GRAVITY WAVES OBSERVED DURING BLLAST

21 June
23 June ⎬ RAIN & CONVECTION
29 June
02 July -> MICROSCALE

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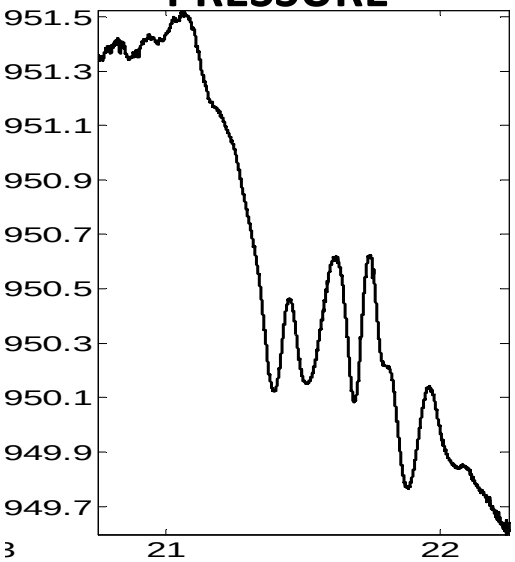
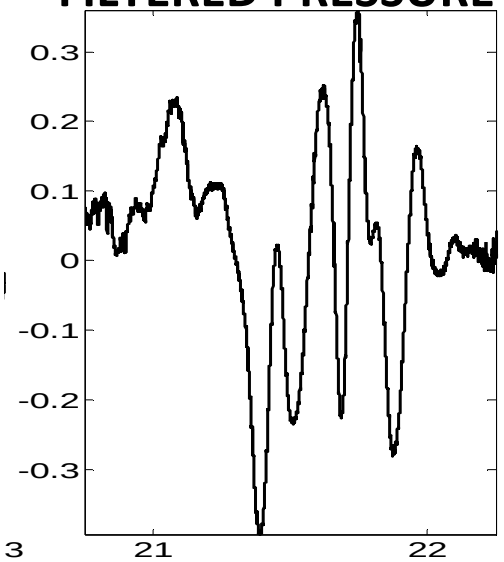
1- MICROBAROMETERS

