Guidance on Observational Undersampling over the Tropical Cyclone Lifecycle

David Nolan, UM/RSMAS

Brad Klotz, CIMAS/HRD

This work is supported by NOAA through the Joint Hurricane Testbed.

I. Previous Work

- Uhlhorn and Nolan (2012) attempted to determine the typical "underestimate" of peak surface winds from aircraft penetrations with SFMR

  They generated hundreds of simulated SFMR profiles by "flying" aircraft through a simulation of Hurricane Isabel (2003).

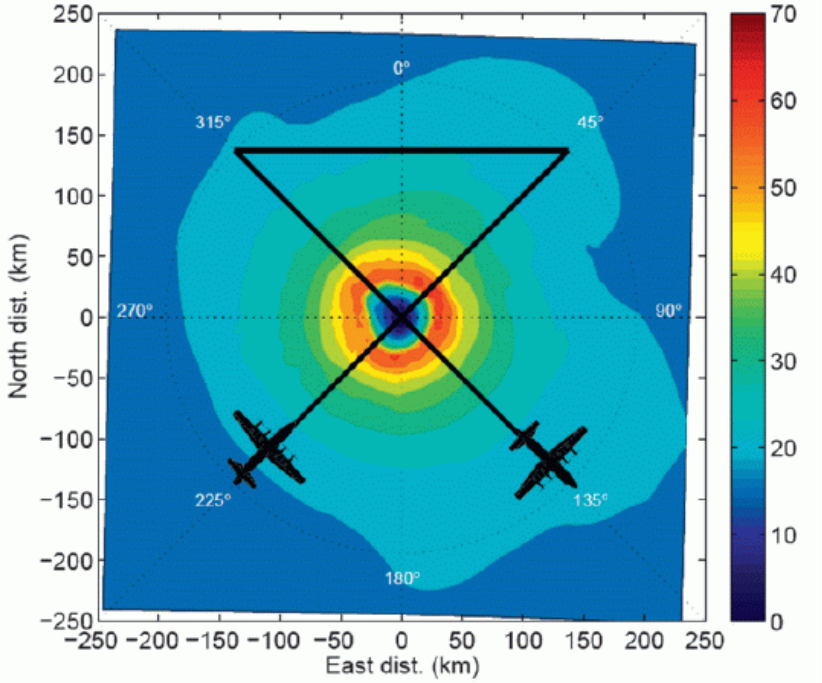


FIG. 6. Single figure-four (or alpha) flight pattern superimposed on a surface wind field snapshot (m s^{-1}). Aircraft symbols identify initial and final points of the pattern.

Main finding:

The peak SFMR wind reported from a single figure-4 flight pattern will underestimate the peak 1-min wind speed by about 8%.

II. Project Goals

1. To apply the same (or improved) methods of Uhlhorn and Nolan (2012) to assess undersampling on a wider variety of hurricanes.

   → Provide guidance for how much to increase surface wind speed estimates from SFMR observations.

2. To use a similar methodology to assess undersampling of minimum surface pressure estimated from dropsondes released in the eye.

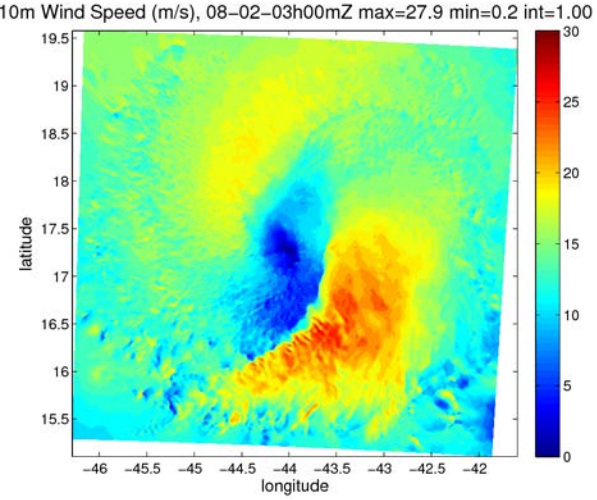
   → Provide improved guidance on surface pressure corrections based on wind speed at splashdown. (NOT COVERED TODAY)

