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30 may-1 Juin. Ile de Ré

# Mapping near-inertial variability in the SE Bay of Biscay from HF radar data and two offshore moored buoys

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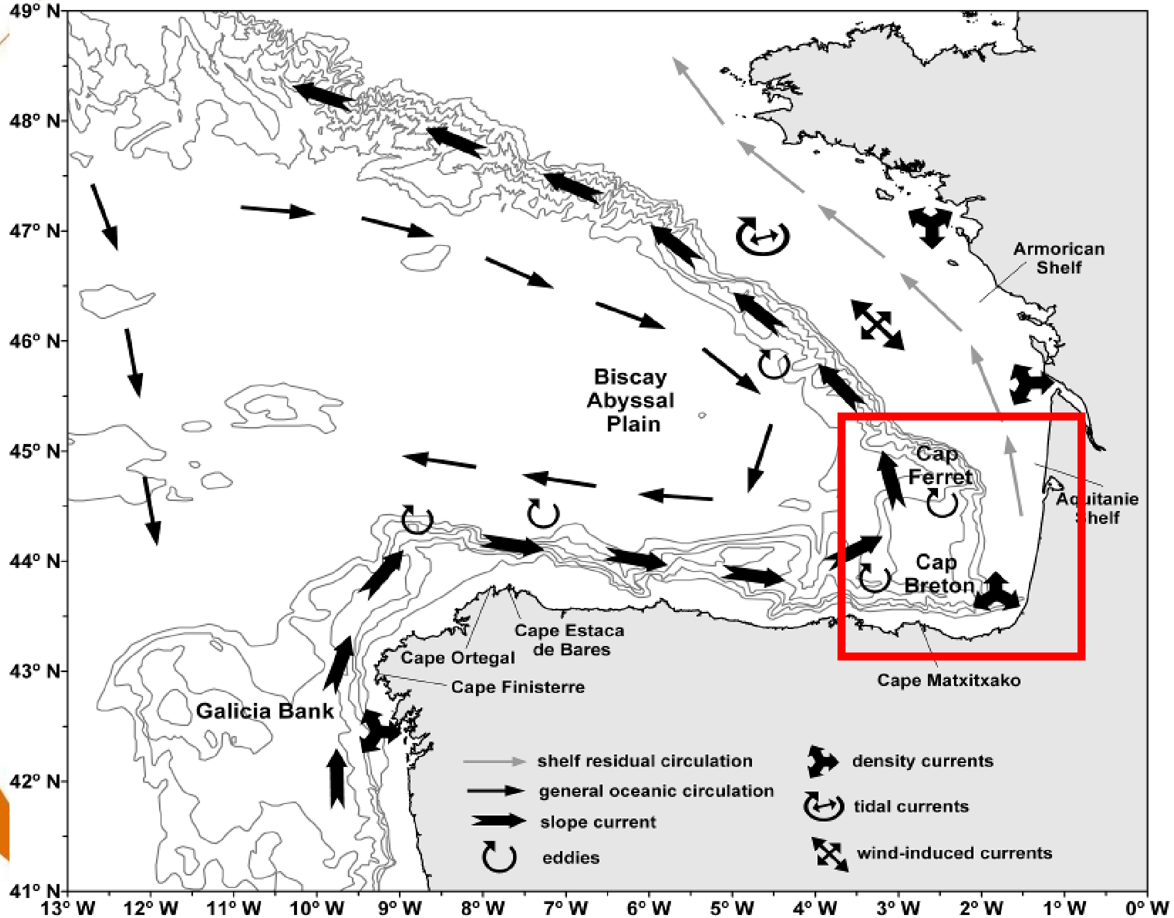
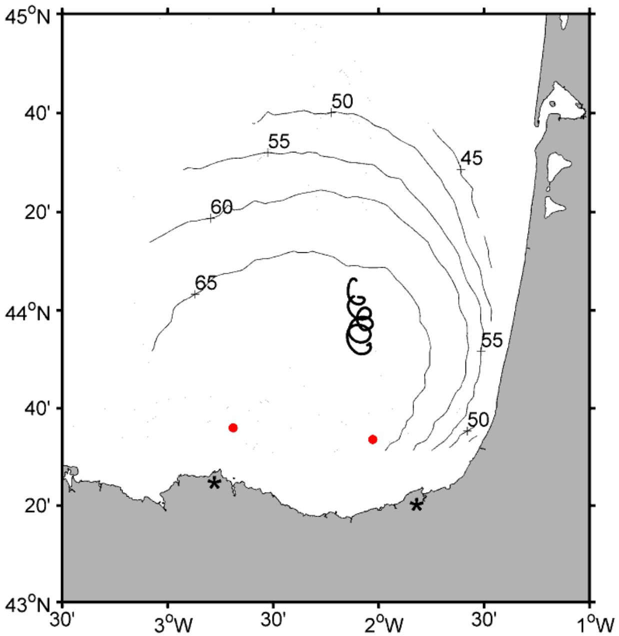
azti tecnalia

