Development of an in situ control system of the turbidity vertical profile: lessons from the winter 2007/2008 measurements

Développement d'un dispositif de contrôle in situ du profil vertical de la turbidité : enseignement des mesures de l'hiver 2007/2008

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contents

Context

- turbidity controls primary prod. & « signs » sediment transport ($\rightarrow$ habitats)
- turbidity generated by current & wave -induced resuspension
- $\rightarrow$ relevant parameter for Operational Coastal Oceanography

Introduction

- strategy
- turbidity from acoustic current-profilers
- need for long-term measurements

Description of the system

- principle
- instruments
- deployment
- calibration procedure

Results from a 4 months experiment

aim: monitoring turbidity in coastal zone

Strategy *(seatech week, 2006)*

mathematical modelling

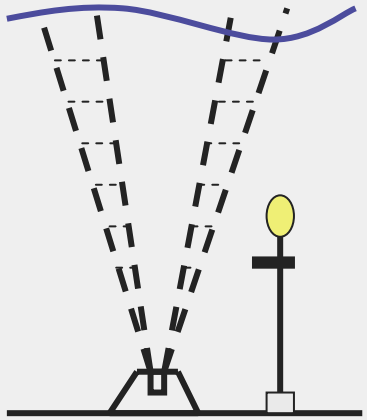
space : *3 D*
time : *continuous*

- **wave model**
- **3D Hydrodynamics**
- **sediment transport**

observations

field measurement

1DV
continuous

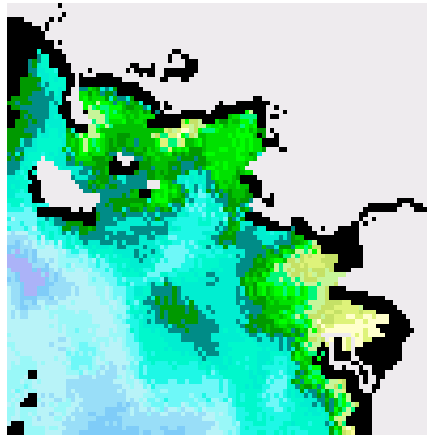


ADCP

turbidimetre

satellite image

2D surface
irregular



seawifs

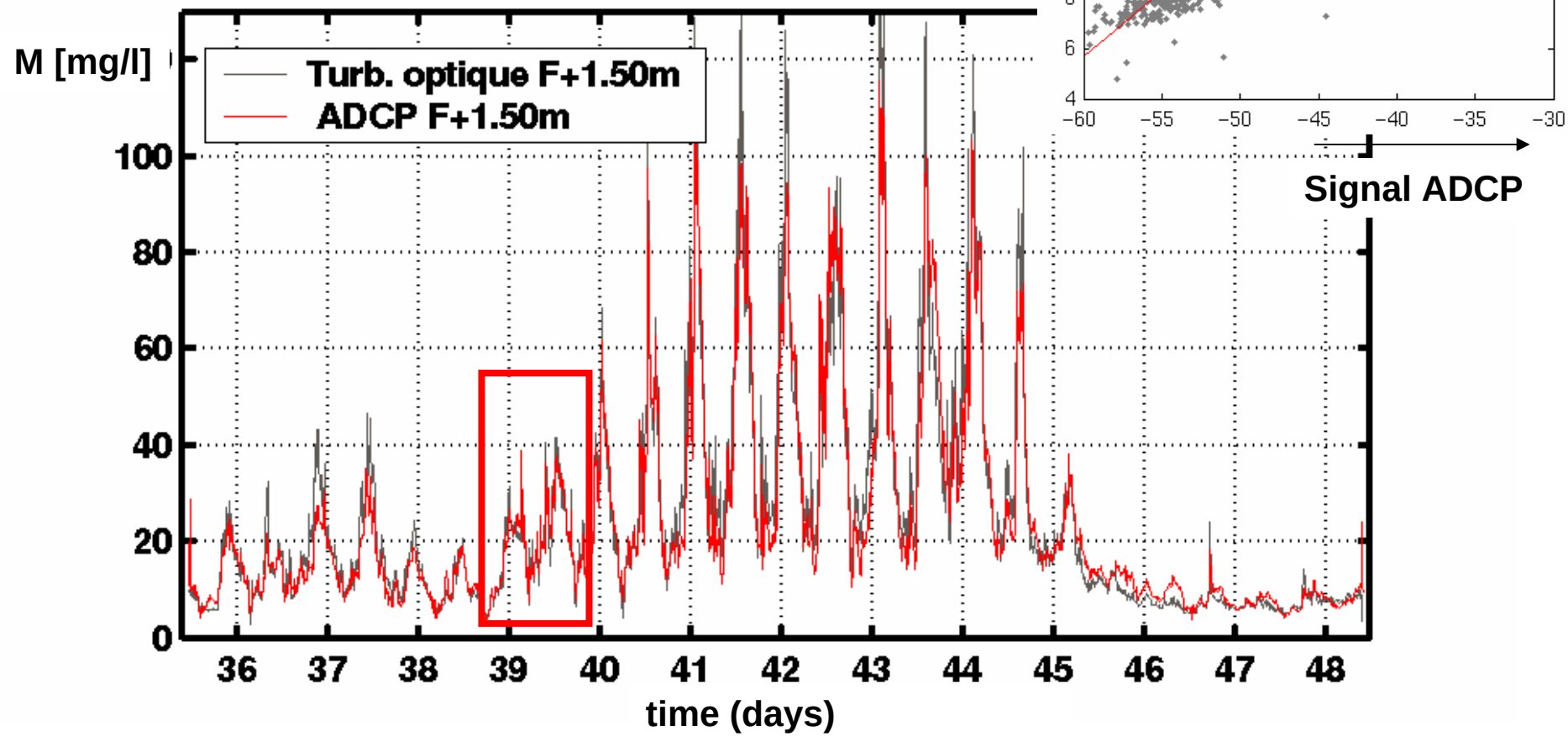
modis

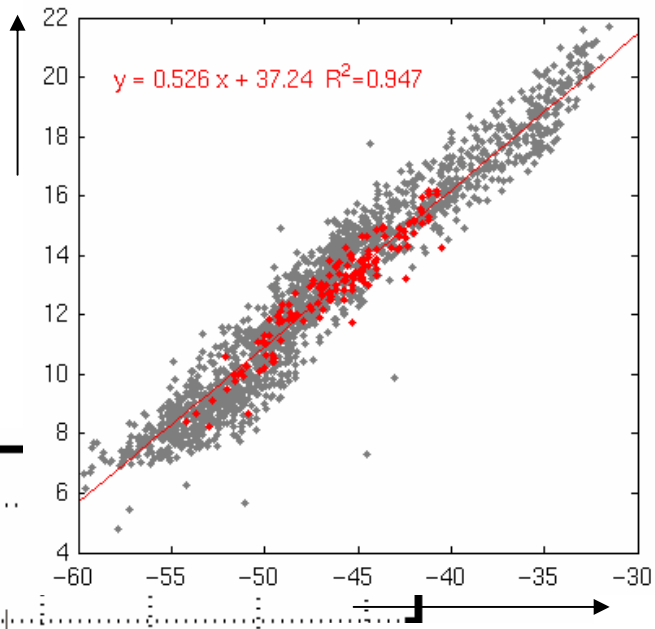
meris

Introduction (2)

Estimation of Suspended Sediment Mass concentration from ADCP

Tessier et al., 2007





Introduction (3)

ADCP 1200 kHz
Oct. 2004

Current (cm/s)