- Pressure
- Filtered Pressure
- Wavelet analysis
- Wave parameters

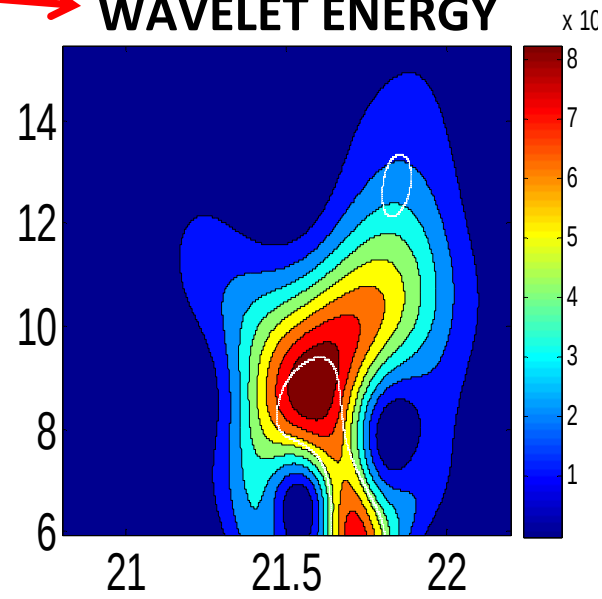
PRESSURE



FILTERED PRESSURE



WAVELET ENERGY

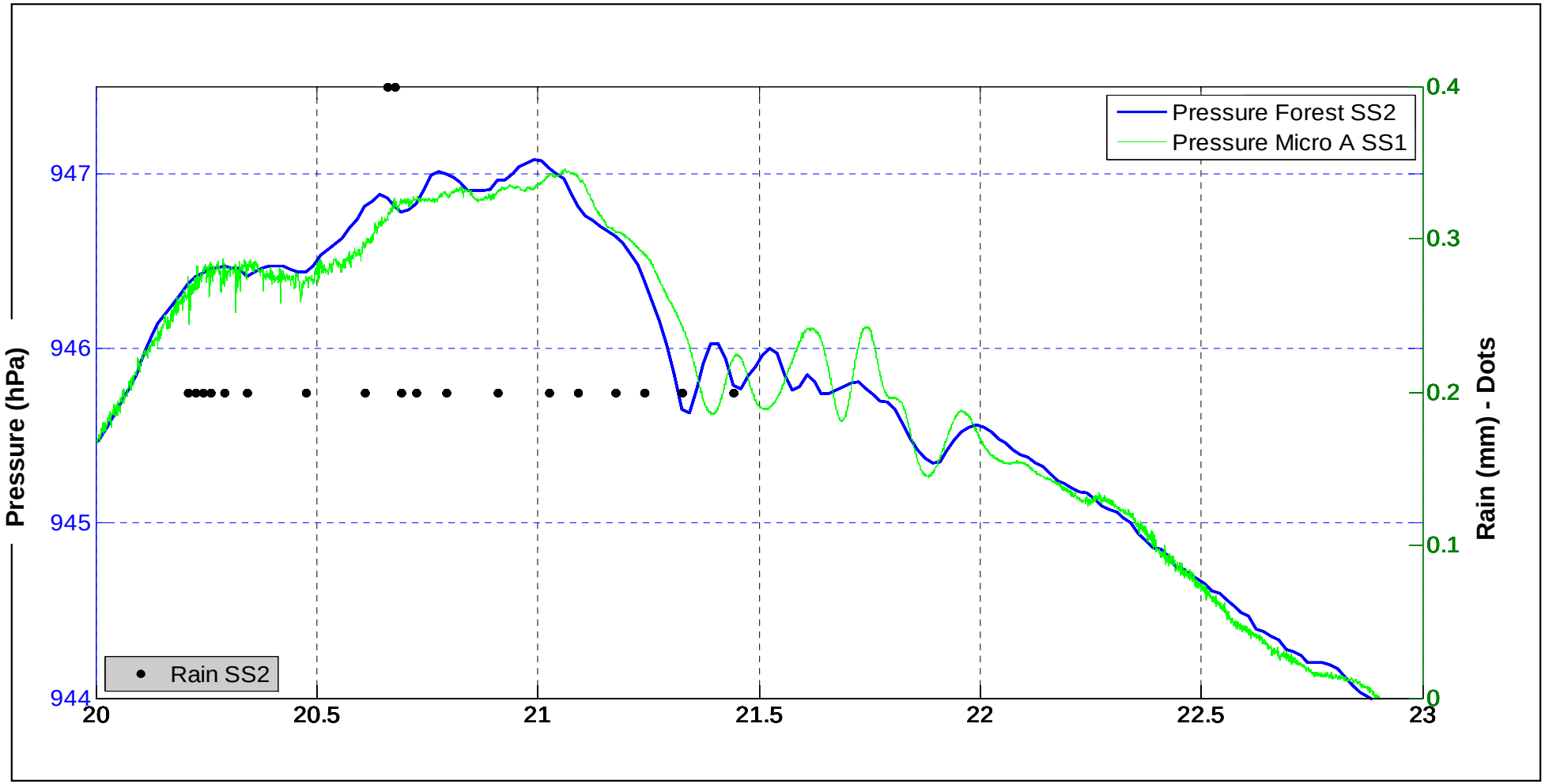


WAVE PARAMETERS

Wave parameters - from 21.4 to 21.7 (8-10min)		
Wavelength	Phase speed	Direction of propagation
8-10	12-14	45-55

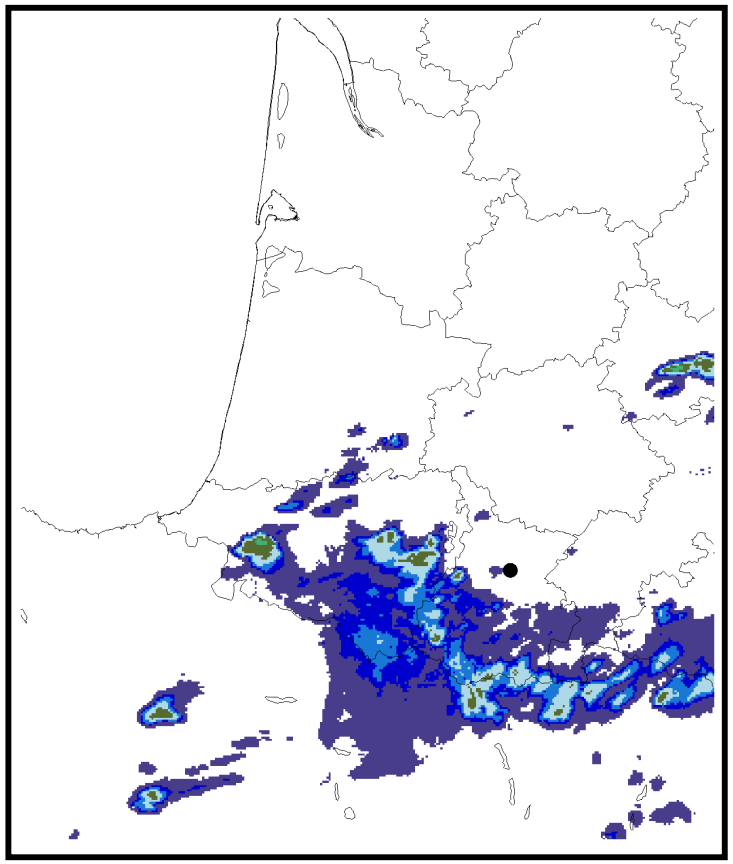
2- OTHER BAROMETERS AND PLUVIOMETERS

- Pressure at other locations (Forest site, Edge Site, Pic du Midi, Tarbes Airport…)
- Rain (SS1 & SS2)