# Introduction

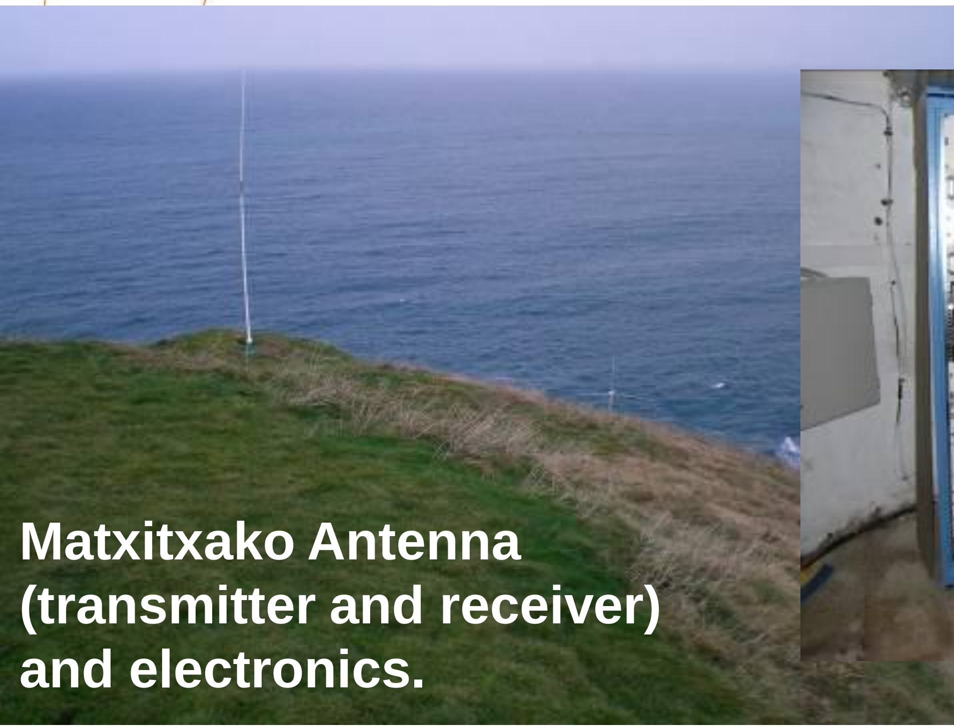
Mean circulation patterns




Study area and available data (BOLD ISOLINES: availability of radar data (%) for the target year 2009 )

# Introduction: the HF radar system main characteristics



**Matxitxako Antenna (transmitter and receiver) and electronics.**

Two radial site stations: HIger (Donostia) and Matxitxako Central combine site in Vitoria

**WORKING SINCE 2009**

**MAIN CARACTERISTICS of the BASQUE SYSTEM**

| Radar Frequency (MHz) | Radar Wavelength (m) | Ocean Wavelength (m) | Depth of Current[1] (m) | Typical Range[2] (km) | Typical Resolution (km) | Typical Bandwidth (kHz) | Upper $H_{1/3}$ Limit[4] (m) |
|---|---|---|---|---|---|---|---|
| 4.86 | 60 | 30 | 2-3 | ~150 | ~ 5 | 30 | 25 |

# Introduction: the HF radar system main characteristics

## FROM CROSS SPECTRA TO RADIAL VELOCITIES

**MUSIC (MUltiple SIgnal Classification) Algorithm**

[Schmidt, R.O., (1986), *IEEE Trans. Antennas Propagat.,* vol. AP-34, pp. 276-280]

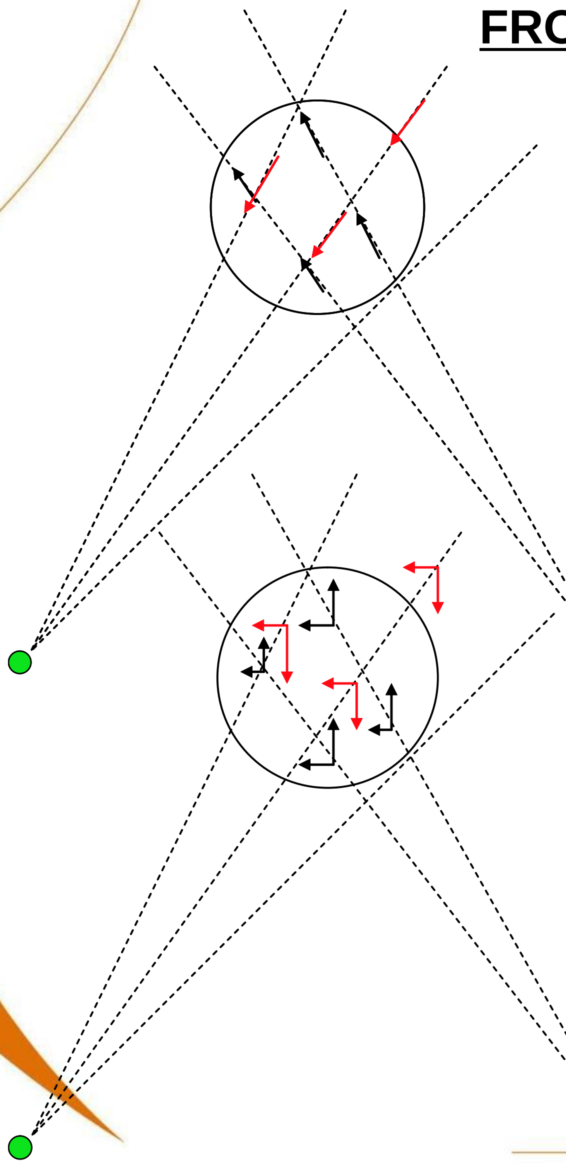
- Linear solutions based on eigen-analysis of averaged spectral covariances
- Capable of more than two solutions with little added numerical burden
- Chooses the number of bearings based on both eigenvalue & amplitude ratios
- Capable of incorporating measured, distorted antenna patterns

