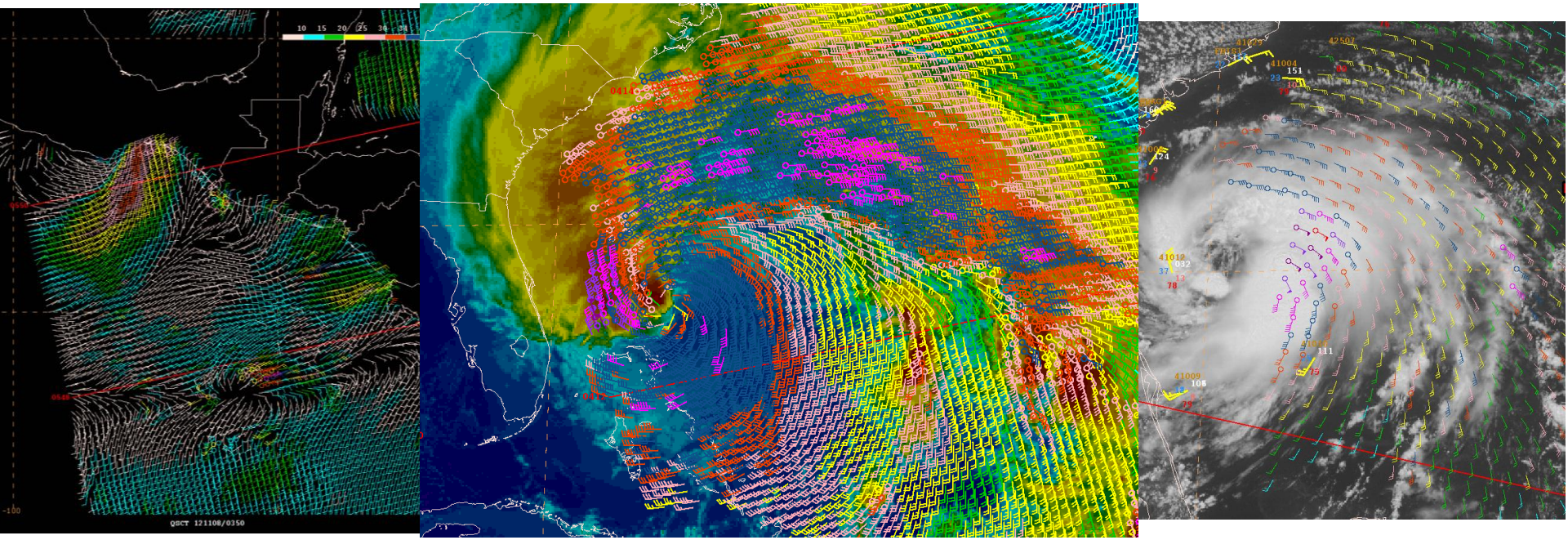
National Hurricane Center Ocean Vector Wind Update



Michael J. Brennan

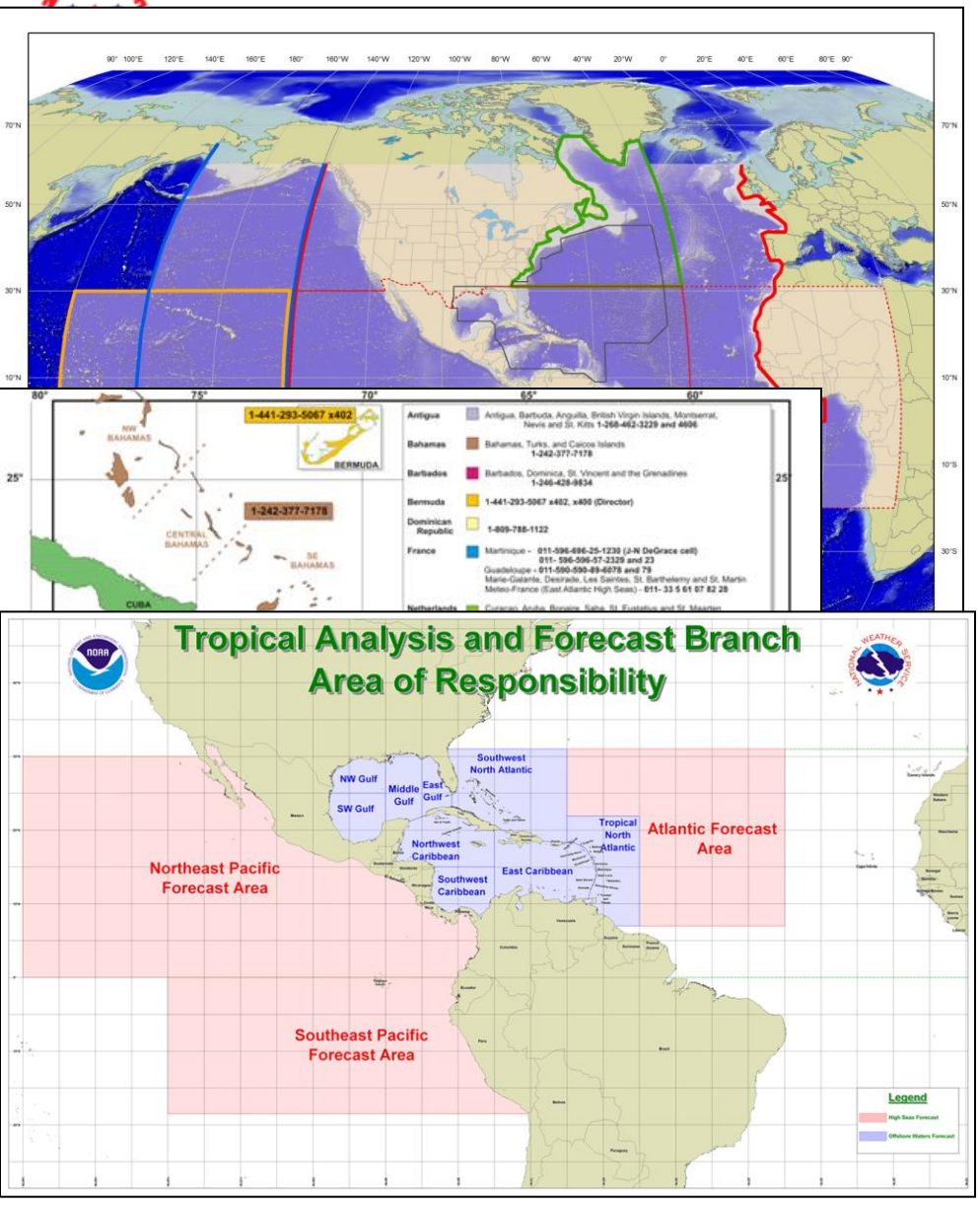
NOAA/NWS/NCEP National Hurricane Center, Miami, Florida

International Ocean Vector Wind Science Team Meeting

Kona, Hawaii

8 May 2013

NHC Overview

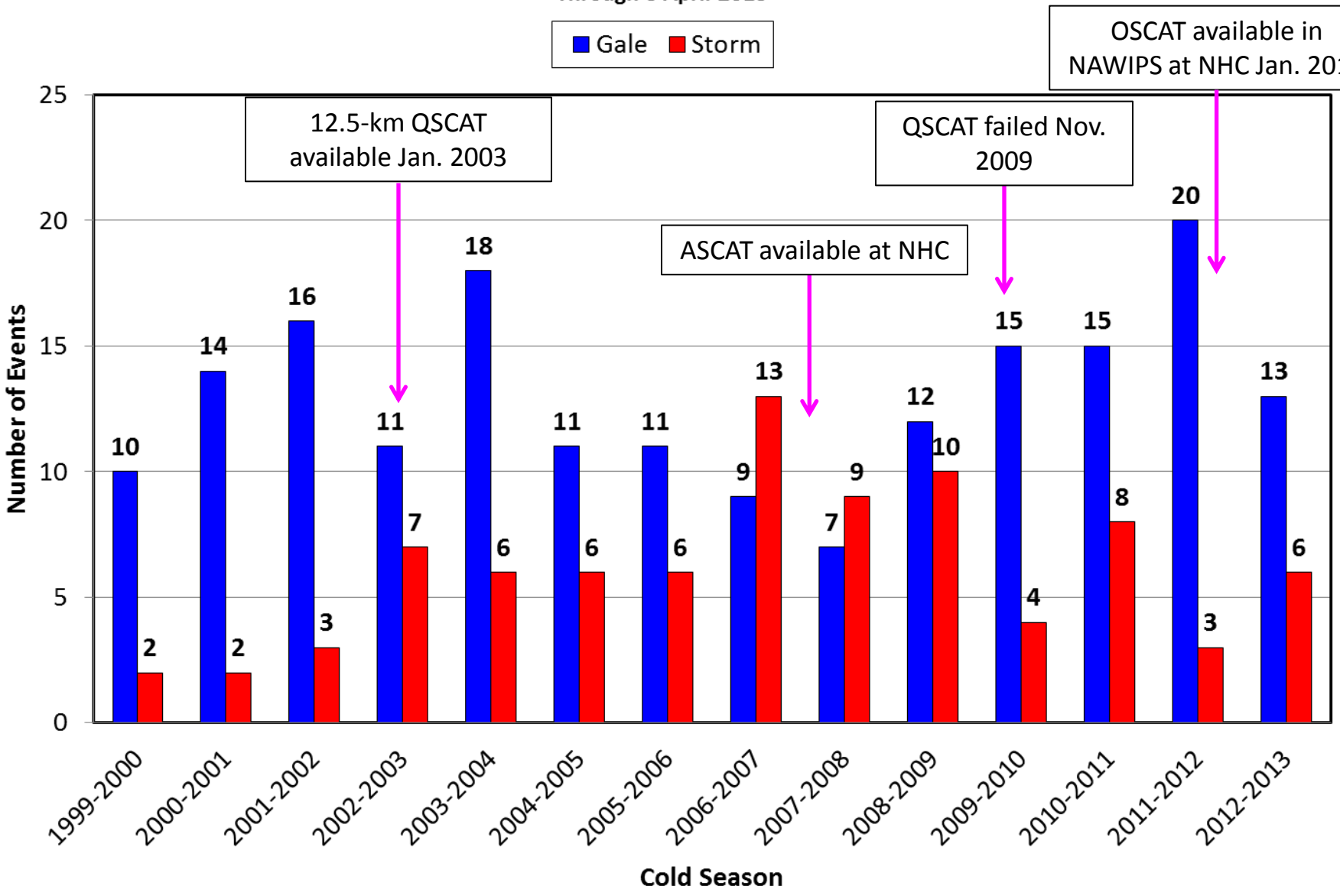


- TC forecast responsibility for Atlantic and Eastern North Pacific basins, including coastal TC watch/warning responsibility for U.S. (including PR and USVI)
- Coordinate TC watches and warnings with other nations on our AOR (mostly WMO Region IV)
- Marine forecast responsibility for tropical North Atlantic and tropical Eastern Pacific (North and South) – an area of about 14 million nm^2
- Surface analysis (NWS Unified Surface Analysis) from 20°S to 30°/31°N from 140°W eastward to 20°E
- Backup responsibility for HFO/CPHC, OPC, and AWC

Summary Statistics and Usage Trends

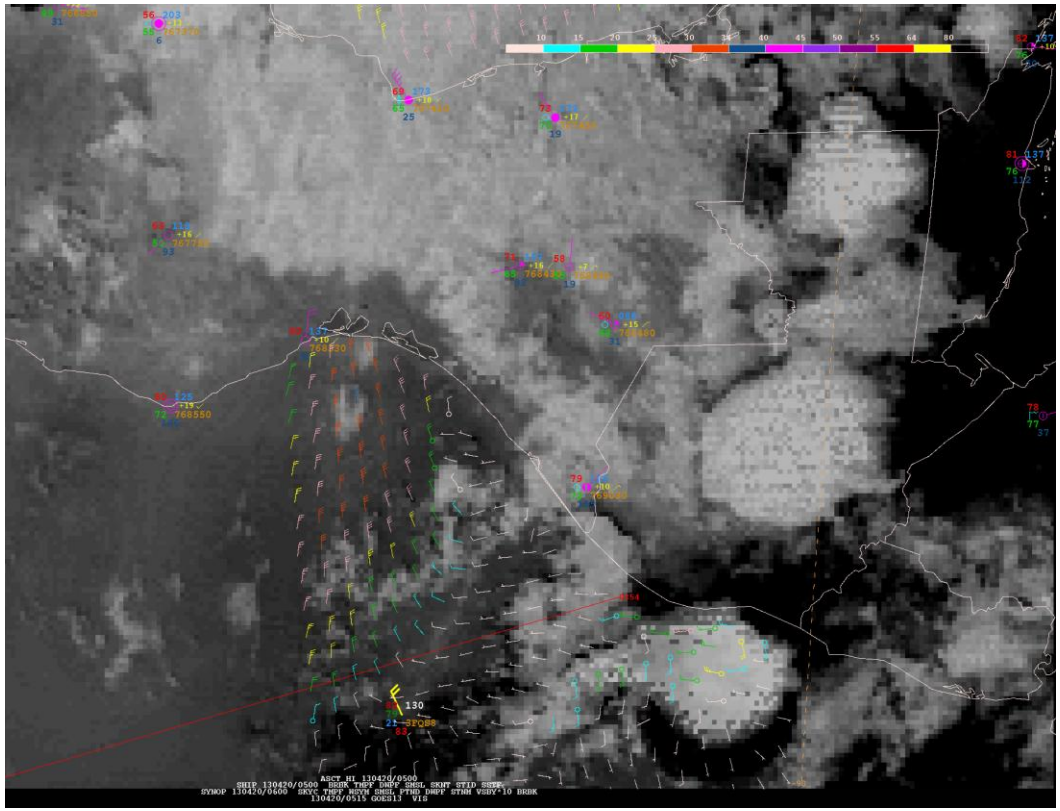
Gale and Storm Force Tehuantepec Events 1999-2013