3. To use a similar approach to provide estimates of undersampling of surface wind speed provided by scatterometers.

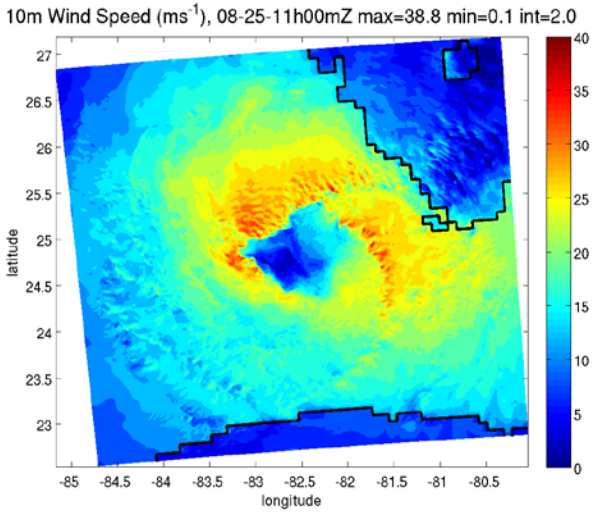
   → Provide guidance for how much to increase surface wind speed estimates from scatterometer overpasses.

III. Simulation Data Sets

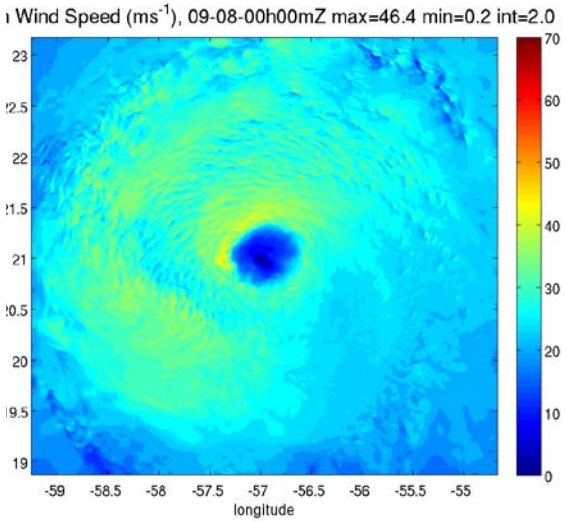
HNR1 - TS



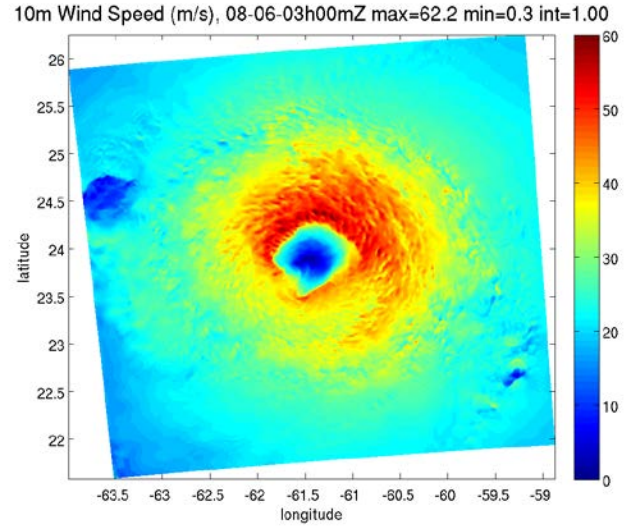
HNR2



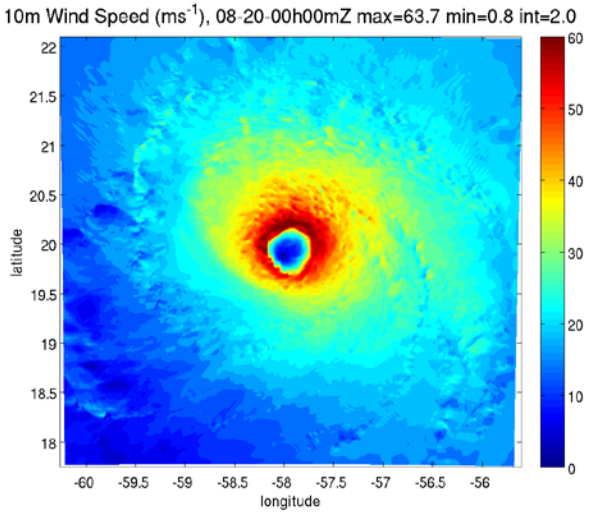
Ideal – Cat2



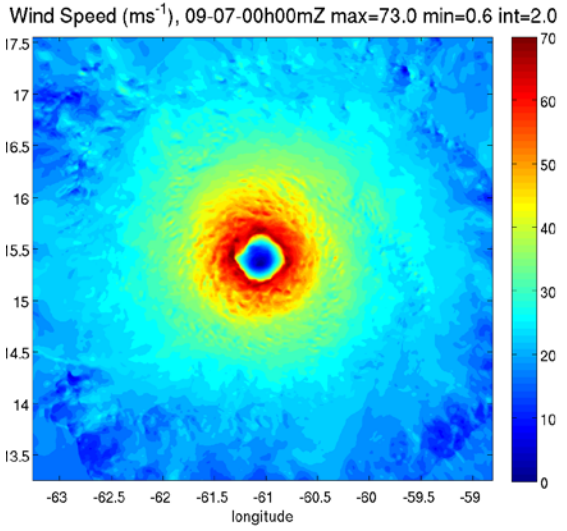
HNR1 – Cat4