***OUTPUT: Vectors in polar coordinate system centered at receiving antenna:***

- ✓ ***1 radial map per averaged cross spectra file***
- ✓ ***Typically, seven radial maps "merged" into one hourly map (3-hours running average)***
- ✓ ***Angular resolution is 5˚***

# Introduction: the HF radar system main characteristics

## FROM RADIAL TO TOTAL VELOCITIES



Several radials from each site contribute to each total vector, being resolved into orthogonal components (U, V)

Linear least squares performed on U, V components separately

From radials with:

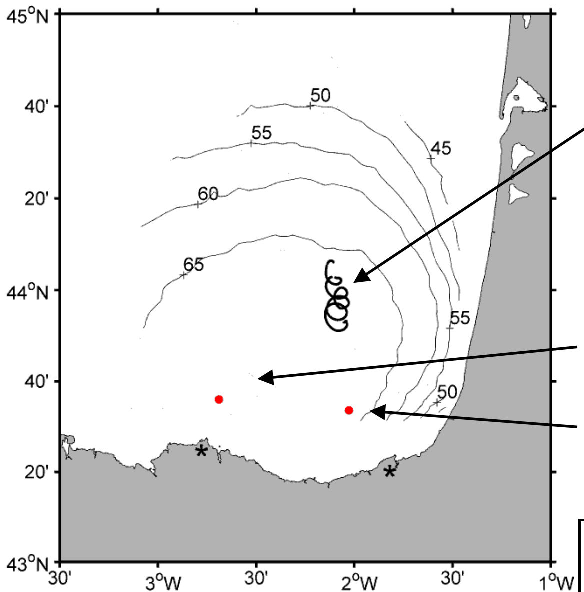
- An **angle of incidence** greater than α
  **α min = 30º**
- And **total velocities < 120 cm/s**

Defining a

- **GRID SPACING: 5km**
- **AVERAGING RADIUS: of 20 KM**

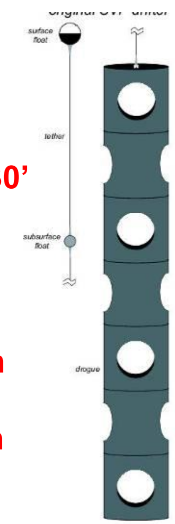
# HF radar vs. In-situ data

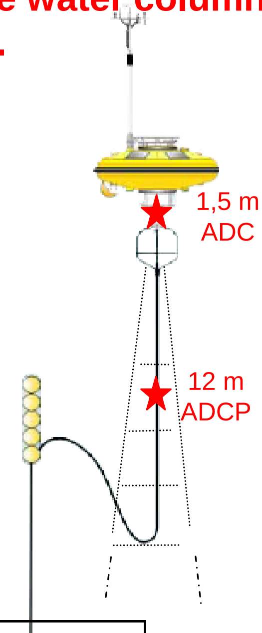
**HF RADAR (4.5 MHz) integrates currents vertically within the first 2-3 m of the water column.**
**Radial resolution= 5km; angular reolution 5º; 3h running window hourly data.**