Through 3 April 2013

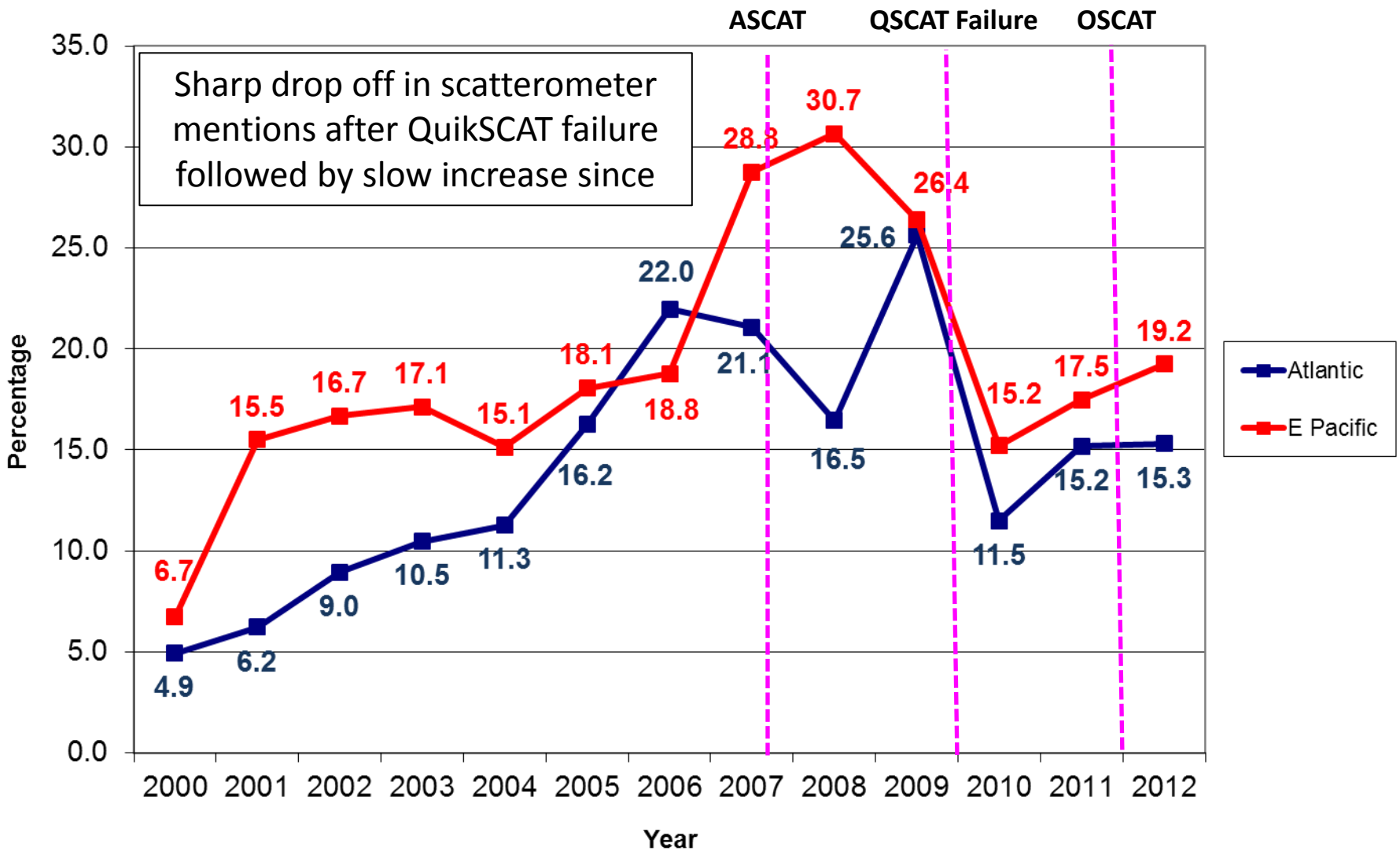


Tehuantepec Event Trends

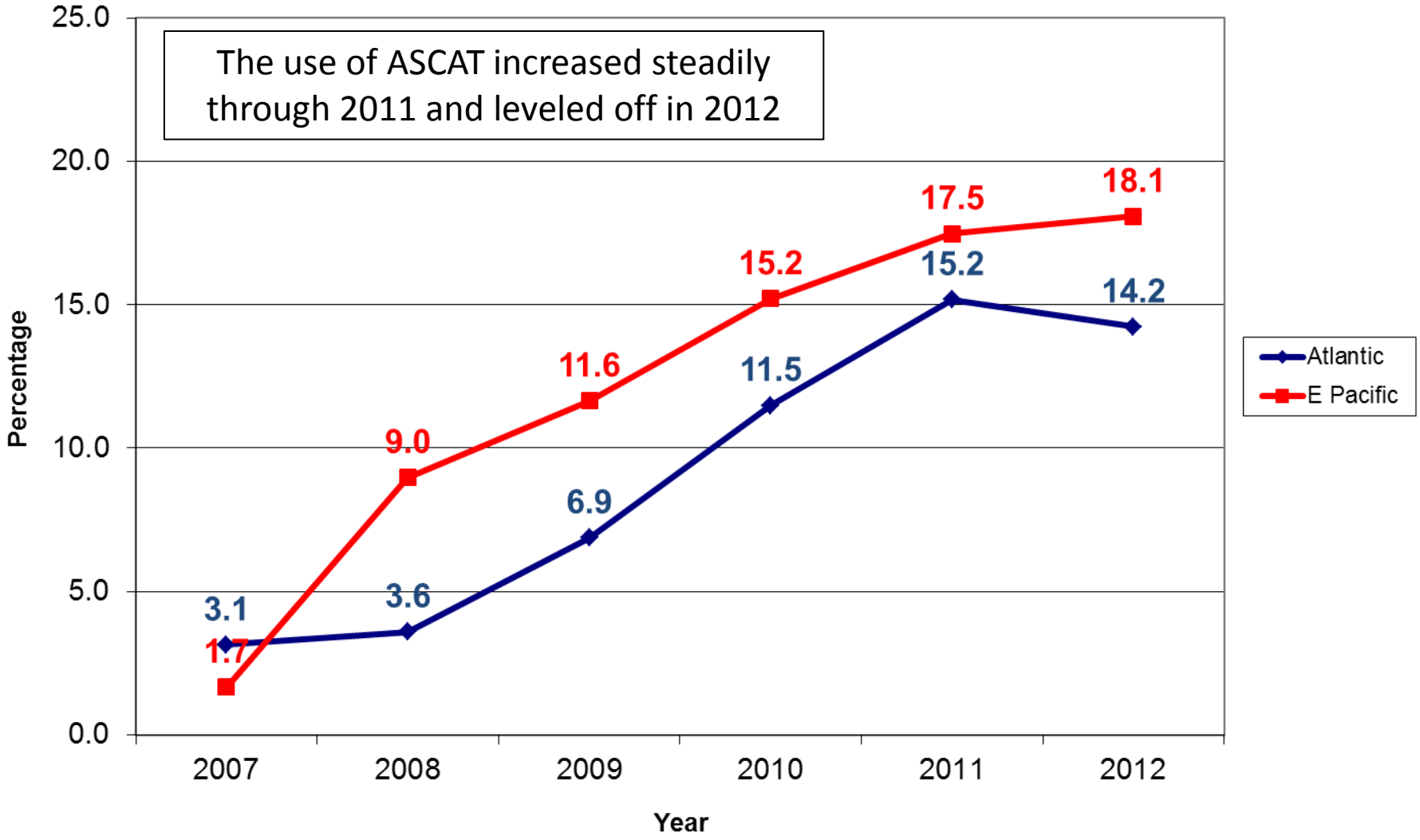
- 25-km QuikSCAT era (1999-2002)
  - 15.6 total events per year
  - 13.3 gale, 2.3 storm
- 12.5-km QuikSCAT era (2003-2009, including ASCAT since 2007)
  - 19.4 total events per year
  - 11.3 gale, 8.1 storm
- Post-QuikSCAT era (2009-2013)
  - 21 events per year
  - 15.8 gale, 5.3 storm



ASCAT pass 0354 UTC 20 April 2013


Percentage of NHC Tropical Cyclone Discussions Mentioning QuikSCAT, ASCAT, or OSCAT
2000-2012
ASCAT
QSCAT Failure
OSCAT
Sharp drop off in scatterometer mentions after QuikSCAT failure followed by slow increase since
Percentage
Year
Atlantic
E Pacific
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
6.7 15.5 16.7 17.1 15.1 18.1 18.8 28.8 30.7 26.4 15.2 17.5 19.2
4.9 6.2 9.0 10.5 11.3 16.2 22.0 21.1 16.5 25.6 11.5 15.2 15.3

Percentage of NHC Tropical Cyclone Discussions Mentioning ASCAT 2007-2012



Forecast Challenges

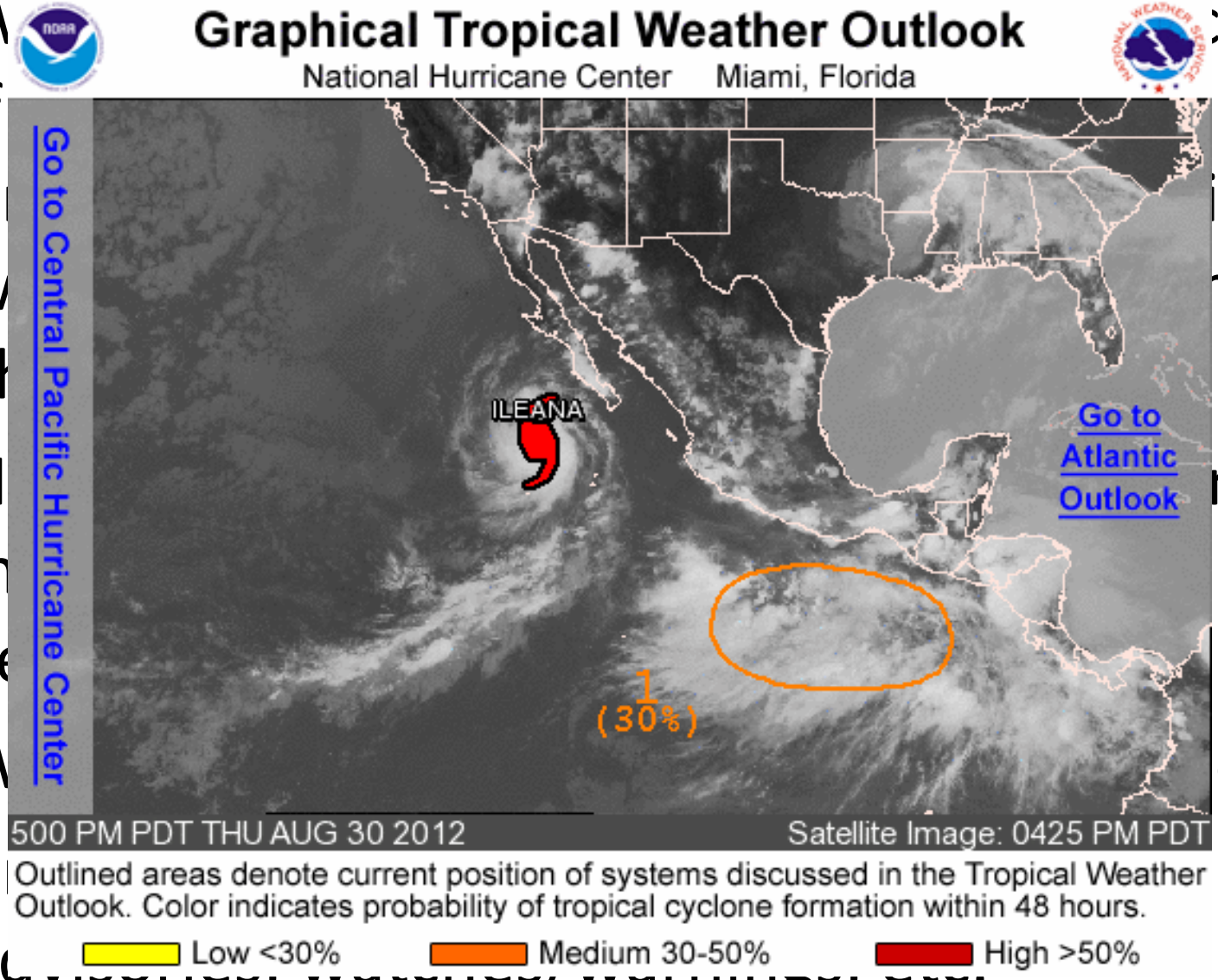
Tropical Cyclones

- TCs are a multi-scale problem from genesis, where a mesoscale vortex organizes via convective scale processes that are influenced by the large scale, to the feedback of the mature TC vortex on the synoptic scale and vice-versa
- Weak balance constraints in the tropics and fast upscale error growth due to moist processes make predictability a challenge
- This complex multi-scale interaction and feedback requires high-resolution observations over a wide area that can be used subjectively by the forecaster *and* assimilated into operational NWP guidance
- OSVW is an important part of the observing system, but is currently limited by coverage, resolution, lack of all-weather capability and current operational data assimilation techniques
- Where do we go from here?

