Spatial structure of directional wave spectra in hurricanes.

Oceanografia física

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MOTIVATION

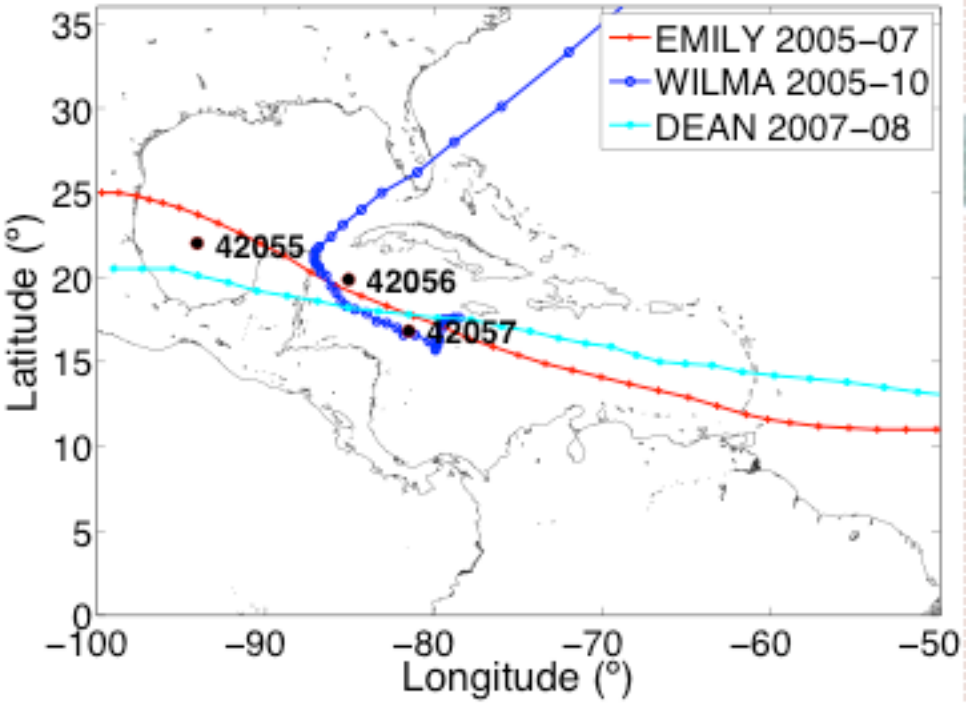
- **Set the basis to be used to asses the ability of numerical models to simulate the wave field in hurricanes.**

- **Characterize the structure of the directional spectrum in the hurricane domain.**

- **Finding the sites of generation of the dominant waves.**

METHODOLOGY

- NDBC directional buoy database in the **Caribbean Sea** and **Gulf of Mexico**.
  - Directional Spectra was:
    - *Estimated from the Fourier moment using the **Maximum Entropy Method** (Ardhuin algorithm, Lygre and Krogstad,1986)*
    - ***Fixed***
      - *Respect to the center of the hurricane using the track, the propagation direction and the Radius of maximum winds*



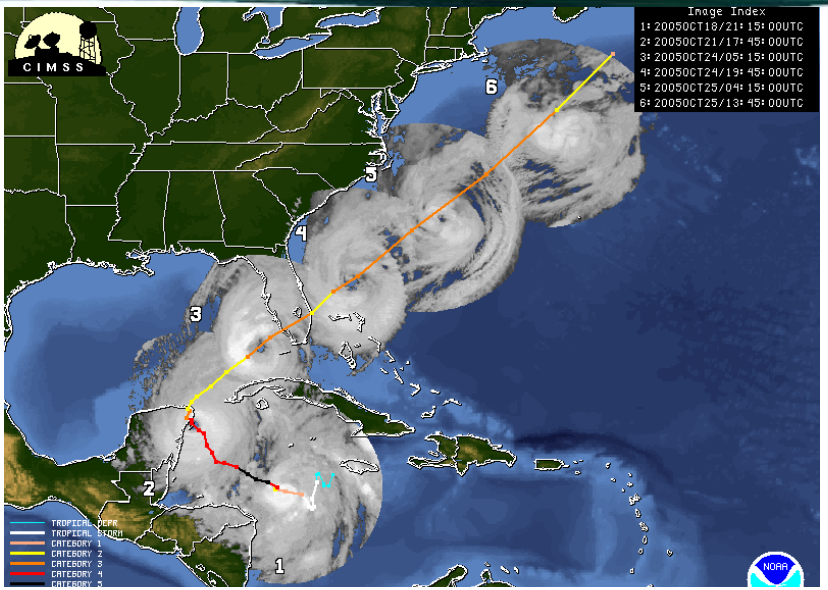
- ***Partitioned in their principal components.*** ***(Portilla et al.2009)***
  - *In order to quantify between local and remote generated energy.*

- **HRD (Hurricane Researcg Division) wind map database**

SUMMARY OF CONCLUSIONS

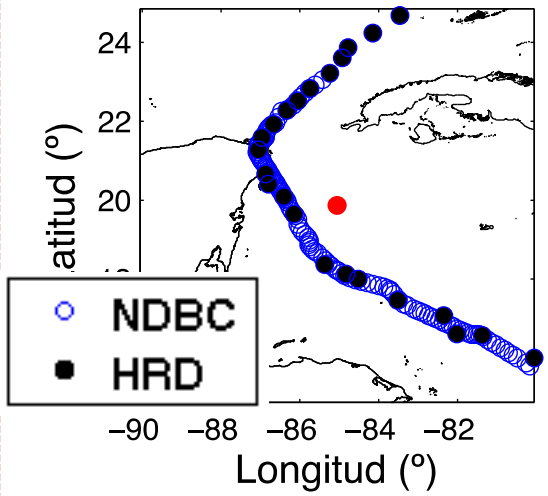
- **Findings are consistent with those found using remote sensing data (e.g. Scanning Radar Altimeter data,** Wright et al. 2001**).**
  - Highest waves are in the right forward quadrant of the hurricane.
    - ***Where the spectral shape tends to become uni-modal.***
  - More complex spectral shapes are observed in the rear quadrants of the spectra.
    - ***Where a tendency of the spectra is to become bi-modal and tri-modal.***

