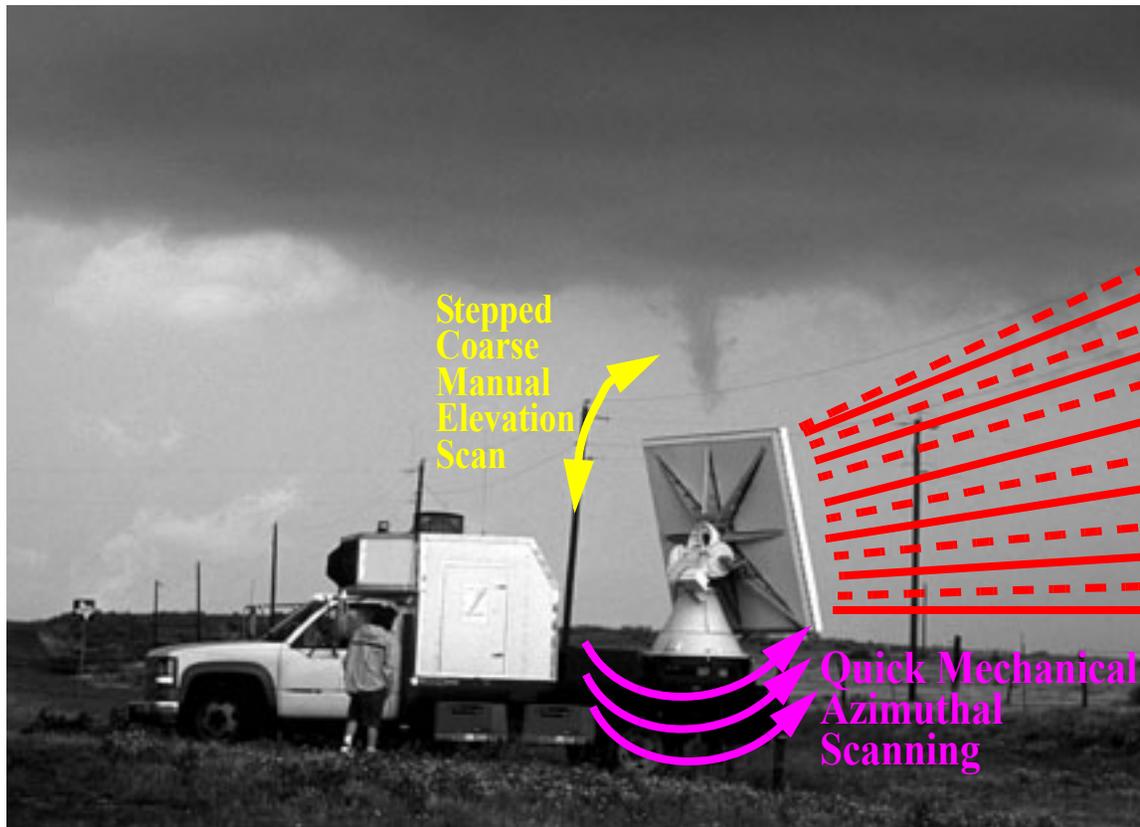
New Observations focusing on
smaller **spatial** and **temporal** scales

~100 meter dual-Doppler

12.5 meter single-Doppler

New Rapid-Scan Multi-Beam Radar
Permits ~10 sec + 3D updates of
gust structures, turbulence, etc.

Multiple-Simultaneous-Beams Tx and Rx



Current
Low Dispersion
Feed

High Dispersion
Feed

9800 MHz	5.5°	11°
9750 MHz	5.0°	10°
9750 MHz	4.5°	9°
9700 MHz	4.0°	8°
9650 MHz	3.5°	7°
9600 MHz	3.0°	6°
9550 MHz	2.5°	5°
9500 MHz	2.0°	4°
9450 MHz	1.5°	3°
9400 MHz	1.0°	2°
9350 MHz	0.5°	1°
9300 MHz	0.0°	0°