Operational Challenges

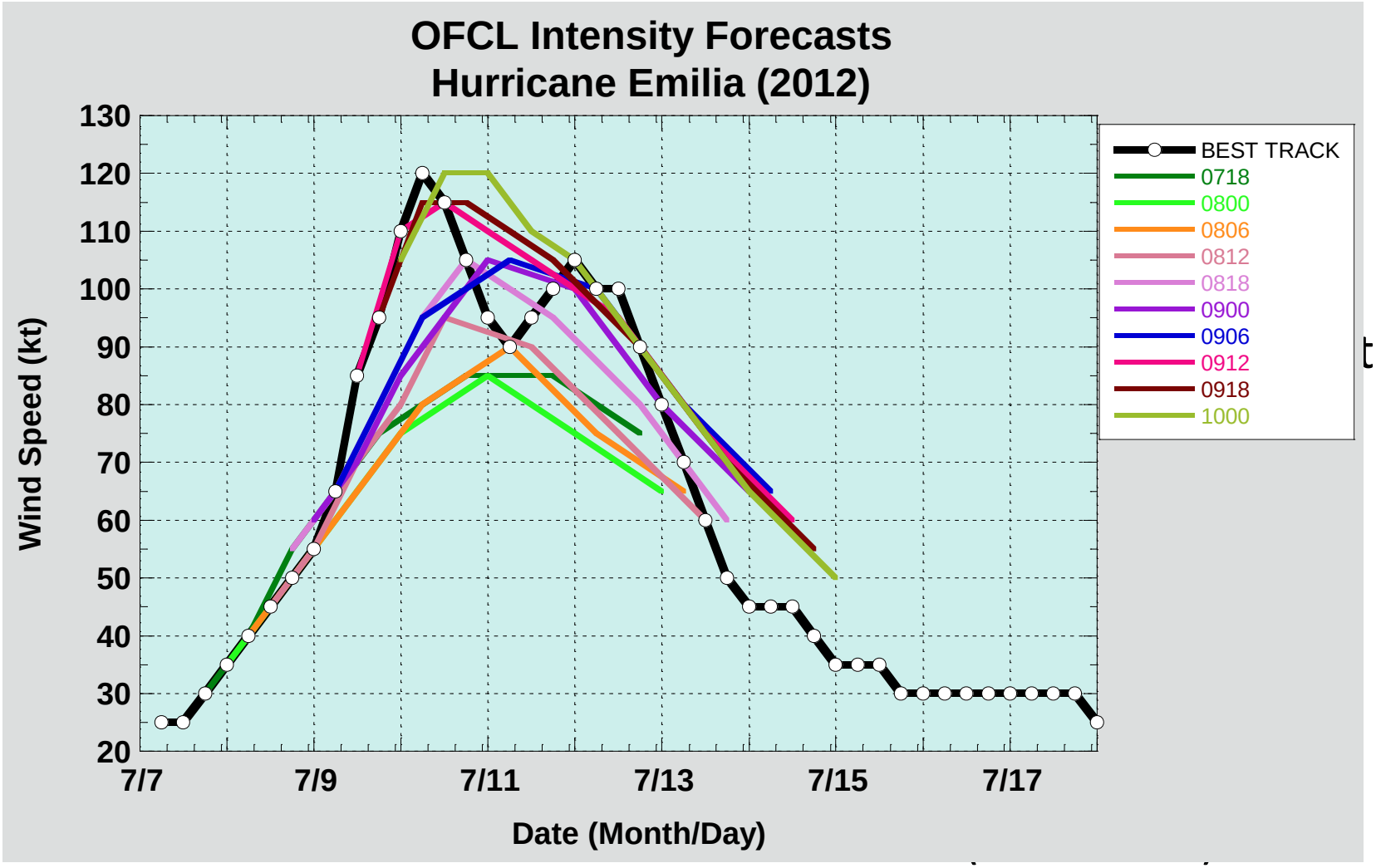
Genesis

- W… …cern if u… …ing w… …ns a ch…
- H… …nd in… ve…
- W… …op?
- C… ad…



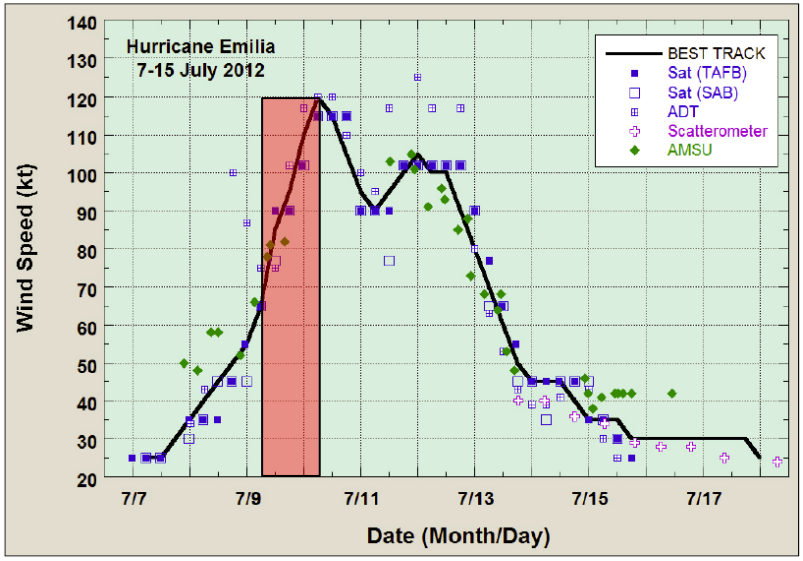
Operational Challenges

Rapid Intensification

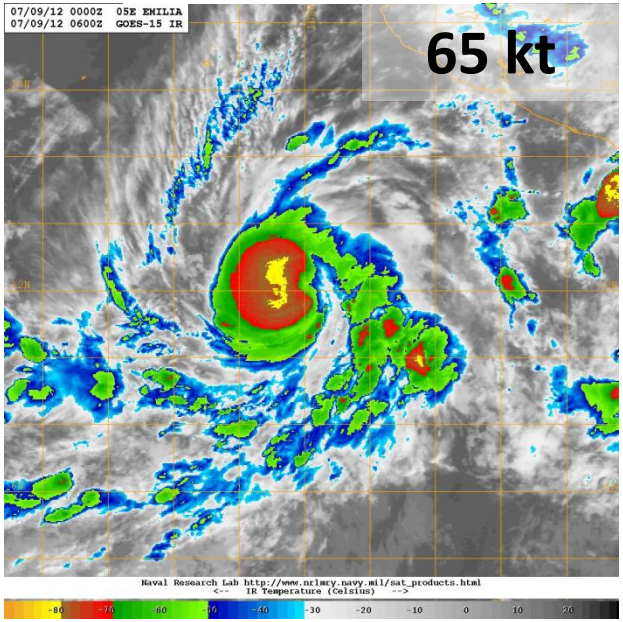


to

Hurricane Emilia (2012)

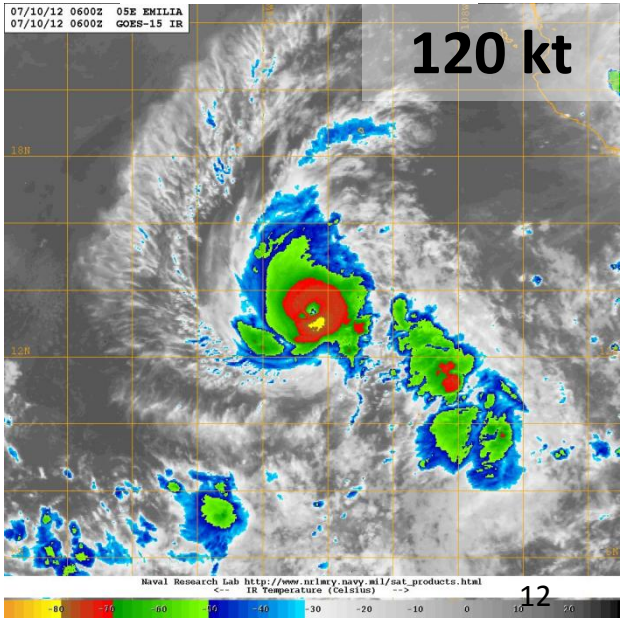


06Z 9 July

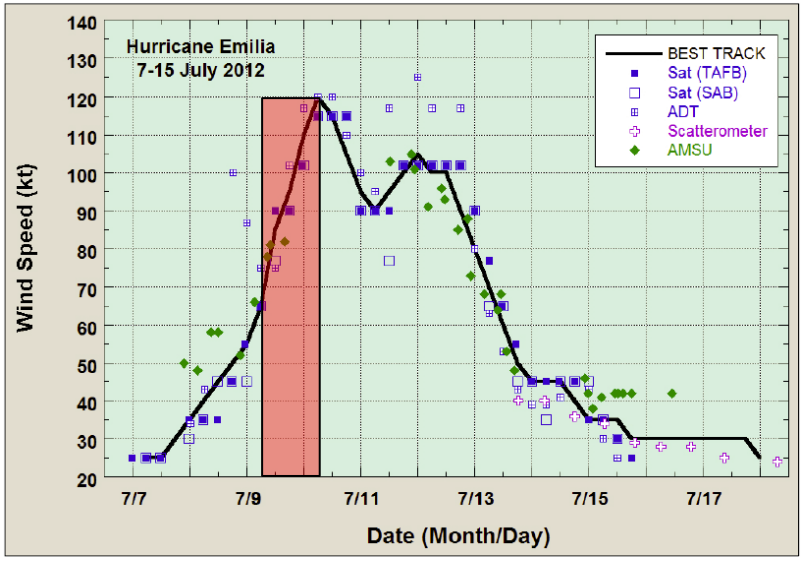


24 hours

06Z 10 July



Hurricane Emilia (2012)



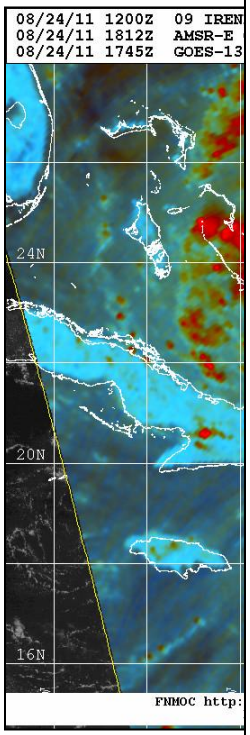
24-h forecasts from 06Z 9 July valid 06Z 10 July

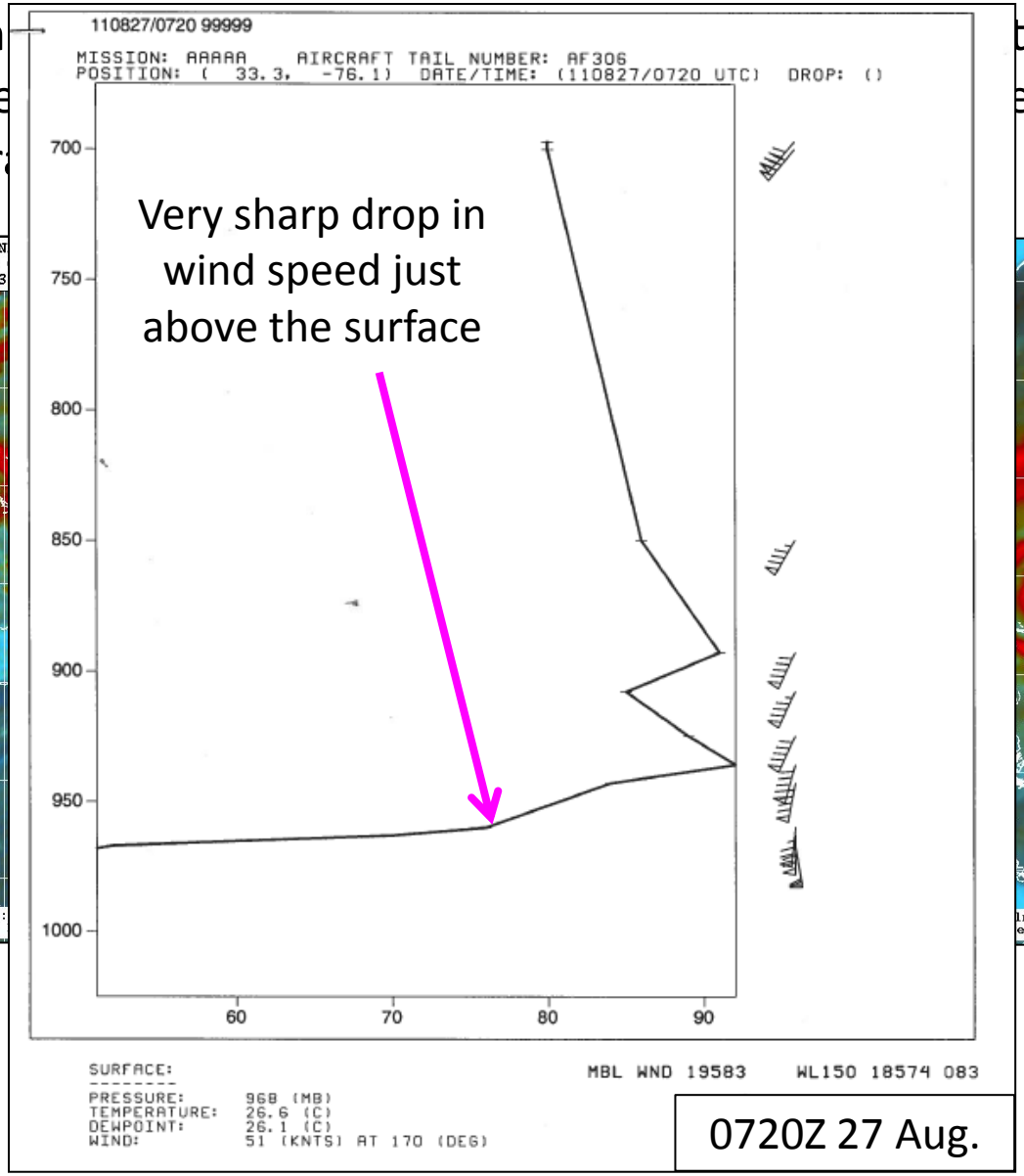
- **DSHP: 97 kt (-23 kt)**
- **LGEM: 87 kt (-33 kt)**
- **GHMI: 77 kt (-43 kt)**
- **HWFI: 85 kt (-35 kt)**
- **IVCN: 87 kt (-33 kt)**
- **OFCL: 95 kt (-25 kt)**

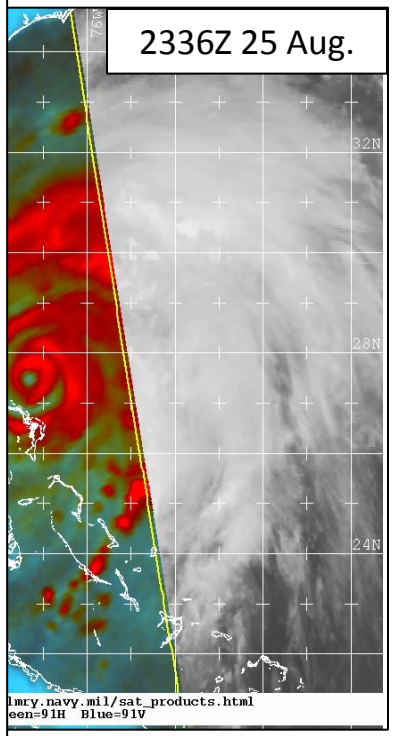
Operational Challenges

Structure

- Irene began [illegible] this cycle did not complete, le [illegible] e., no eyewall) and unable to tr[illegible]