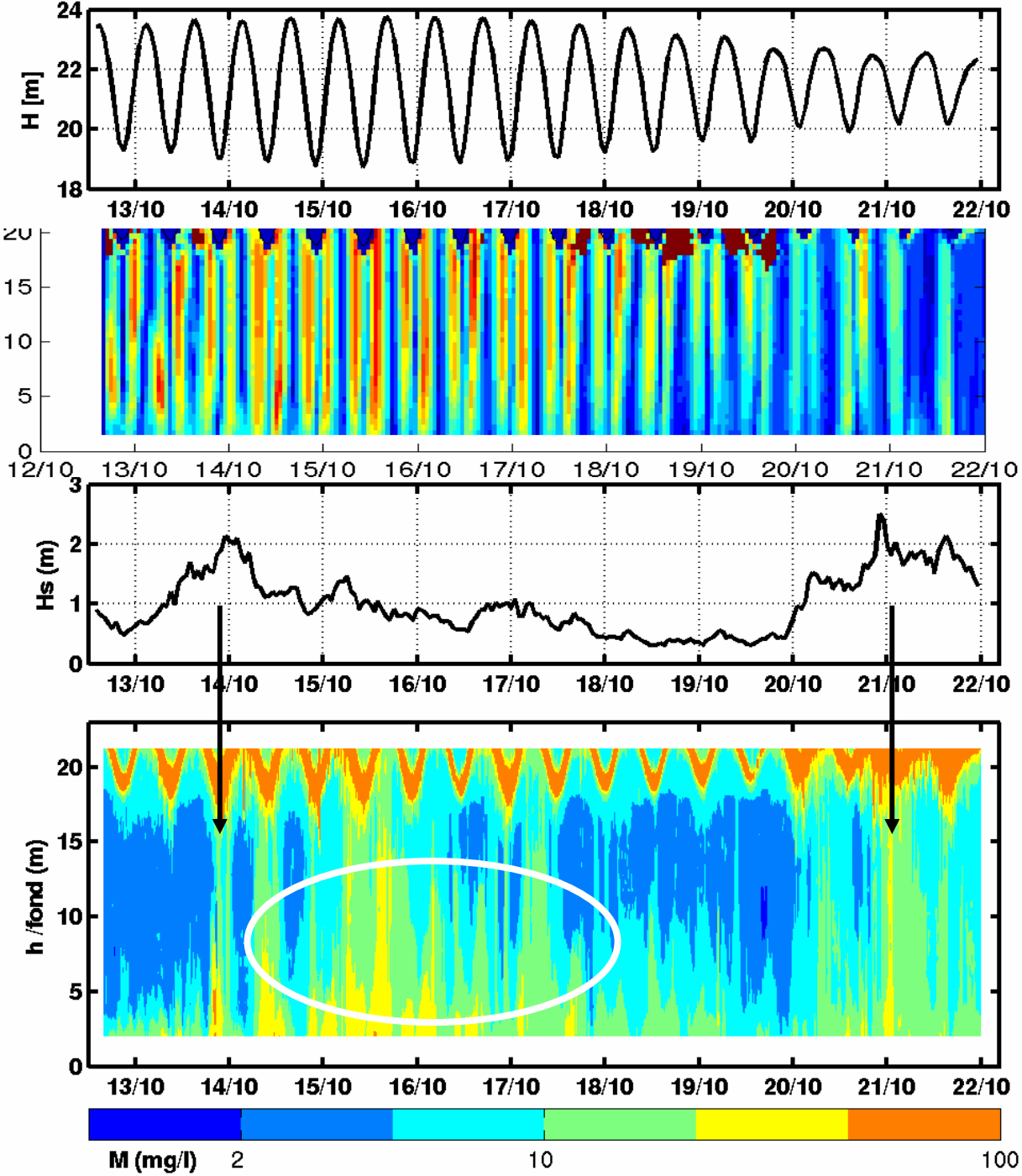
Waves Hs (m)

Concentration (mg/l)

h (m)

Advection

or local erosion ?



Introduction (4)

(from Tessier, 2006)

forçings

tide

River discharges

wind

waves

Simulating turbidity from Oct. 2004 to Feb. 2005

Surf.

~ 20 m

bottom

0 1 10 100 mg/l 1000

measurements

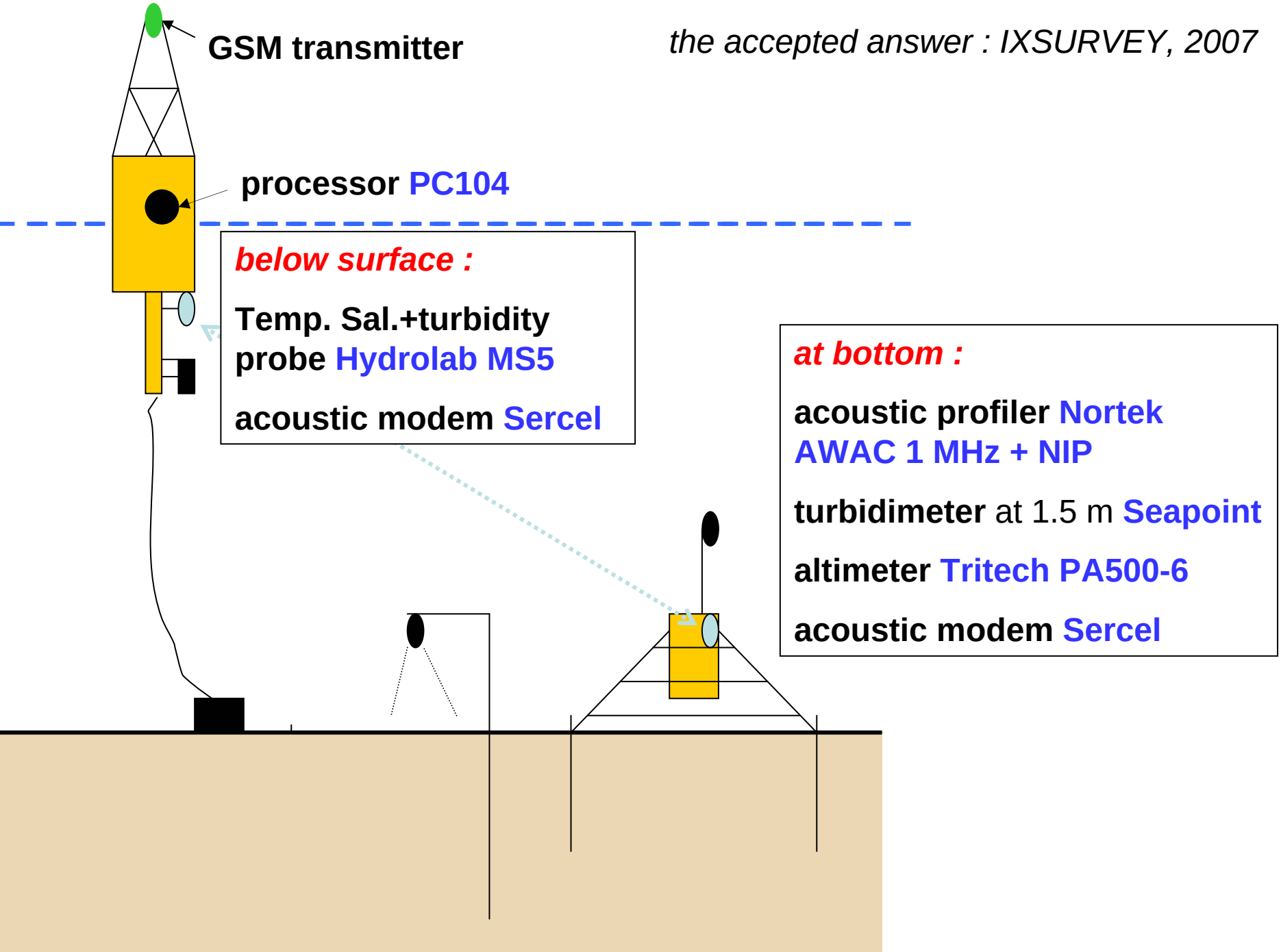
Requirements → *call for proposals*

- Current profile from a (protected) bottom acoustic probe
- Directional wave spectrum
- Turbidity profile
- Hydrology : Salinity (surf.) + Temperature (surface + bottom)
- Erosion/deposition with altimeter *(to reduce ambiguities)*
- Calibration : turbidimeter with wiper (surface + bottom)
  + episodic CTD profiles + sampling

Typical deployment

- 4 months, with intermediate retrieval & cleaning
- Acquisition rate: current (vertical resolution : 0.5 m) + hydrology : 30'
  wave spectrum : 60 '