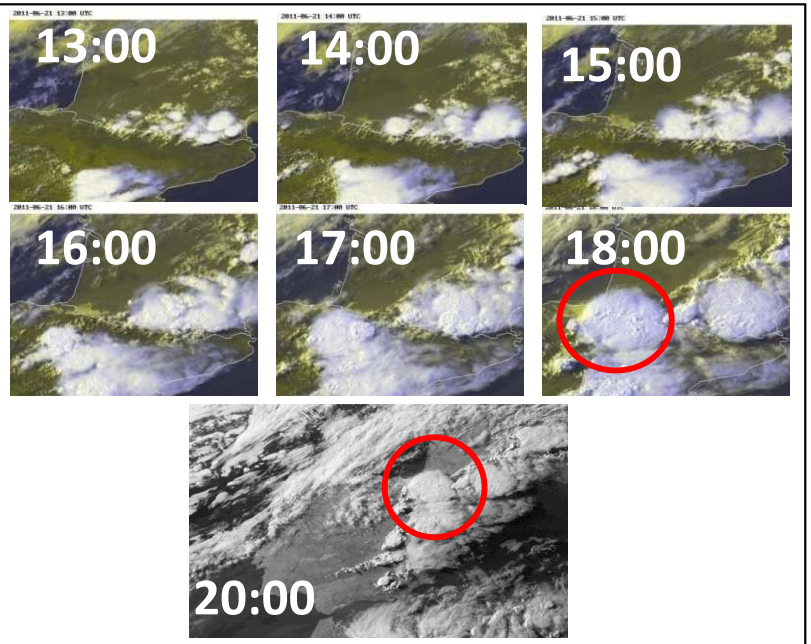


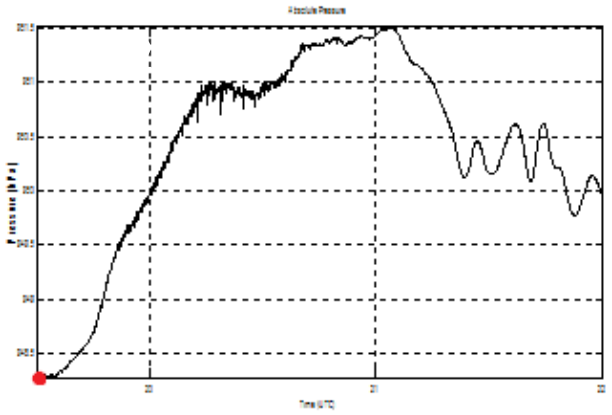
3- SATELLITE AND RADAR

- Precipitation
- Cloudiness and storms development



19:30





4. – WIND PROFILERS

