Ocean surface current measurements by WERA HF-radars: Hawaii & Adriatic

Cedric Chavanne

Pierre Flament

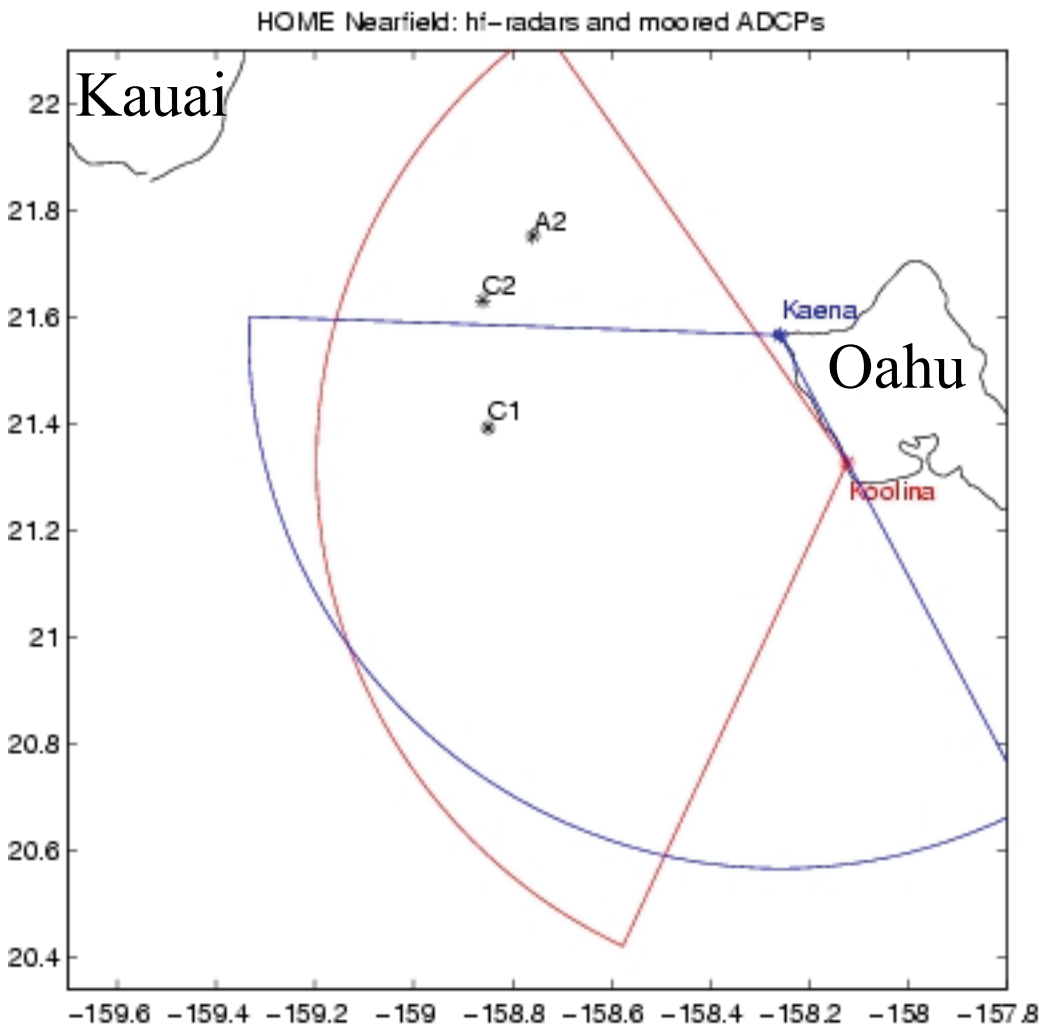
University of Hawaii, USA

Overview

- HOME: Hawaiian Ocean Mixing Experiment
  - Characteristics
  - Calibrations
  - Validations
  - Tidal currents
  - Mesoscale currents
- AMEX: Adriatic Mesoscale Experiment
  - Characteristics
  - Problems
- Conclusions

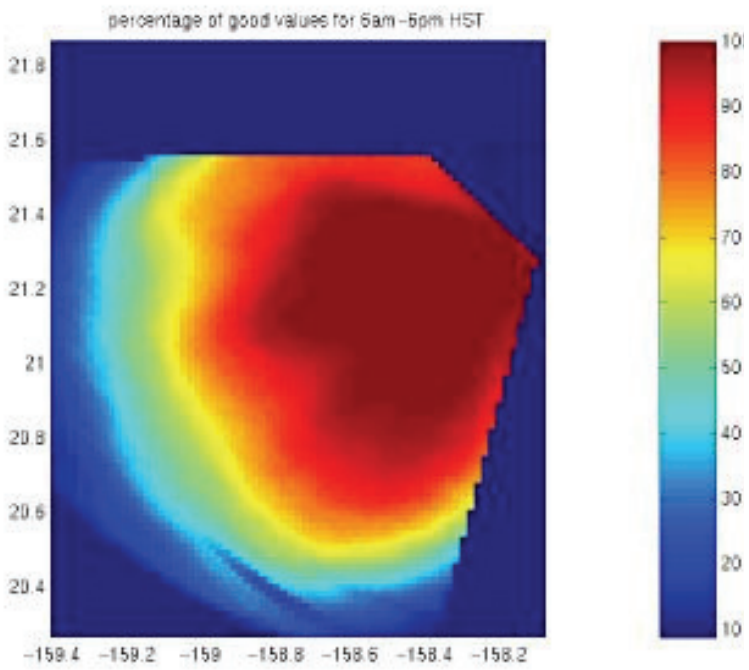
HOME

- 2 sites with 16 Rx antennas
- 16 MHz, 125 kHz continuous chirp
- 9 months (sep 2002 – may 2003)
- 9-min acquisitions every 20 min
- Moored ADCPs