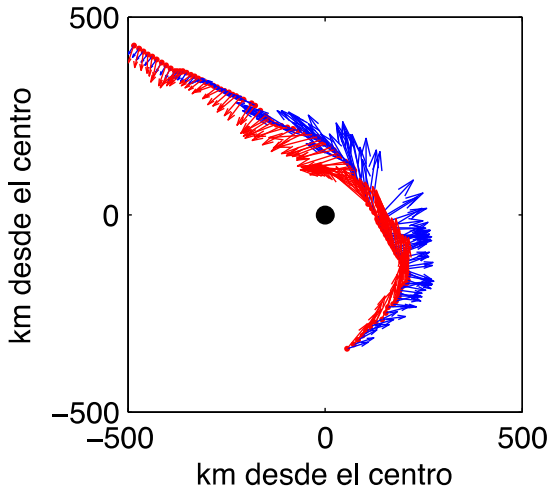
WILMA 15/10/2005 – 26/10/2005

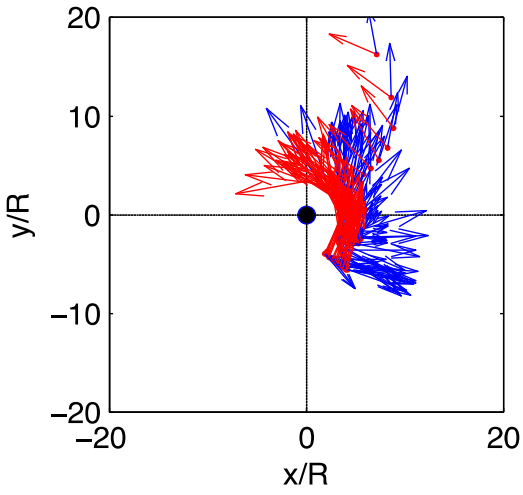


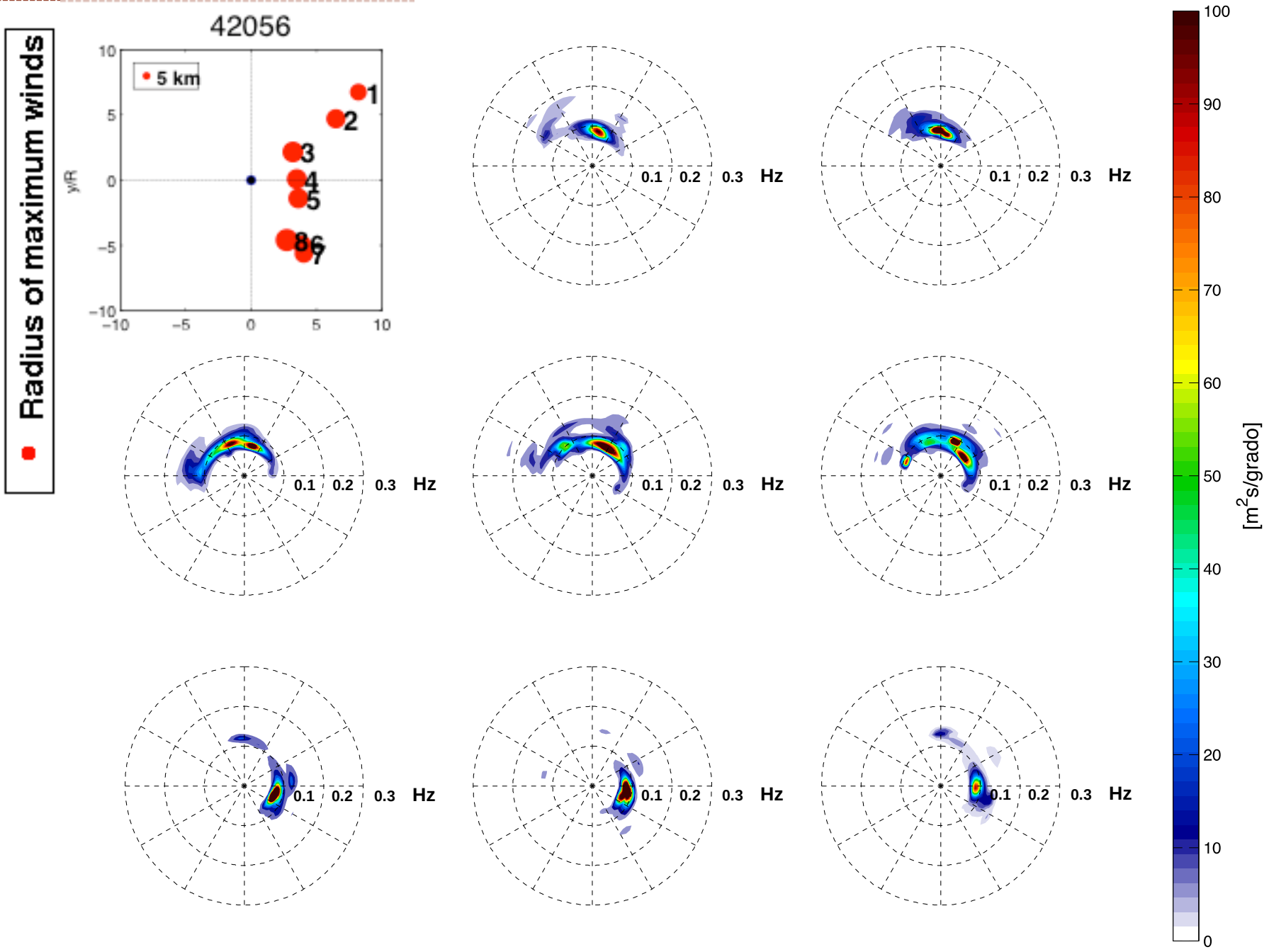
Following (Young, 2006)