Drifter -

**Centred at 8 m**
**10 m long drogue**
**GPS positions every 30'**
**3h running mean**






Matxitxako

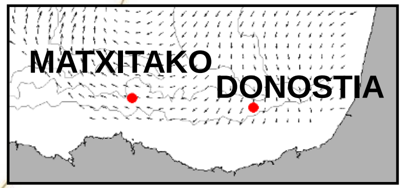
Donostia

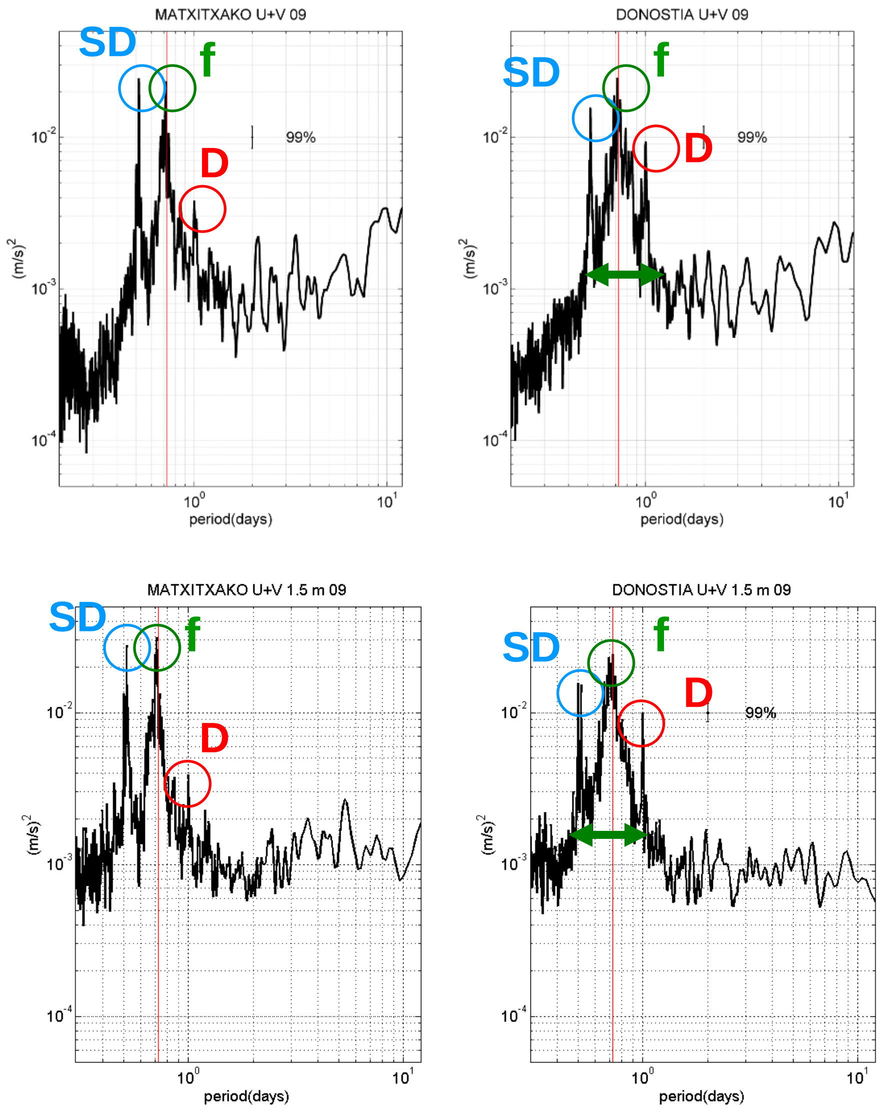
**At 1.5 –and 12 m**
**Hourly data,**
**3h running mean**

| | R<br>u, v | RMS [cm·s$^{-1}$]<br>u, v | MRD<br>u, v |
|---|---|---|---|
| Matxitxako 1.5 m vs. radar | 0.86, 0.64 | 8.10, 8.12 | -1.10, -0.92 |
| Matxitxako 12 m vs. radar | 0.74, 0.50 | 10.79, 9.11 | -1.85, -2.70 |
| Donostia 1.5 m vs. radar | 0.53, 0.35 | 10.38, 12.89 | -1.31, 0.44 |
| Donostia 12 m vs. radar | 0.37, 0.21 | 10.31, 13.40 | 0.84, -0.22 |
| Drifter vs. radar | 0.72, 0.91 | 16.54, 9.22 | -0.22, -0.01 |
| Matxitxako 1.5 m vs. 12 m | 0.80,0.60 | 9.96, 8.92 | 1.97,0.60 |
| Donostia 1.5 m vs. 12 m | 0.37, 0.28 | 11.91, 11.61 | -1.36, -0.83 |