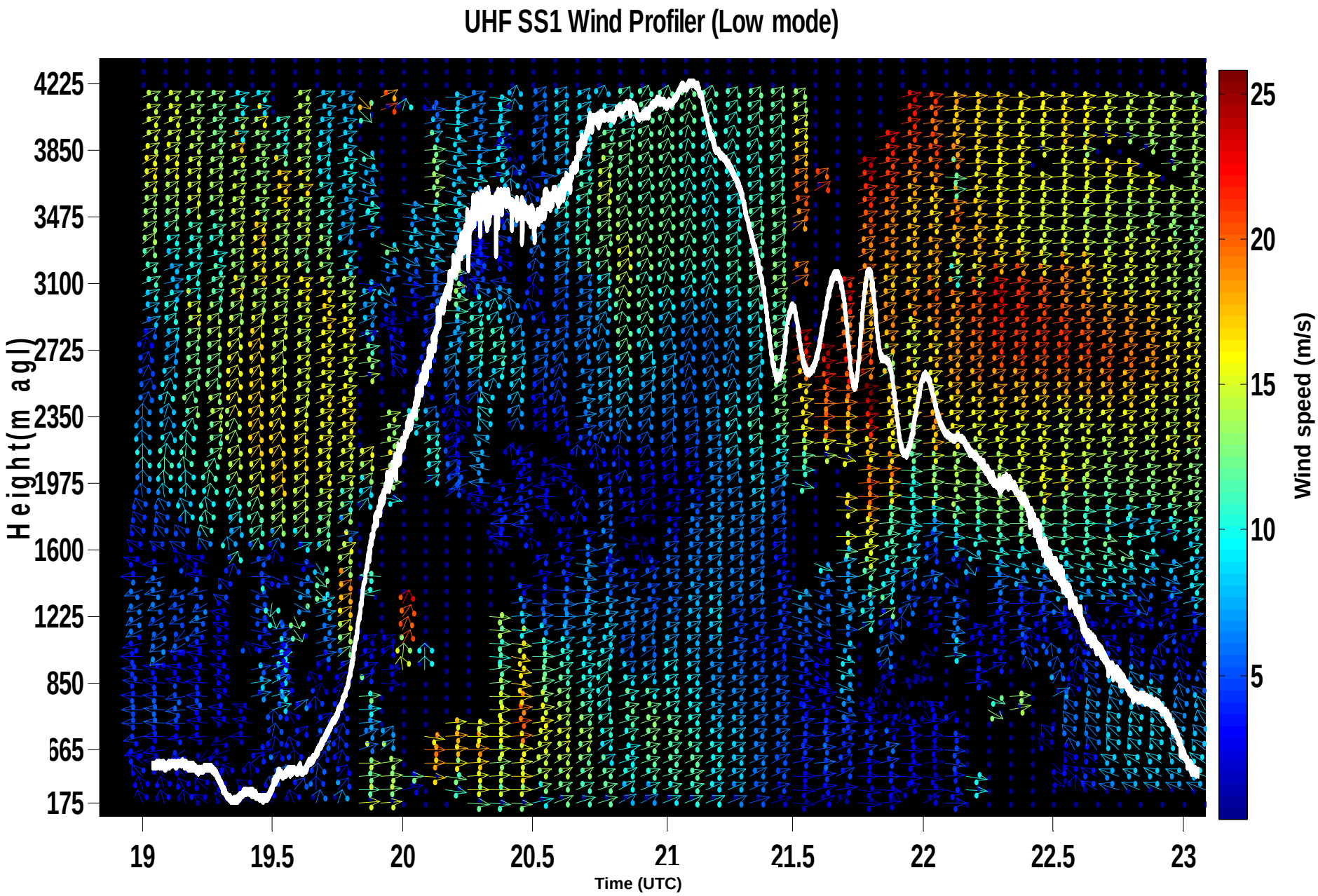
- **UHF SS1**
- **UHF SS2**

] Low and high modes

- **VHF**
- **SODAR**

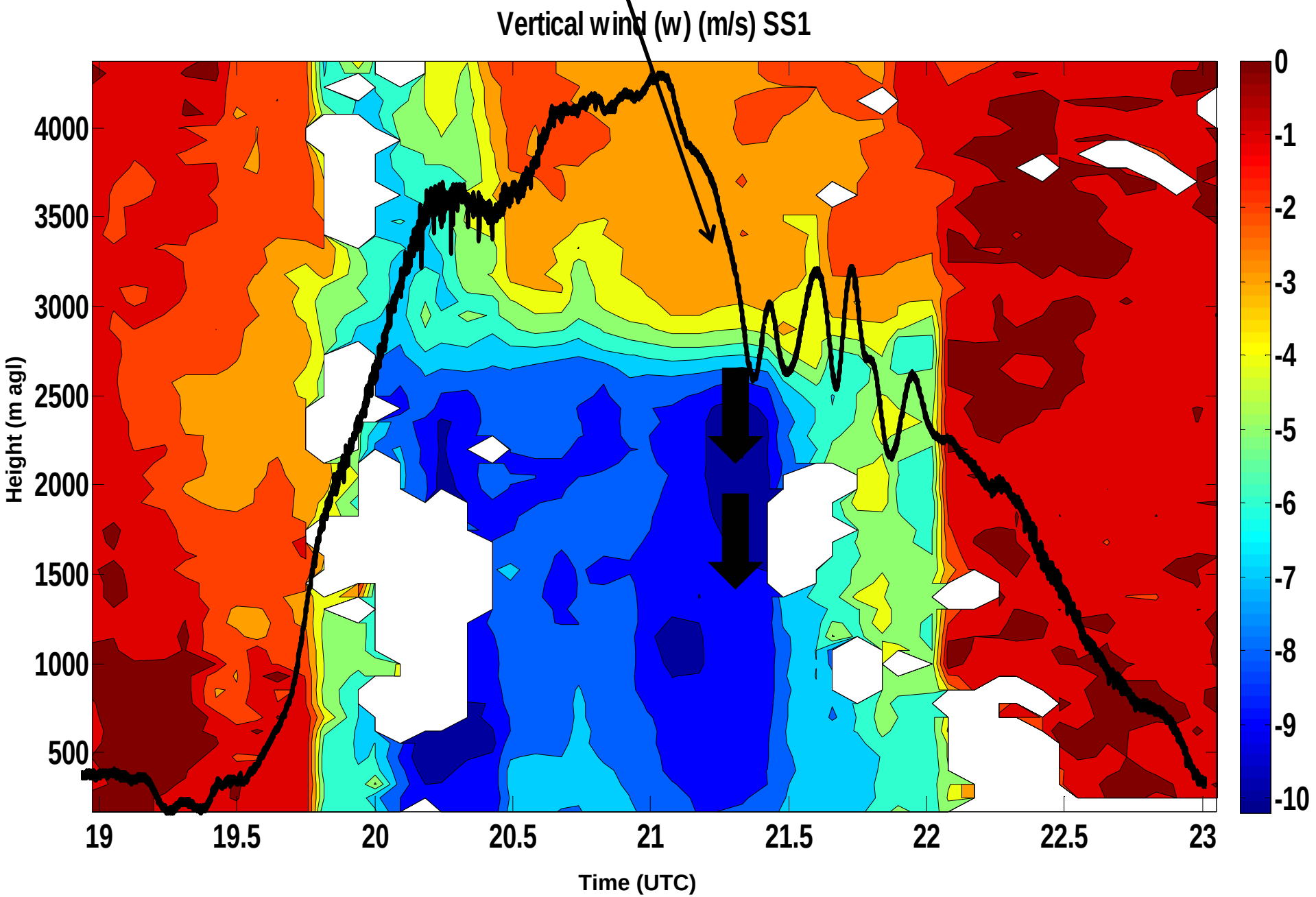
4- UHF SS1 (low mode)