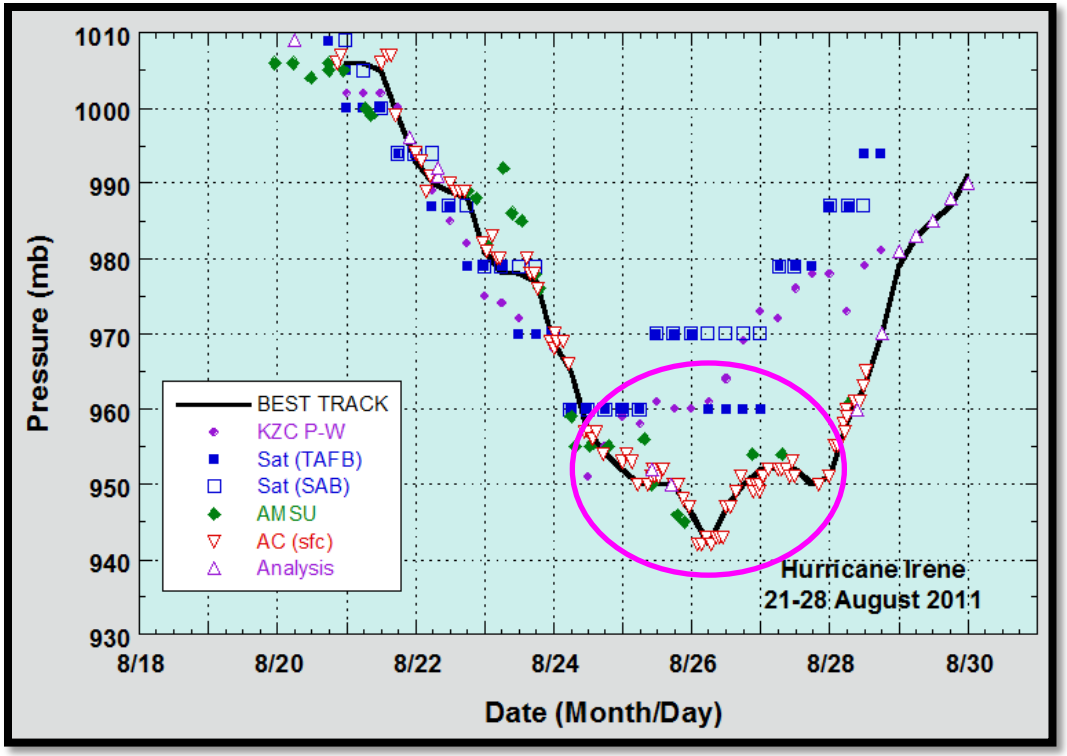


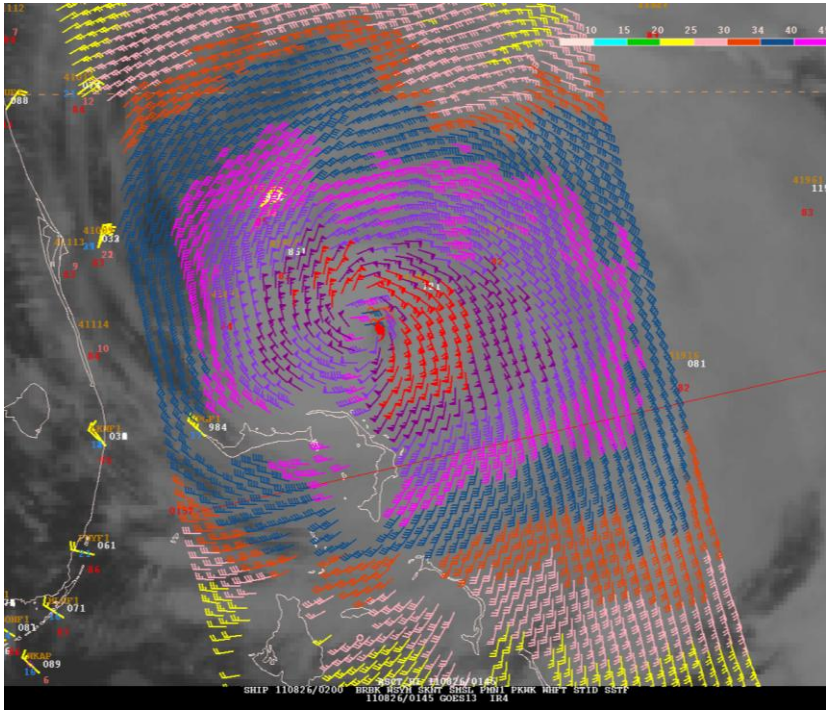


Operational Challenges

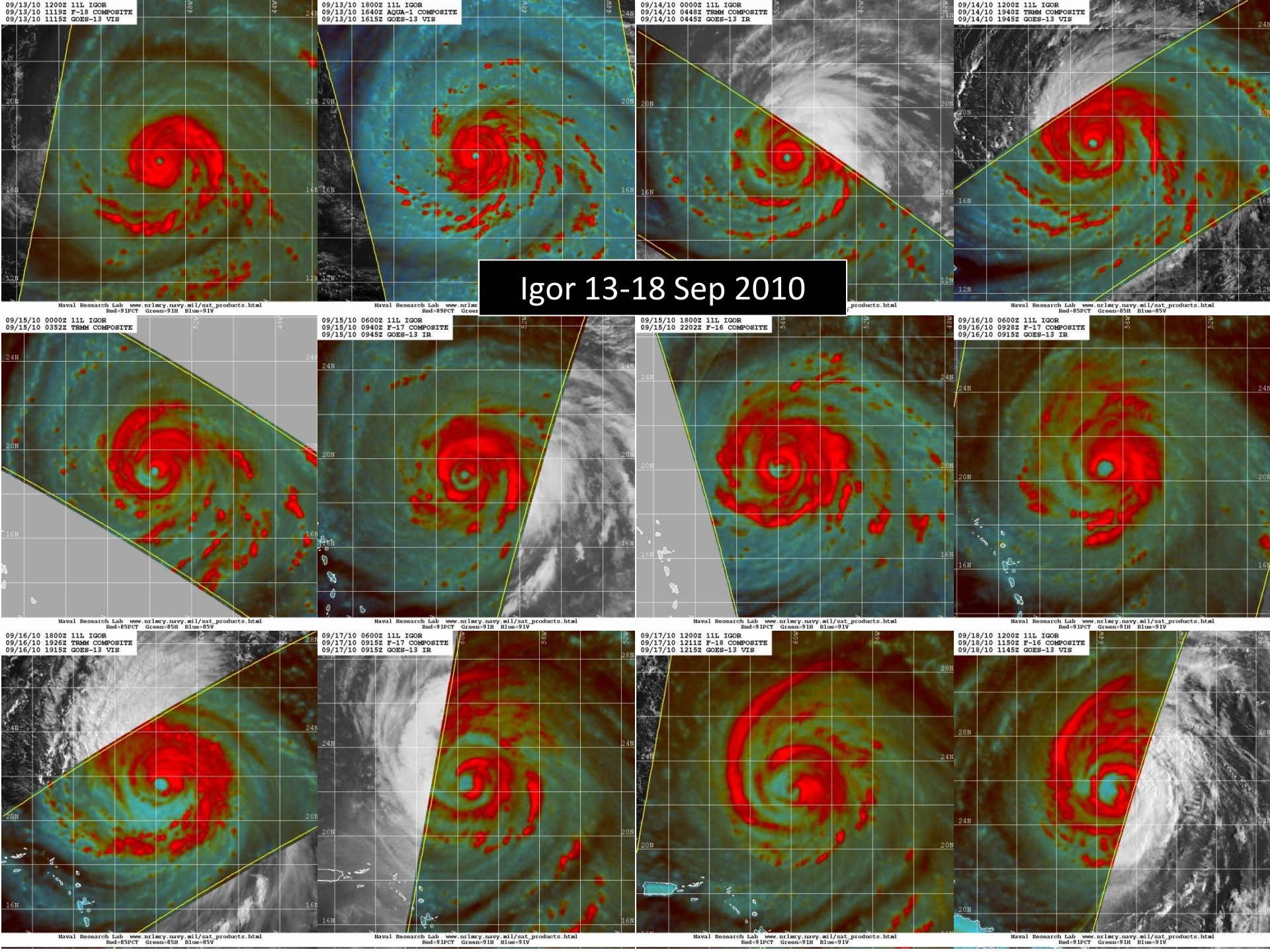
Structure

- Irene's minimum central pressure continued to decrease after the maximum winds peaked on 24 August
- The central pressure remained low, with values typically associated with major hurricanes through 27 August
- Due to the lack of an inner core after the failed eyewall cycle, Irene's structure evolved such that the wind field grew in size rather than intensity
  - Hurricane force winds extended as far as 90 miles from the center on 26-27 August

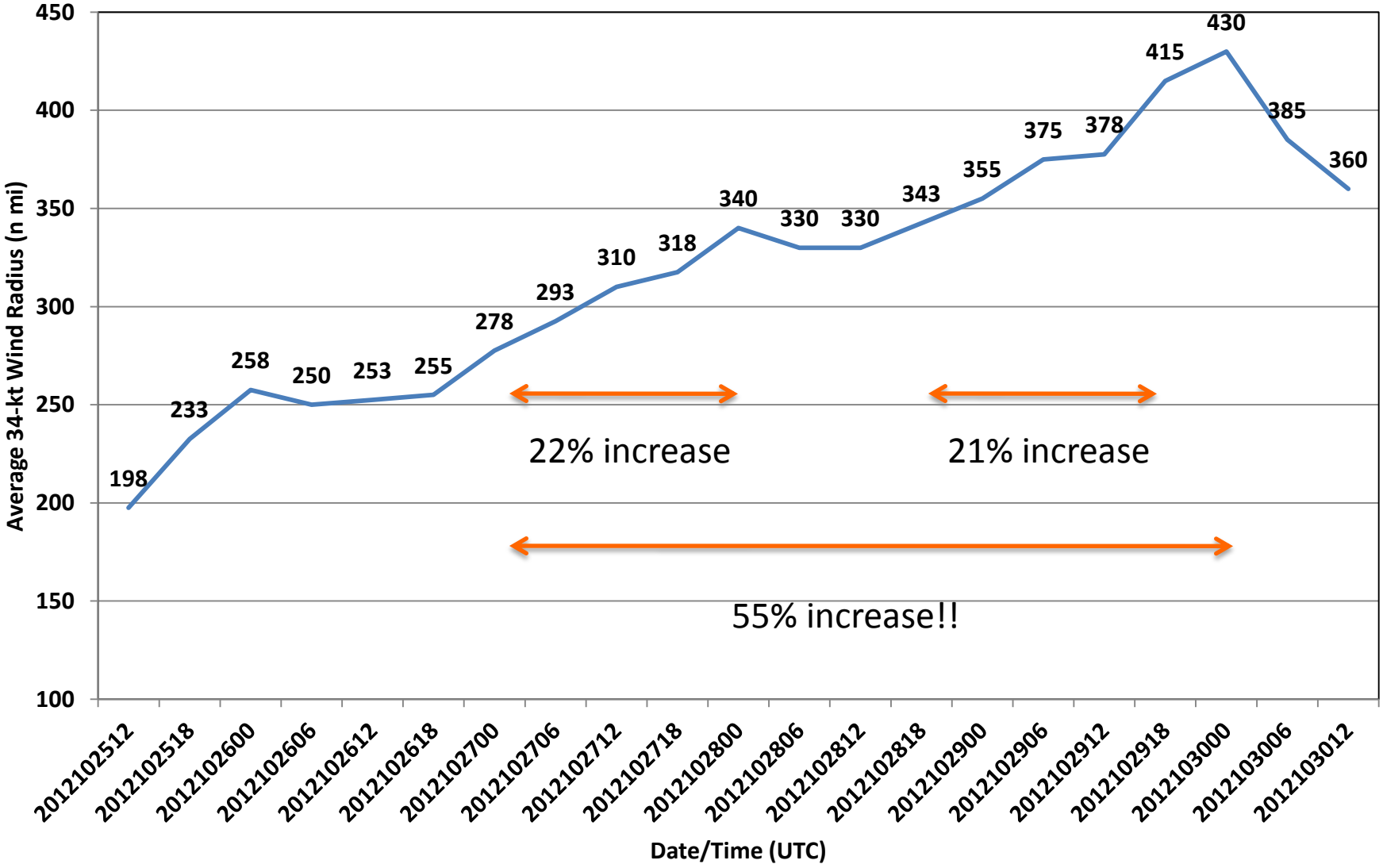




ASCAT winds around 02Z 26 August


09/13/10 1200Z 11L IGOR
09/13/10 1119Z F-18 COMPOSITE
09/13/10 1115Z GOES-13 VIS
09/13/10 1800Z 11L IGOR
09/13/10 1640Z AQUA-1 COMPOSITE
09/13/10 1615Z GOES-13 VIS
09/14/10 0000Z 11L IGOR
09/14/10 0448Z TRMM COMPOSITE
09/14/10 0445Z GOES-13 IR
09/14/10 1200Z 11L IGOR
09/14/10 1940Z TRMM COMPOSITE
09/14/10 1945Z GOES-13 VIS
Igor 13-18 Sep 2010
09/15/10 0000Z 11L IGOR
09/15/10 0352Z TRMM COMPOSITE
09/15/10 0600Z 11L IGOR
09/15/10 0940Z F-17 COMPOSITE
09/15/10 0945Z GOES-13 IR
09/15/10 1800Z 11L IGOR
09/15/10 2202Z F-16 COMPOSITE
09/16/10 0600Z 11L IGOR
09/16/10 0928Z F-17 COMPOSITE
09/16/10 0915Z GOES-13 IR
09/16/10 1800Z 11L IGOR
09/16/10 1926Z TRMM COMPOSITE
09/16/10 1915Z GOES-13 VIS
09/17/10 0600Z 11L IGOR
09/17/10 0915Z F-17 COMPOSITE
09/17/10 0915Z GOES-13 IR
09/17/10 1200Z 11L IGOR
09/17/10 1211Z F-18 COMPOSITE
09/17/10 1215Z GOES-13 VIS
09/18/10 1200Z 11L IGOR
09/18/10 1150Z F-16 COMPOSITE
09/18/10 1145Z GOES-13 VIS