***Idea of vertical shear***

# HF radar vs. In-situ data



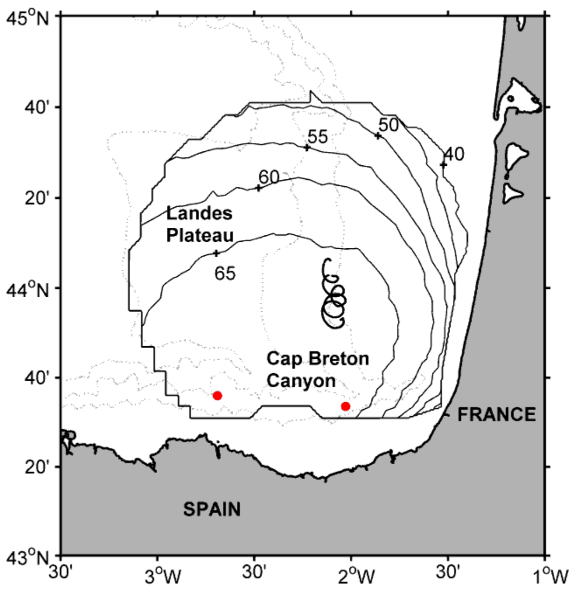



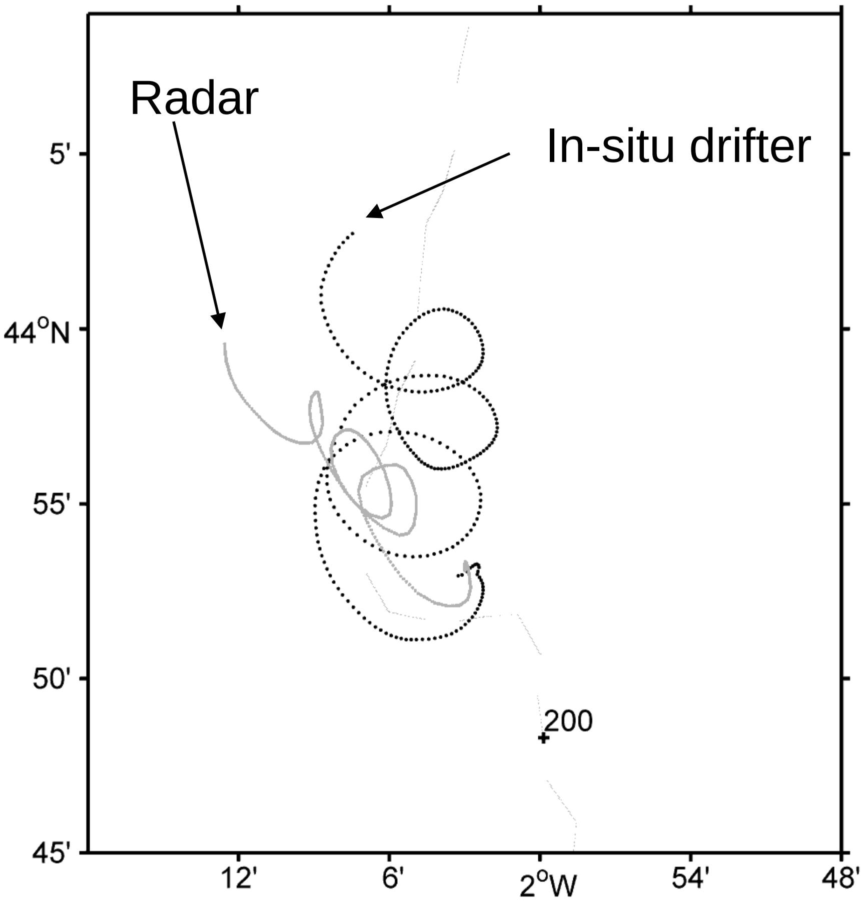

Radar

ADC 1,5 m

# HF radar vs. In-situ data

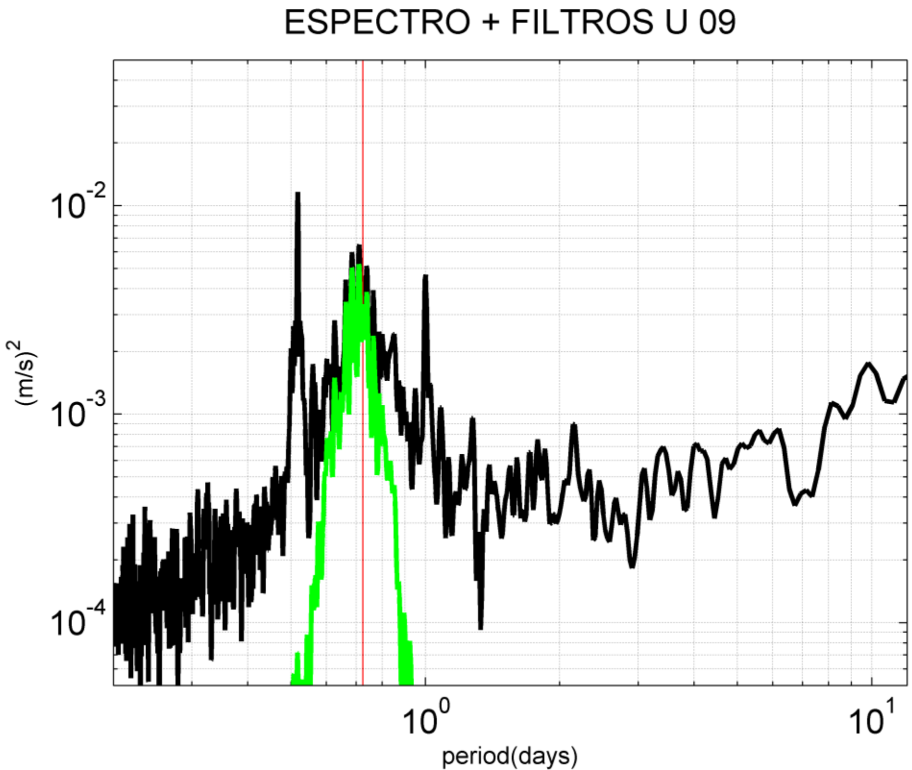
- Dispersion model applied to radar data to reproduce the observed trajectory
- Radar-derived trajectory: smaller amplitude (? Smoothing of data) and mean drift direction rotated to the W (? Ekman)