- Horizontal wind



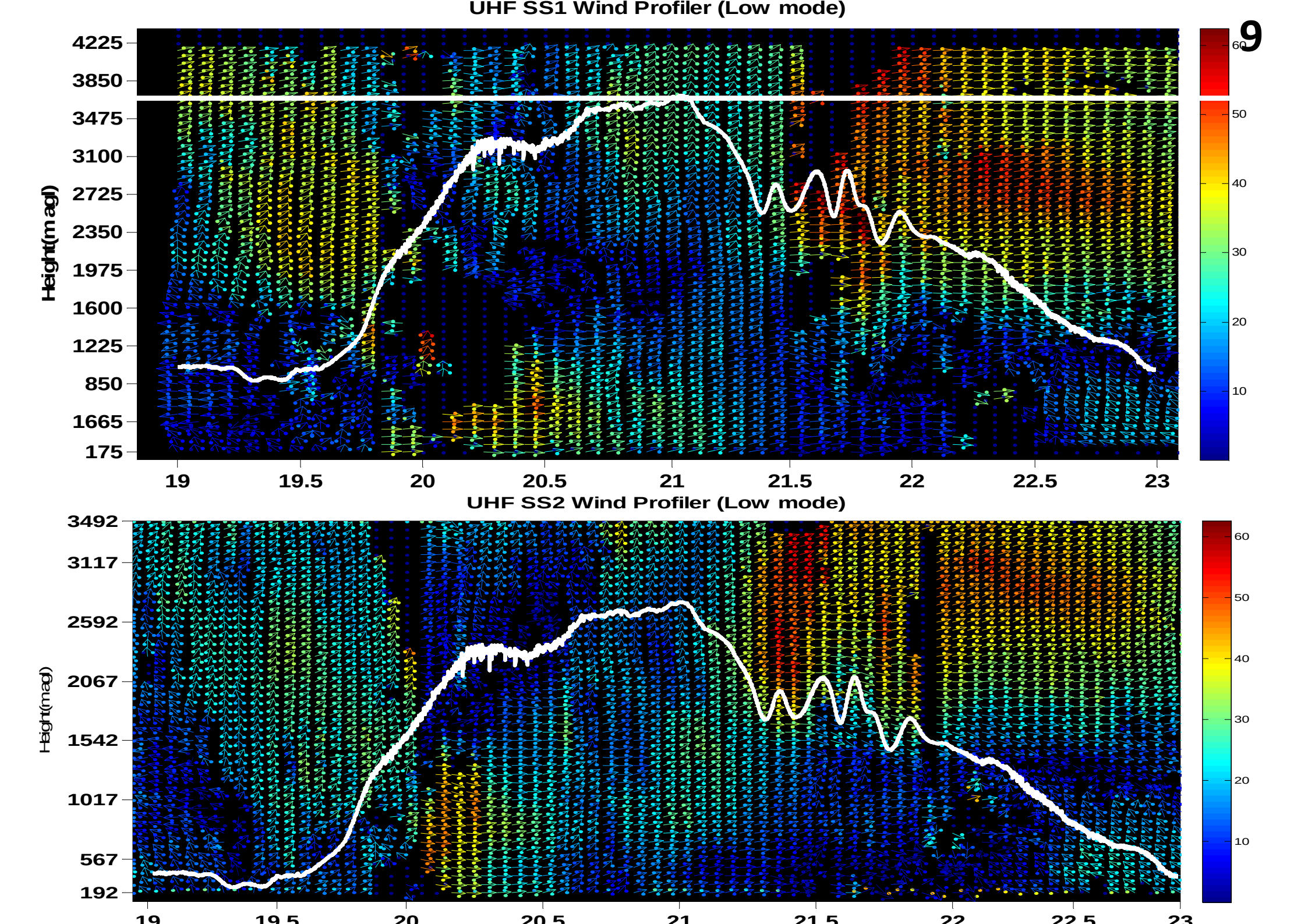
4- UHF SS1 (low mode)

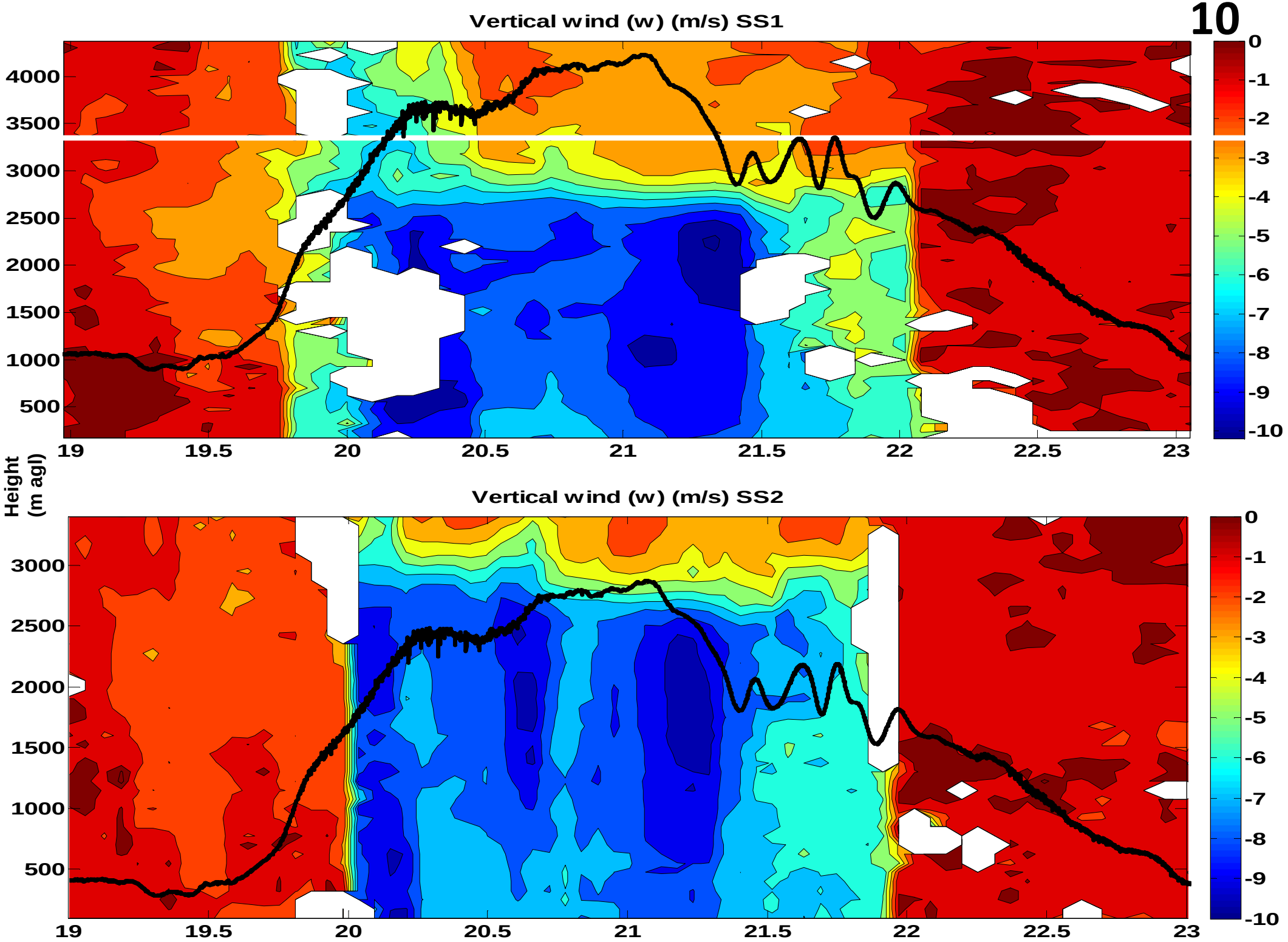
- Vertical wind (w)
- Gravity wave associated to “wake low” (common in MCSs)