the accepted answer : IXSURVEY, 2007

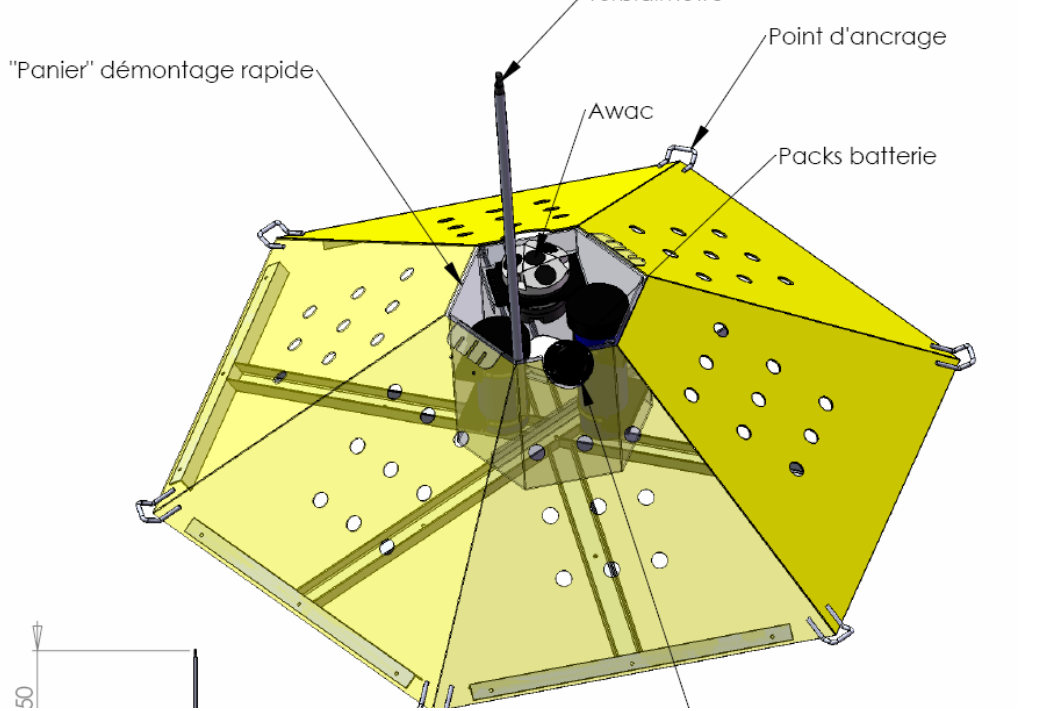


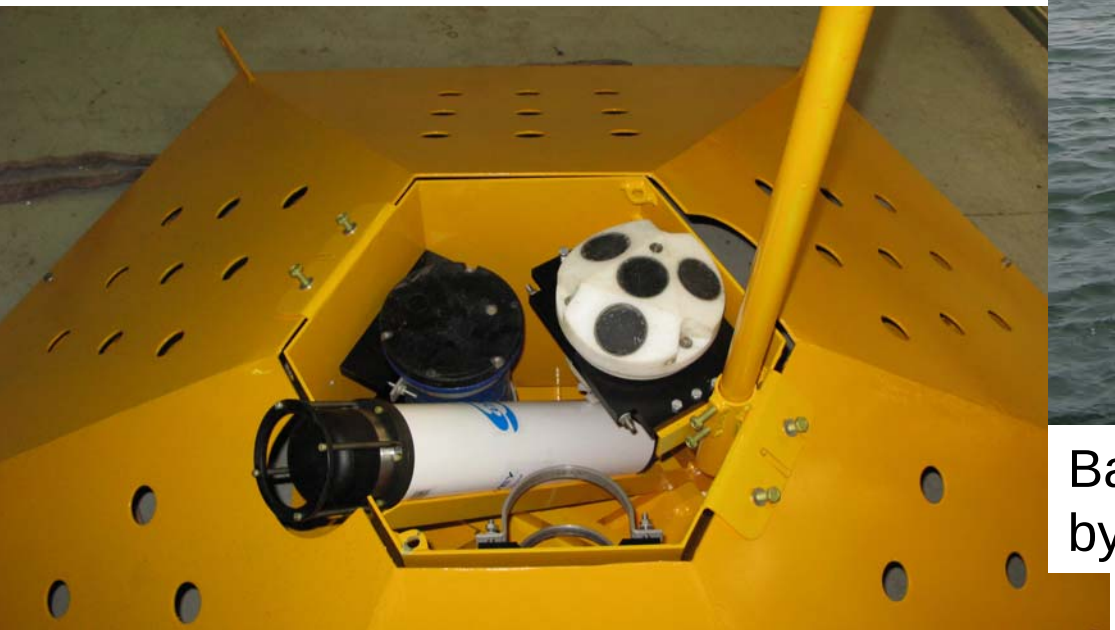
Two original features

Bottom instruments in a basket easily retrieved by divers

Real time data transmission

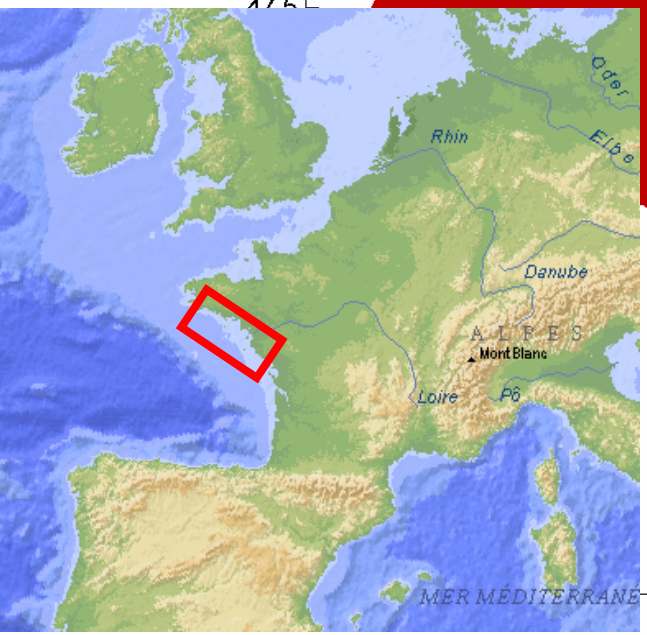
- Acoustic modems MATS (Sercel)
- GPS location
- PC104 data selection *(integrated parameters for waves…)*
- GSM transmission





Basket with instruments retrieved by divers

Location of the mooring

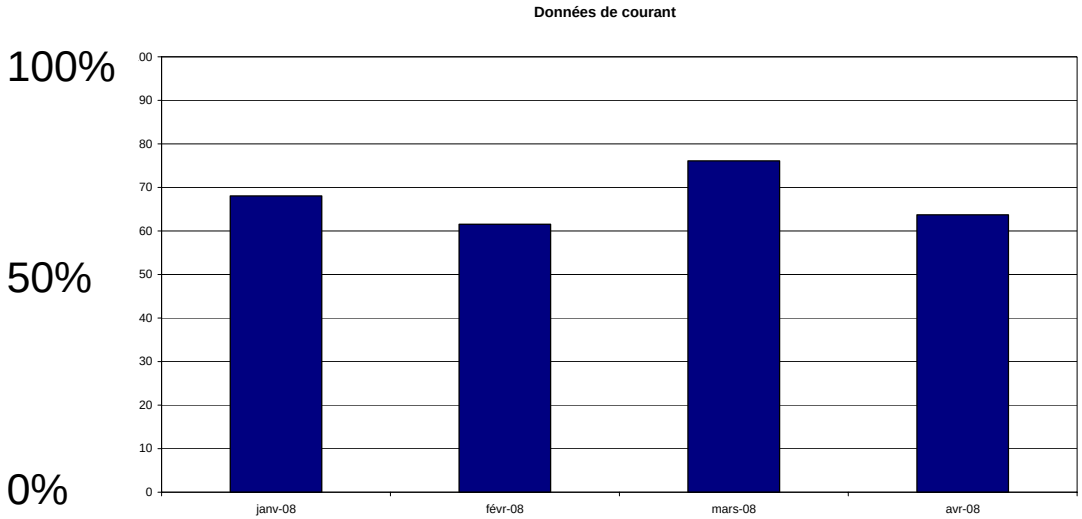


Sand/mud bottom :