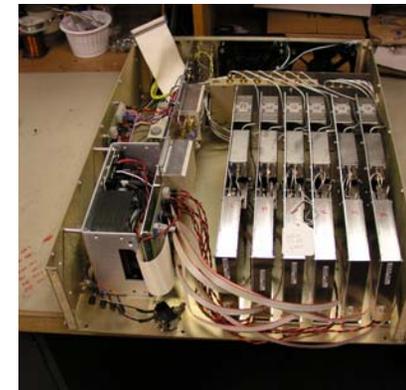
Multi-Channel
Receiver

Each Chan
Processed
Separately
by PIRAQ3

6 beams 2003 --- 12 beams 2004

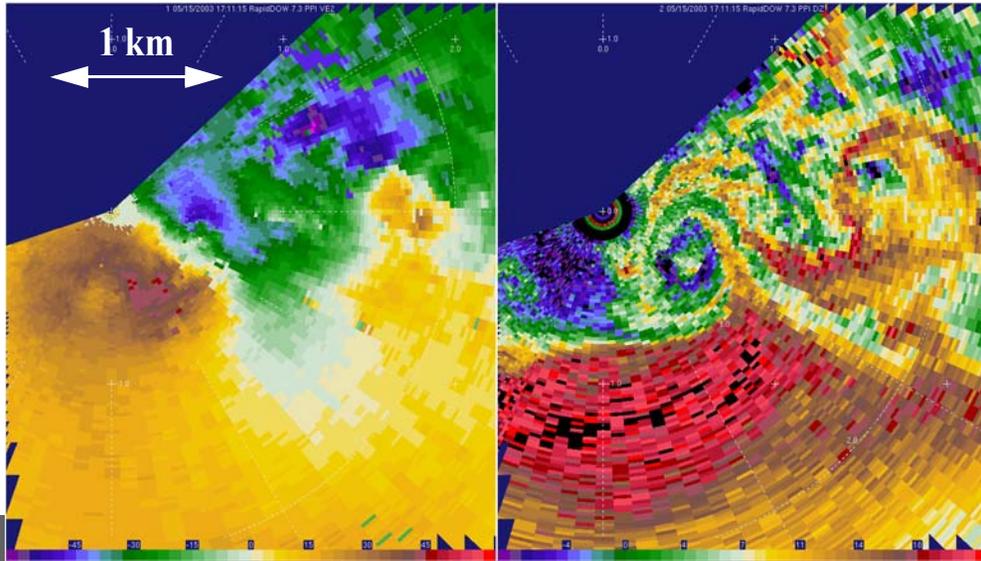
Design is very modular, so adding beams is simple