4- UHF SS1 and UHF SS2 (low and high mode)

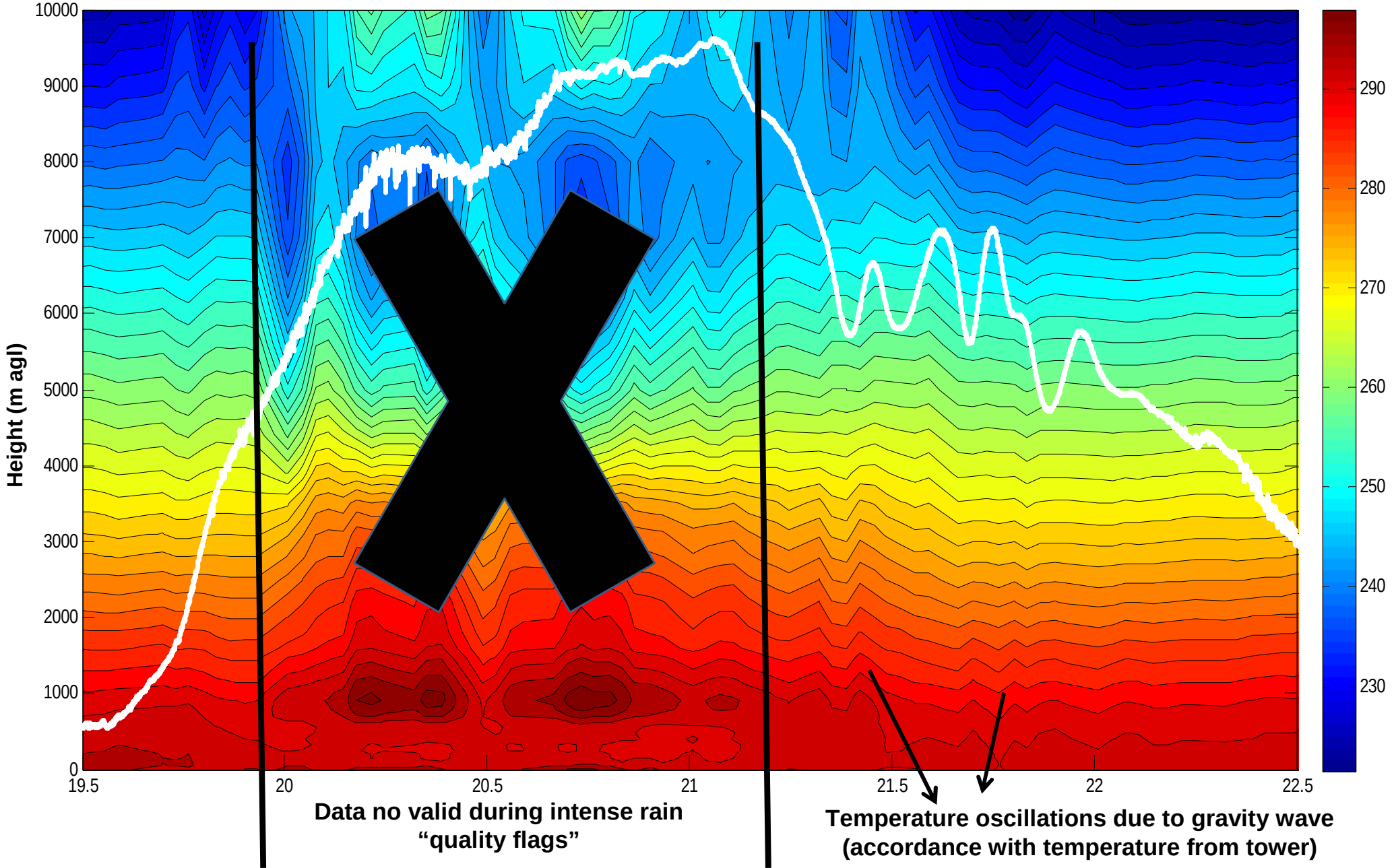
- Comparison between UHF SS1 & UHF SS2 (similar values)


UHF SS1 Wind Profiler (Low mode)
Height(magl)
4225
3850
3475
3100
2725
2350
1975
1600
1225
850
1665
175
19
19.5
20
20.5
21
21.5
22
22.5
23
60
50
40
30
20
10
9
UHF SS2 Wind Profiler (Low mode)
Height(magl)
3492
3117
2592
2067
1542
1017
567
192
19
19.5
20
20.5
21
21.5
22
22.5
23
60
50
40
30
20
10