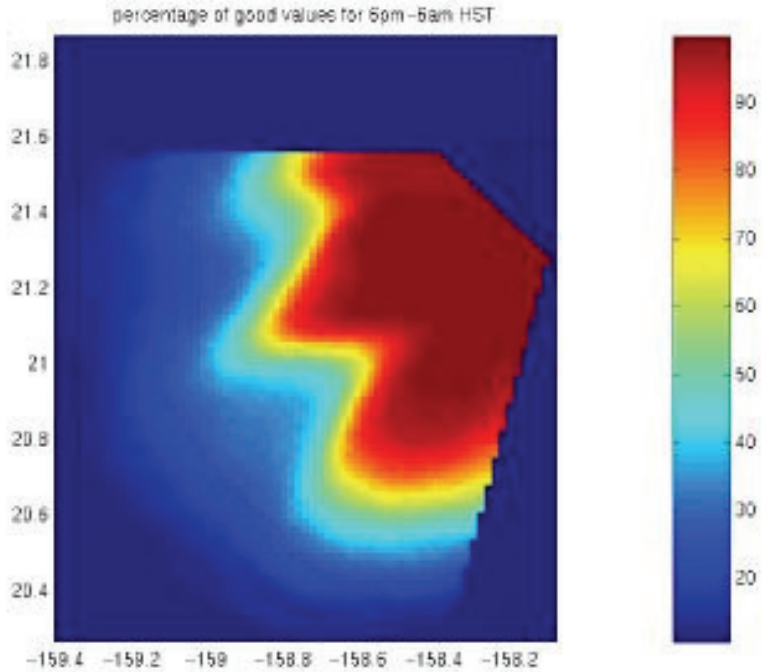


Spatial coverage

Daytime: 130km



Nightime: 90km

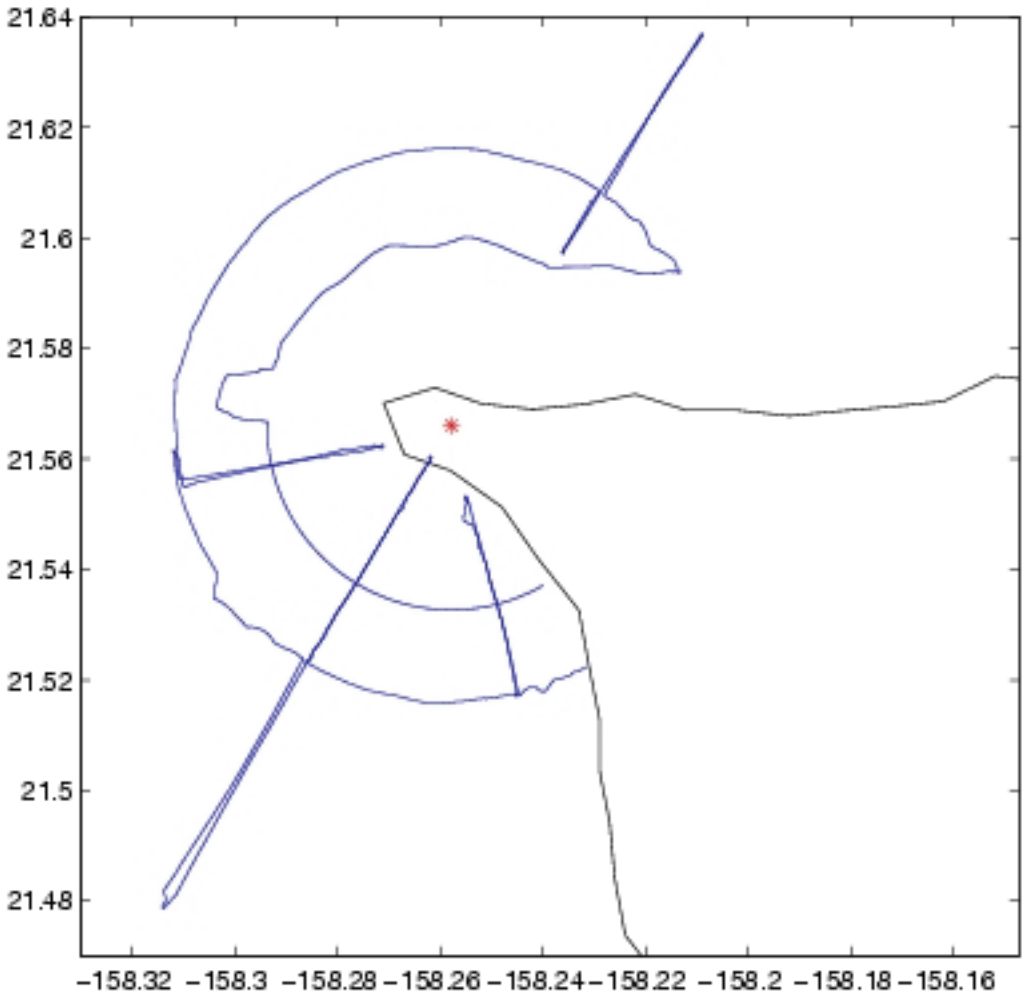


Koolina

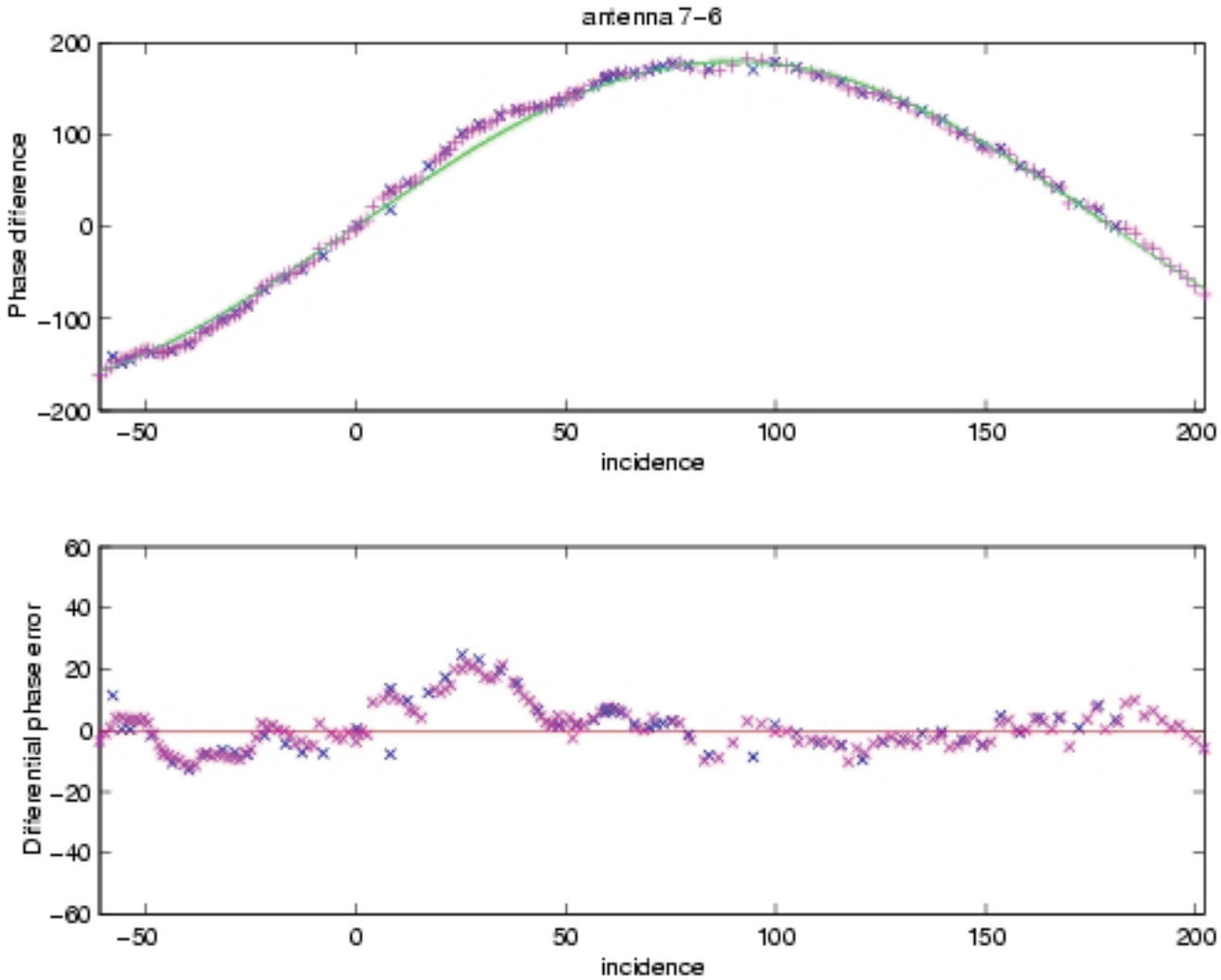
Kaena

Calibrations

- transmitter on R/V Wyrtki
- Continuous sinusoid at 16 MHz
- Passive listening by radar
- Ship position by differential GPS

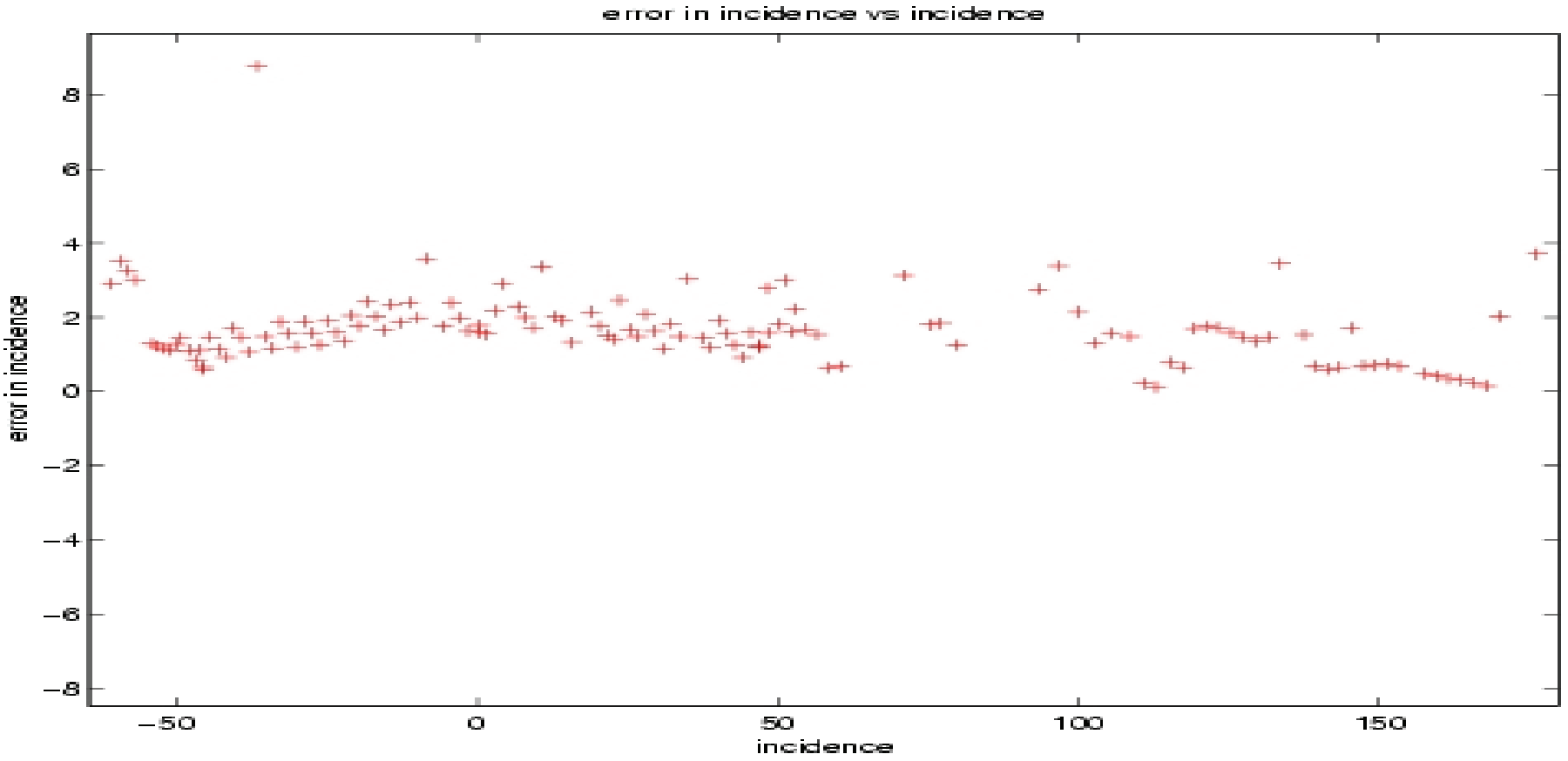


Phases vs azimuth (Kaena)