Sandy Average 34-kt Wind Radius



U.S. Fatalities in Atlantic TCs

Sandy:
- 72 direct U.S. fatalities
- 41 (57%) due to storm surge

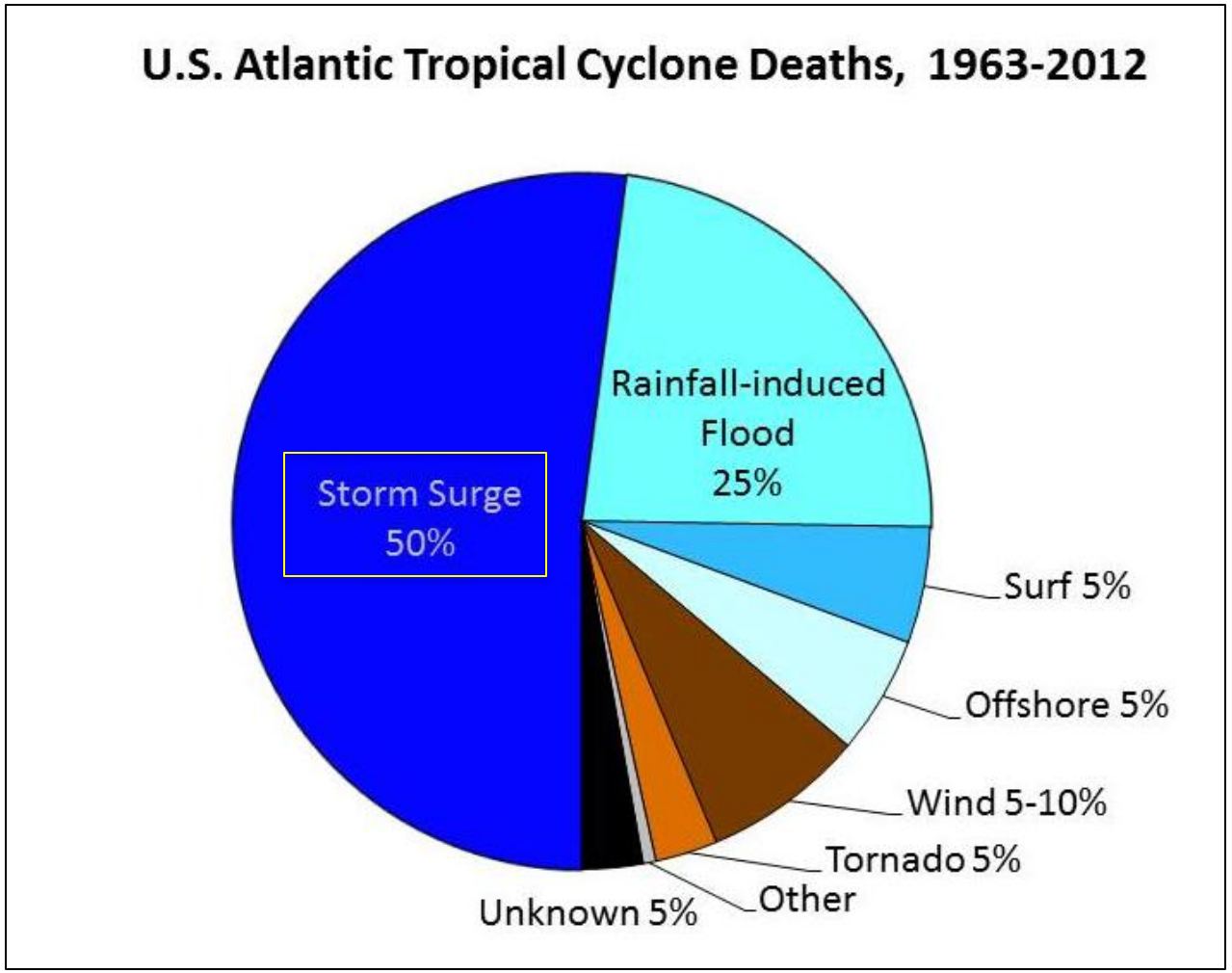
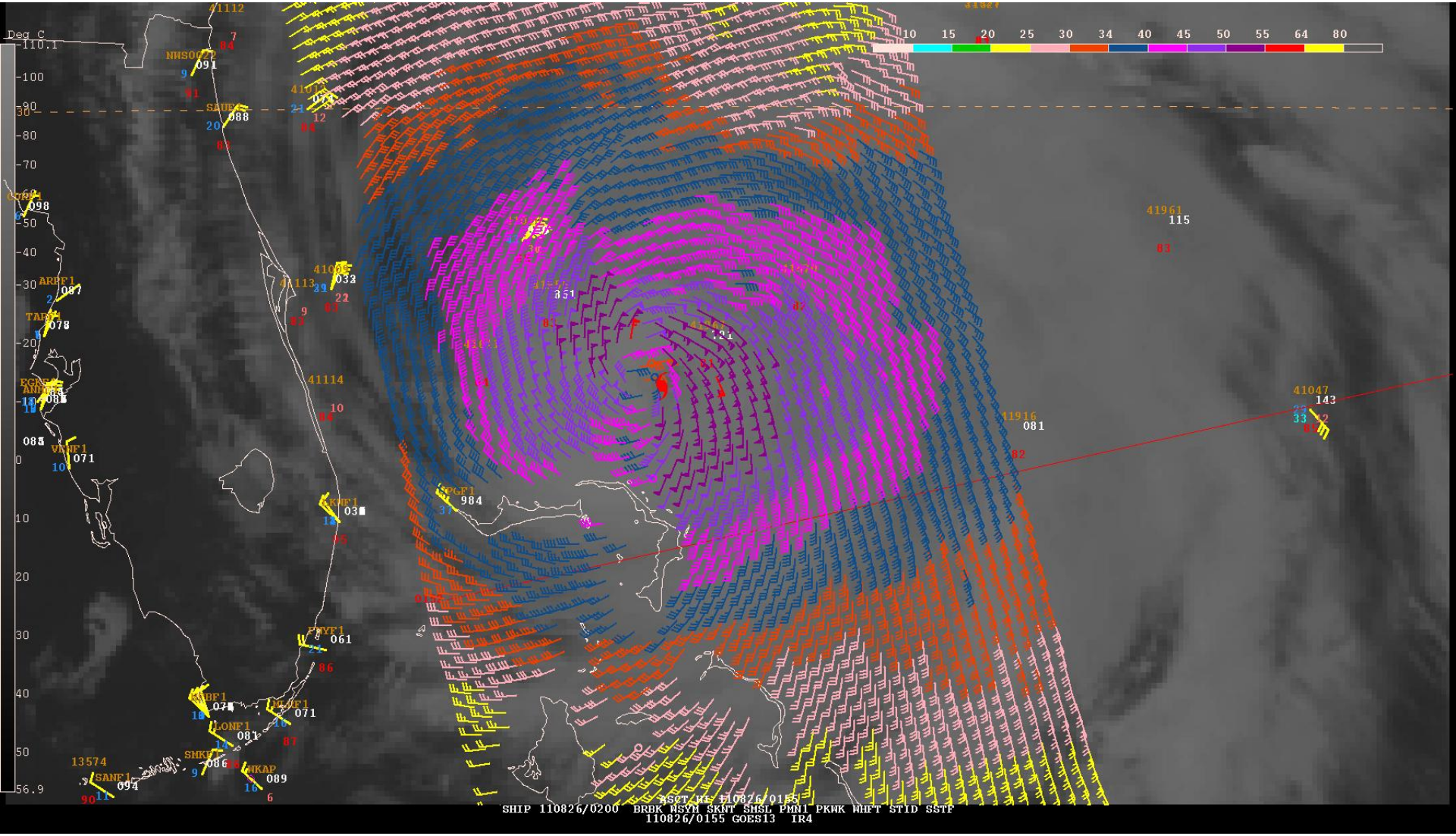


Image and analysis courtesy Ed Rappaport (NHC)

Case Examples with Current Instruments

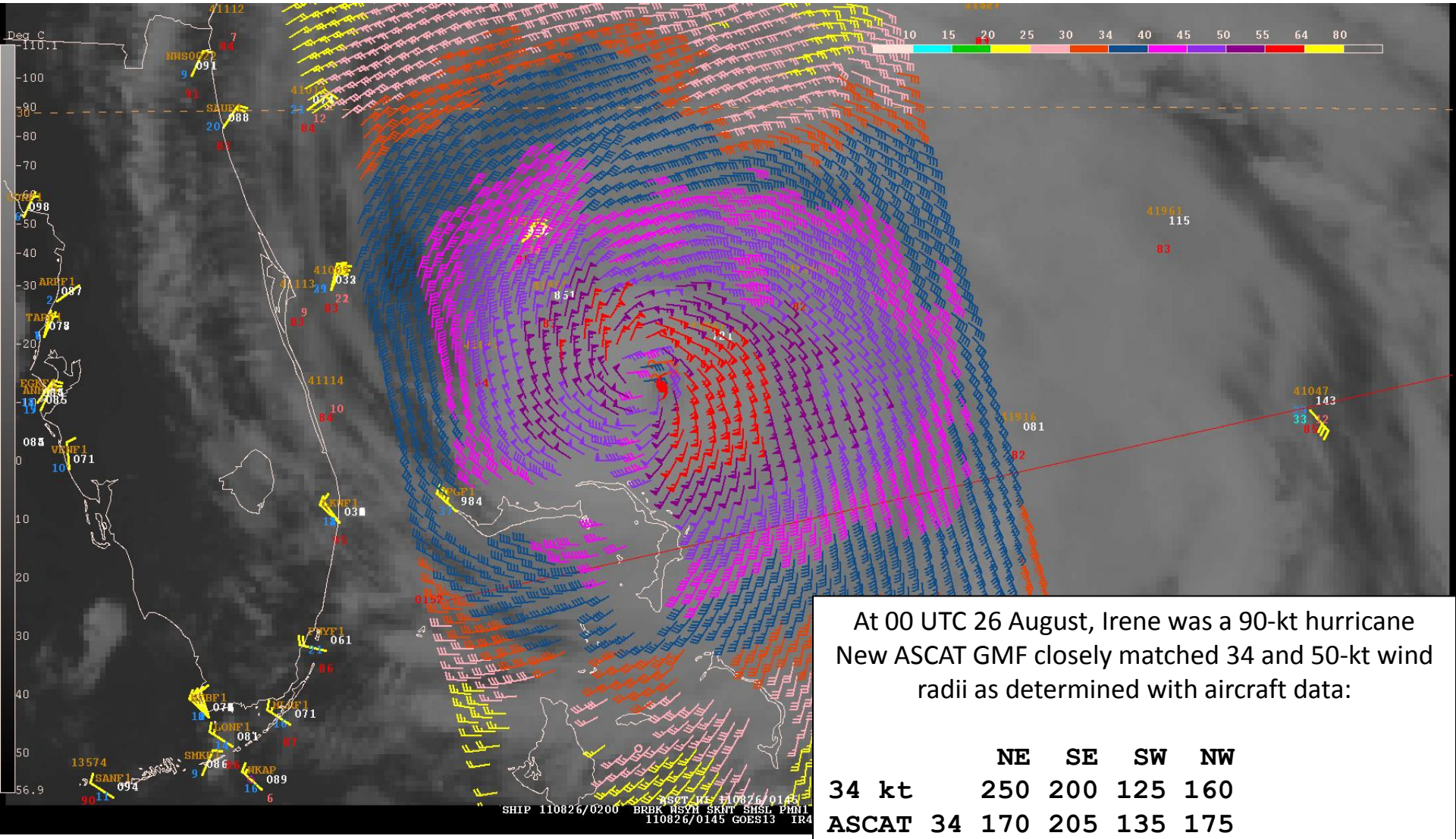
Original NOAA ASCAT GMF

Hurricane Irene 0152 UTC 26 August 2011



New NOAA ASCAT GMF

Hurricane Irene 0152 UTC 26 August 2011

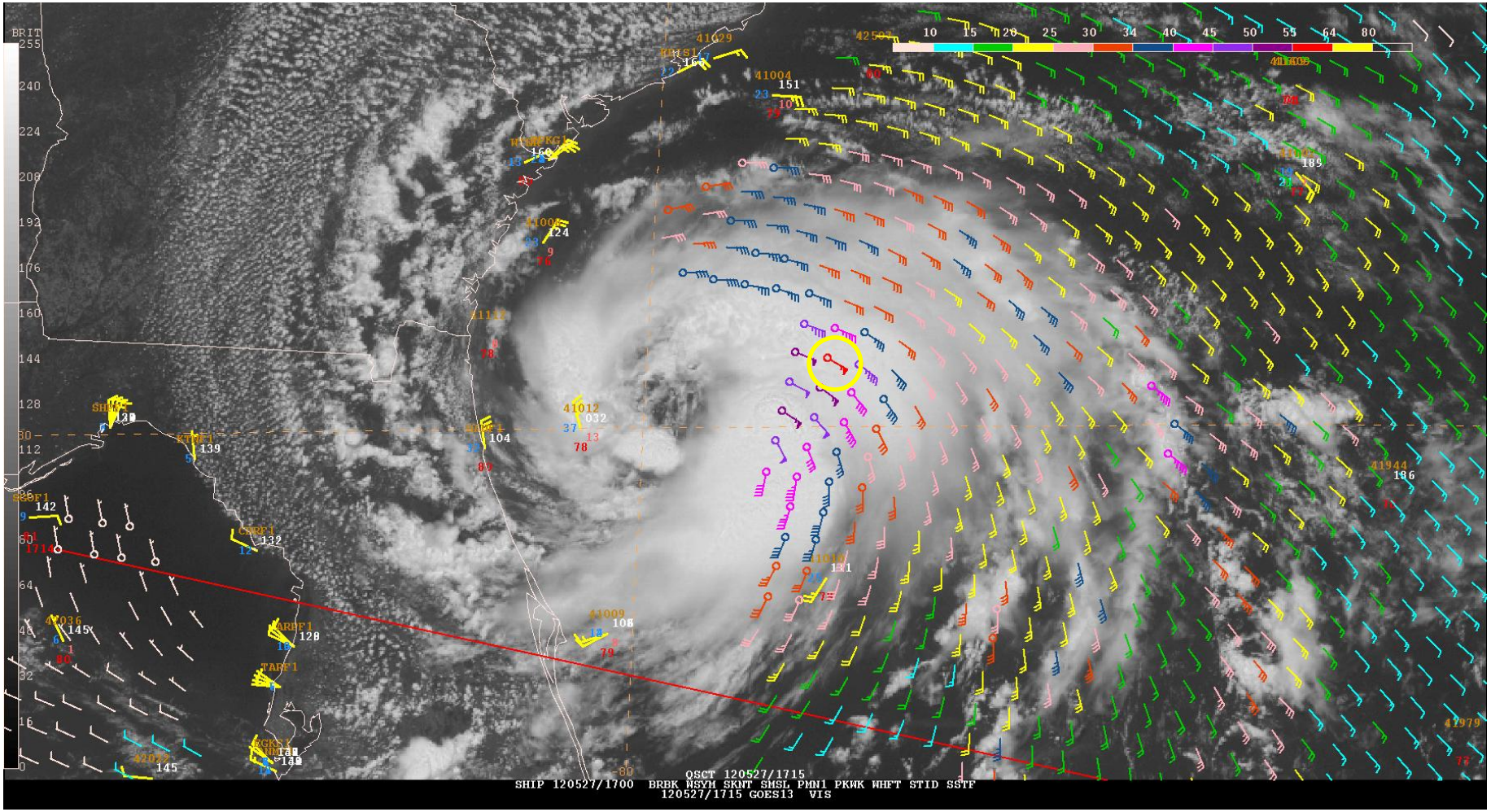


At 00 UTC 26 August, Irene was a 90-kt hurricane
New ASCAT GMF closely matched 34 and 50-kt wind radii as determined with aircraft data:

	NE	SE	SW	NW
34 kt	250	200	125	160
ASCAT 34	170	205	135	175
50 kt	110	100	50	75
ASCAT 50	90	105	60	70

OSCAT

Tropical Storm Beryl – 1714 UTC 27 May 2012

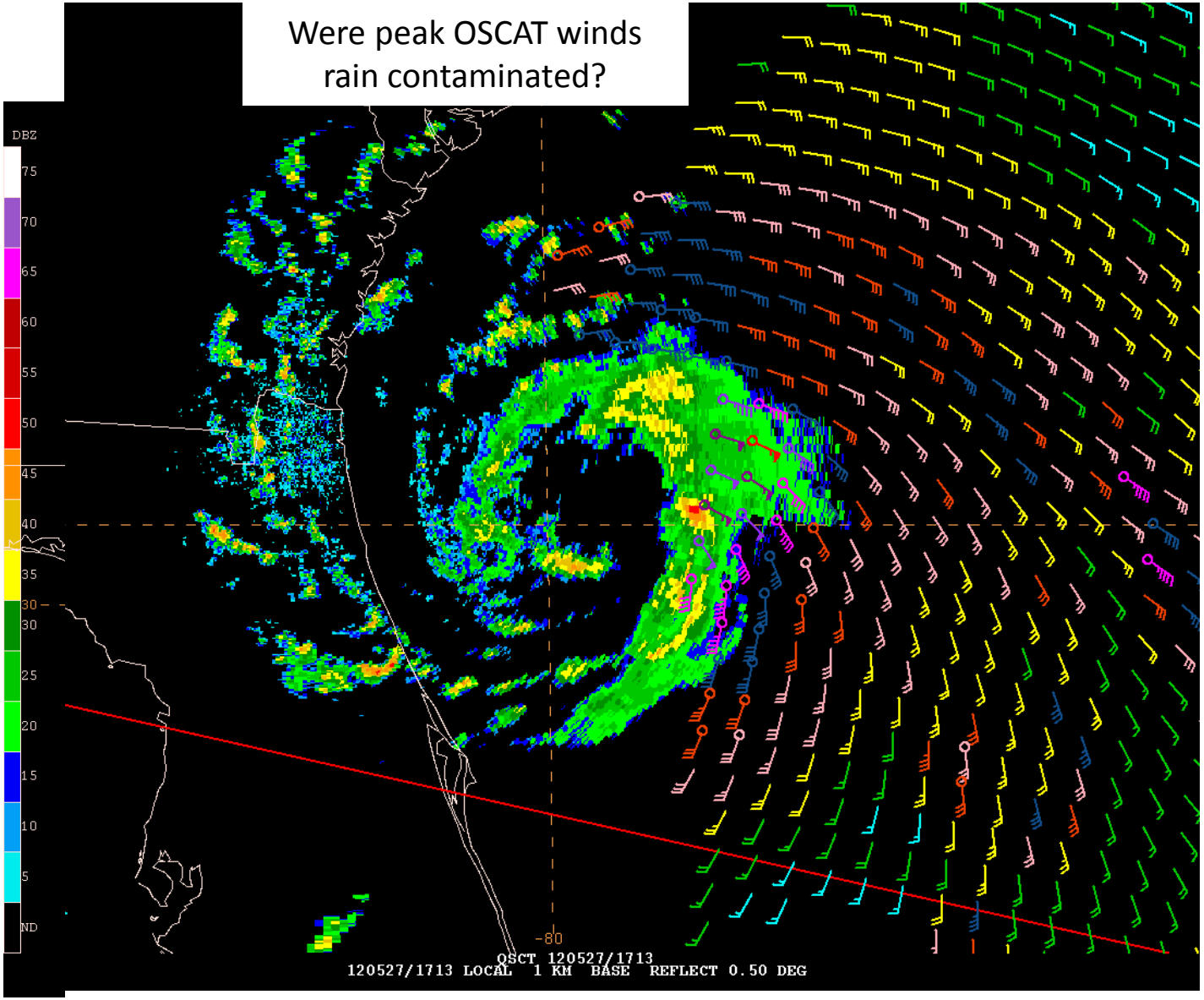


OSCAT showed peak winds of 55 kt in Beryl, the actual intensity of the system at that time. However, aircraft data around 2100 UTC showed strongest winds were in a band to the west of the center, with weaker winds of around 35 kt where OSCAT peak winds were

OSCAT

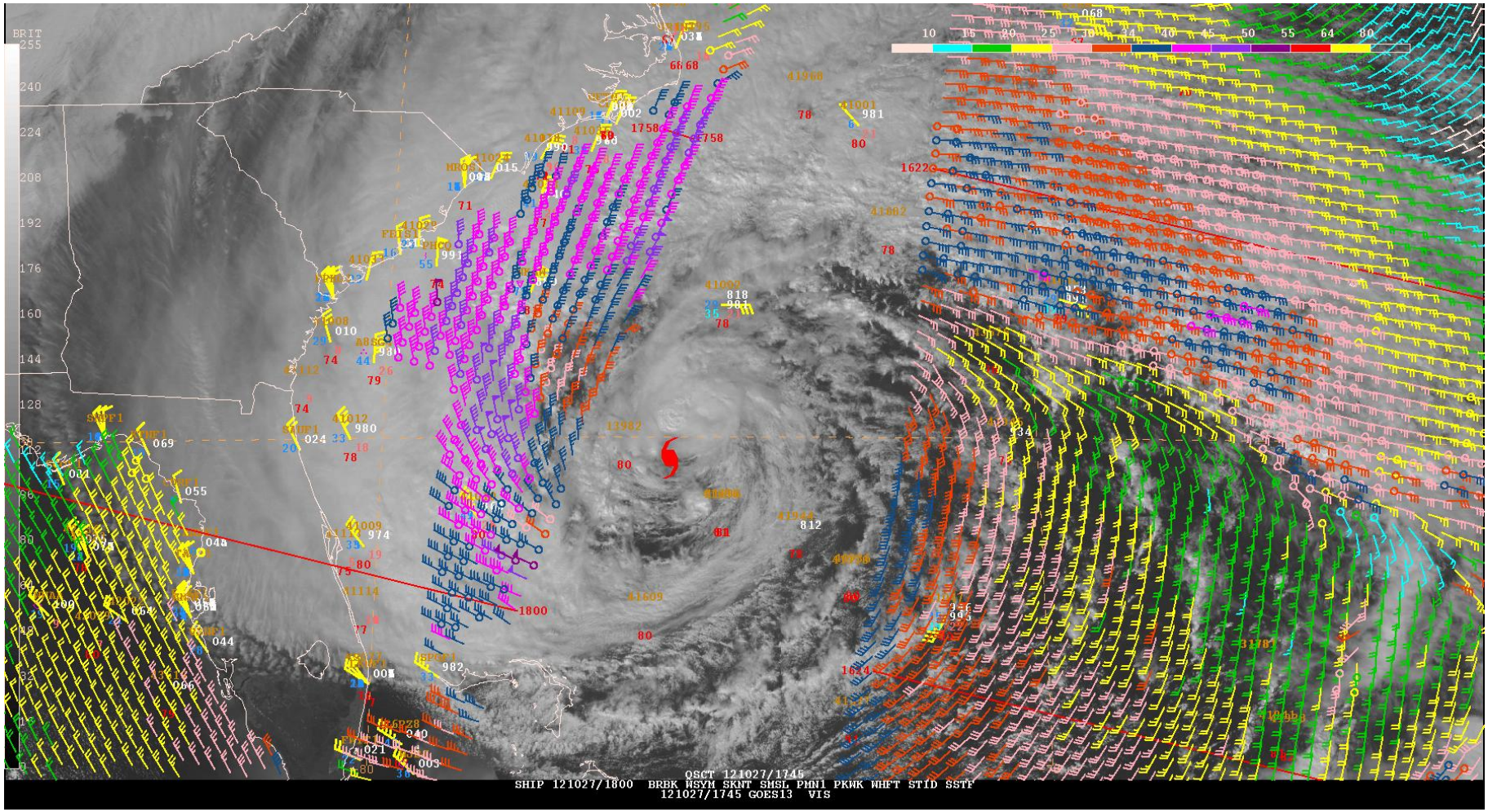
Tropical Storm Beryl – 1714 UTC 27 May 2012

Were peak OSCAT winds rain contaminated?



OSCAT

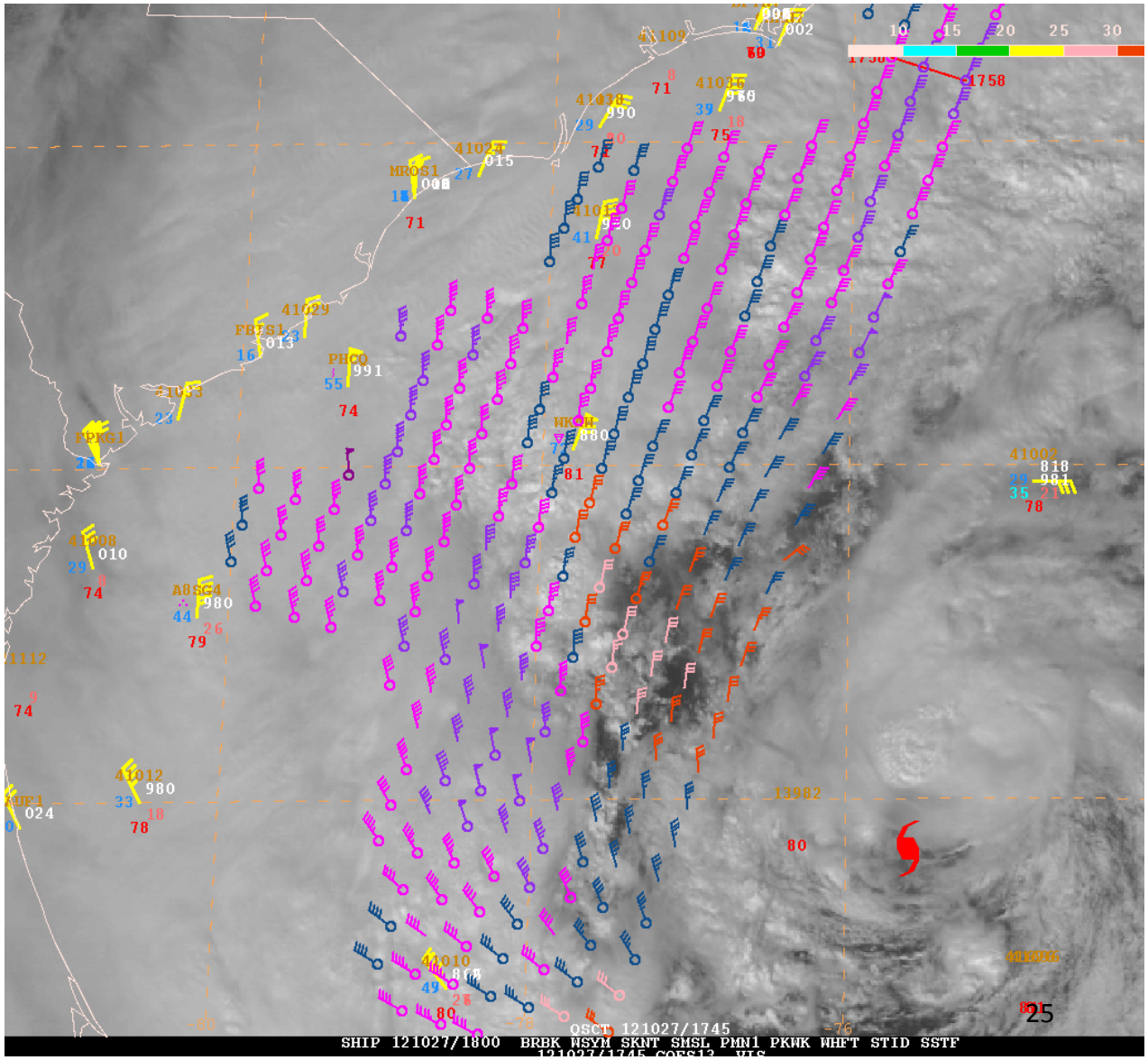
Hurricane Sandy – 1800 UTC 27 October 2012