SURVEY

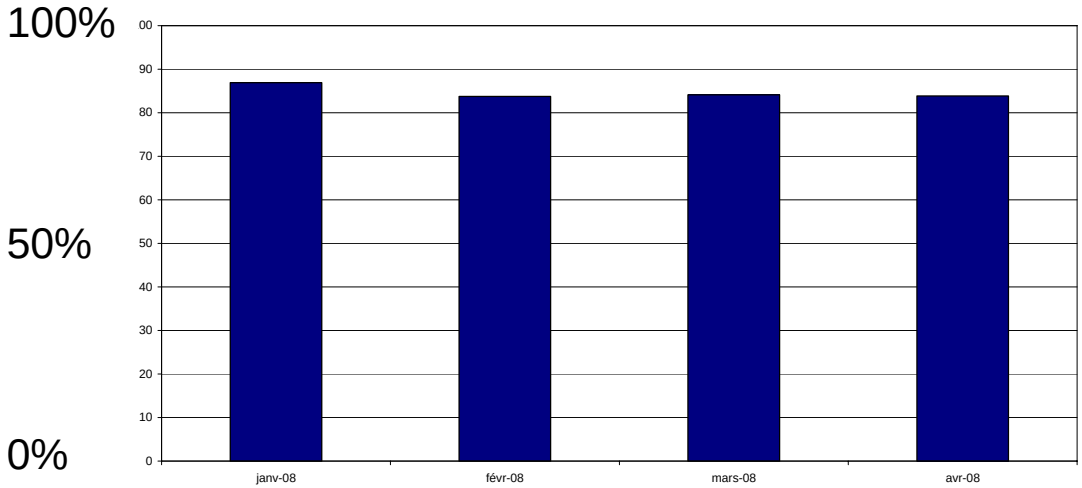
Real time availability of

- current data



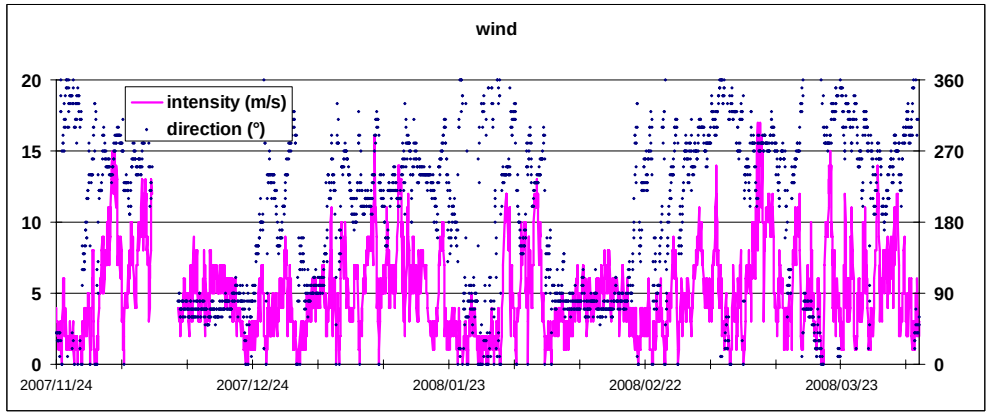
Jan feb march apr

- wave data



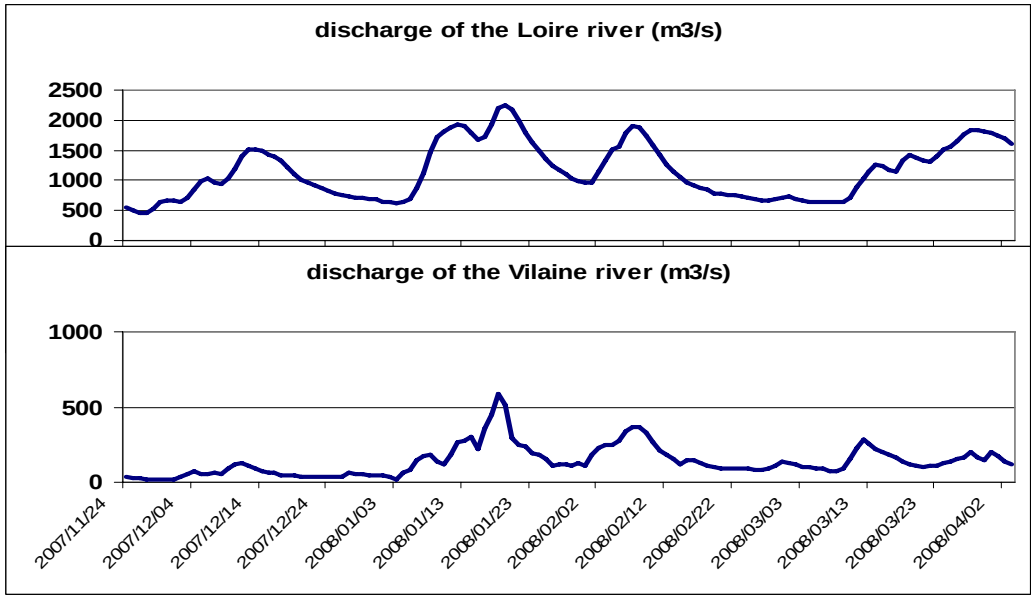
Forcings

wind

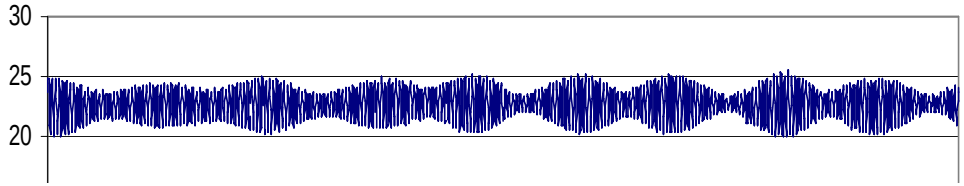


Loire river discharge

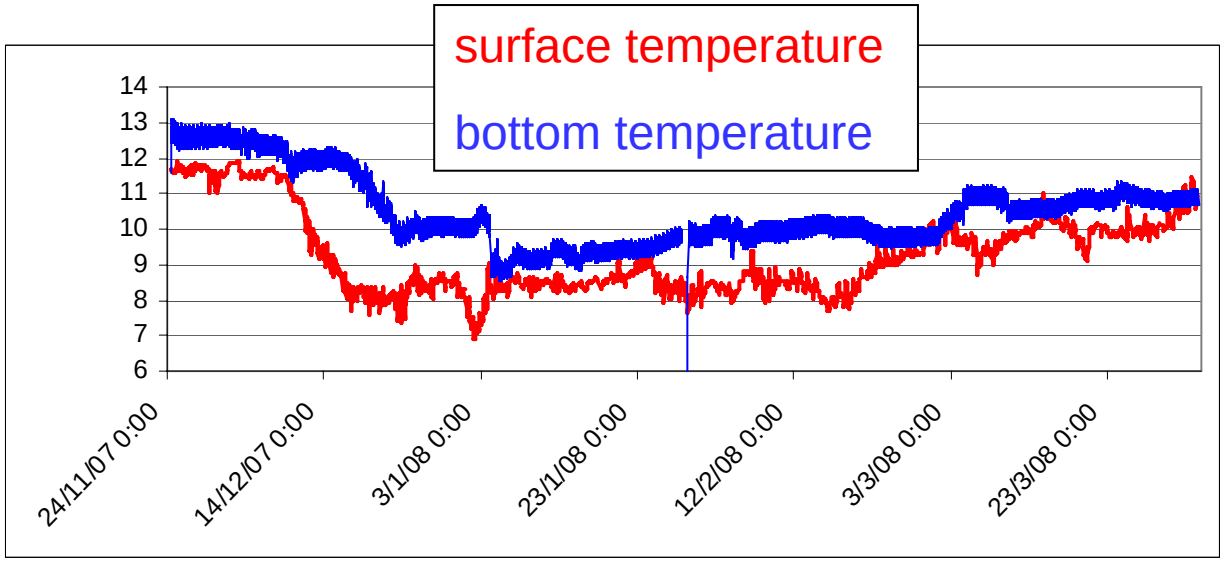
Vilaine river discharge

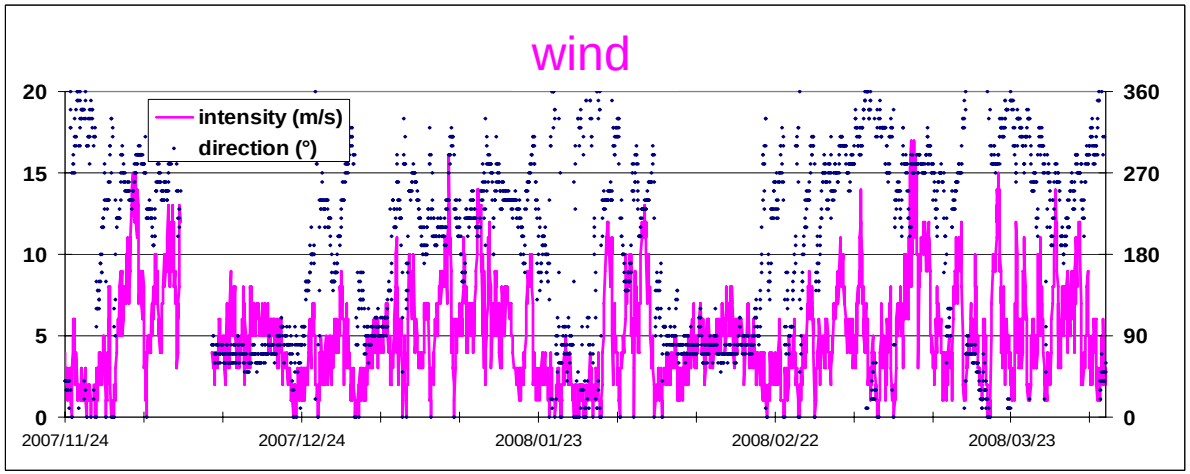