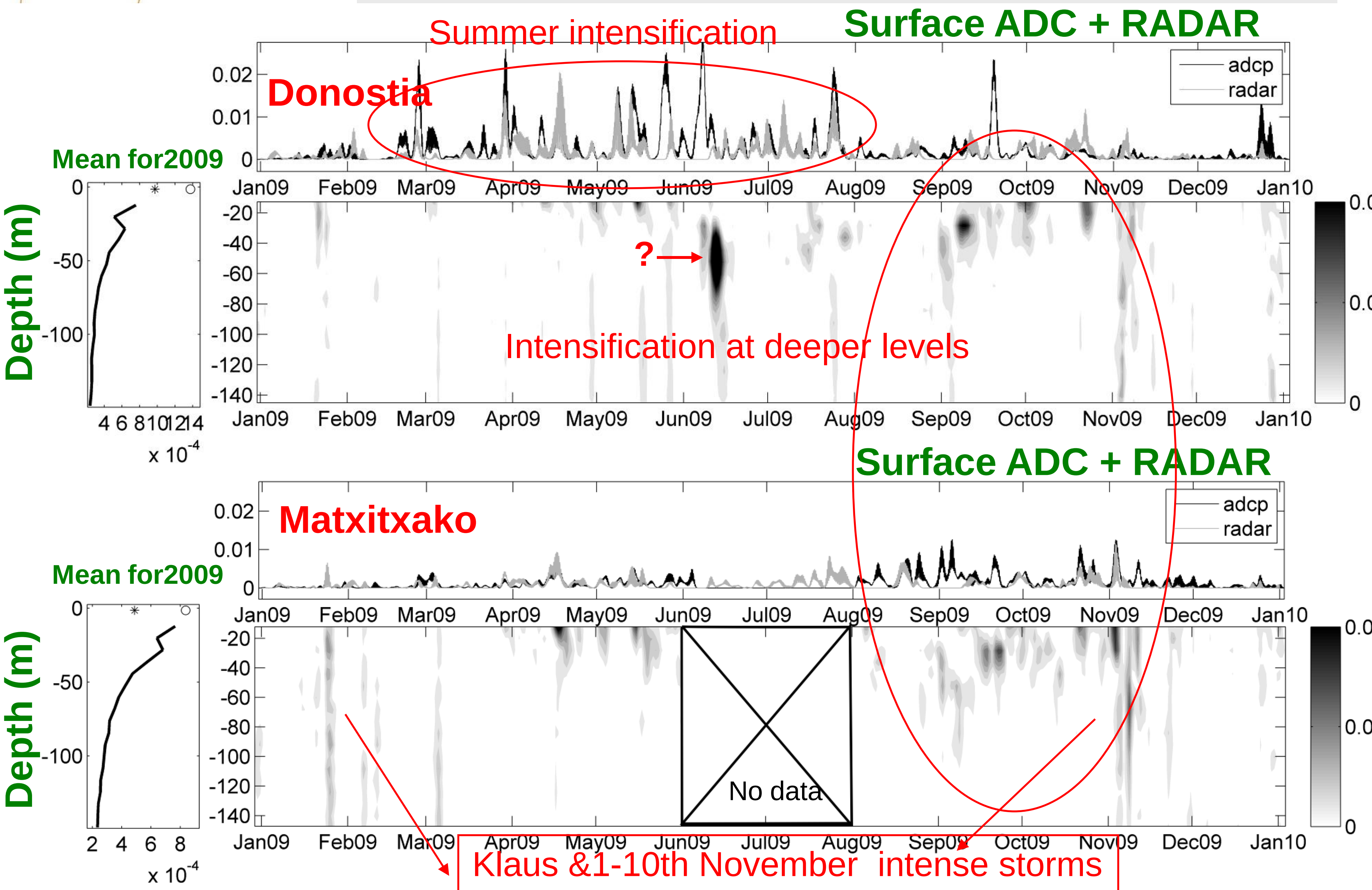
# *Distribution of near-inertial KE*

- 10th order digital Butterworth band pass filter [Emery and Thomson, 2001] applied to each velocity component
  - near-inertial: pass band 14 h <T<20 h
  - sub-inertial : low pass T>30