OSCAT

Hurricane Sandy – 1800 UTC 27 October 2012

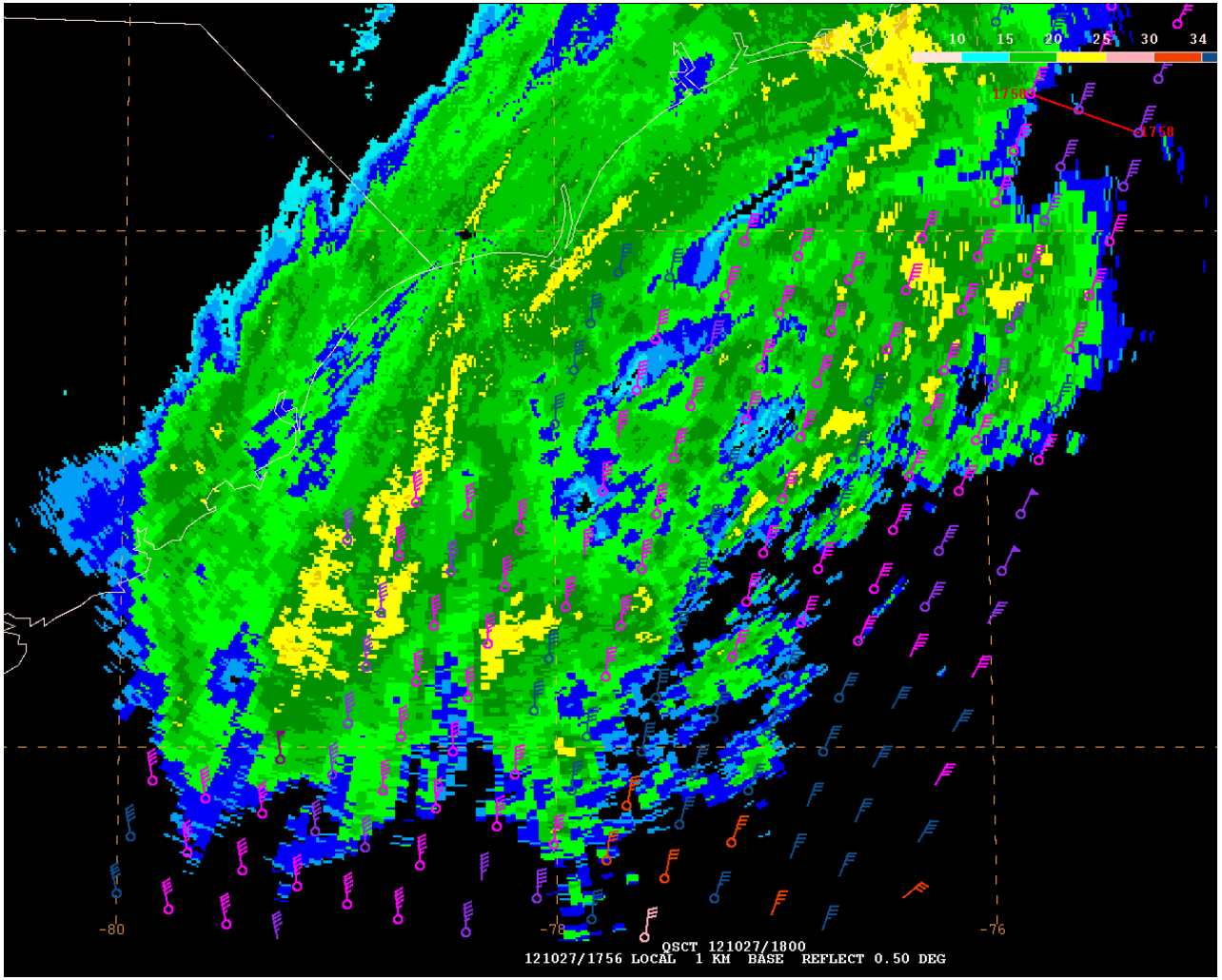
- OSCAT pass over western half of Sandy's circulation looks reasonable when compared to ship/buoy observations
- Not a lot of obvious variability due to rain seen in heavier bands on satellite or radar
- Most retrievals are rain flagged



OSCAT

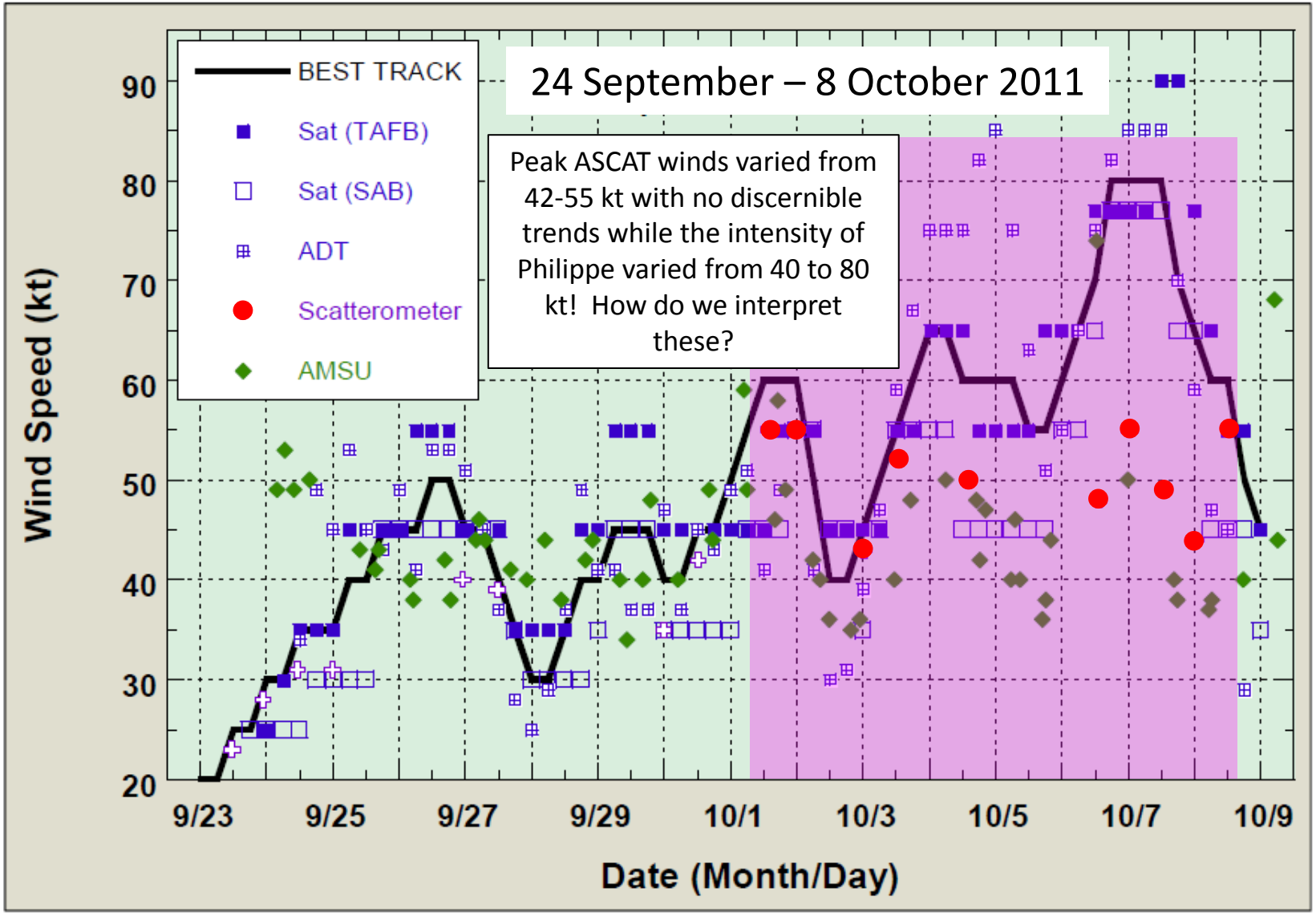
Hurricane Sandy – 1800 UTC 27 October 2012

- OSCAT pass over western half of Sandy's circulation looks reasonable when compared to ship/buoy observations
- Not a lot of obvious variability due to rain seen in heavier bands on satellite or radar
- Most retrievals are rain flagged

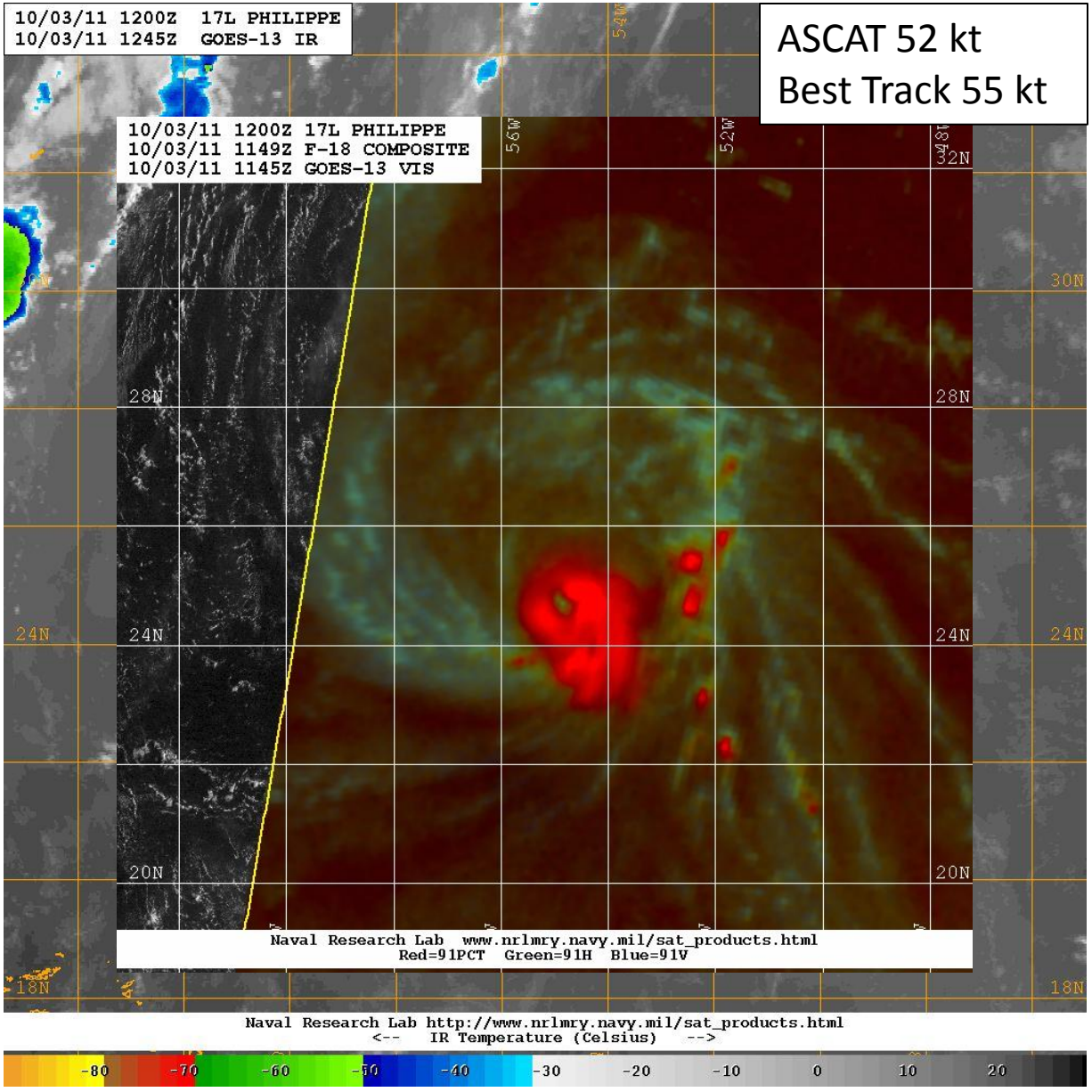


1756 UTC KLTX (Wilmington, NC) base reflectivity

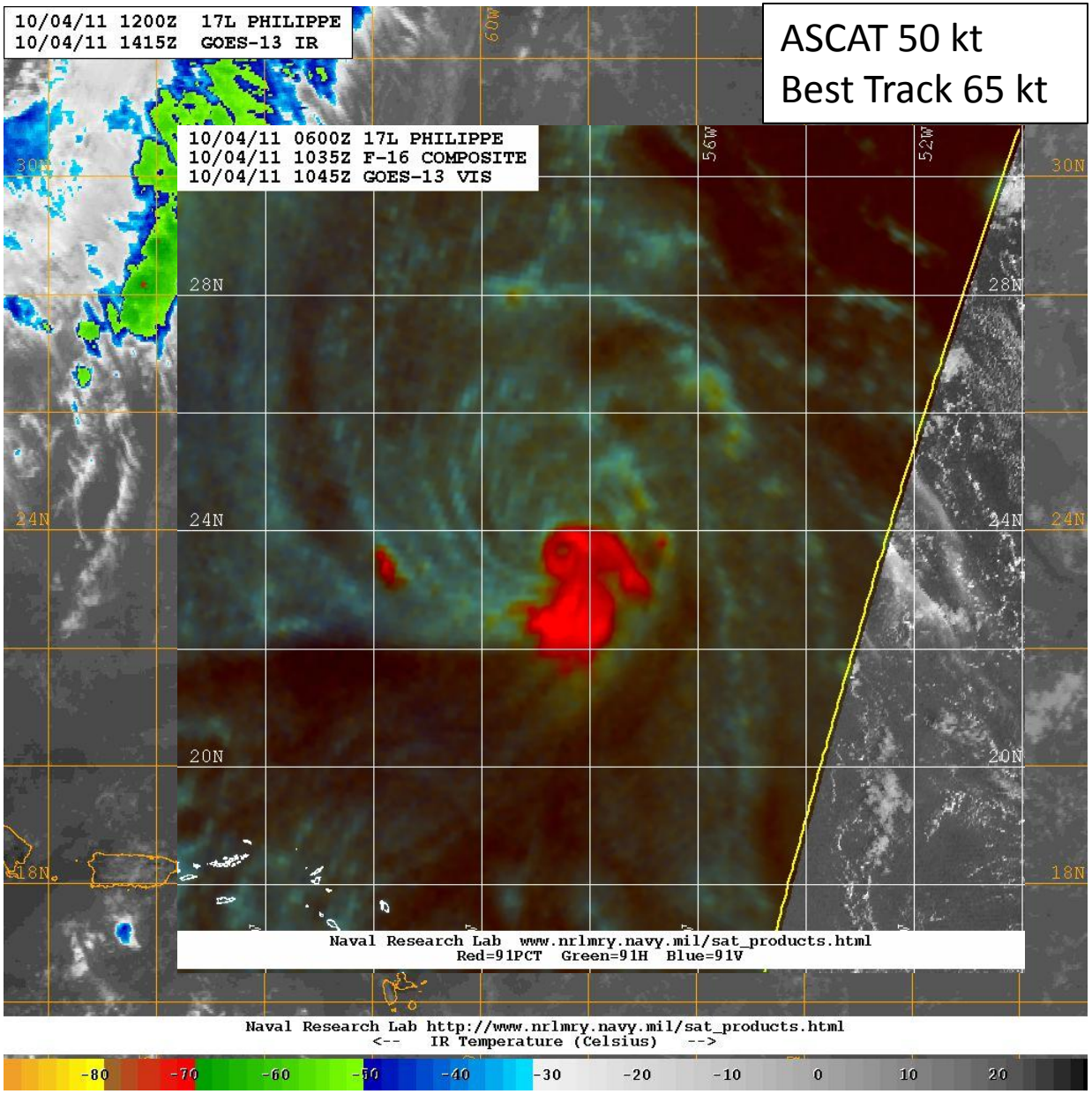
Best Track Intensity of Philippe (2011)