Vertical wind (w) (m/s) SS1
Vertical wind (w) (m/s) SS2
Height (m agl)
4000
3500
3000
2500
2000
1500
1000
500
19
19.5
20
20.5
21
21.5
22
22.5
23
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10

6- HATPRO RADIOMETER HUMIDITY & TEMPERATURE PROFILER

- Temperature & Humidity up to 10000m
- Brunt Väisäla frequency
- Potential temperature



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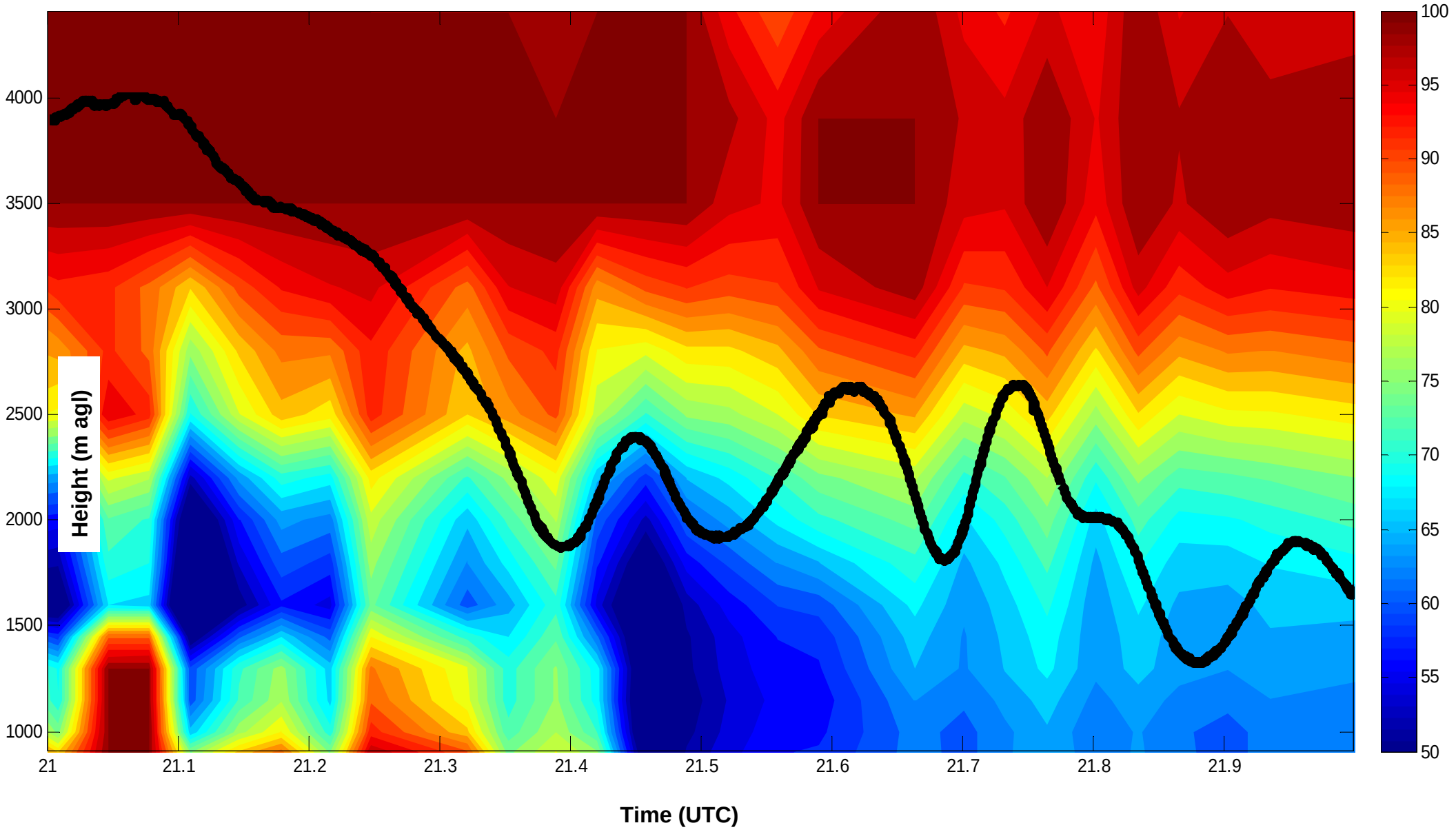