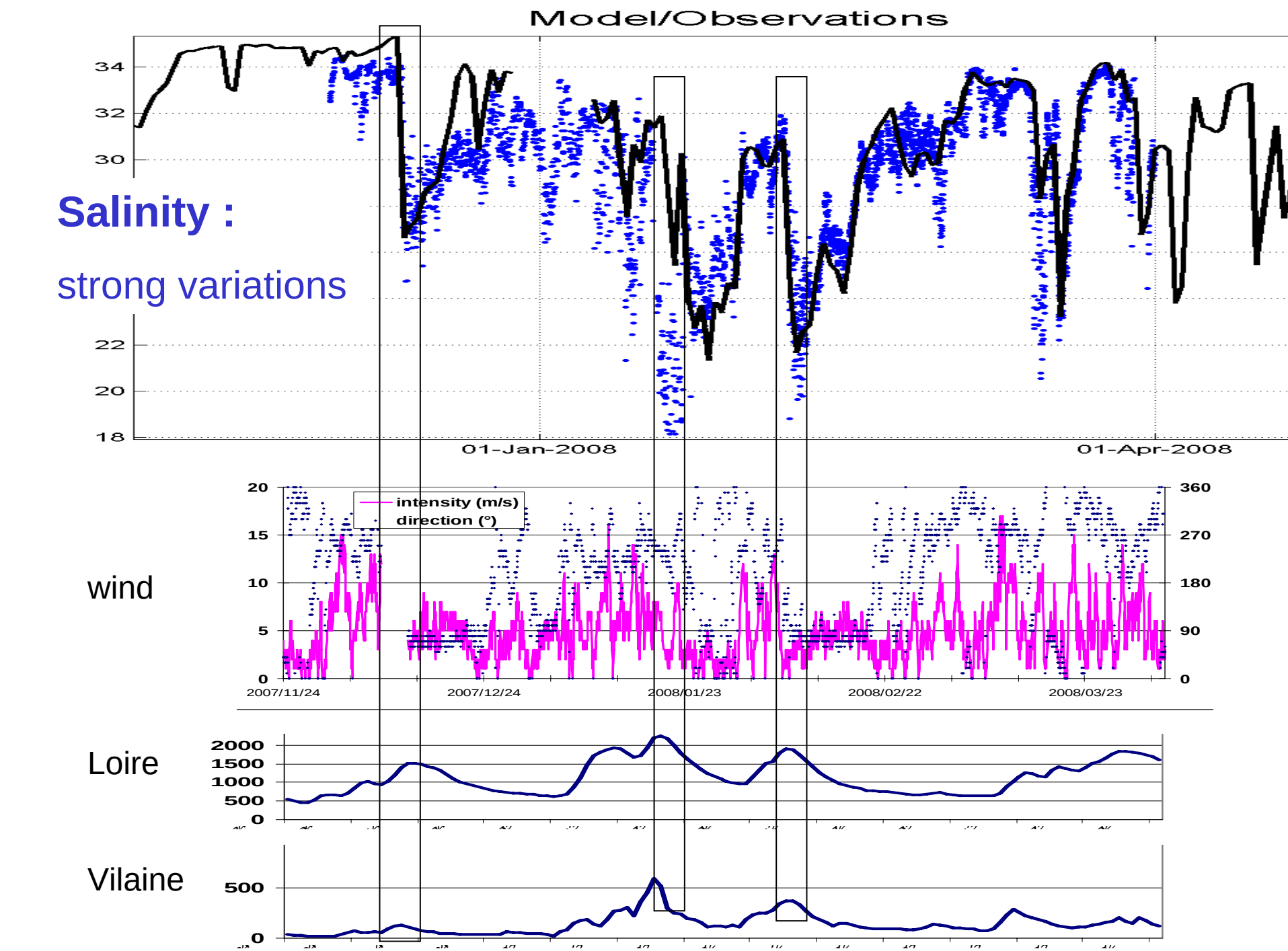
tide

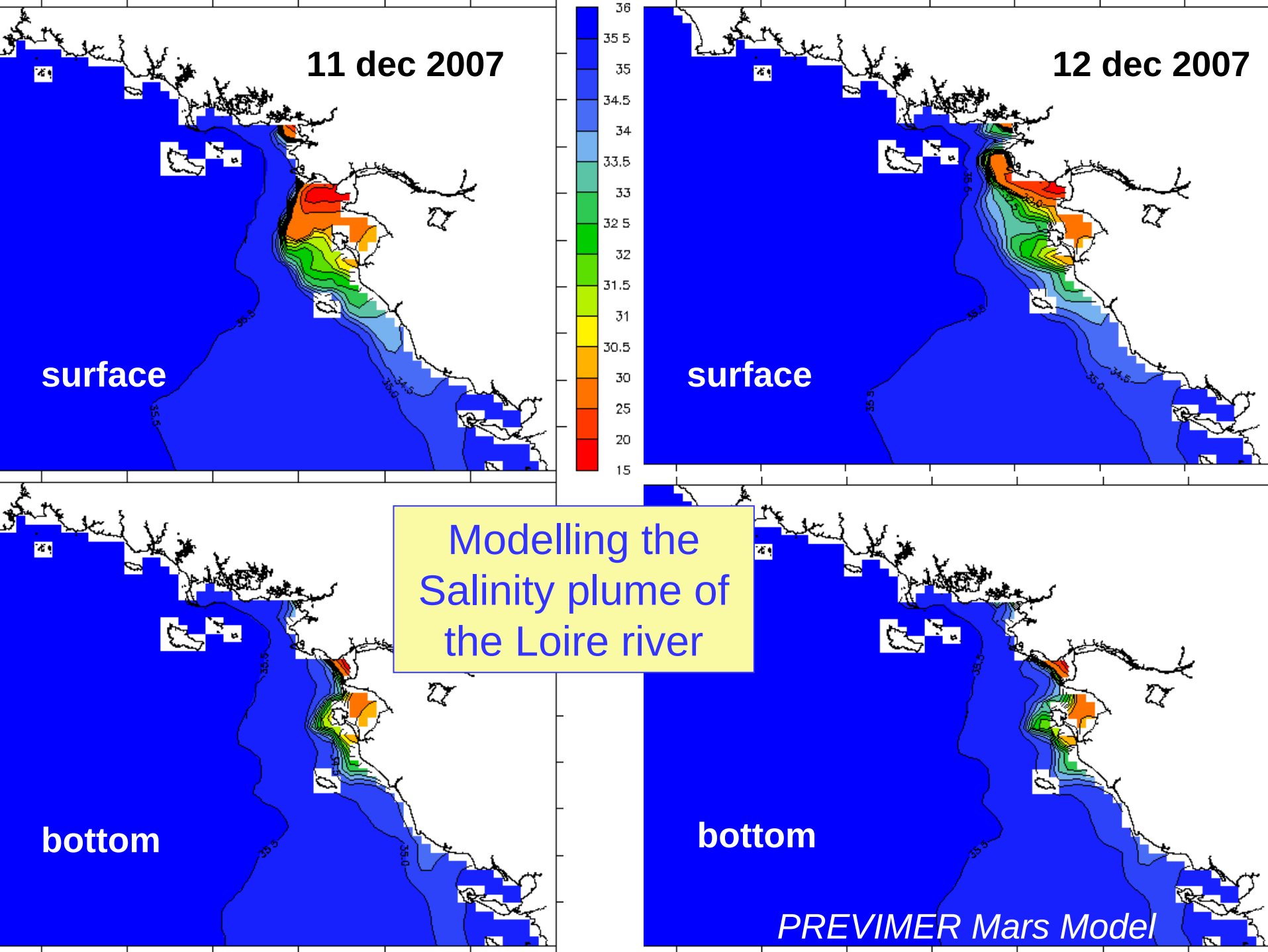


Hydrology


surface temperature
bottom temperature
14
13
12
11
10
9
8
7
6
24/11/07 0:00
14/12/07 0:00
3/1/08 0:00
23/1/08 0:00
12/2/08 0:00
3/3/08 0:00
23/3/08 0:00

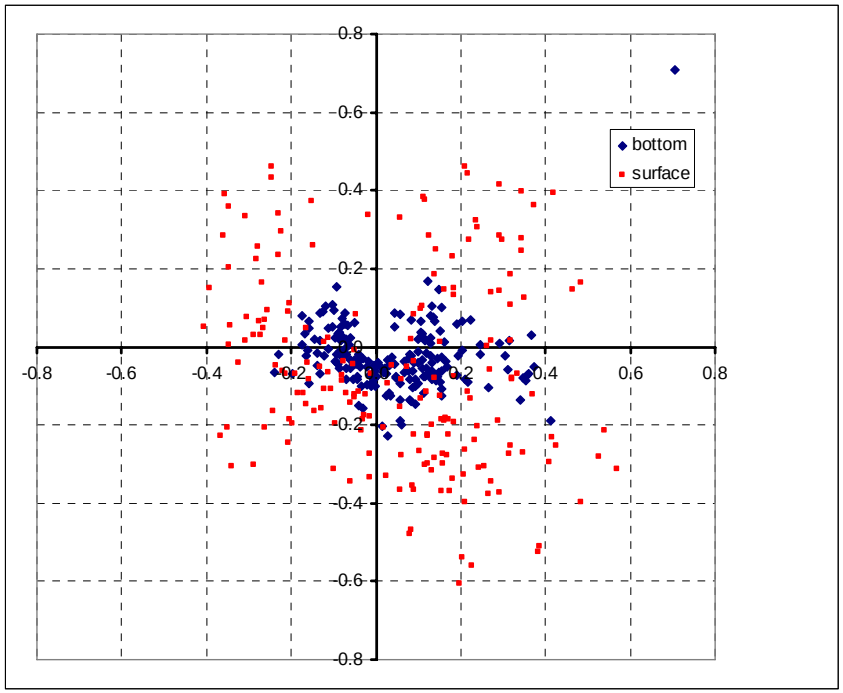

wind
intensity (m/s)
direction (°)
20
15
10
5
0
360
270
180
90
0
2007/11/24
2007/12/24
2008/01/23
2008/02/22
2008/03/23