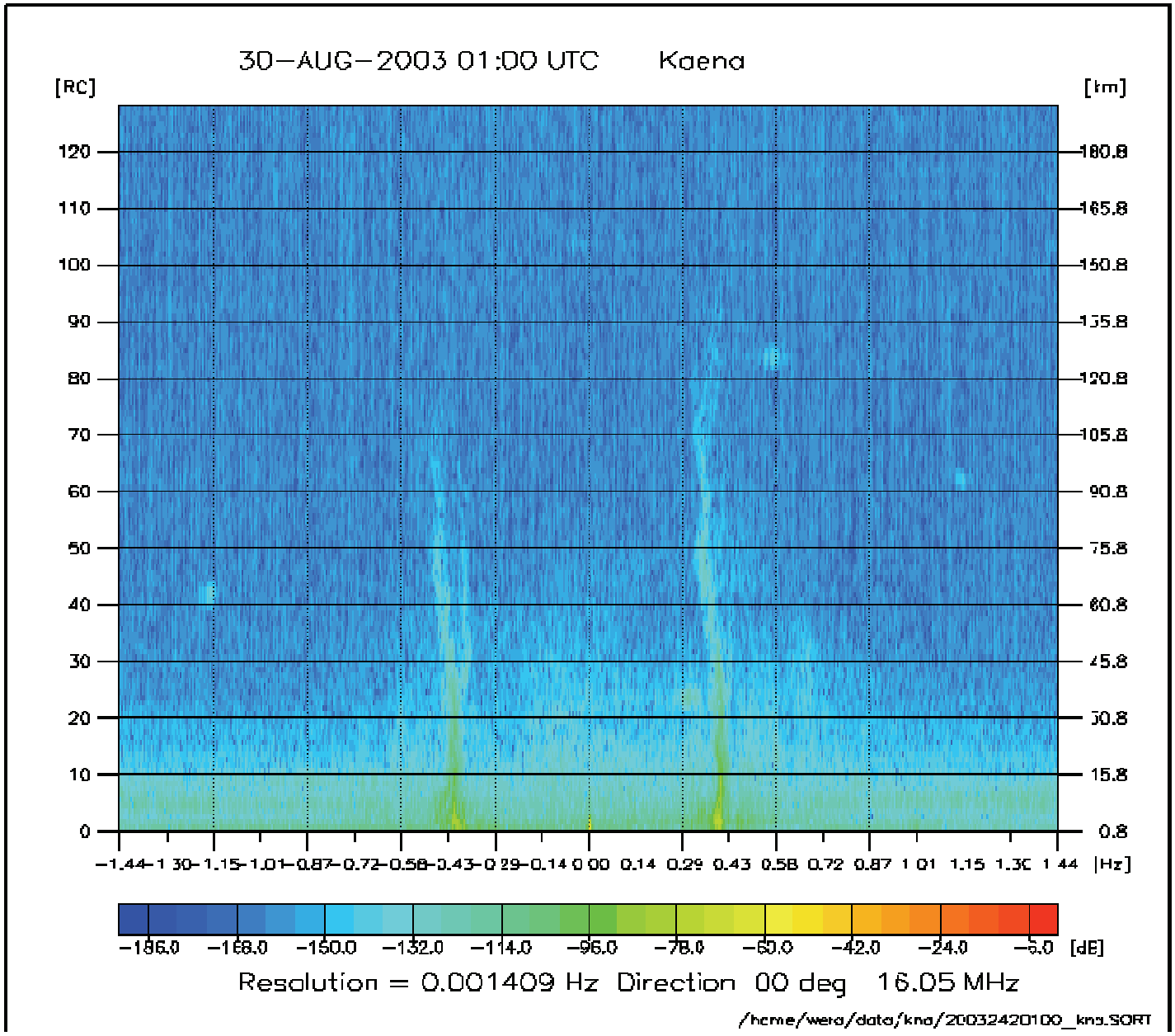


Beam-steering error

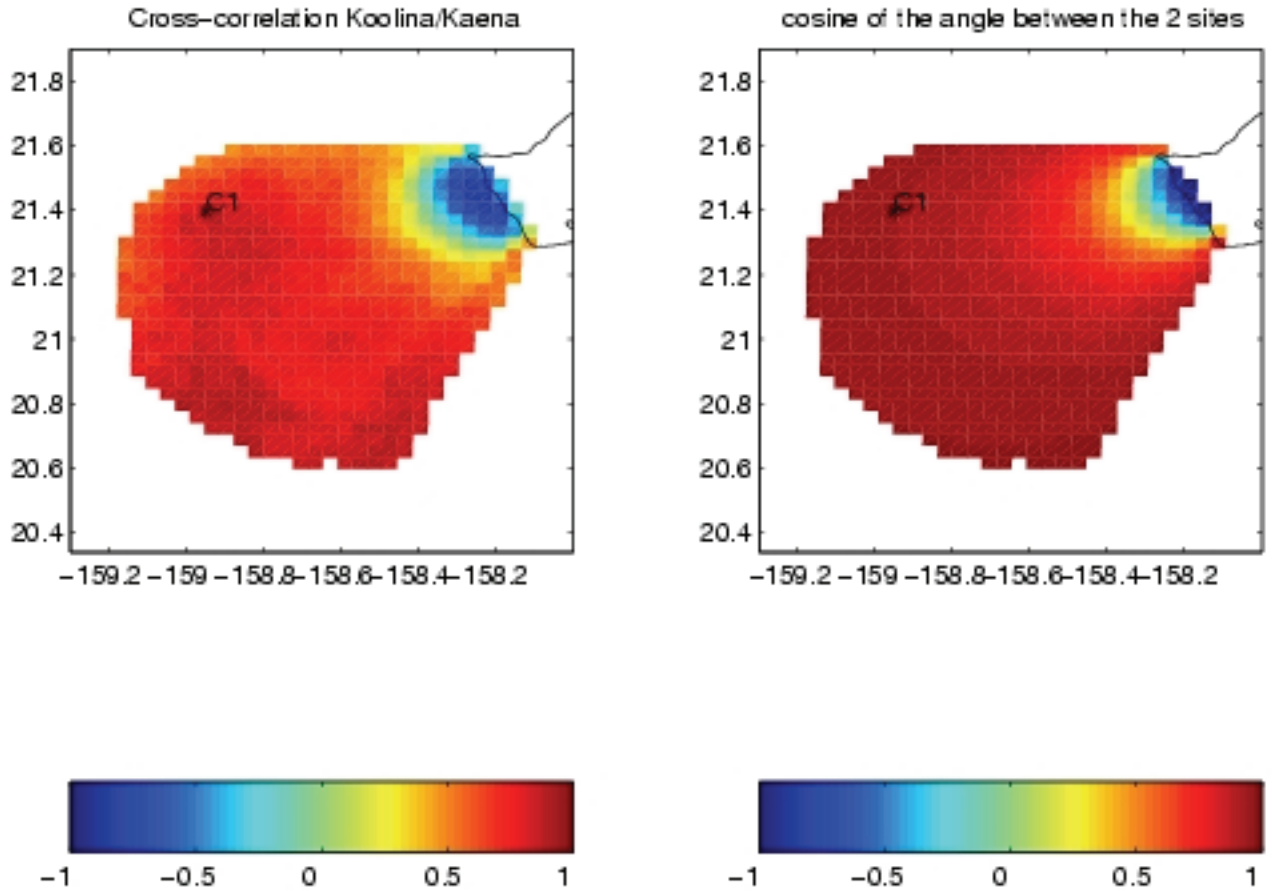
Beamformed direction – true direction (GPS)



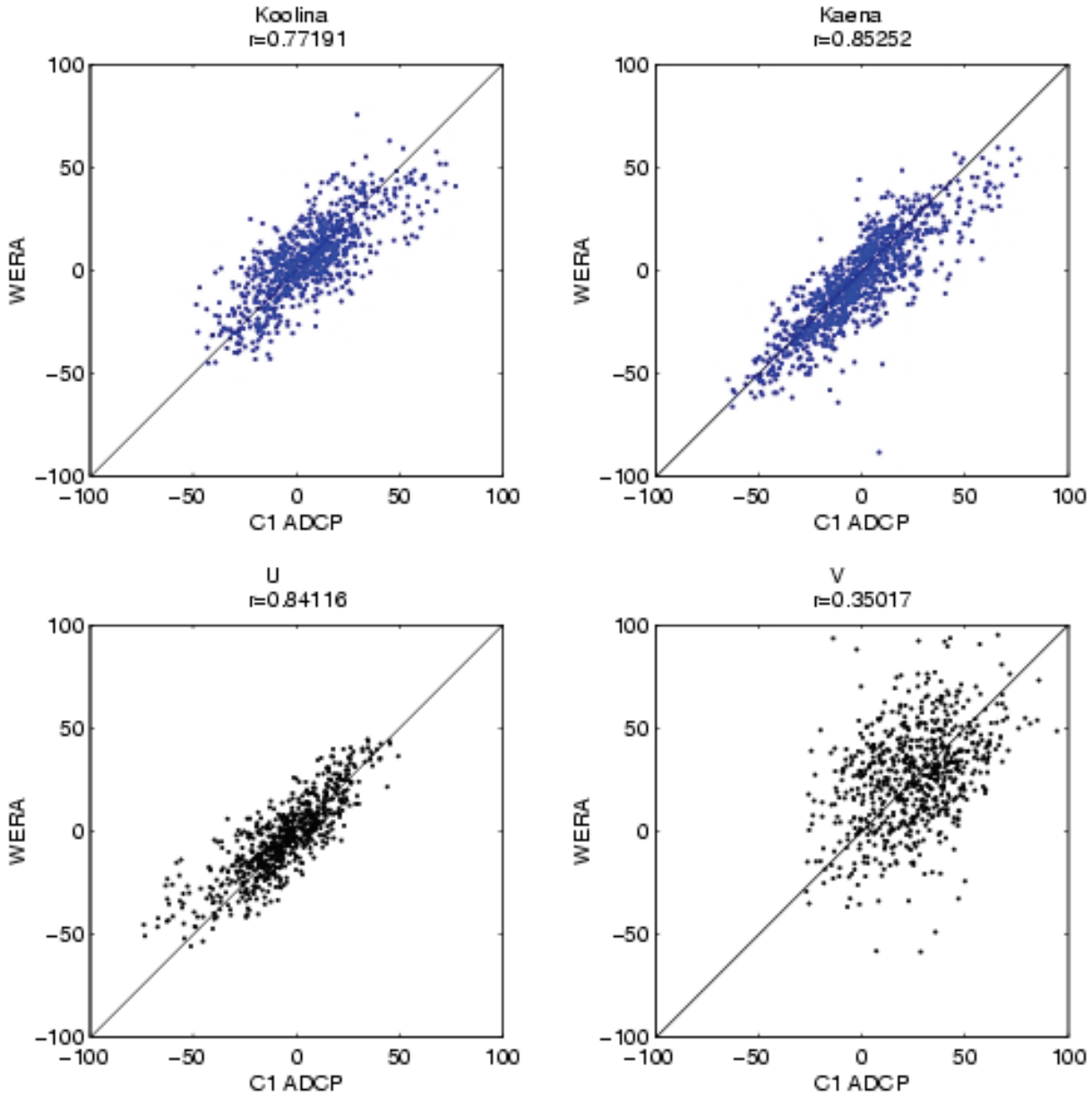
Example of spectra (Kaena)