Peak direction
Wind direction

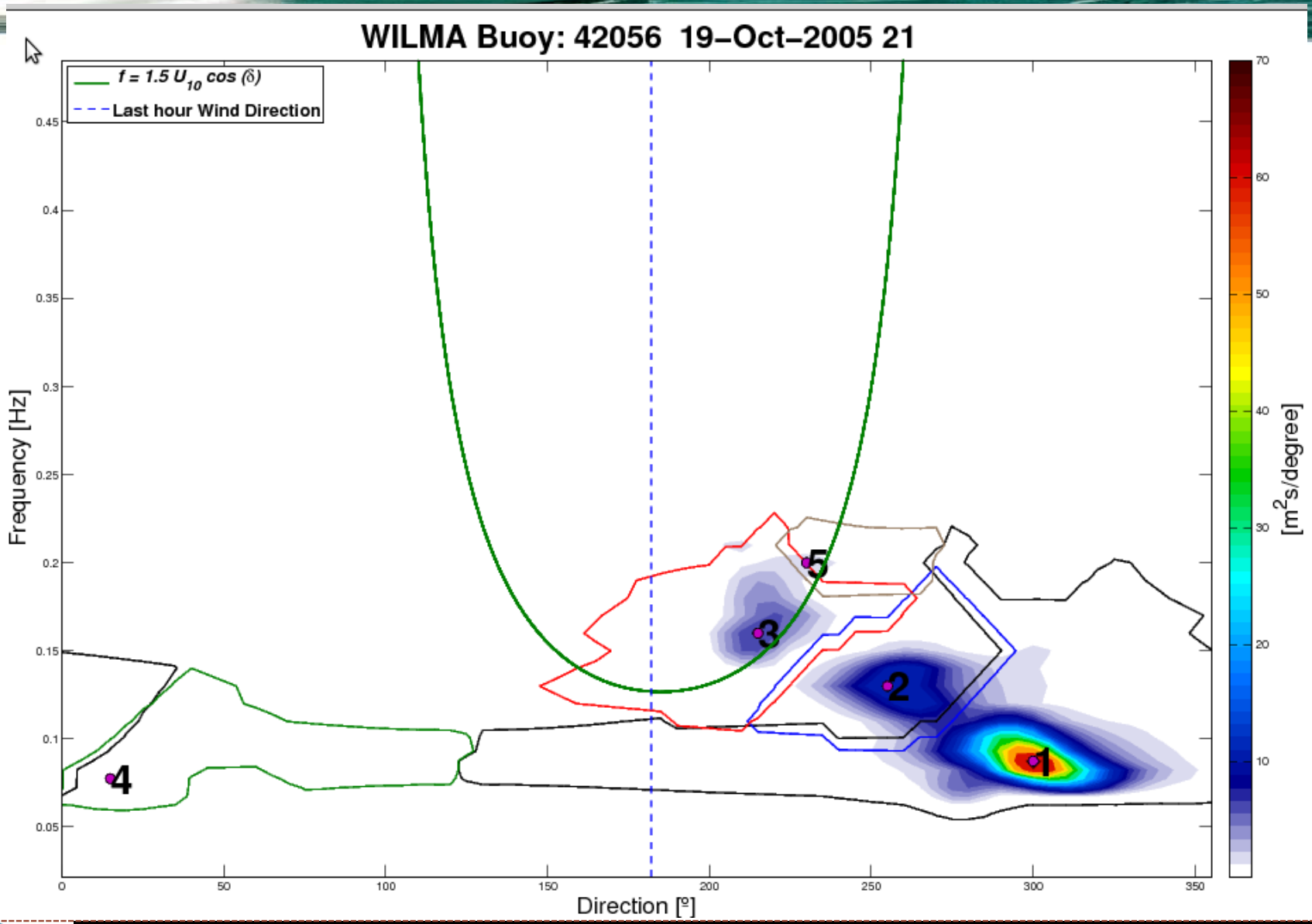


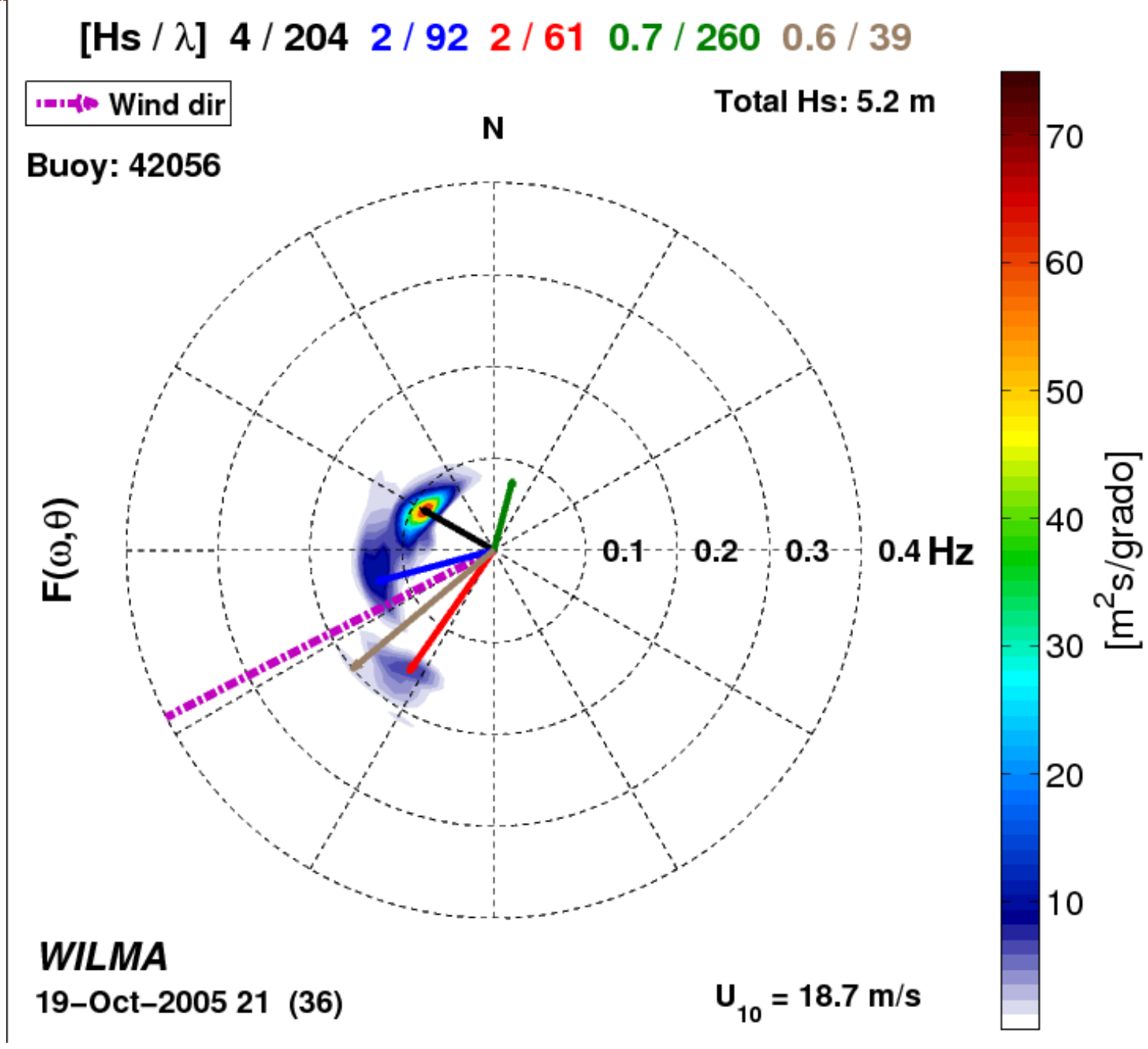





Radius of maximum winds
42056
5 km
1
2
3
4
5
6
7
8
y/R
0.1
0.2
0.3
Hz
100
90
80
70
60
50
40
30
20
10
0
[m²s/grado]