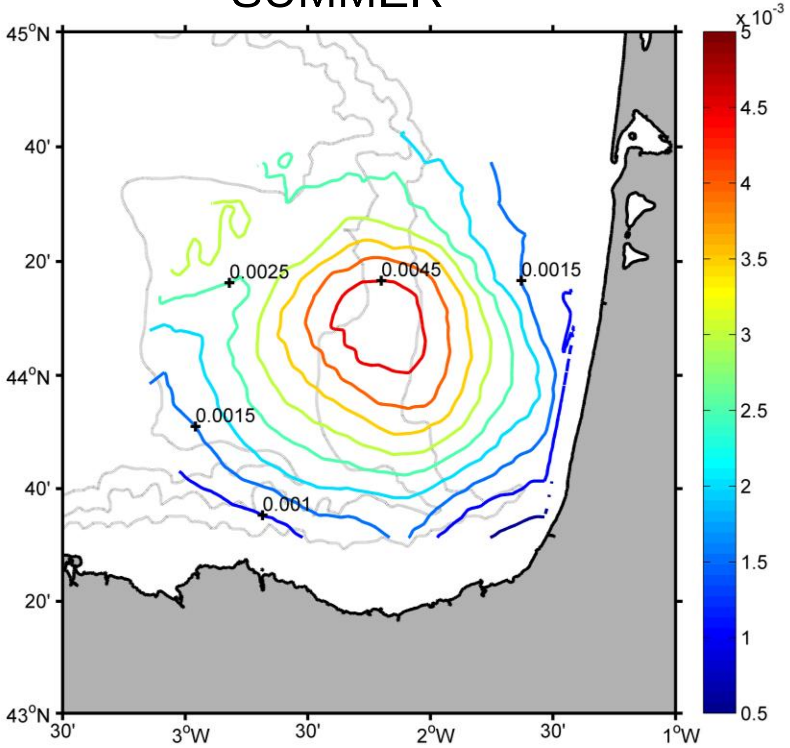

Example for the near-inertial pass band

# *Distribution of near-inertial KE $(cm^2/s^2)$*

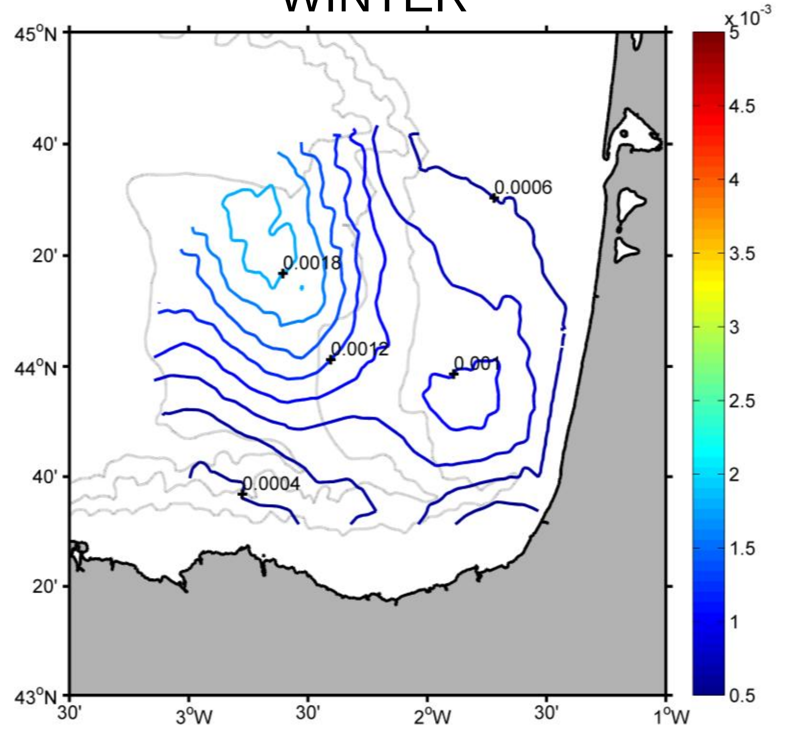


# *Distribution of near-inertial KE ($cm^2/s^2$)*

SUMMER




WINTER




Isobaths: 200, 1000 and 2000 m.

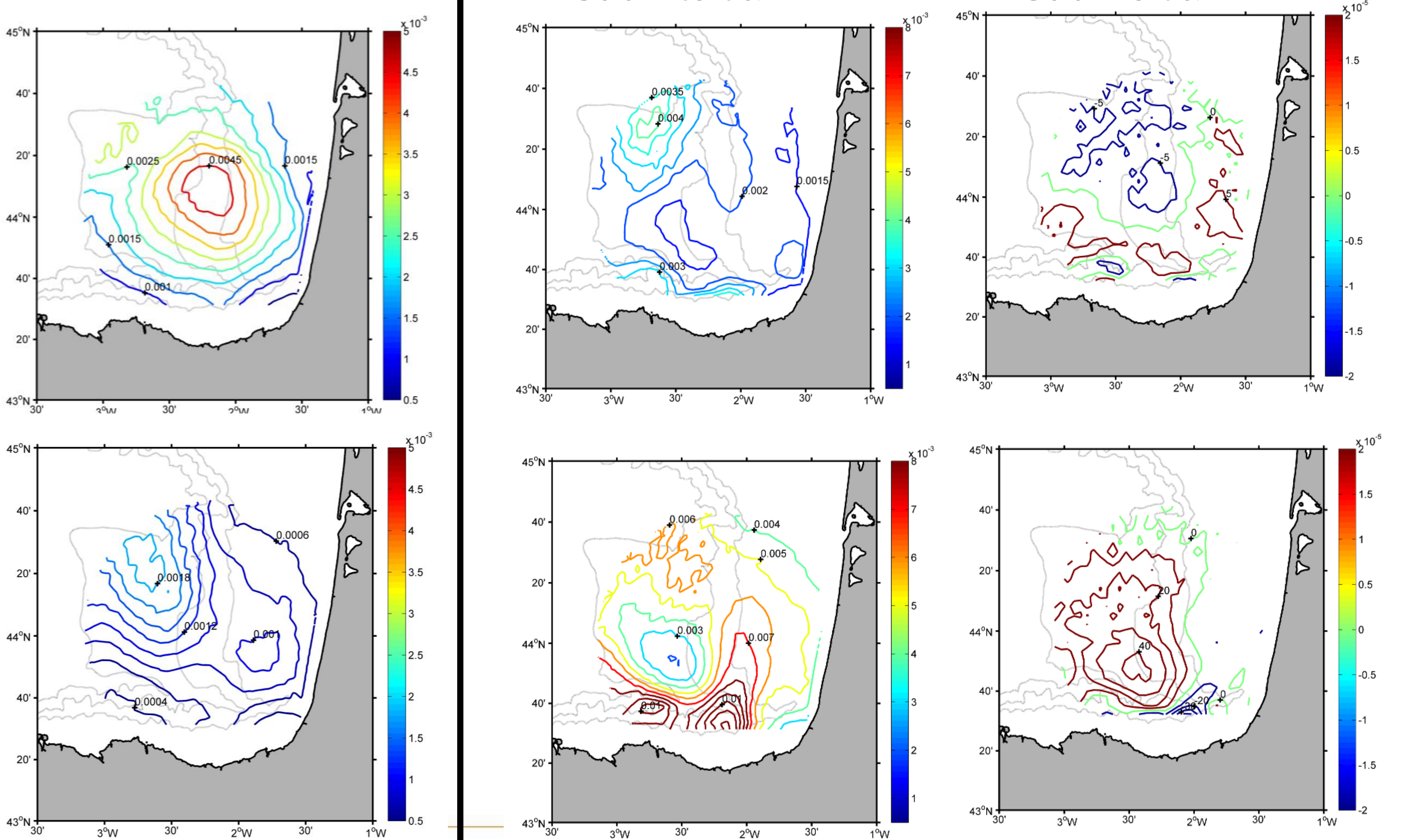
# Distribution of near-inertial KE ($cm^2/s^2$)- Connection with background field?