Model/Observations
34
32
30
22
20
18
01-Jan-2008
01-Apr-2008
Salinity :
strong variations
wind
intensity (m/s)
direction (°)
20
15
10
5
0
360
270
180
90
0
2007/11/24
2007/12/24
2008/01/23
2008/02/22
2008/03/23
Loire
2000
1500
1000
500
0
Vilaine
500
0

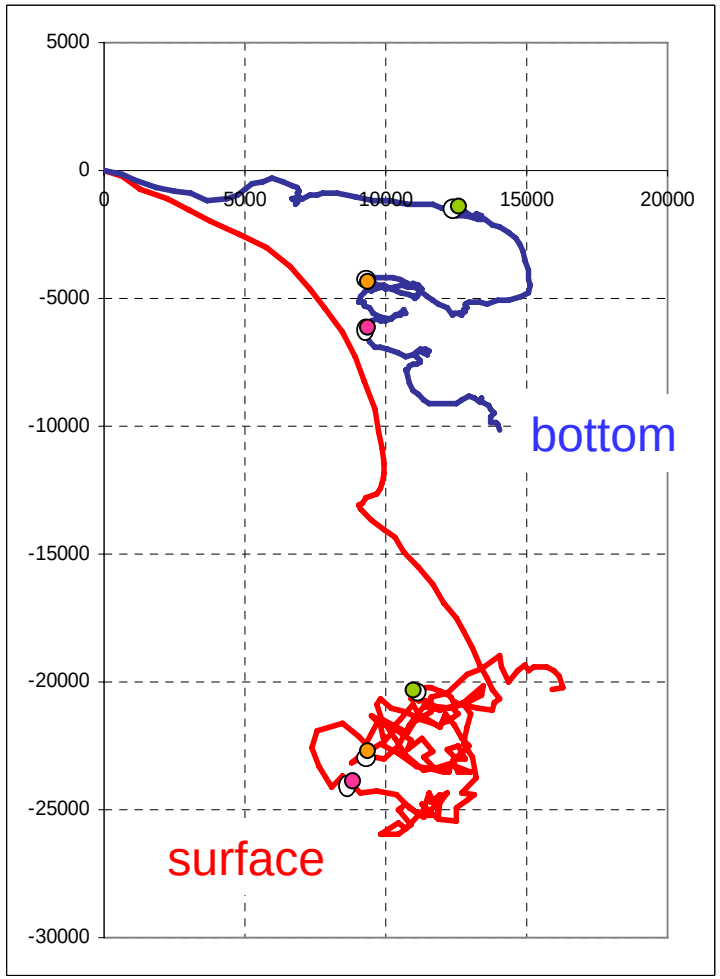

11 dec 2007
12 dec 2007
surface
surface
bottom
bottom
Modelling the Salinity plume of the Loire river
36
35 5
35
34.5
34
33.5
33
32 5
32
31.5
31
30.5
30
25
20
15
PREVIMER Mars Model