Partitioning (following Portilla et al.2009)




[Hs / λ] 4 / 204 2 / 92 2 / 61 0.7 / 260 0.6 / 39
Wind dir
Total Hs: 5.2 m
N
Buoy: 42056
F(ω,θ)
0.1
0.2
0.3
0.4 Hz
70
60
50
40
30
20
10
[m²s/grado]
WILMA
19–Oct–2005 21 (36)
U10 = 18.7 m/s

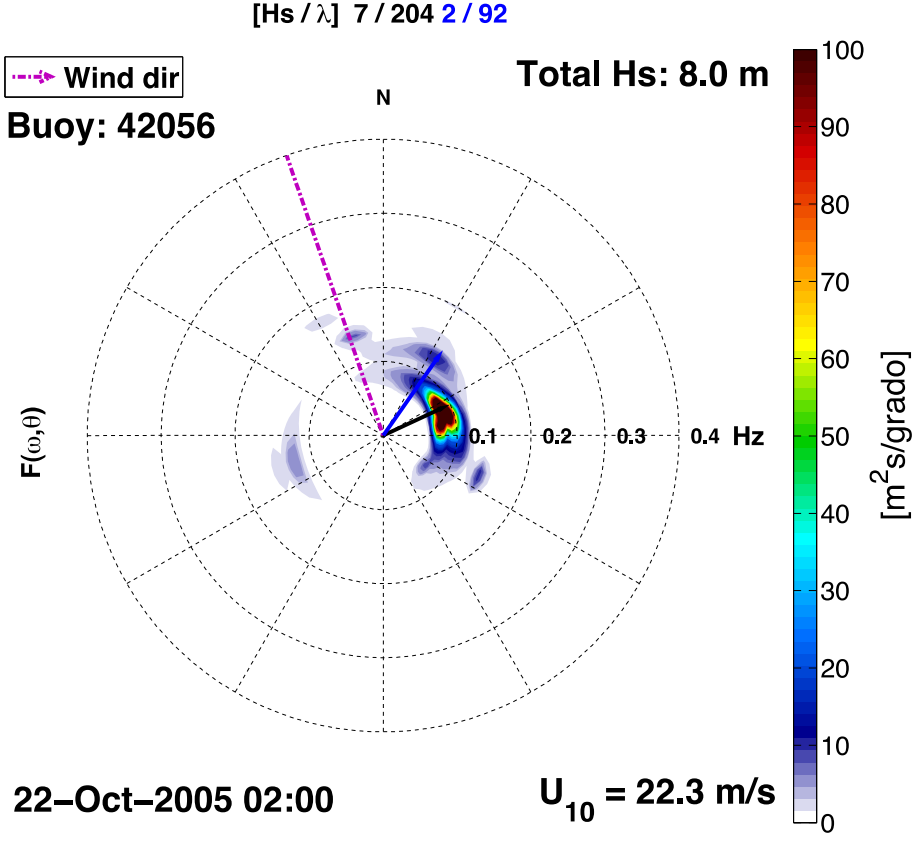
SWELL "SOURCE"