Sub-intertial KE

Sub-inertial RV

SUMMER

WINTER



# ???

**SUMMER**

- **Weaker and more variable winds, predominantly from the NW**
- **anticlyclonic pattern with negative vorticity offshore of 200 bathy**
- **Stratification, thermocline at 50 m**

- The surface near-inertial KE values are much more intense and centred in the middle of the Landes plateau.
- Surface intensification of the near-inertial oscillations due to stratification.
- Weak negative RV background field which would favour the oscillations (but it is too weak to explain the observed distribution).

**WINTER**

- **Intense winds (mainly SW)**
- **Well-defined cyclonic pattern, positive vorticity over the slope**
- **Well-mixed water column**

- Less intense near-inertial KE, confined in the NW of the domain, over the deeper part of the slope
- Much weaker near-inertial oscillations at surface levels. Deeper mixed layer, and thus less amplitude generation
- Winter background cyclonic circulation much more intense. The near-inertial oscillations decrease in areas where the mean flow is intense and present strong RV positive values (upper slope).

**✓No clear impact of background field (at least in summer when it is weak)**

**✓Impact of the seasonal differences in atmospheric/buoyancy forcings**

**✓The summer-winter difference might be also due to wave propagation characteristics (Cg) and interaction with coast and bathymetry.**

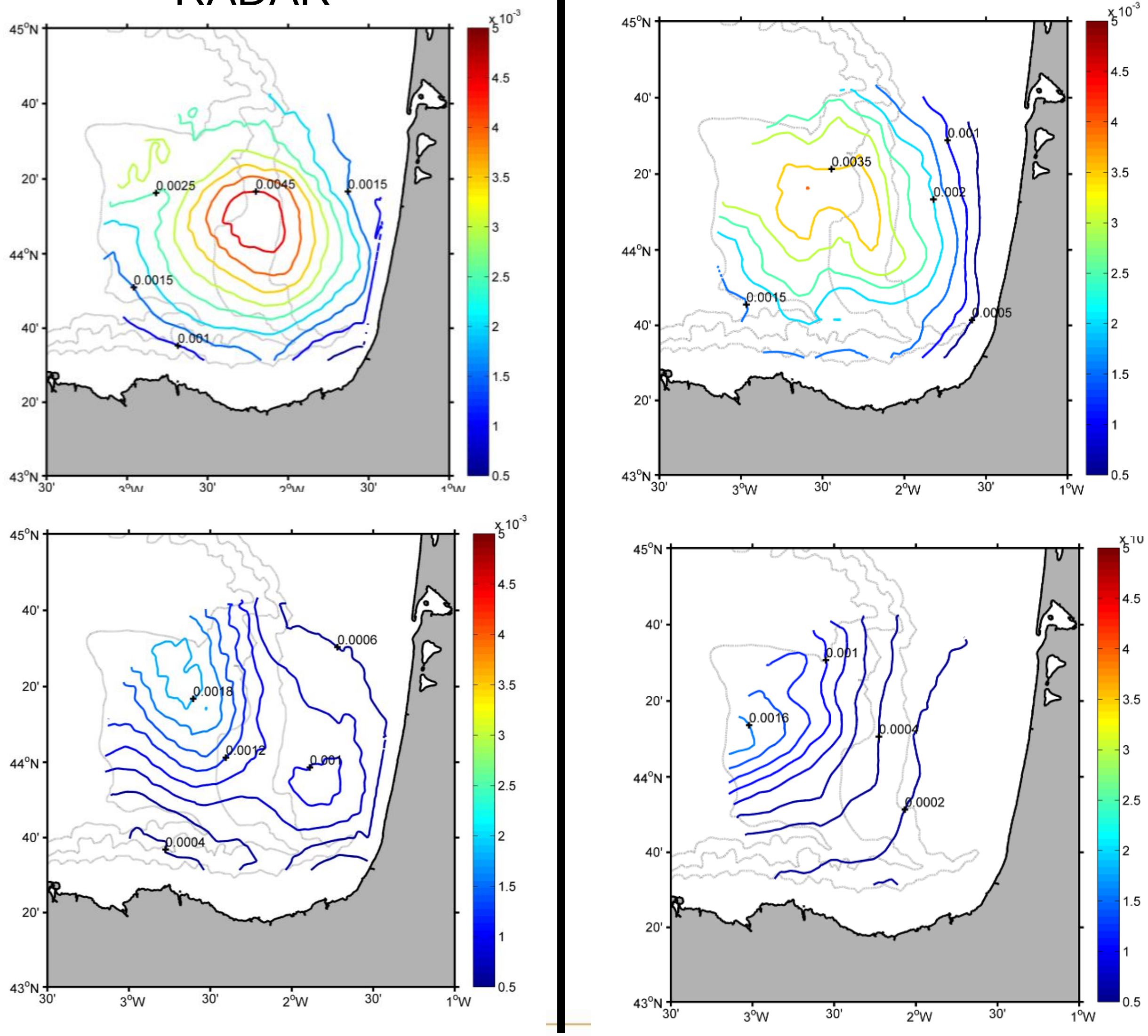
# Next? ROMS/ other model data + other in-situ data (ASPEX)?

RADAR

ROMS

SUMMER

WINTER



**Merci!**