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



Tornado passes < 700 m from Rapid-DOW

Multiple Simultaneous Slices



11°

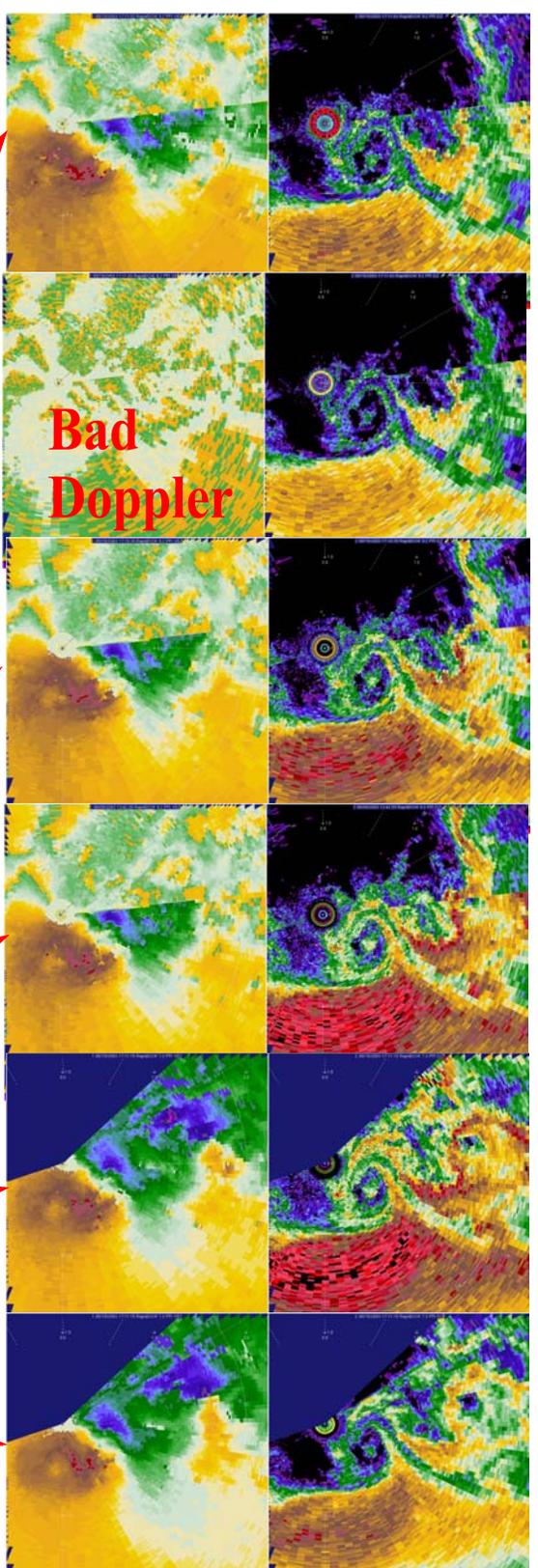
10°

9°

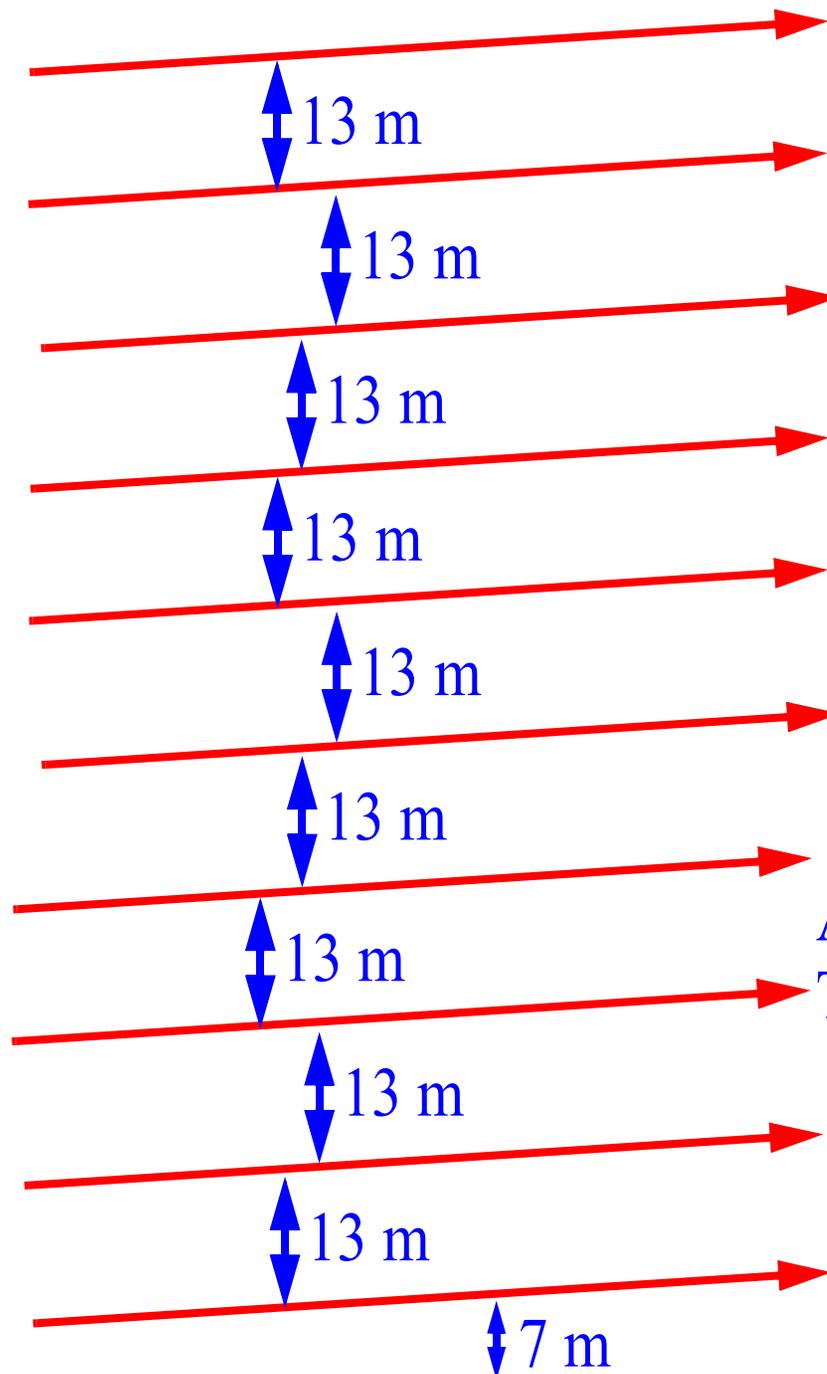
8°

7°

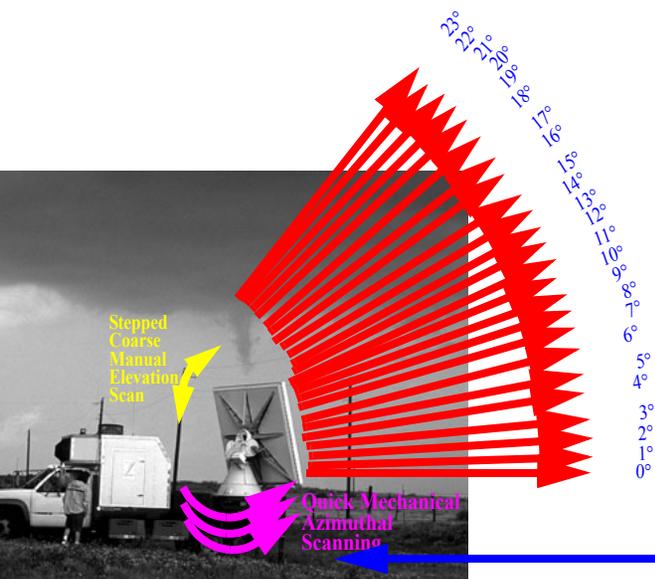
6°



Ultrafine (13m) observations
in 3D, every 15-20 seconds
of windgust structures.



At, around, and over
TTU in situ tower.



800 meters