BATHYELLI Project

Set-up of CD using spatial altimetry and kinematic GPS

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- Aims of BATHYELLI project
- Why computing CD in ITRS ?
- Methodology
- Spatial Approach
- Kinematic GPS Approach
- Conclusion

Aims of BATHYELLI project

- To produce a model of CD surface related to the ITRS ellipsoid
- To produce models of reference surfaces in hydrography (CD, MSL, LAT, IGN69, geoid, ITRS ellipsoid)
- To change from a vertical reference to another, particularly from a marine to a terrestrial reference
- To carry out bathymetric surveys with GPS, avoiding tidal and meteorological corrections
- To enable measuring BATHYmetry with reference to ELLIpsoid

  → BATHYELLI

Why computing CD in ITRS ?

- On coastal sites, CD geodetically connected to a fixed mark nearby tide gauge

Pb : tide marks are removable or destroyable features

- Offshore : determined by establishing a relationship (concordance method) between a temporary offshore tide gauge and the tide gauge of the reference port

Pb : the computation is not very precise

→ a stable, accurate and accessible reference system is thus necessary

→ model of CD related to the ITRS ellipsoid

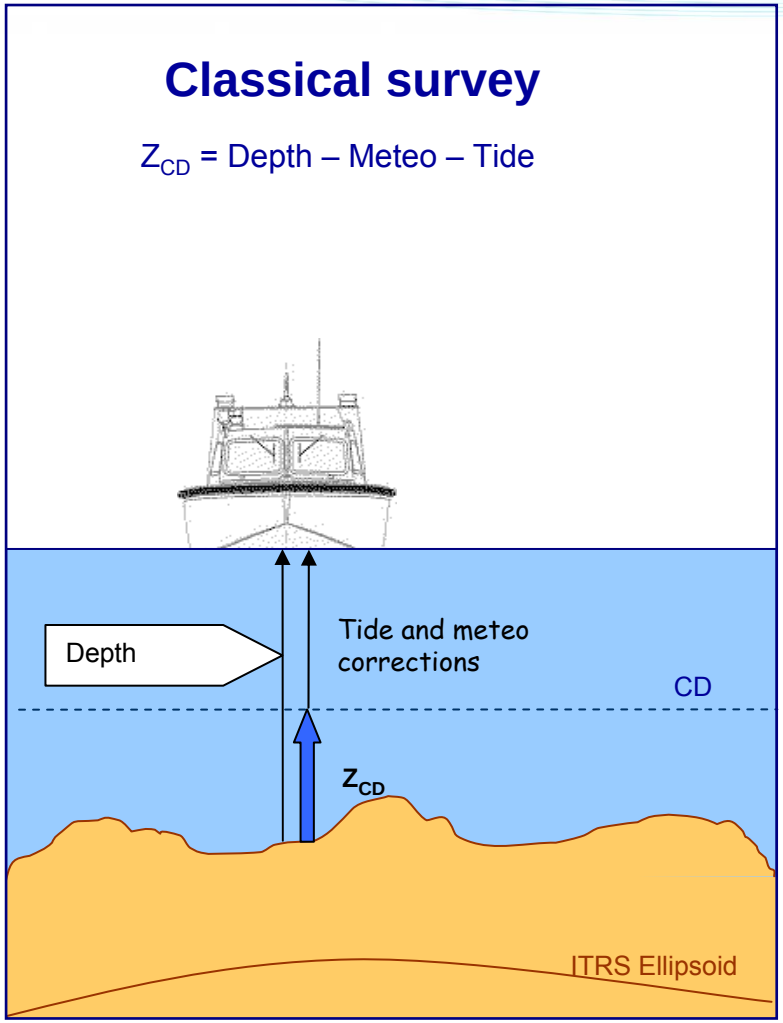
Why computing CD in ITRS ?