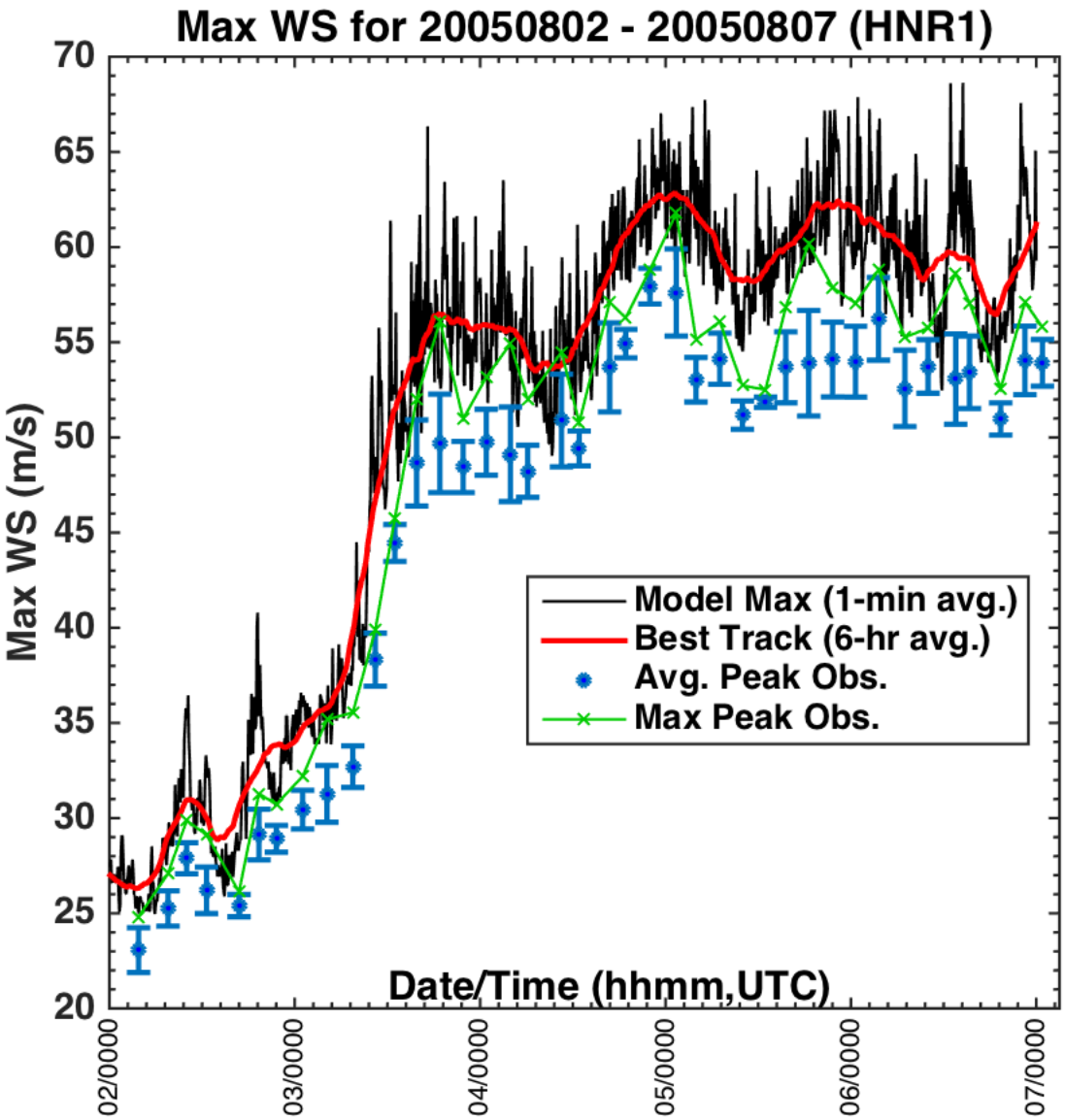
Bill



Ideal – Cat5



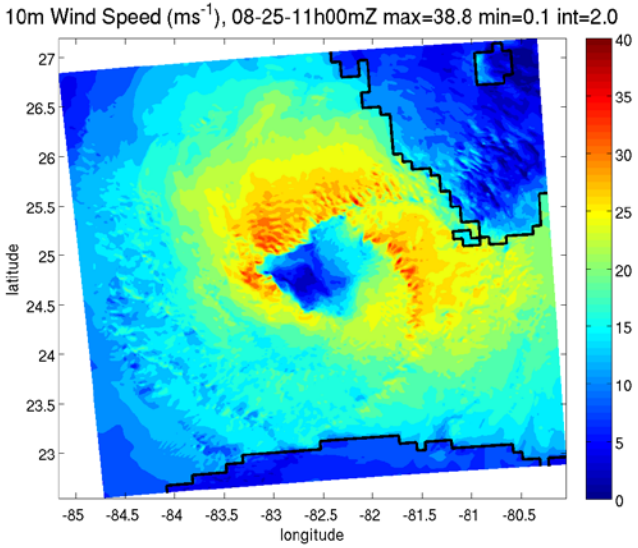
IV. Wind Speed Undersampling



8 simulated figure-4s every 3 hours

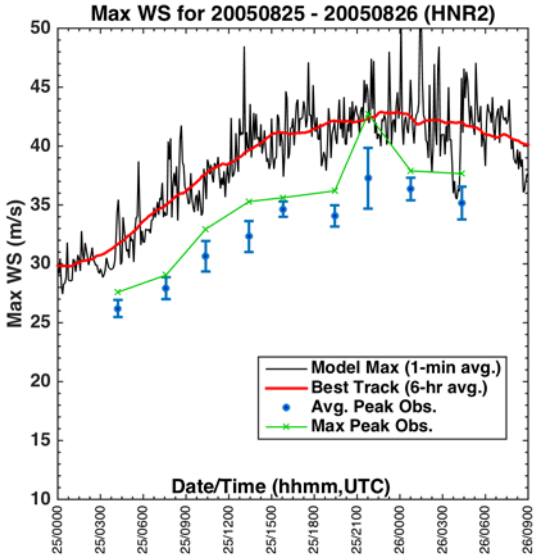
Mean undersampling of "best track" intensity is 11%