Auto-validation

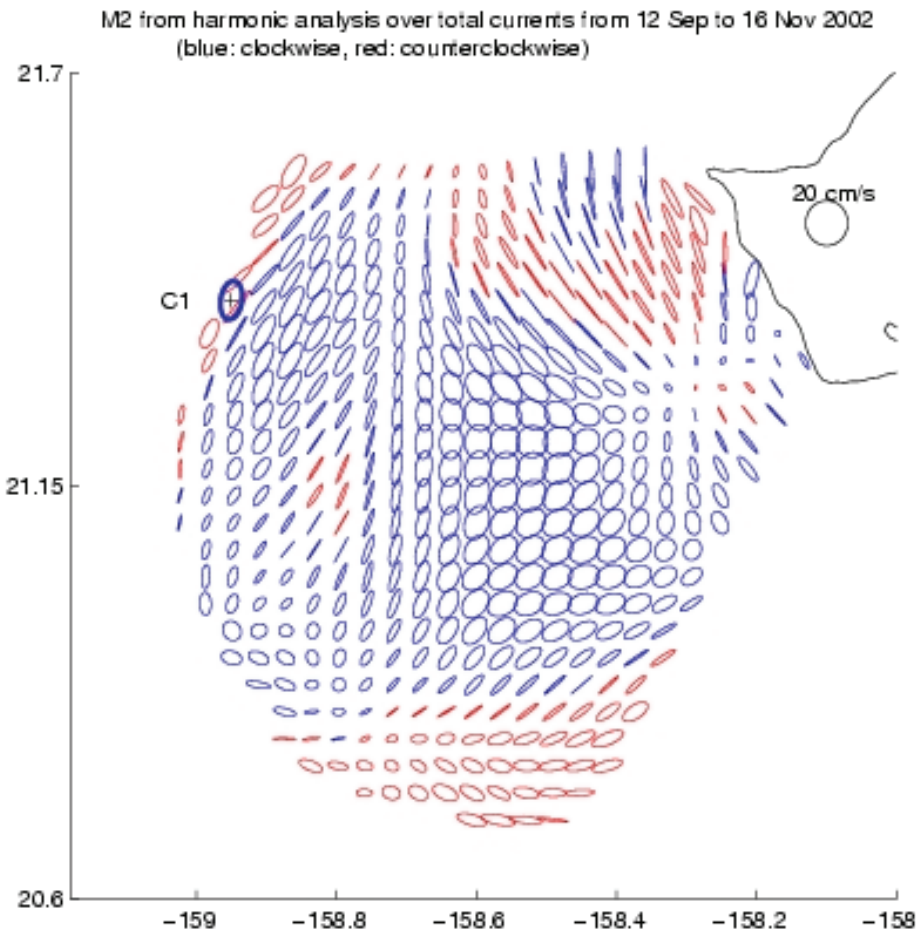


Comparison with ADCP C1

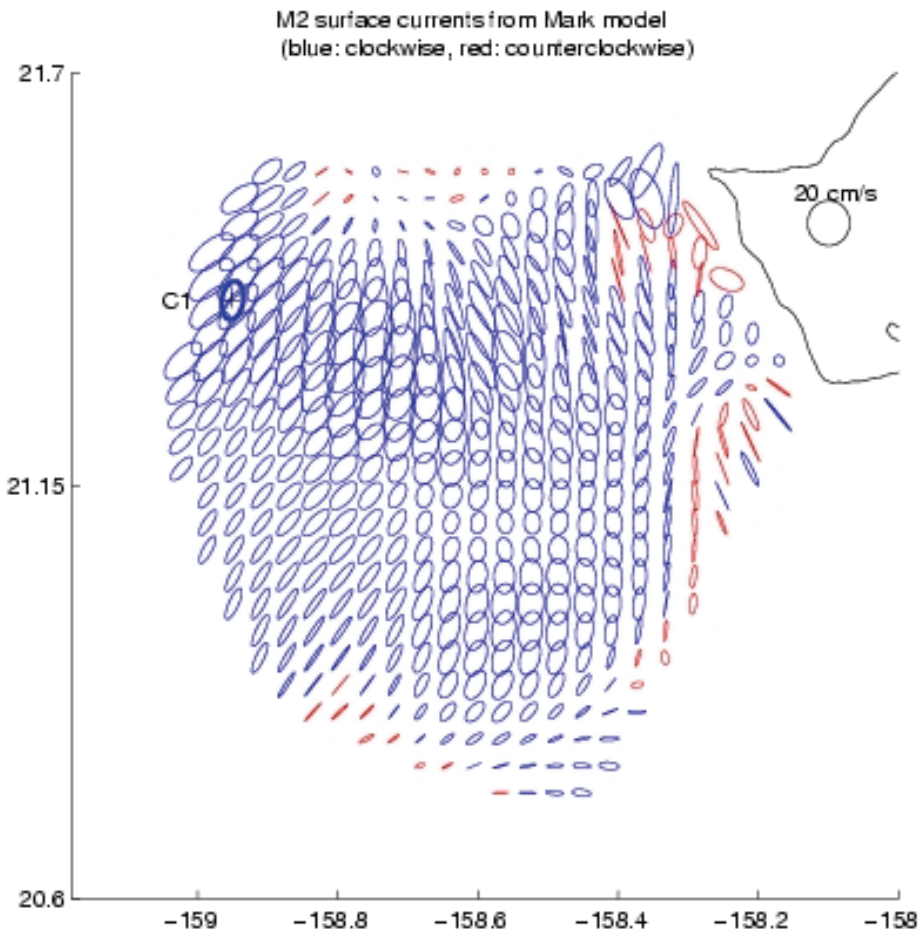


M2 tidal current ellipses

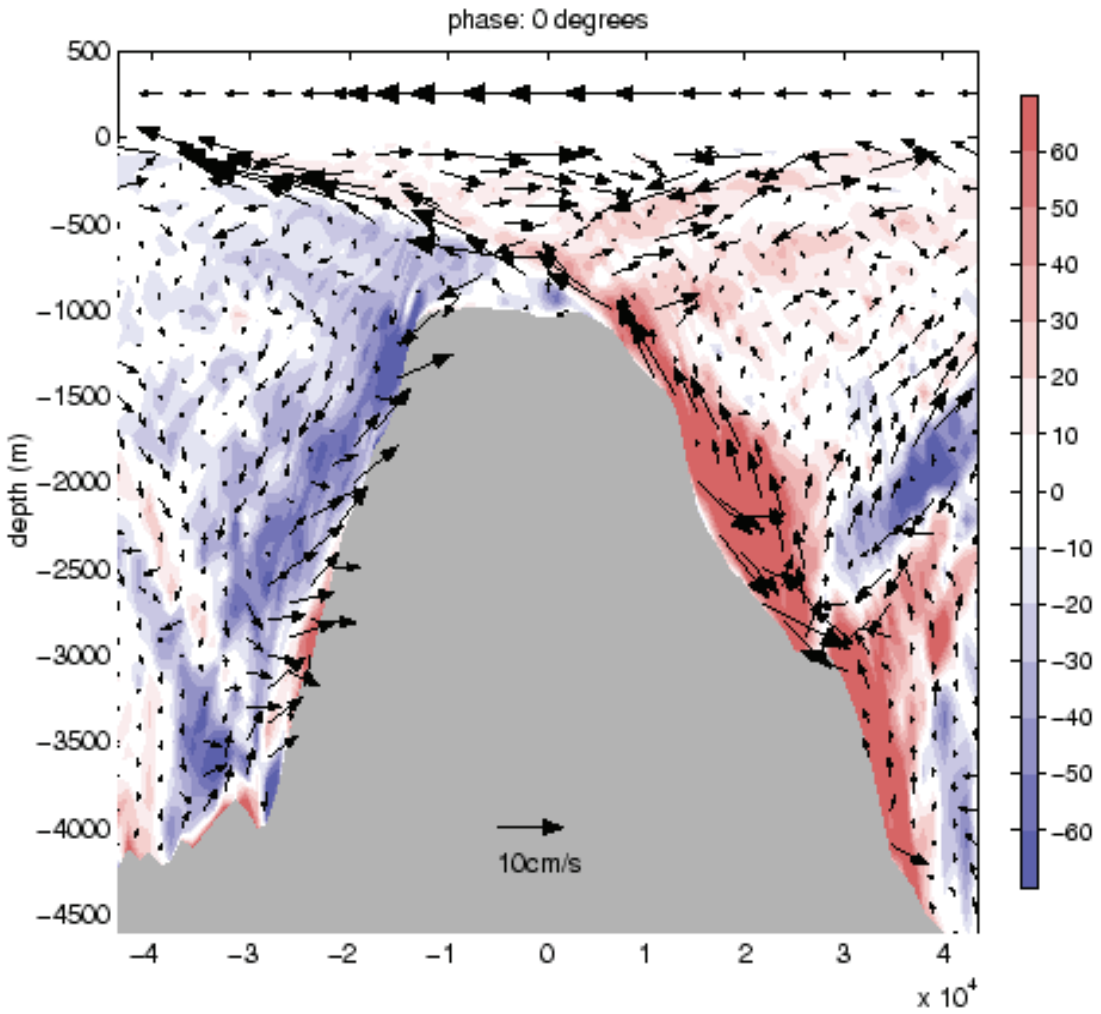
WERA

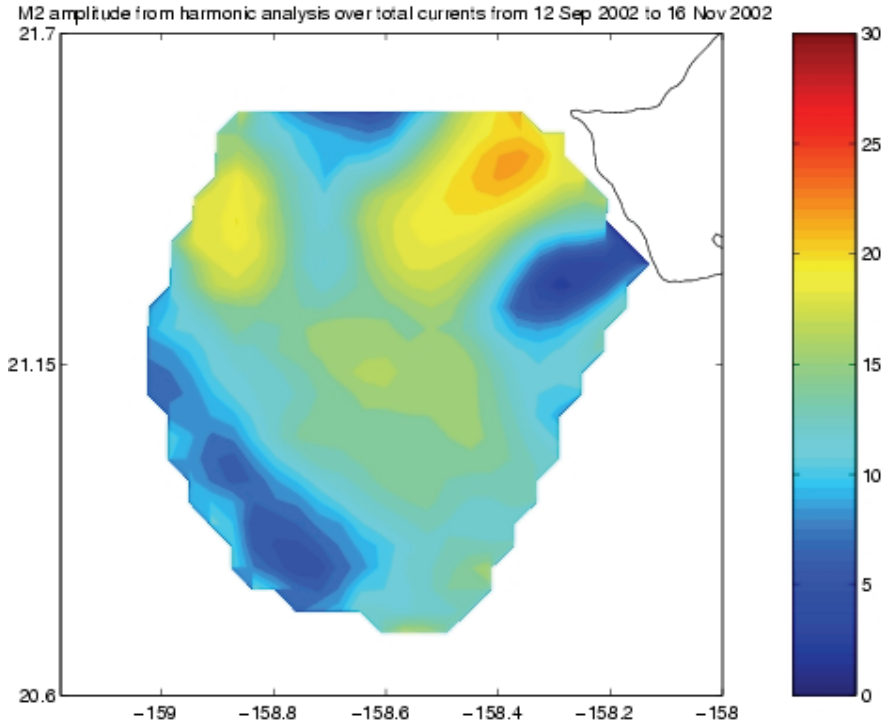


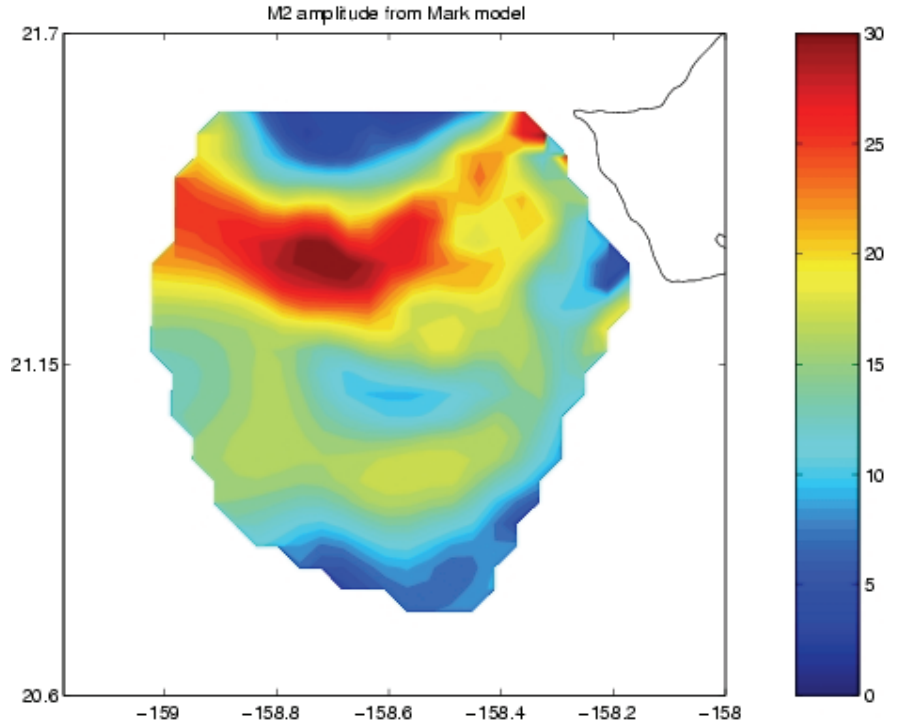
POM model

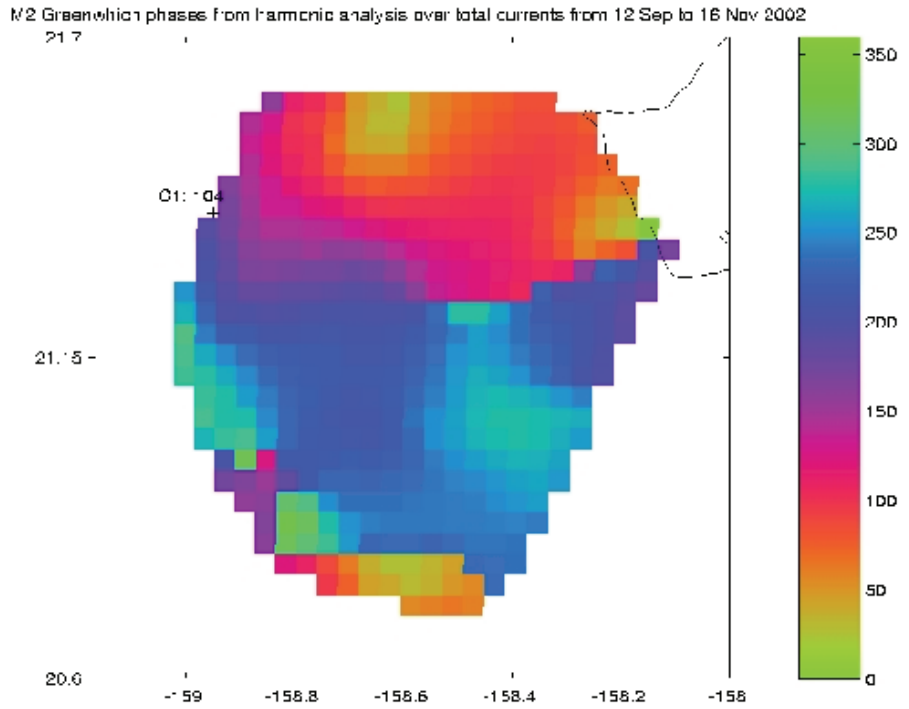


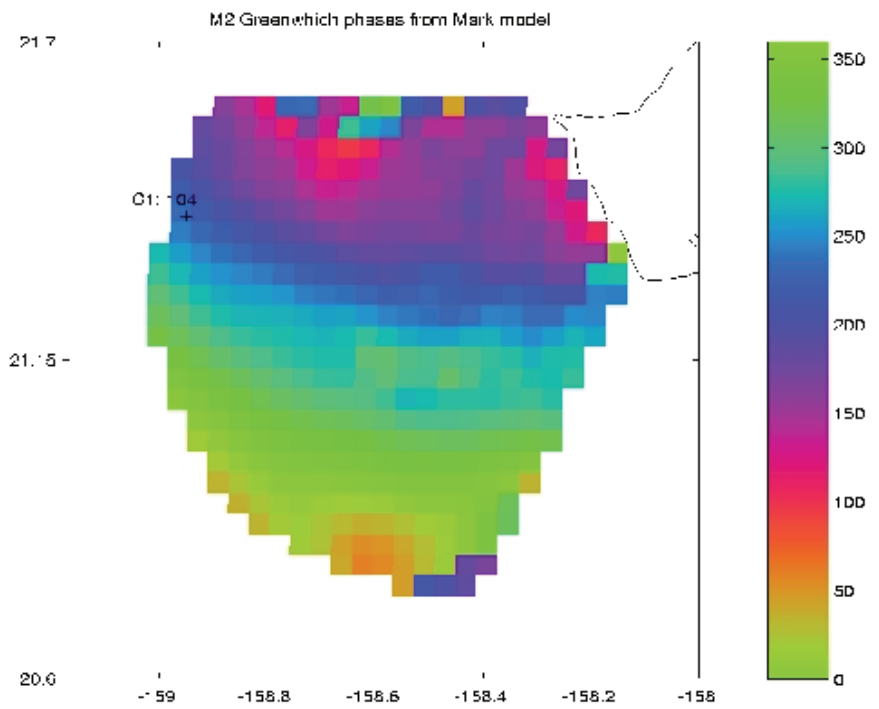
M2 tidal currents and isopycnal displacement (POM model, Merrifield and Holloway, 2002)




M2 amplitude from harmonic analysis over total currents from 12 Sep 2002 to 16 Nov 2002
21.7
21.15
20.6
-159