Current measurements …

current scatter plot



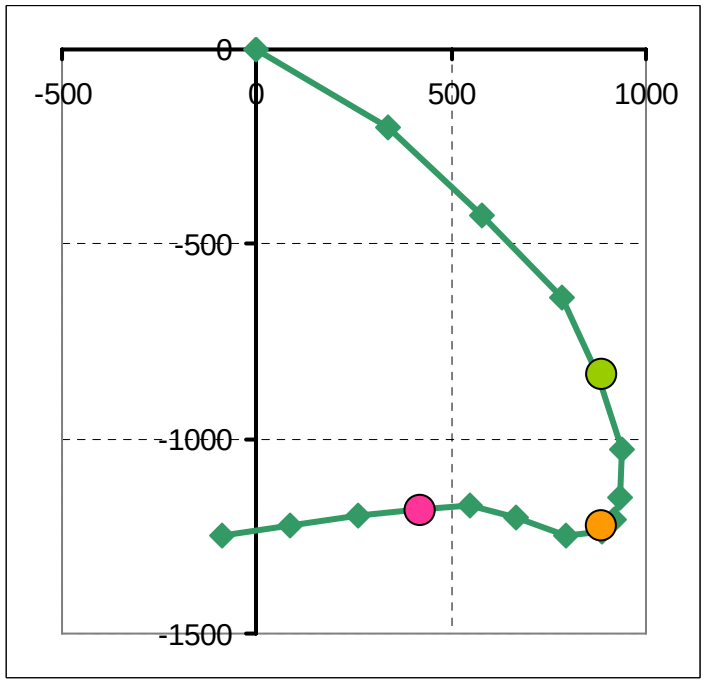
progressive vector diagram



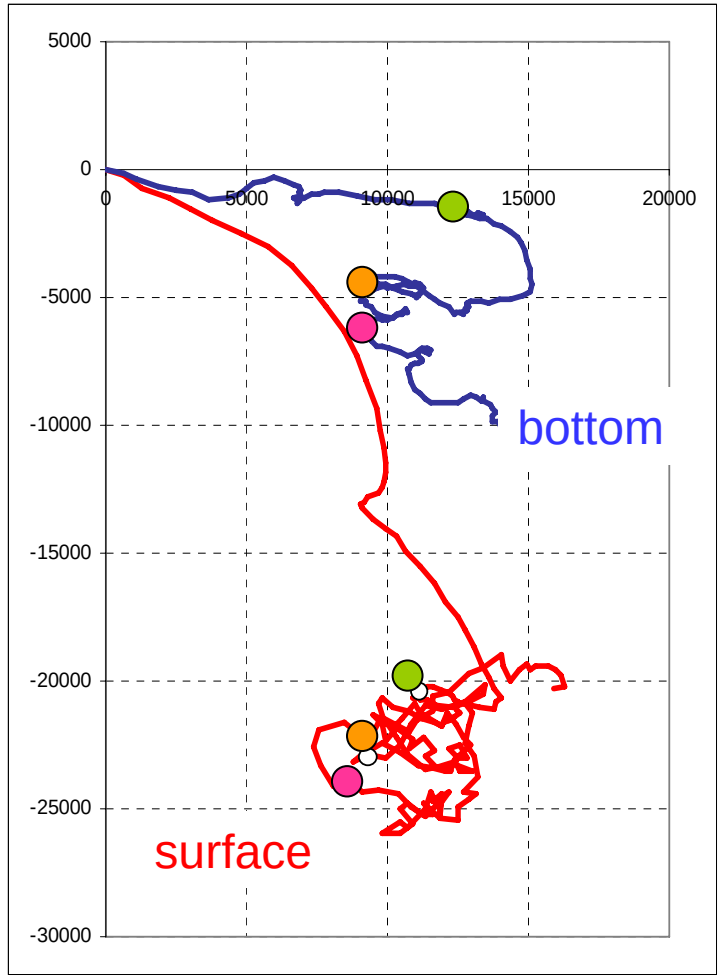
Effect of wind

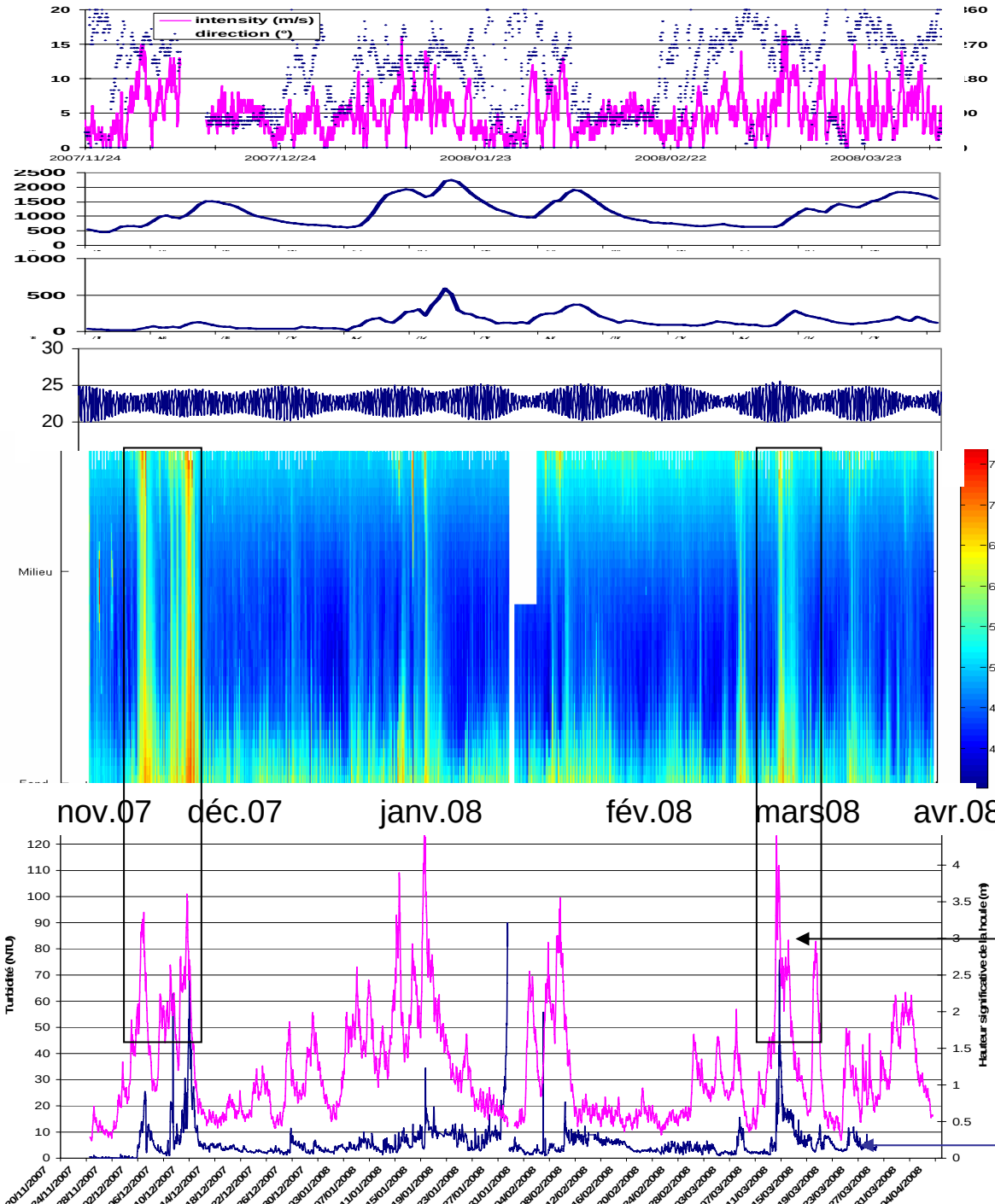
***wind** progressive vector diagram*

(km)



progressive vector diagram





wind

Loire

Vilaine

tide

forcings

acoustic turbidity dB

Hs waves (m)

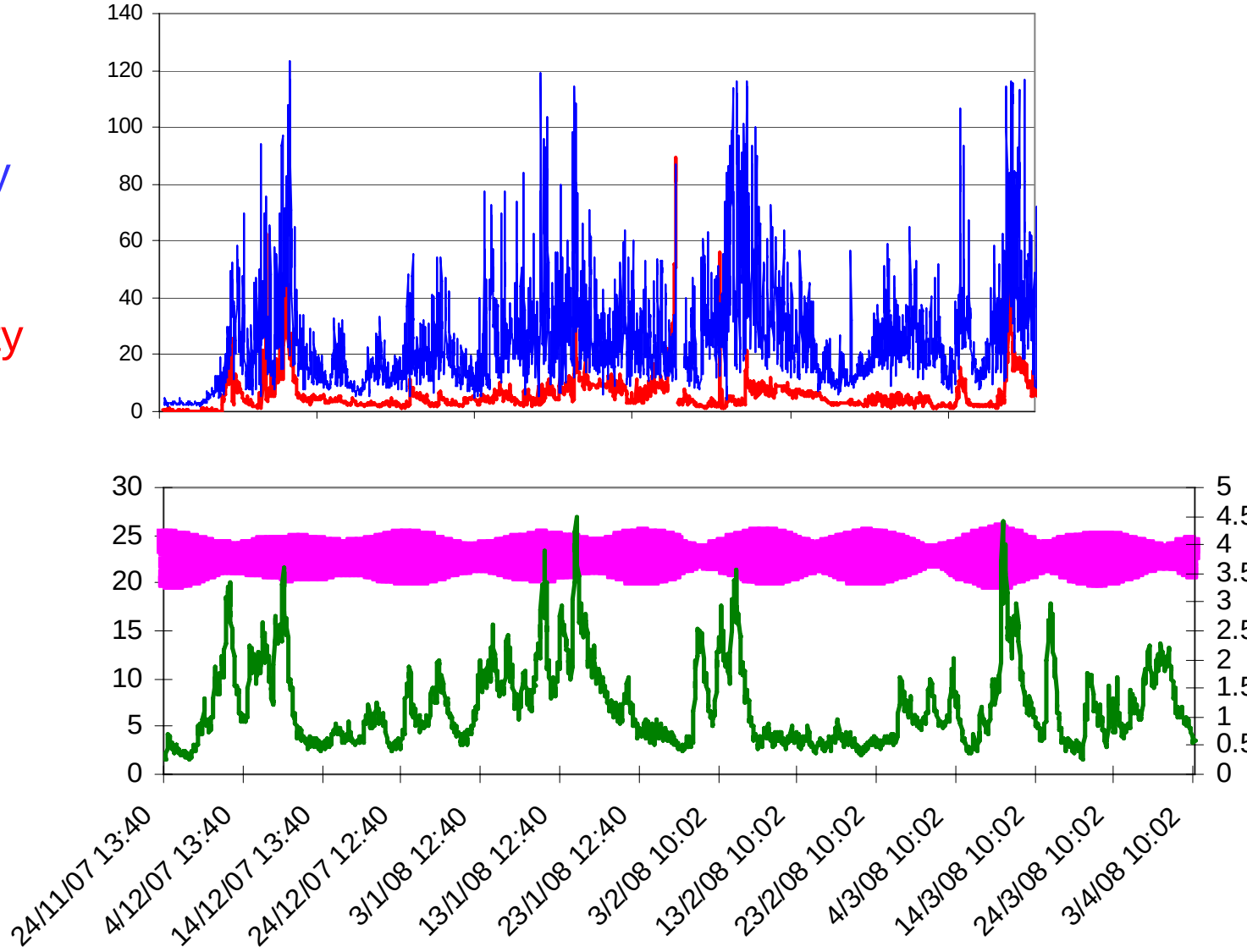
bottom turbidity NTU

Bottom turbidity

Surface turbidity

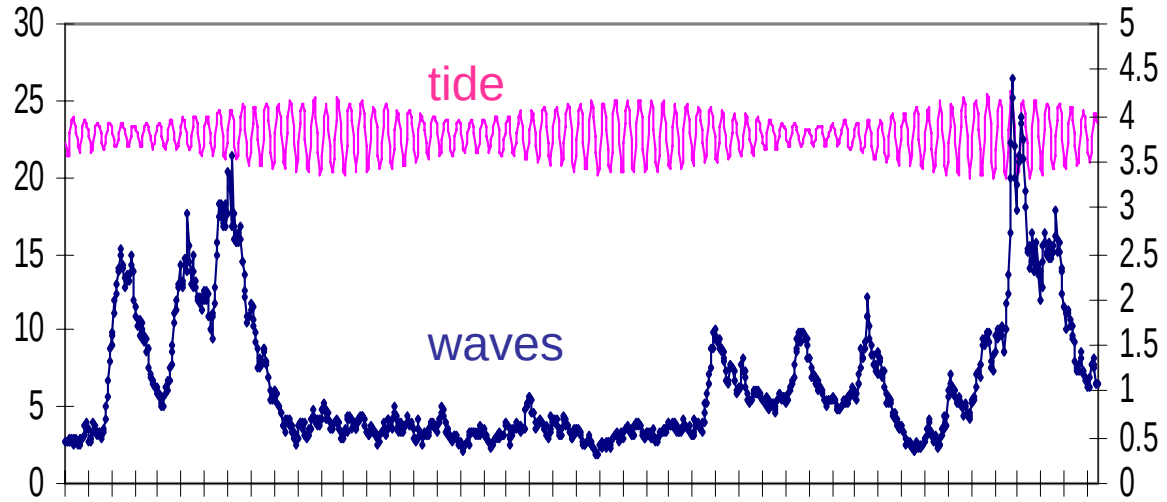
Tide

Waves



Turbidity source : local erosion or advection ?