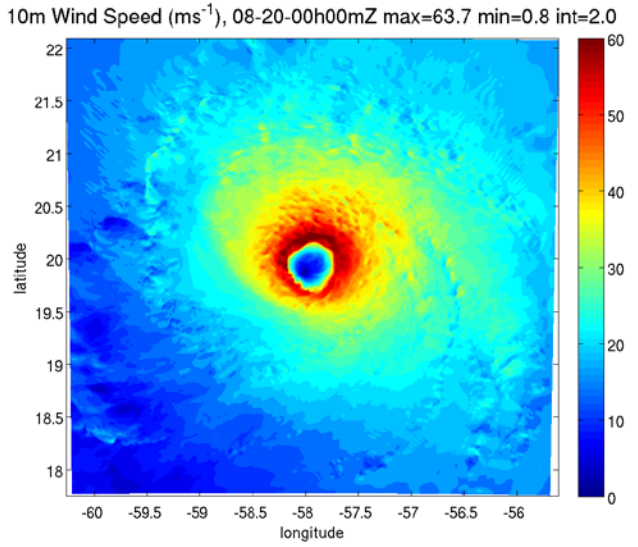
14% during RI



Nature Run 2

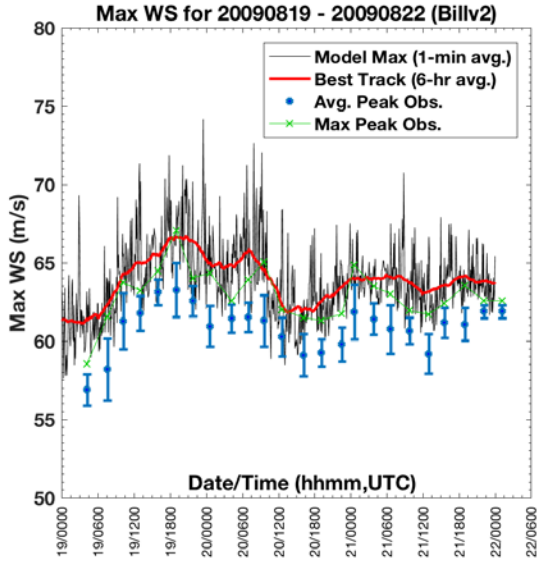
Typical Underestimate: 16%





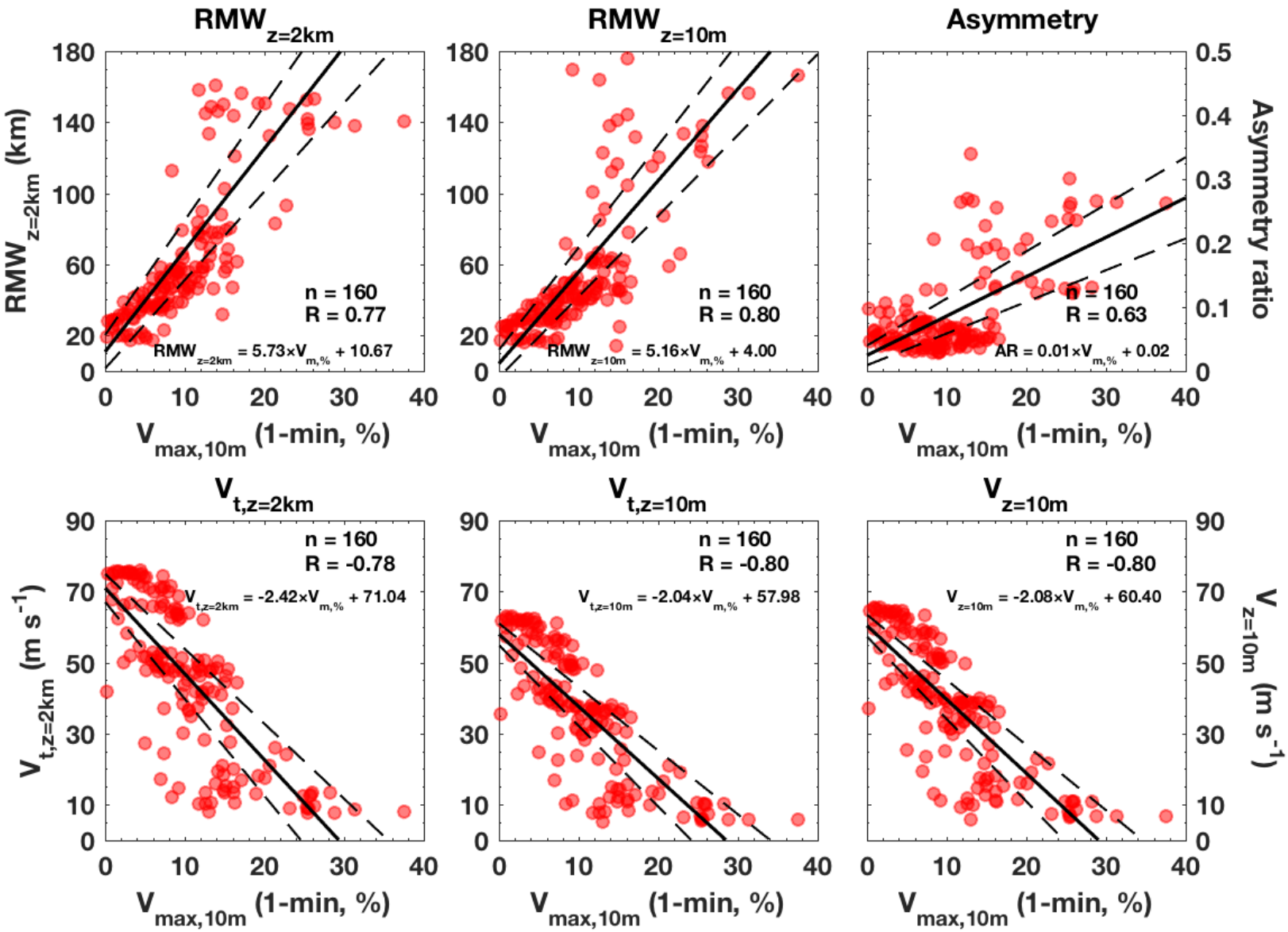
Hurricane Bill

Typical Underestimate: 5%



Undersampling seems to be: Greater for larger size, more asymmetry.
Less for higher intensity.

Asymmetry = sqrt($V_1^2 + V_2^2$)/V_0



V. Implementation

- How can forecasters use this information in real time?

Current idea:

	TS	CAT 1-2	CAT 3-5
Small	10%	5%	5%
Medium	15%	10%	5%
Large	20%	15%	10%

V. Implementation

- How can forecasters use this information in real time?

Current results:

	TS	CAT 1-2	CAT 3-5
Small RMW_{10} < 30 km	8.9%	5.7%	3.1%
Medium 30 km to 60 km	14.0%	10.6%	6.1%
Large RMW_{10} > 60 km	17.8%	10.7%	--

VI. Estimates of Scatterometer Undersampling

→ Using the horizontal resolution and scanning strategies described in peer-reviewed literature to produce ASCAT-like 10-m wind fields

→ Simulating variations in coverage, viewing angle, and rain impacts to better determine wind speed underestimates