-158.8
-158.6
-158.4
-158.2
-158
30
25
20
15
10
5
0

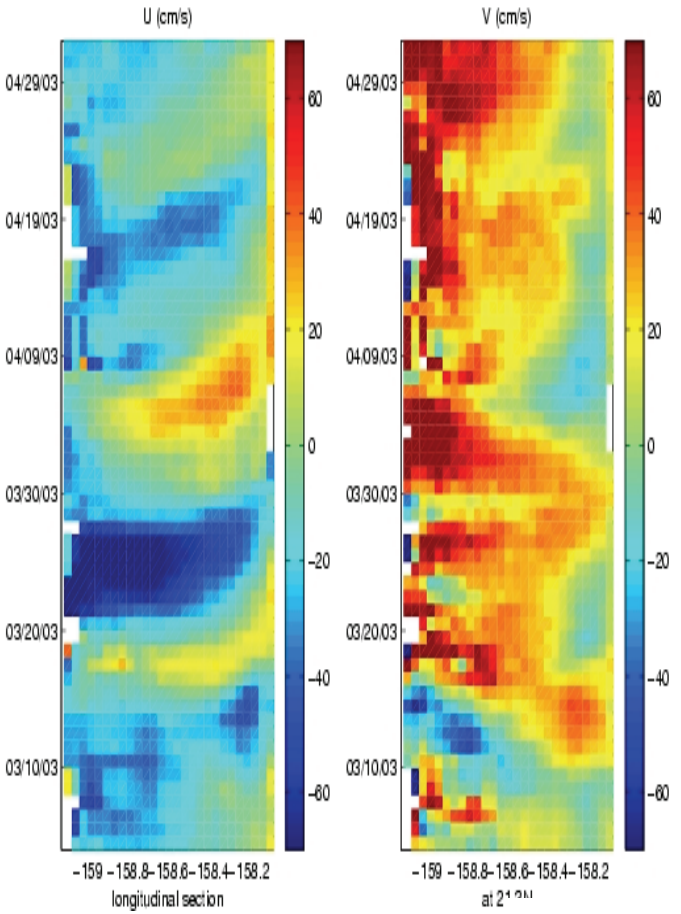

M2 amplitude from Mark model
21.7
21.15
20.6
-159
-158.8
-158.6
-158.4
-158.2
-158
30
25
20
15
10
5
0


M2 Greenwhich phases from harmonic analysis over total currents from 12 Sep to 16 Nov 2002
21.7
21.15
20.6
-159
-158.8
-158.6
-158.4
-158.2
-158
350
300
250
200
150
100
50
0


M2 Greenwhich phases from Mark model
21.7
21.15
20.6
-159
-158.8
-158.6
-158.4
-158.2
-158
350
300
250
200
150
100
50
0

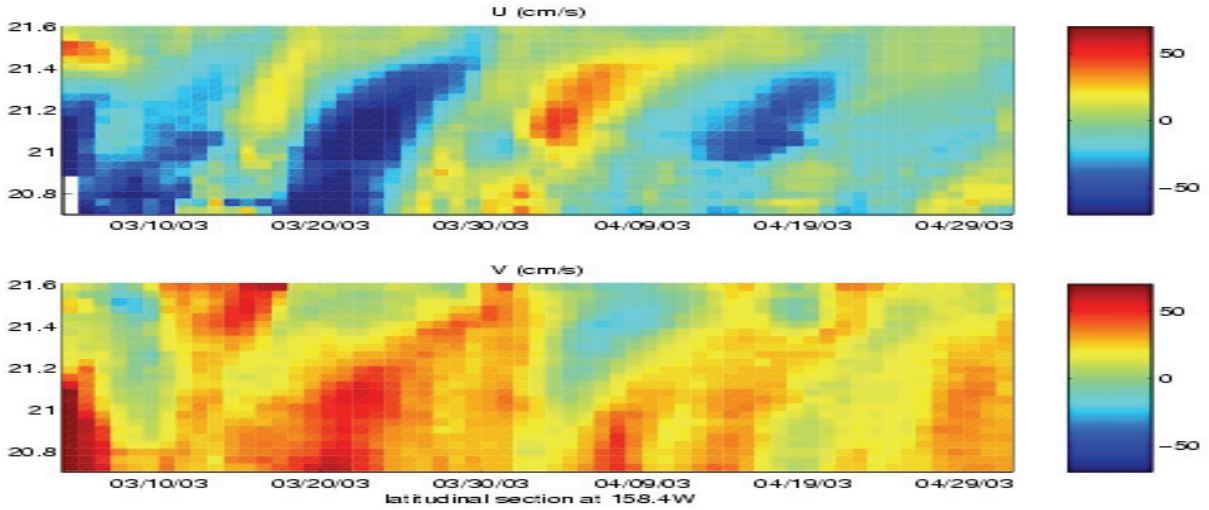
Mesoscale currents (3-day low-pass filtered)