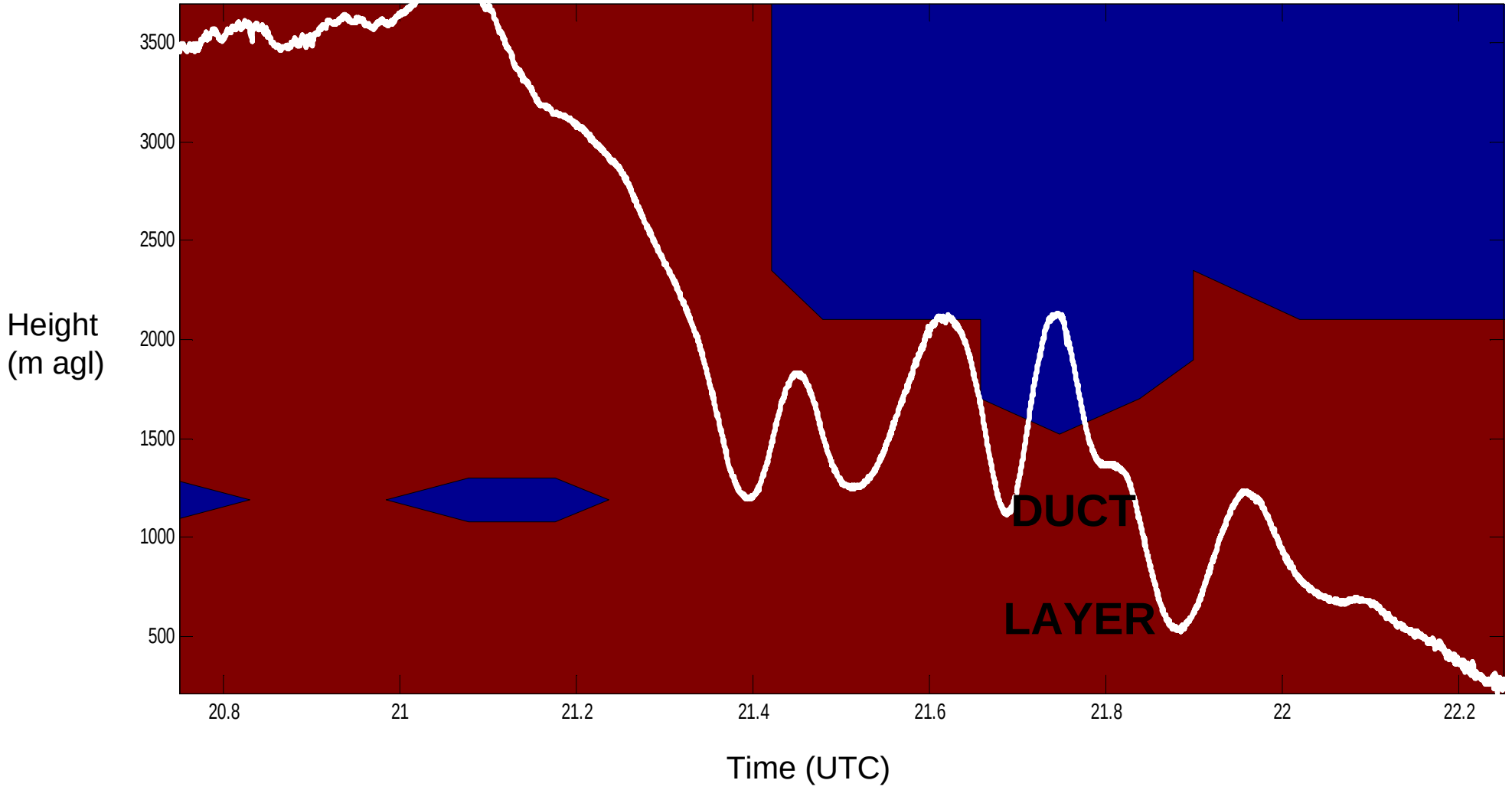
DUCT LAYER

-**Red color -> $m^2 > 0$ -> Wave propagation and maintenance**

Vertical wavenumber:

$$m^2 = \frac{N^2}{c_i^2} + \frac{\bar{U}_{zz}}{c_i} - k_h^2 - \frac{1}{4H^2}$$

- **Calculated from --> Temperature (HATPRO Radiometer)**
  --> Wind (UHF)
  --> Wave parameters (microbarometers)



- OTHERS

- Pic du Midi station (P, ws, wd, T)
- SODAR Capvern, Ceilometer, LIDAR (cloud base height)
- 60m & 8m towers (T, ws, wd, HR)

- OTHER DATA FOR MICROMETEOROLOGICAL Gravity Wave (2 JULY)

- Thermocouples (T at 1.5cm, 3cm …)
- Infrared camera (Surface T oscillations)

- FINAL GOAL-

- **Characterization of gravity waves (wave parameters)**
- **Horizontal and vertical propagation**
- **Suggestion of gravity waves origin and generator mechanisms**

"21st June case –> near monochromatic wave associated to a "wake low" in a Mesoscale Convective System, formed by strong downdrafts and ducted between surface and 2000m, favored by strong wind shear"

- The "wake low" is a rapid decrease in pressure due to downdraft in the

THANKS !

Recommended bibliography:

-Fujita, T. (1955), Results of Detailed Synoptic Studies of Squall Lines. Tellus, 7: 405–436. doi: 10.1111/j.2153-3490.1955.tb01181.x

-Houze, Robert A., M. I. Biggerstaff, S. A. Rutledge, B. F. Smull, 1989: Interpretation of Doppler Weather Radar Displays of Midlatitude Mesoscale Convective Systems. *Bull. Amer. Meteor. Soc.*, **70**, 608–619.

-Johnson, R. H. (2001). Surface Mesohighs and Mesolows. *Bulletin of the American Meteorological Society*, *82*(1), 13–31.

-Johnson, Richard H., Paul J. Hamilton, 1988: The Relationship of Surface Pressure Features to the Precipitation and Airflow Structure of an Intense Midlatitude Squall Line. *Mon. Wea. Rev.*, **116**, 1444–1473.

- Loehrer, Scot M., Richard H. Johnson, 1995: Surface Pressure and Precipitation Life Cycle Characteristics of PRE-STORM Mesoscale Convective Systems. *Mon. Wea. Rev.*, **123**, 600–621.

- **Please, send any questions, suggestions or corrections to:**

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