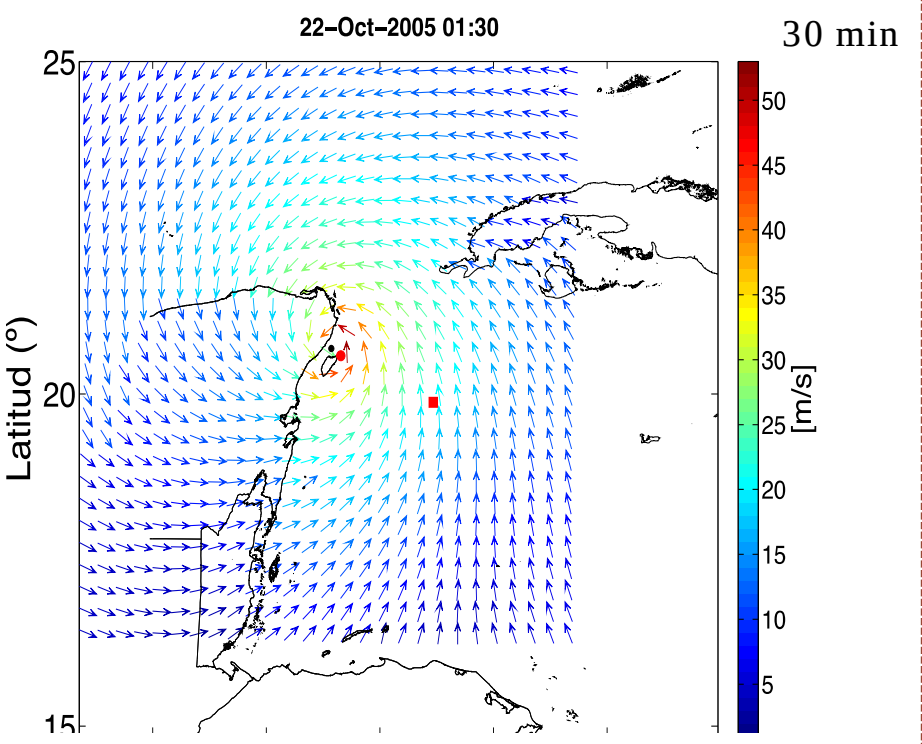
Deep water dispersion relationship

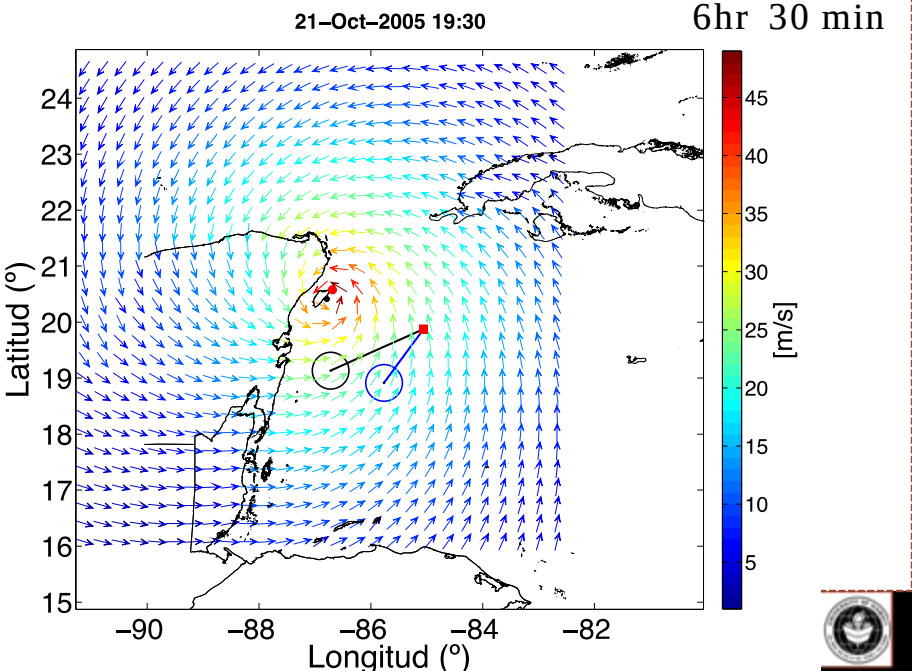
$$\omega^2 = gk \qquad \omega = Angular\,frequency \quad k = Wavenumber$$

Wave energy travels at the Group Velocity

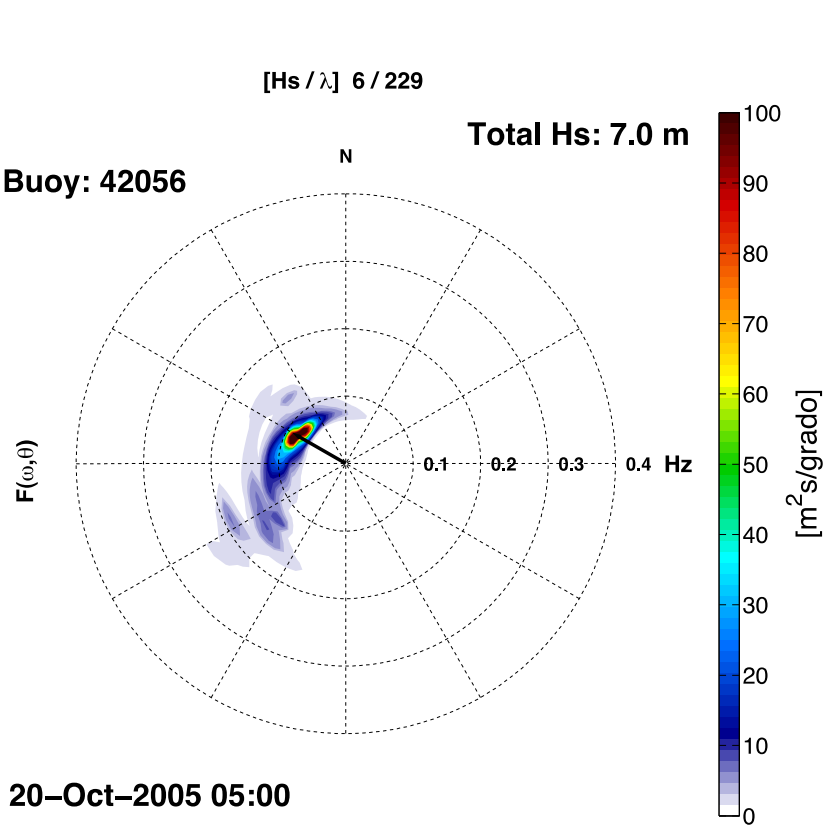
$$C_g = \frac{\partial \omega}{\partial k} = \frac{g}{2\omega} = \frac{distance}{time}$$