Longitudinal section
(at 21.3N)



U V

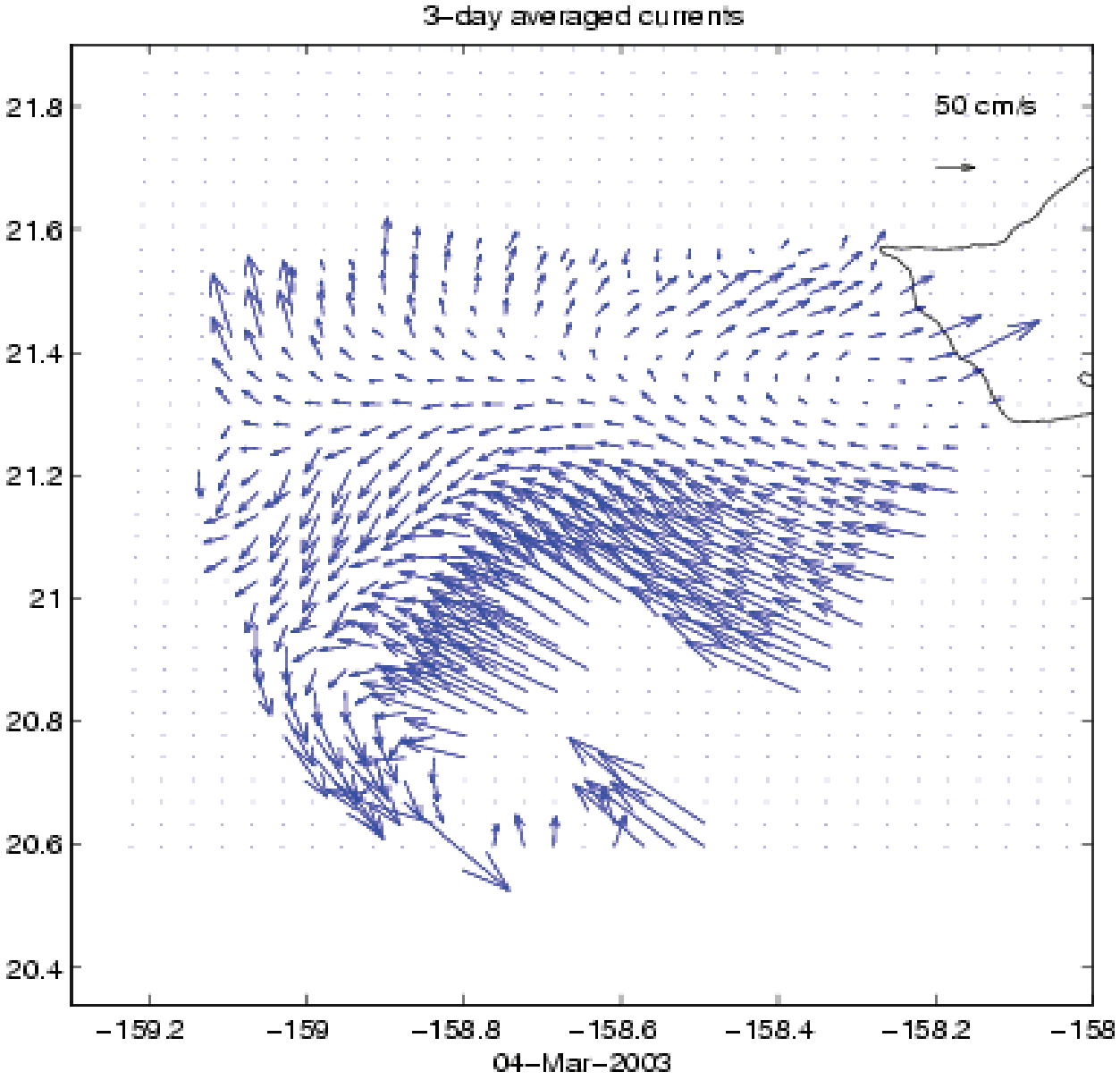
Latitudinal section (at 158.4W)



U

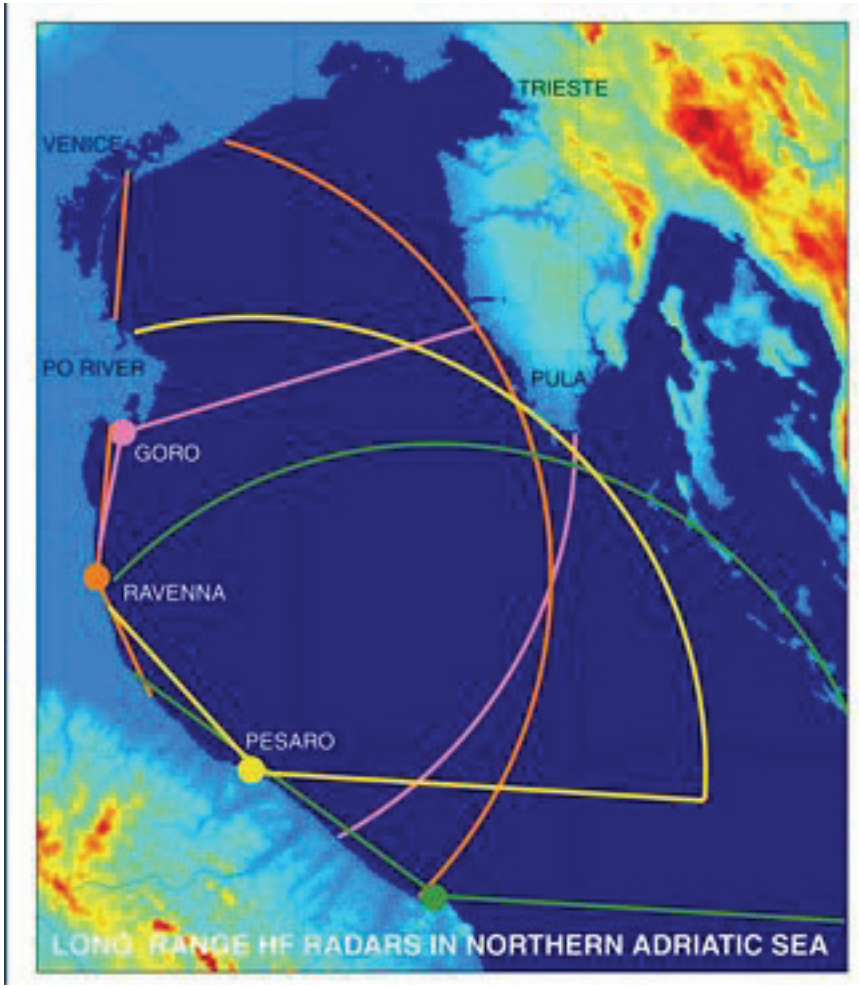
V

Mesoscale currents
(3-day low-pass filtered



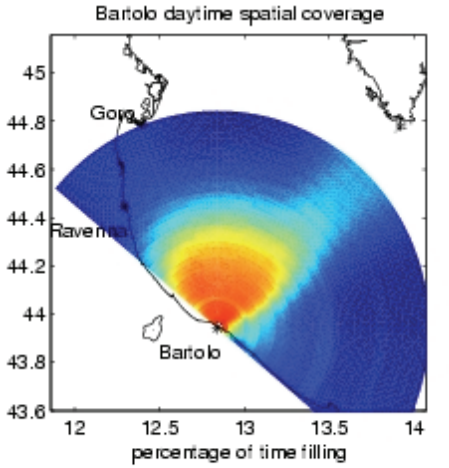
AMEX

- 1 site with 16 Rx antennas: Goro
- 2 sites with 4 & 6 Rx antennas: Ravenna & Bartolo
- 16 MHz, 125 kHz continuous chirp
- 2 years (nov 2002 – nov 2004)
- 12-min acquisitions every 30 min