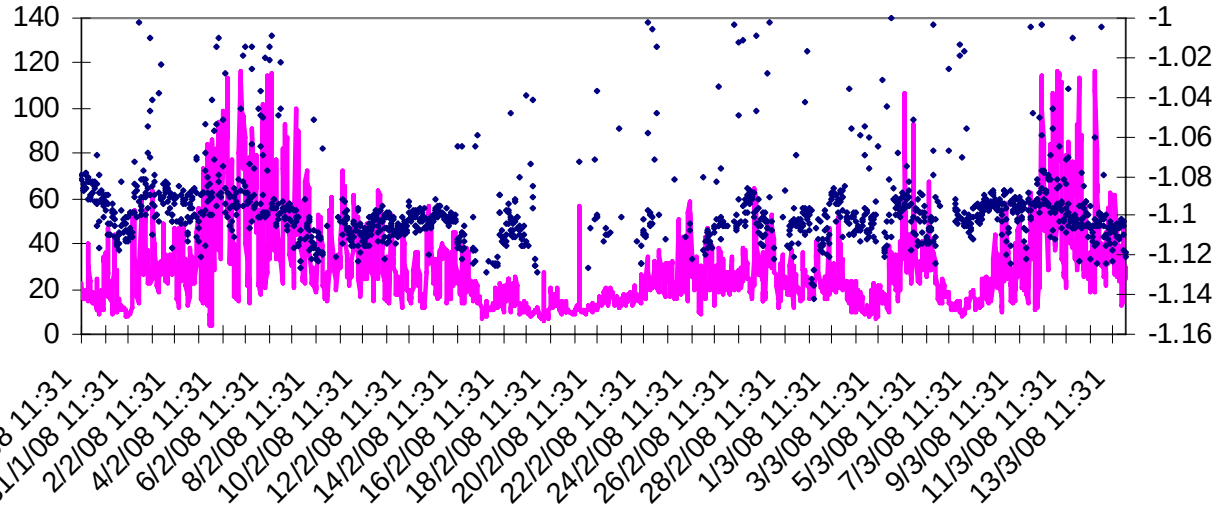
measured forcings



sediment level

and

bottom turbidity



Concluding comments

- success !

- acoustic profilers : measure local forcings + suspended matter concentration

  + *sediment level : allows to distinguish advection / local erosion/depos.*

- calibration procedure : *attention !*

- acoustic turbidity : *still in progress…*

  material in suspension : organic, mineral, flocculation effects ?

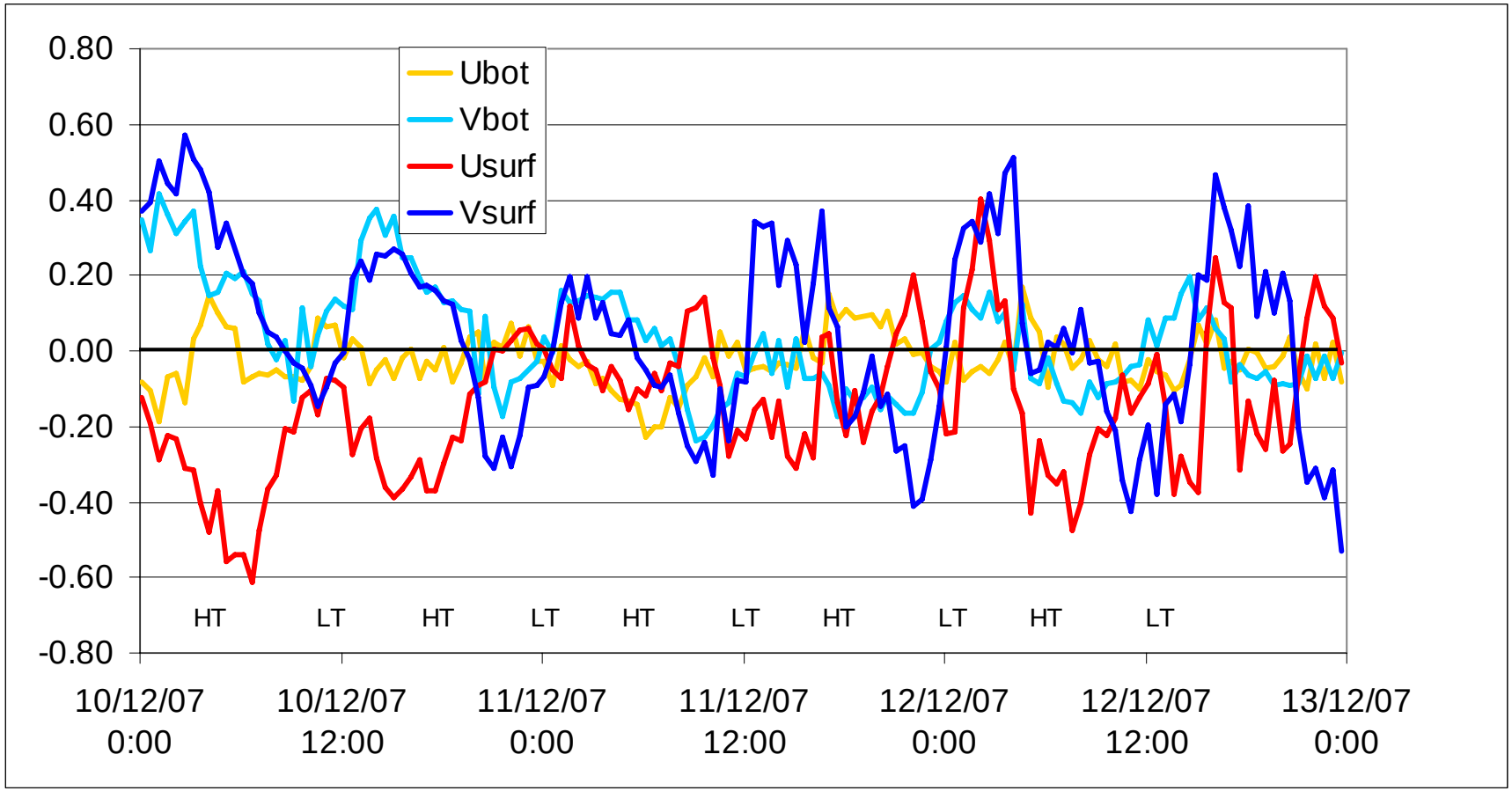
  ambiguities near surface

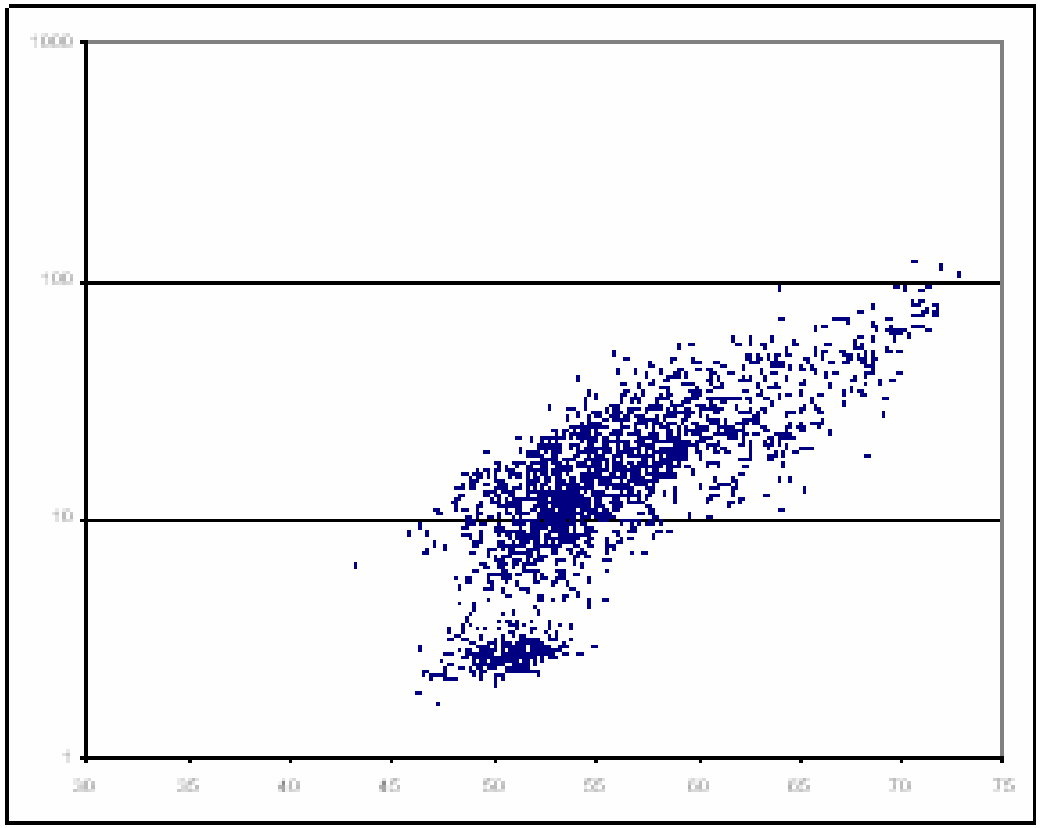
- processes : *modelling required !*

- real time data transmission :

  safety (location)

  data assimilation in modelling ?


0.80
0.60
0.40
0.20
0.00
-0.20
-0.40
-0.60
-0.80
Ubot
Vbot
Usurf
Vsurf
HT
LT
HT
LT
HT
LT
HT
LT
HT
LT
10/12/07 0:00
10/12/07 12:00
11/12/07 0:00
11/12/07 12:00
12/12/07 0:00
12/12/07 12:00
13/12/07 0:00


1000
100
10
1
30
35
40
45
50
55
60
65
70
75