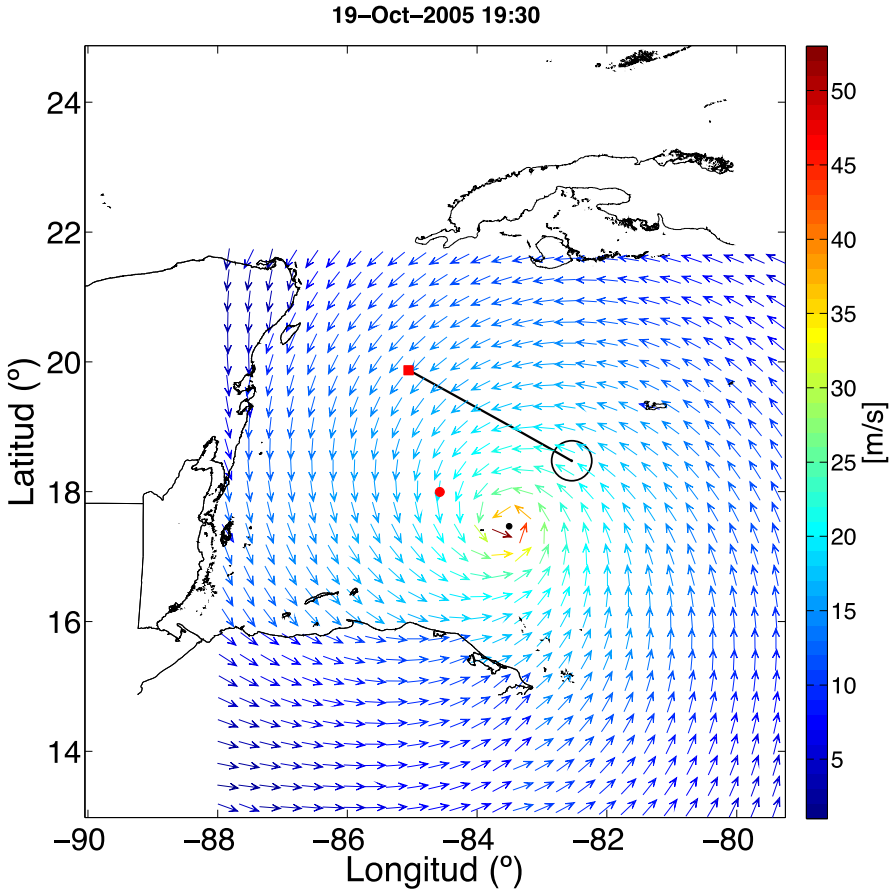




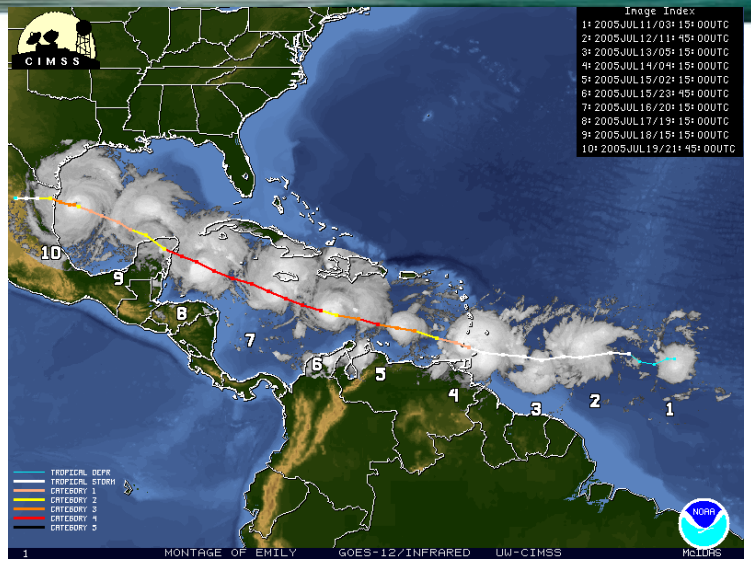


10 hr 30 min

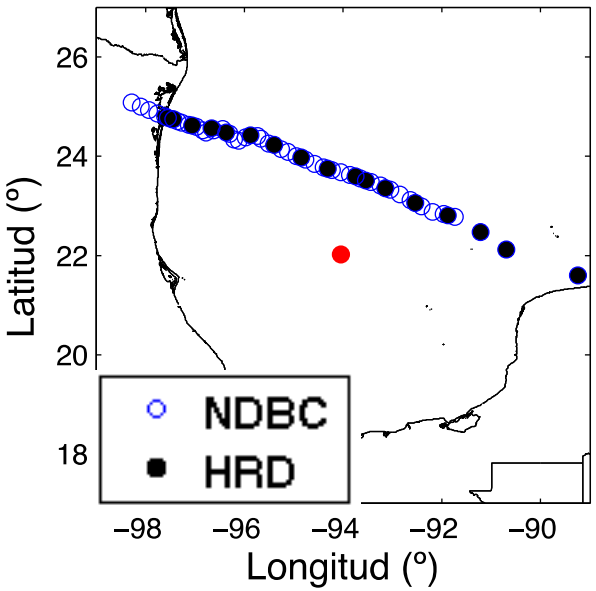

[Hs / λ] 6 / 229
Total Hs: 7.0 m
Buoy: 42056
N
F(ω,θ)
0.1
0.2
0.3
0.4 Hz
100
90
80
70
60
50
40
30
20
10
0
[m²s/grado]
20–Oct–2005 05:00

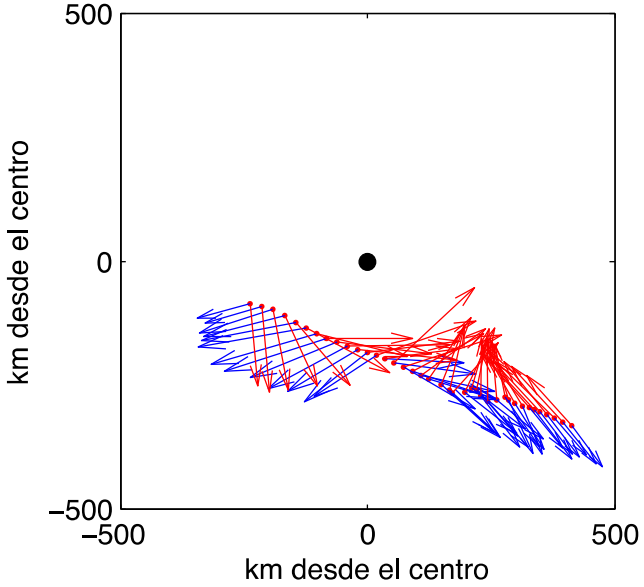

19–Oct–2005 19:30
24
22
20
18
16
14
Latitud (°)
–90
–88
–86
–84
–82
–80
Longitud (°)
50
45
40
35
30
25
20
15
10
5
[m/s]