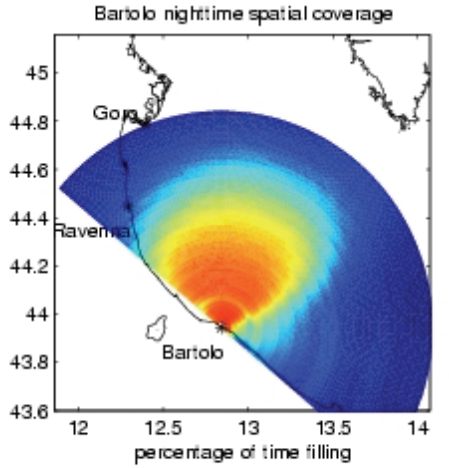


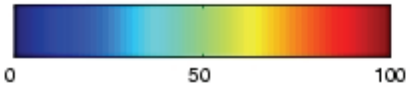
Spatial coverage

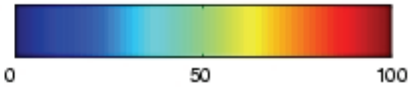
55 km



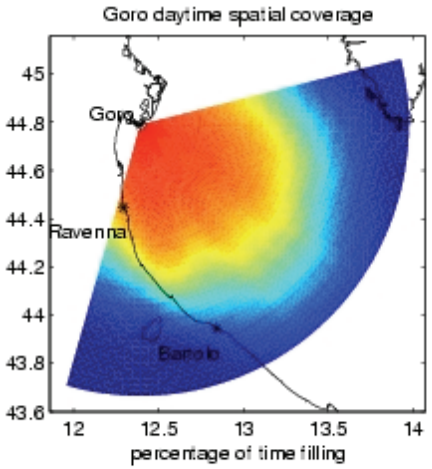
65 km



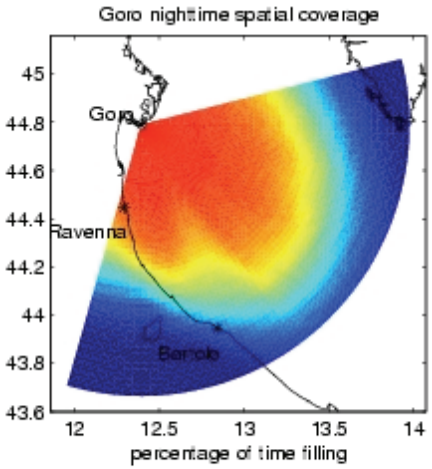


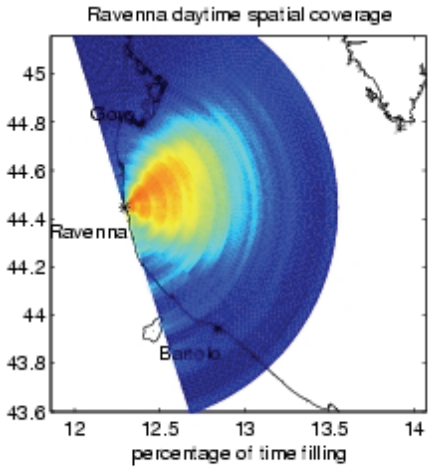


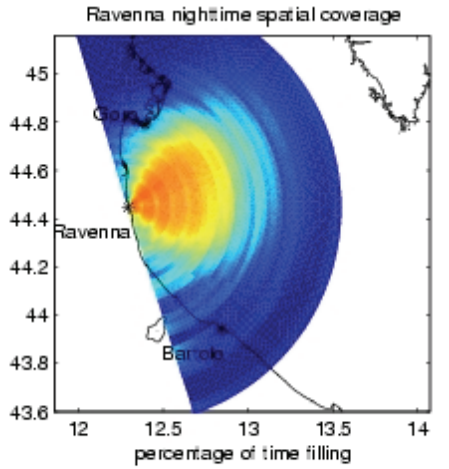
90 km

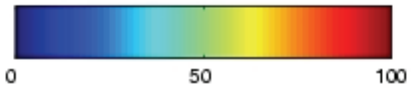


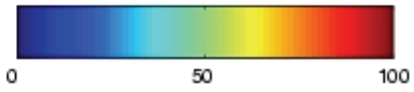
110 km

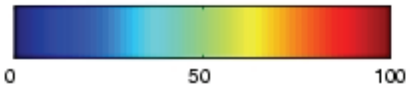


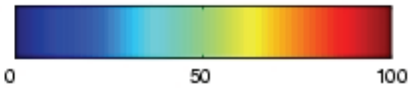




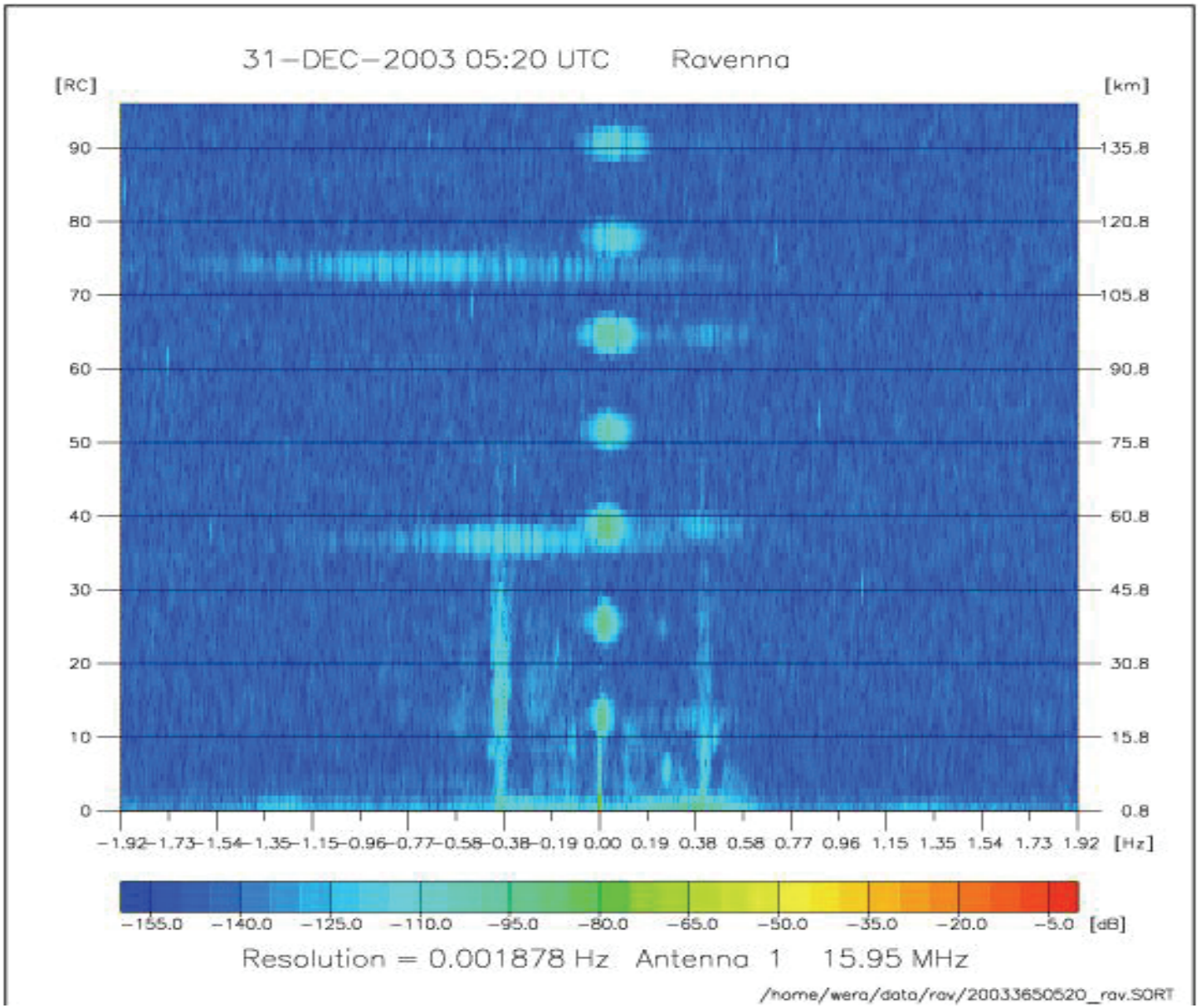


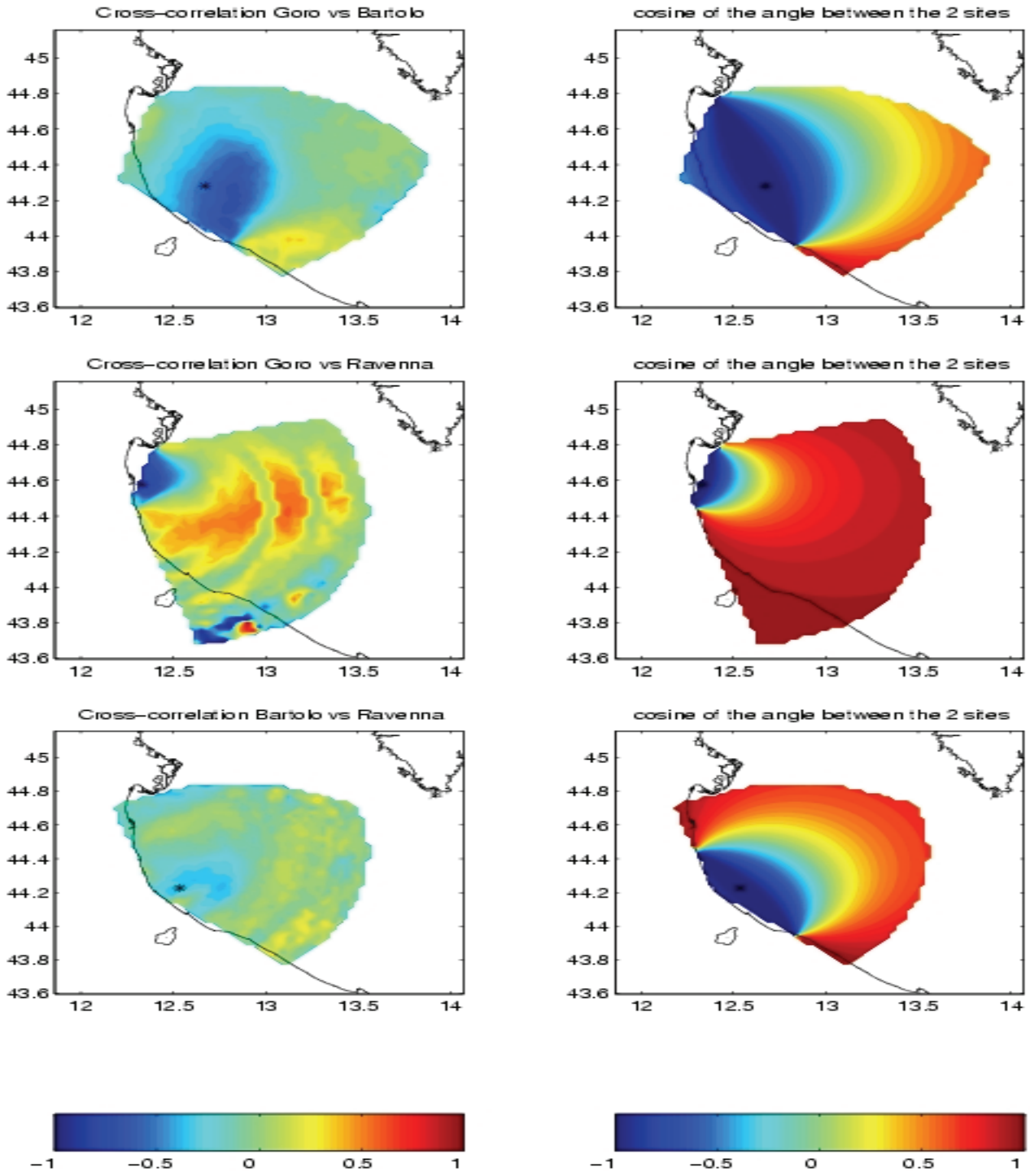




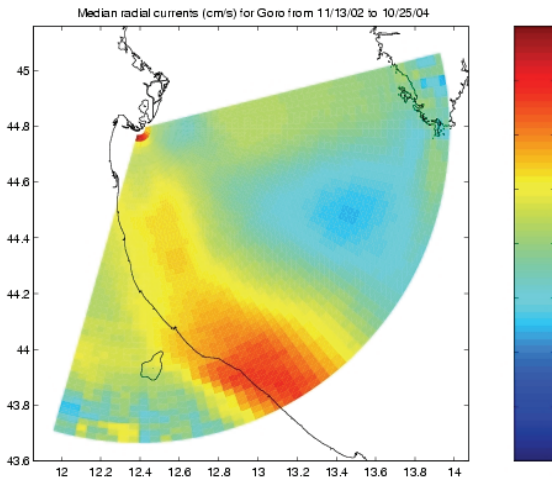


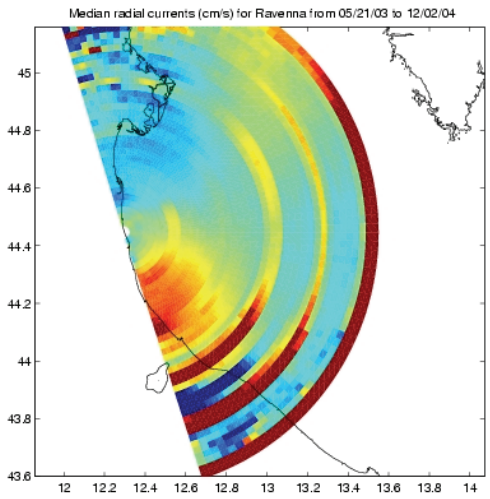
Example of spectra (Ravenna)

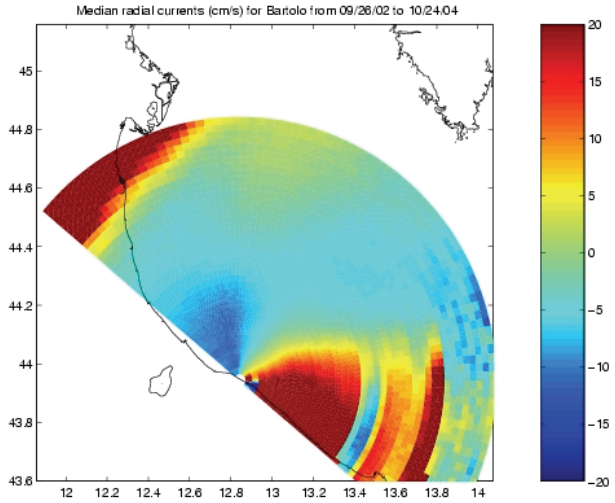


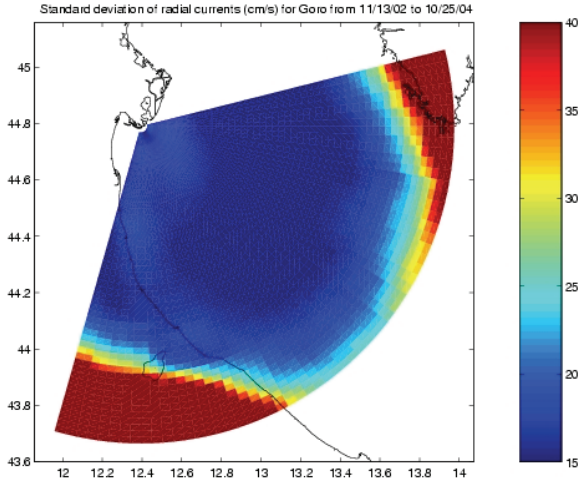