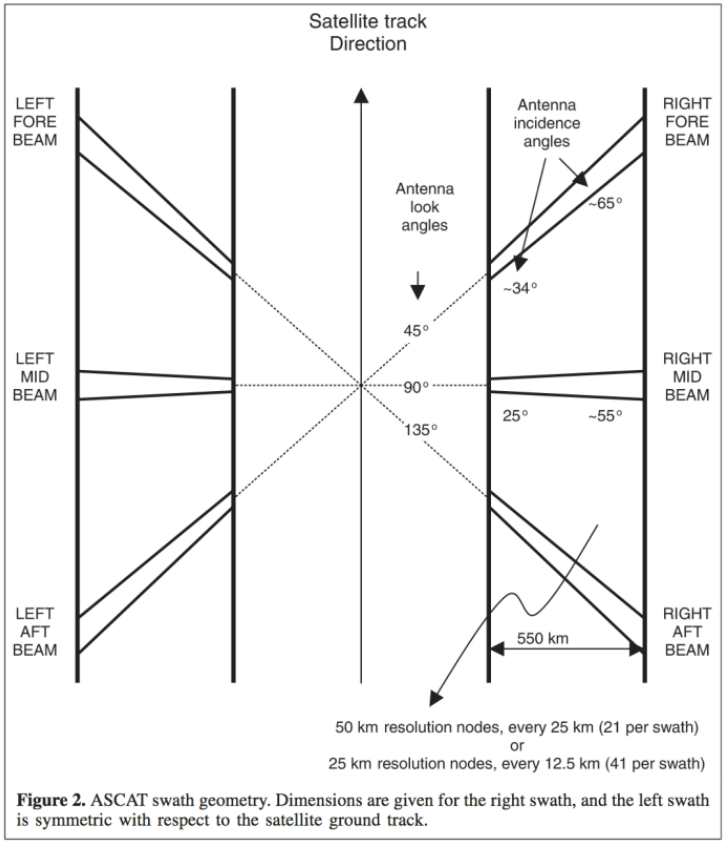
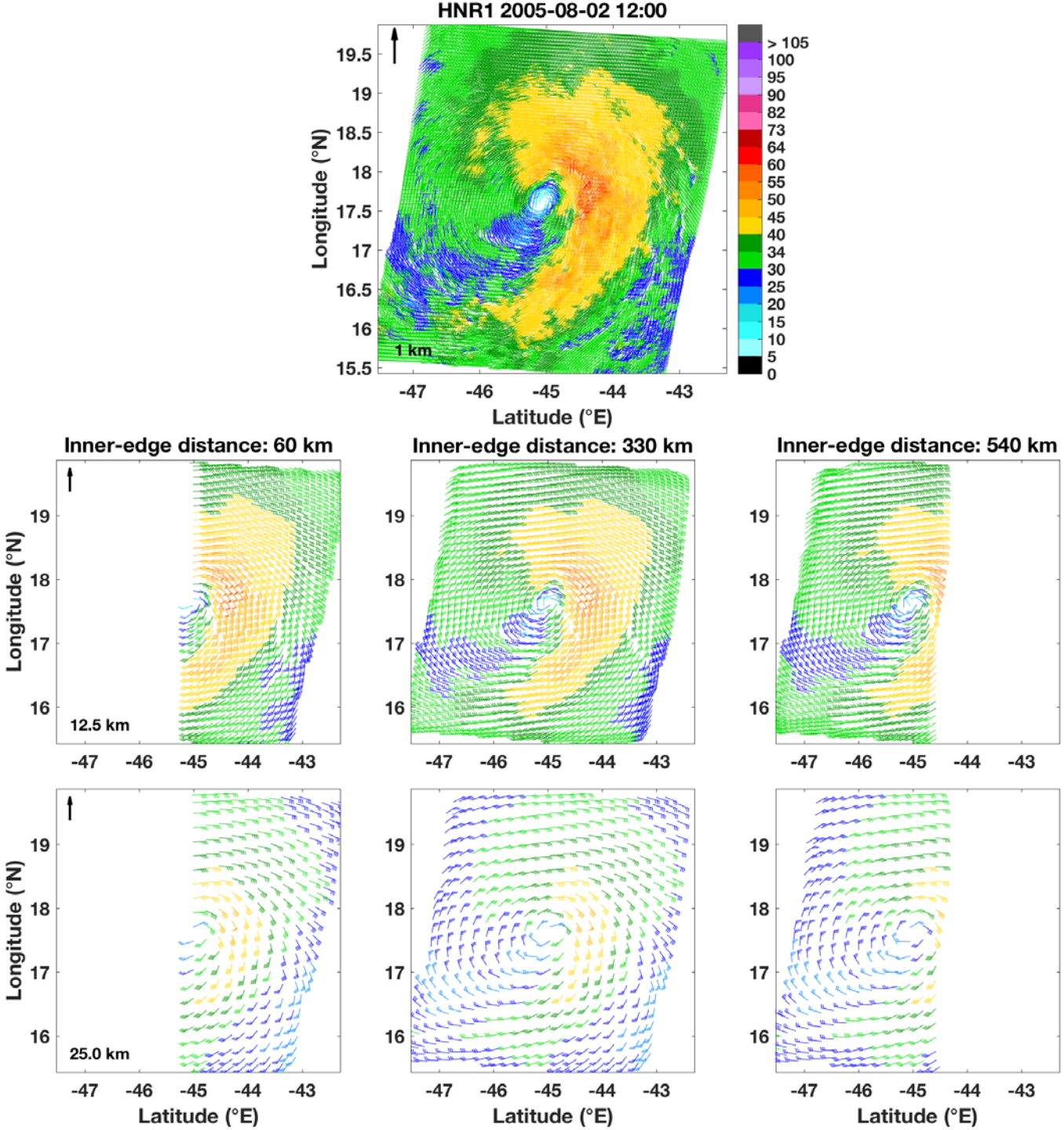


Figure 2. ASCAT swath geometry. Dimensions are given for the right swath, and the left swath is symmetric with respect to the satellite ground track.

Figa-Saldana et al. 2002


HNR1 2005-08-02 12:00
Longitude (°N)
Latitude (°E)
1 km
> 105
100
95
90
82
73
64
60
55
50
45
40
34
30
25
20
15
10
5
0
Inner-edge distance: 60 km
Inner-edge distance: 330 km
Inner-edge distance: 540 km
12.5 km
25.0 km