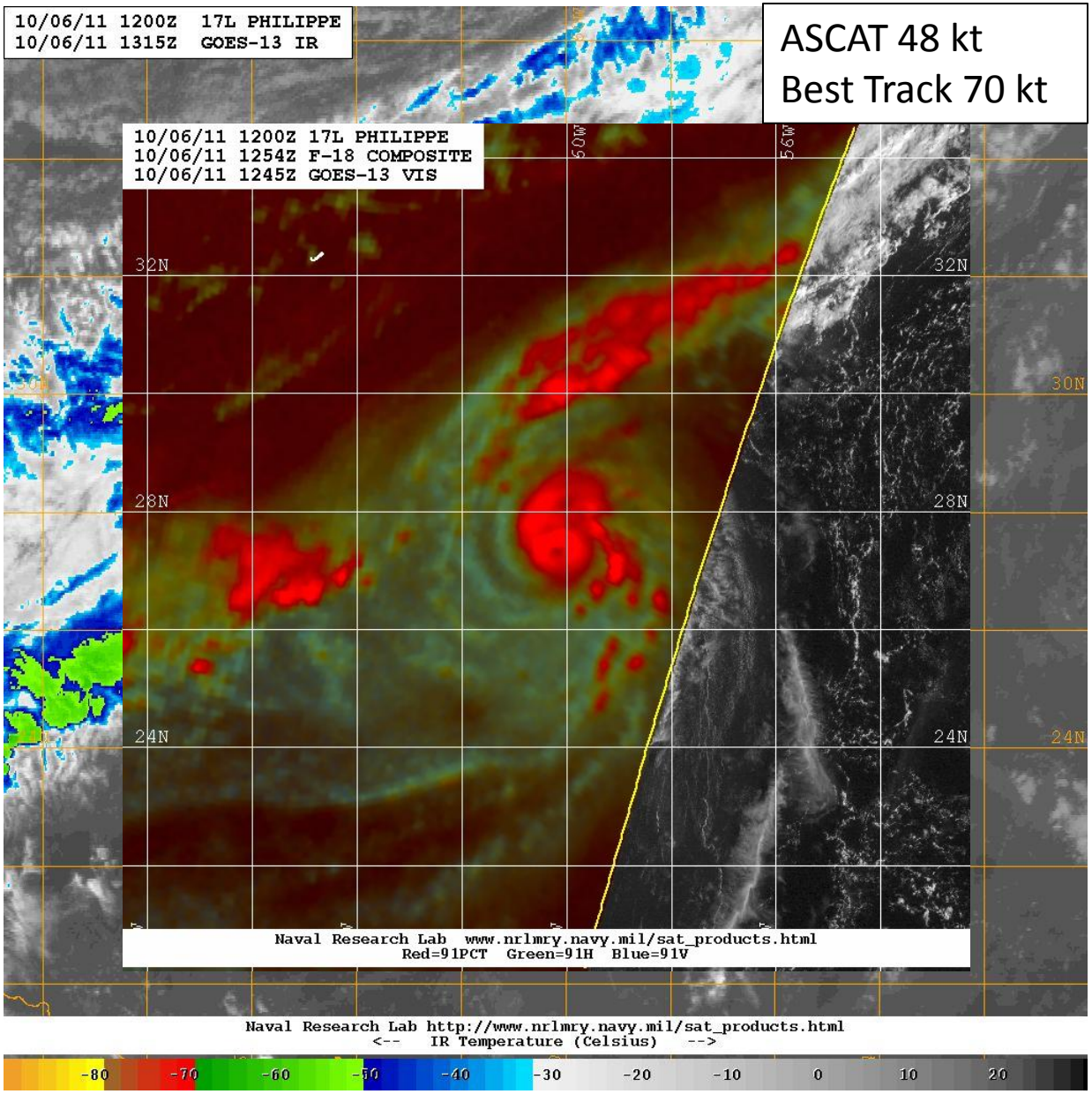
Philippe – 1245Z 3 Oct 2011



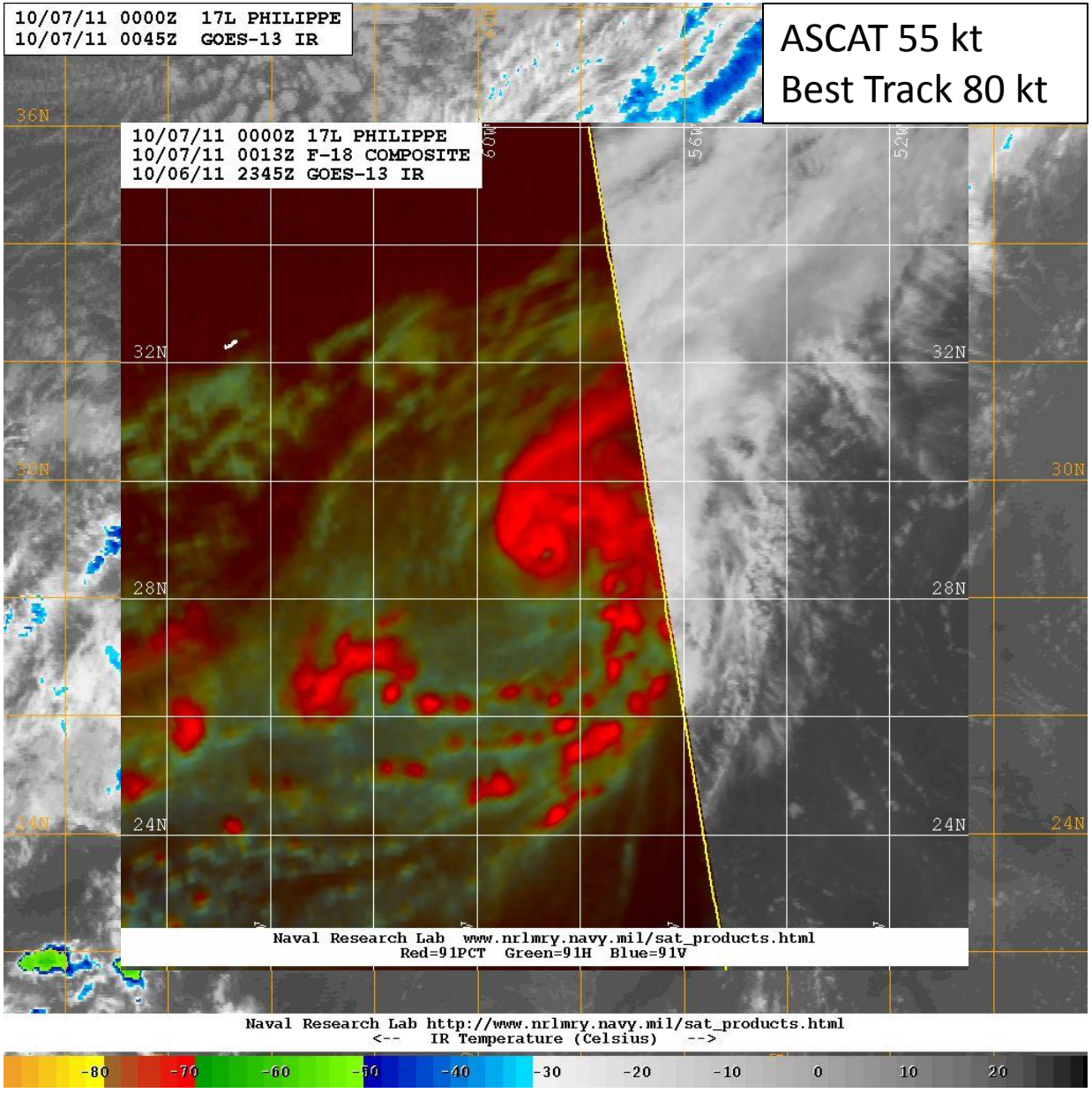
Philippe – 1415Z 4 Oct 2011



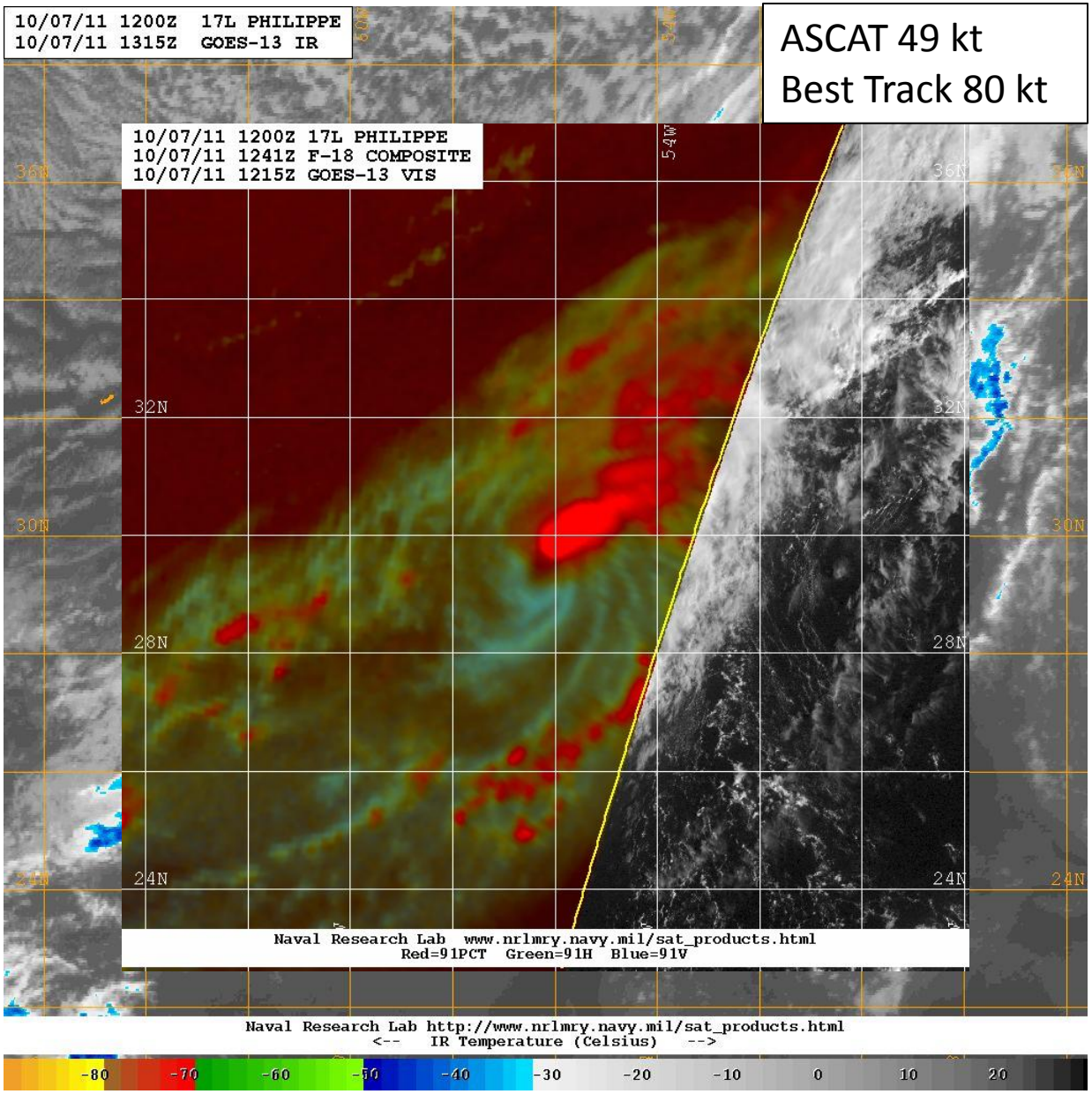
Philippe – 1315Z 6 Oct 2011



Philippe – 0045Z 7 Oct 2011



Philippe – 1315Z 7 Oct 2011



Philippe ASCAT Passes
1-8 October 2011

Date/Time	ASCAT	TAFB Dvorak	SAB Dvorak	ADT	Best Track	ASCAT-Best Track
10/1 1331Z	55	45	45	41	60	-5
10/2 0044Z	55	55	55	55	60	-5
10/3 0024Z	43	45	45	39	45	-2
10/3 1250Z	52	55	55	59	55	-3
10/4 1410Z	50	65	45	75	65	-15
10/6 1328Z	48	77	65	75	70	-22
10/7 0040Z	55	77	77	85	80	-25
10/7 1307Z	49	90	77	85	80	-31
10/8 0022Z	44	77	65	59	65	-21
10/8 1243Z	55	55	45	45	60	-5

NHC's OSVW Wish List

- Better validation of ASCAT in winds above 50 kt in the TC environment
- Improved understanding of OSCAT retrievals in rain and OSCAT behaves across the entire TC life cycle
- Modify configuration of ASCAT A/B orbits to maximize coverage
- Long Term: Co-located wide-swath high-resolution scatterometer and microwave radiometer
  - Observe evolution of inner-core wind field along with moist processes, which contribute to rapid intensity and structural changes critical to improving forecasts and warnings for wind and storm surge