Cross–correlation Goro vs Bartolo
cosine of the angle between the 2 sites
Cross–correlation Goro vs Ravenna
cosine of the angle between the 2 sites
Cross–correlation Bartolo vs Ravenna
cosine of the angle between the 2 sites
45
44.8
44.6
44.4
44.2
44
43.8
43.6
12
12.5
13
13.5
14
−1
−0.5
0
0.5
1

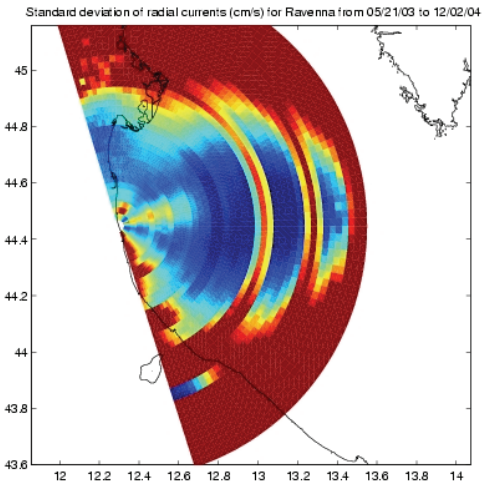
Mean and standard deviation of radial currents

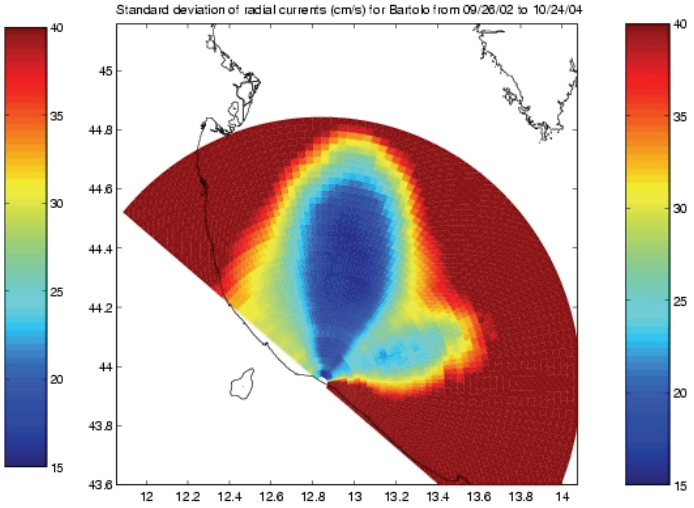




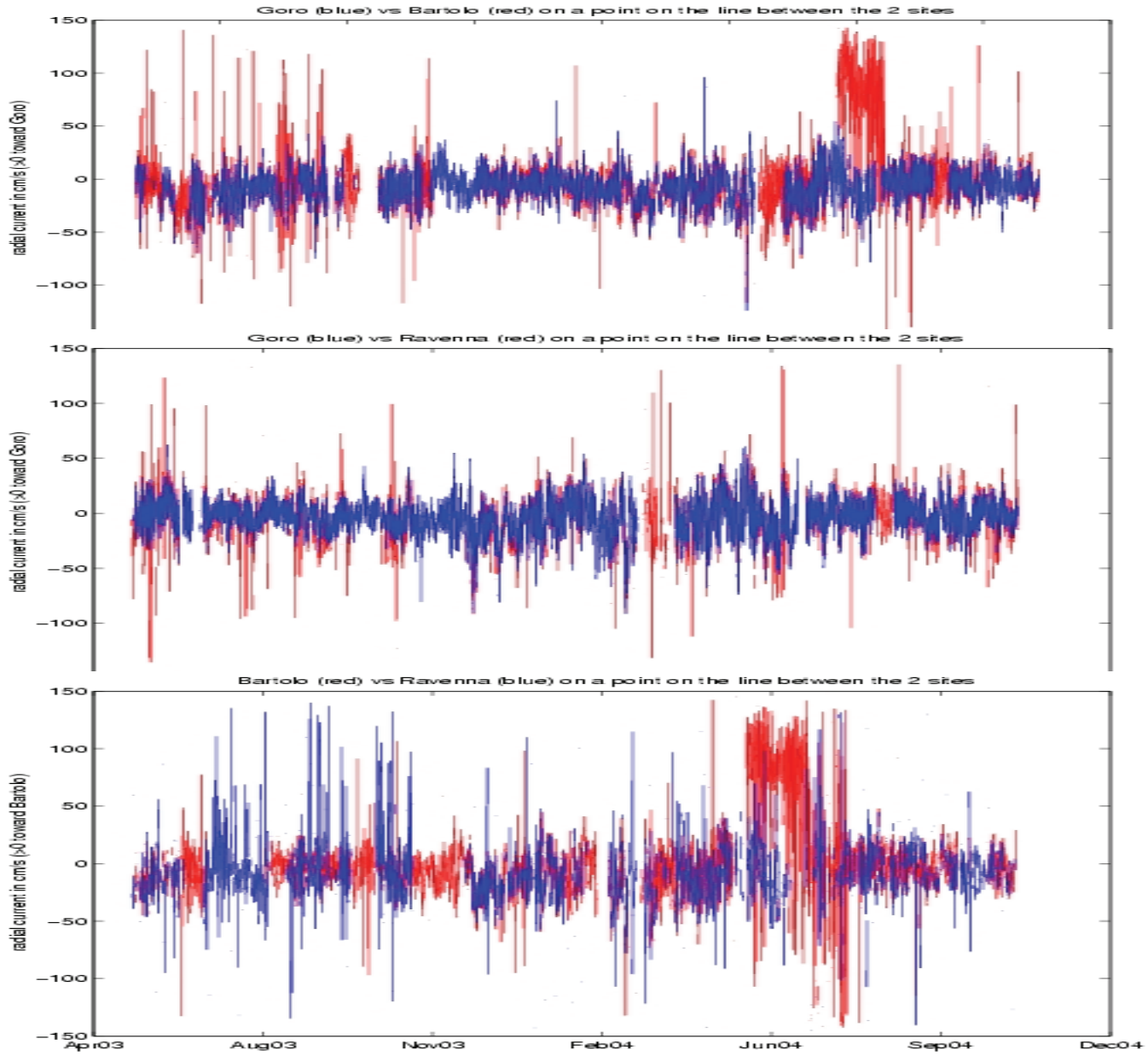








Time series of radial currents



Conclusions

- WERA has great flexibility of operation: beamforming or direction finding, wide range of working frequencies, signal processing in software
- Beamforming is a more robust technique than Direction Finding and gives a greater range
- Beamforming enables to measure waves, but we have not tested it yet ...