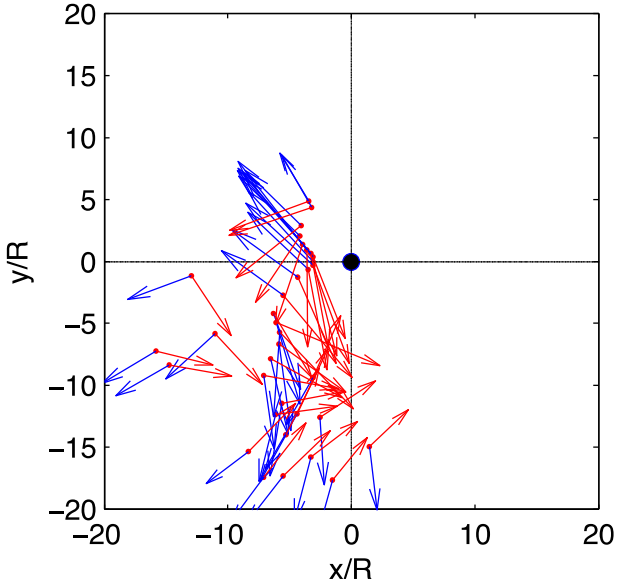
Emily 11/07/2005 – 21/07/2005

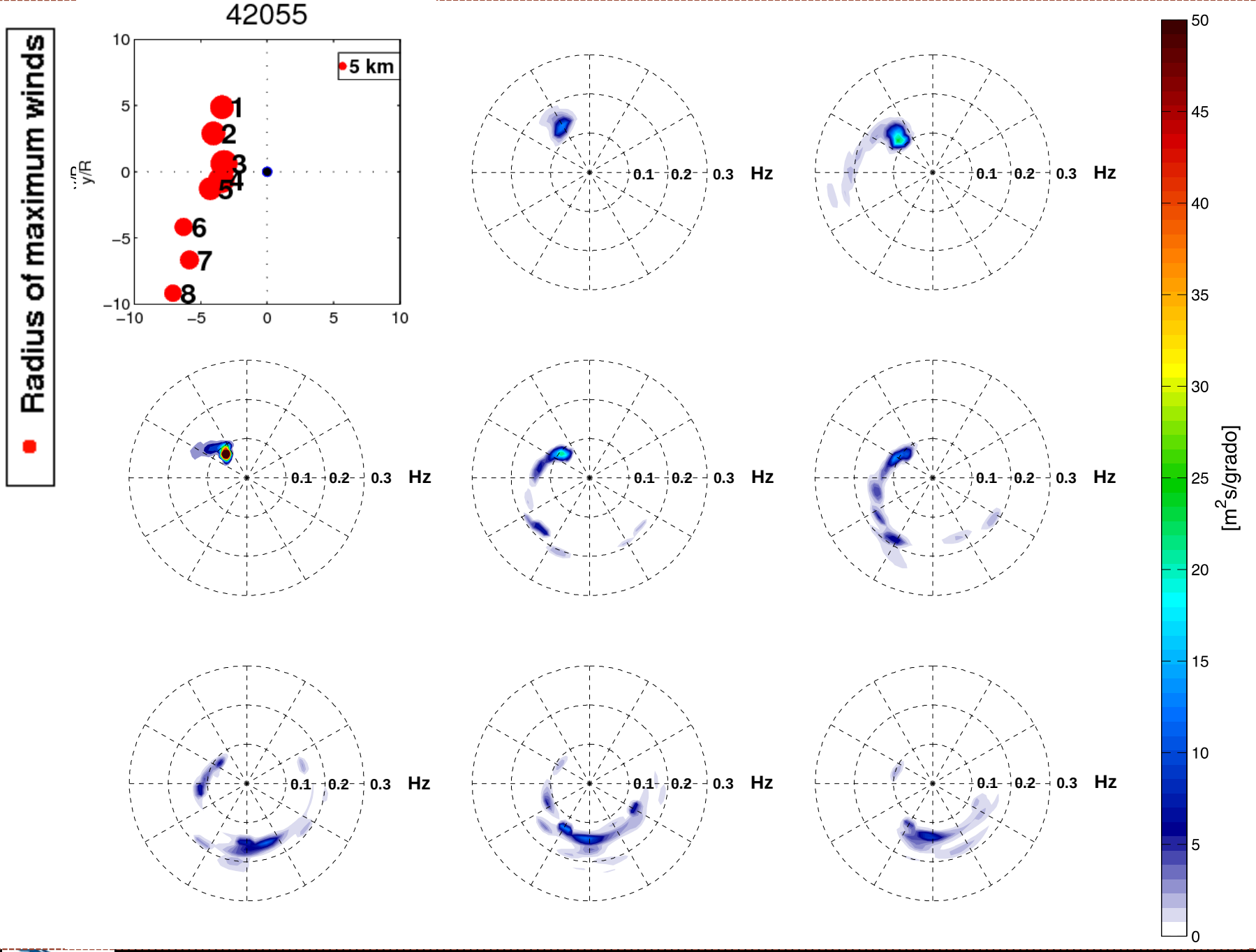


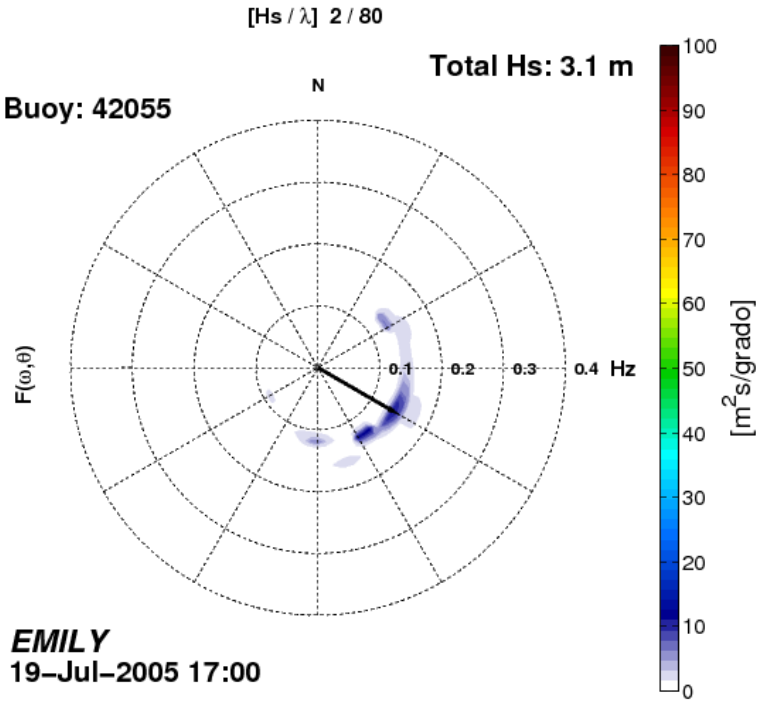
Peak direction
Wind direction

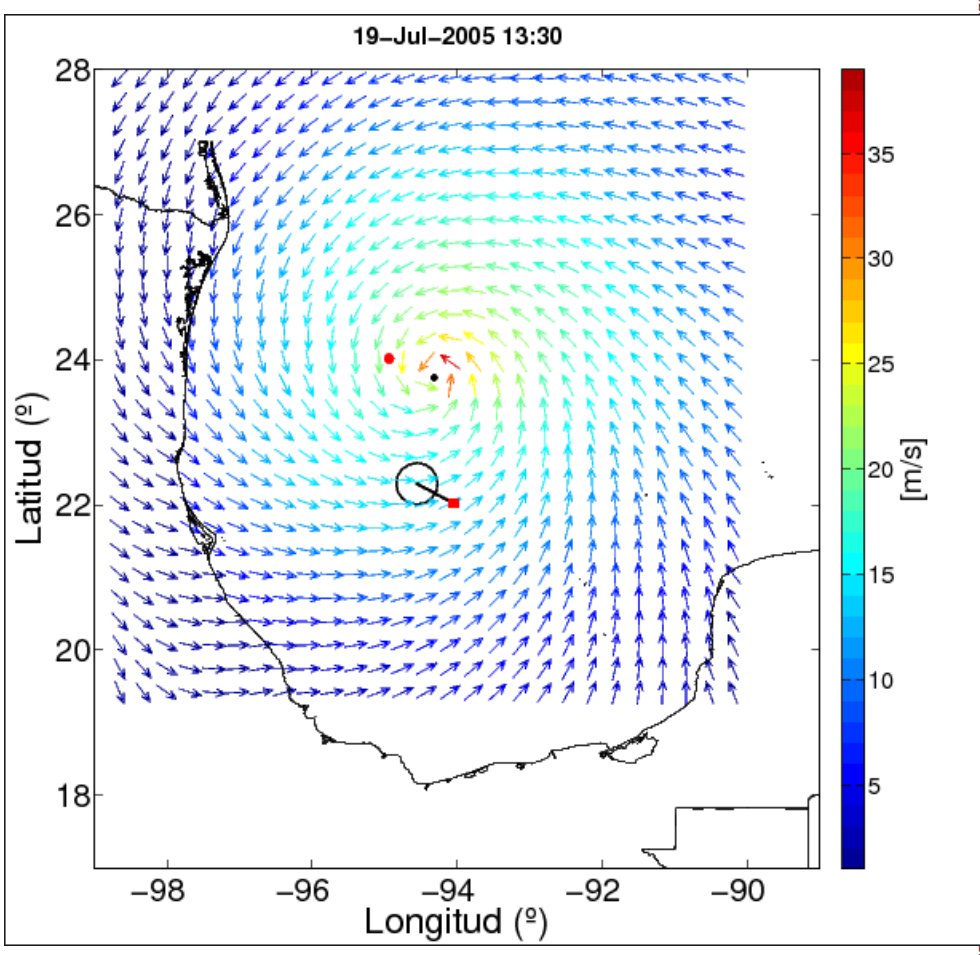




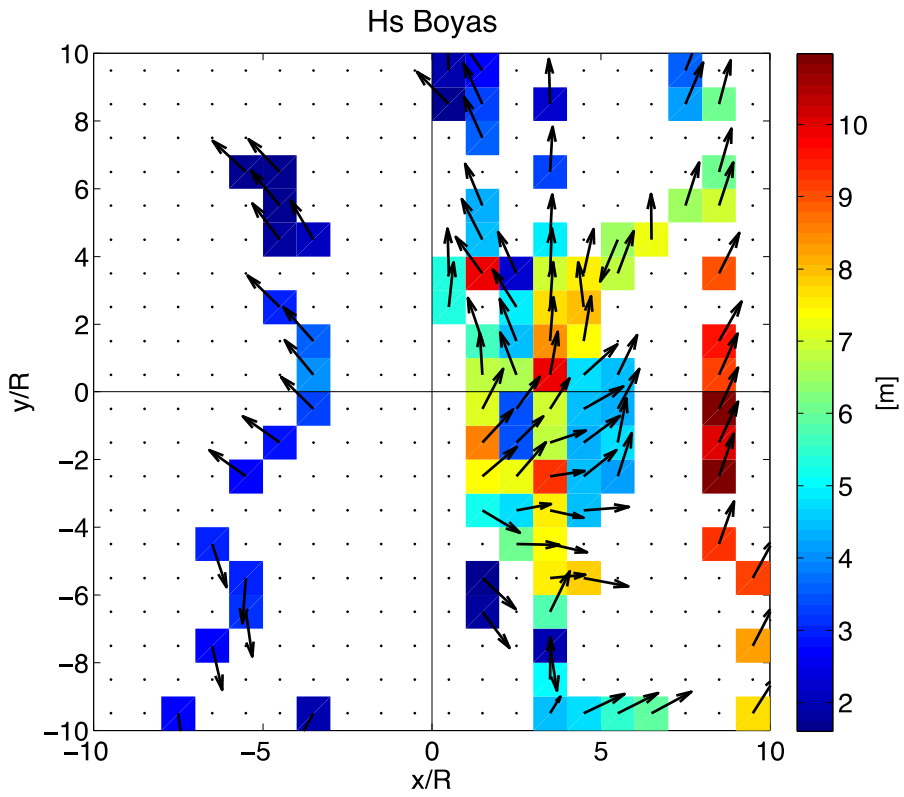


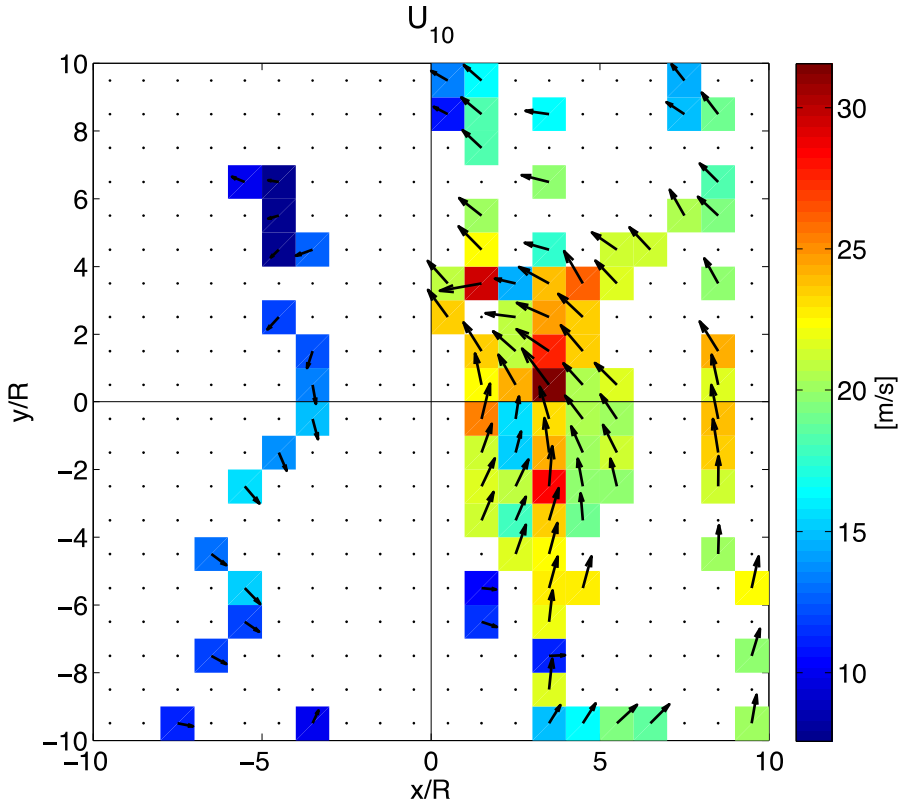

42055
Radius of maximum winds
5 km
x/R
y/R
1
2
3
4
5
6
7
8
0.1
0.2
0.3
Hz
50
45
40
35
30
25
20
15
10
5
0
[m²s/grado]


[Hs / λ] 2 / 80
Total Hs: 3.1 m
Buoy: 42055
N
F(ω,θ)
0.1
0.2
0.3
0.4 Hz
100
90
80
70
60
50
40
30
20
10
0
[m²s/grado]
EMILY
19–Jul–2005 17:00


19–Jul–2005 13:30
28
26
24
22
20
18
Latitud (º)
–98
–96
–94
–92
–90
Longitud (º)
35
30
25
20
15
10
5
[m/s]

Hs of all Hurricanes (fixed data)






Thanks