- With kinematic GPS, using the height of CD with reference to the ellipsoid, we can obtain directly depths related to CD without correcting the data from meteorological effects and tide

→ a new way of performing bathymetric surveys

Classical survey

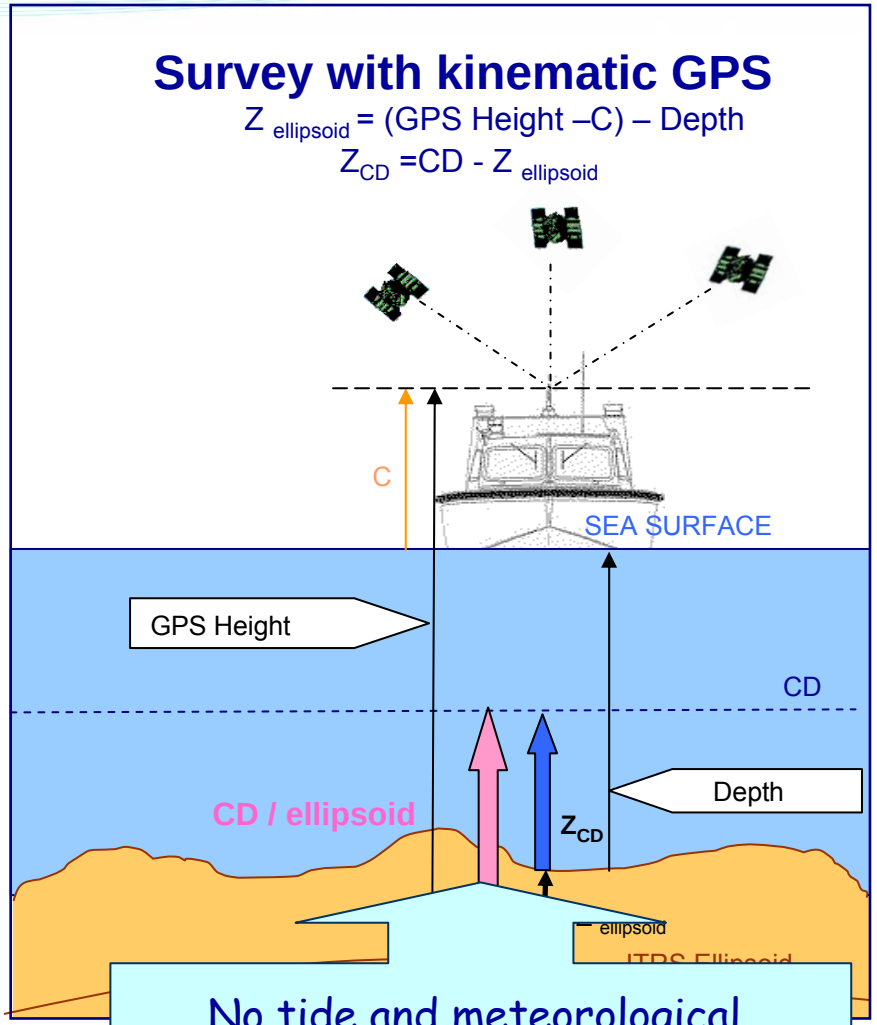
Z_{CD} = Depth – Meteo – Tide



Survey with kinematic GPS

$Z_{ellipsoid}$ = (GPS Height –C) – Depth

Z_{CD} =CD - $Z_{ellipsoid}$



No tide and meteorological corrections

Methodology

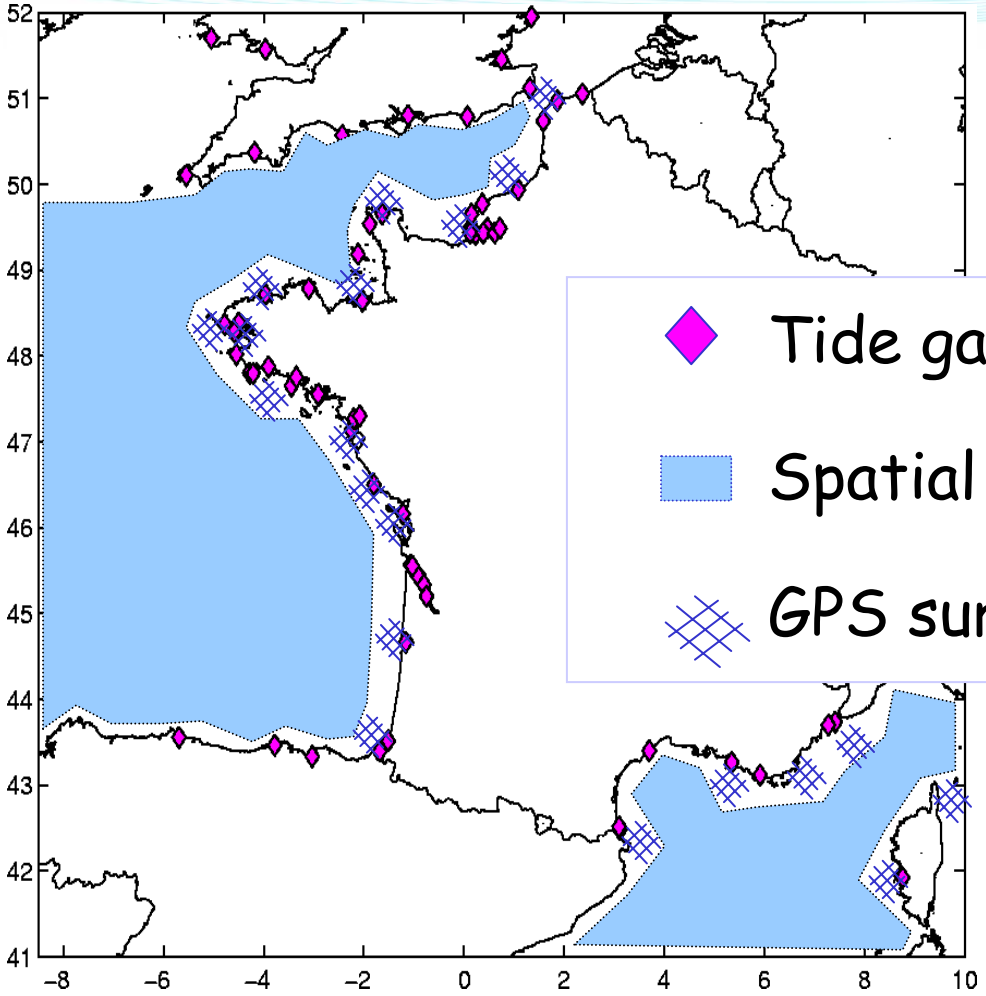
- Idea : to compute MSL with reference to ITRS ellipsoid and to infer CD level related to the same reference

  MSL → LAT : tidal model

  LAT → CD : well known relations

- Spatial altimetry provides the MSS far off the coasts
- Tidal gauges provides the MSL on coastal sites
- To fill the gap between altimetry and tide gauge data, kinematic GPS surveys to measure the MSS with reference to the ellipsoid

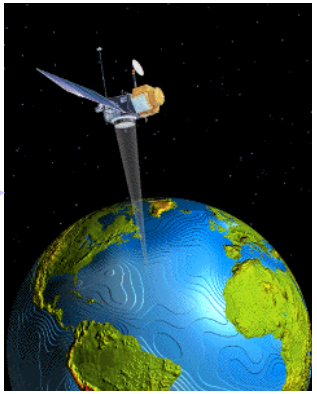
- Interpolation of the data from these 3 different sources will allow to compute precisely the MSL related to ITRS ellipsoid



Tide gauges

Spatial altimetry

GPS surveys



Spatial Approach

- The surface currently available (MSS) is not fully satisfying for hydrography

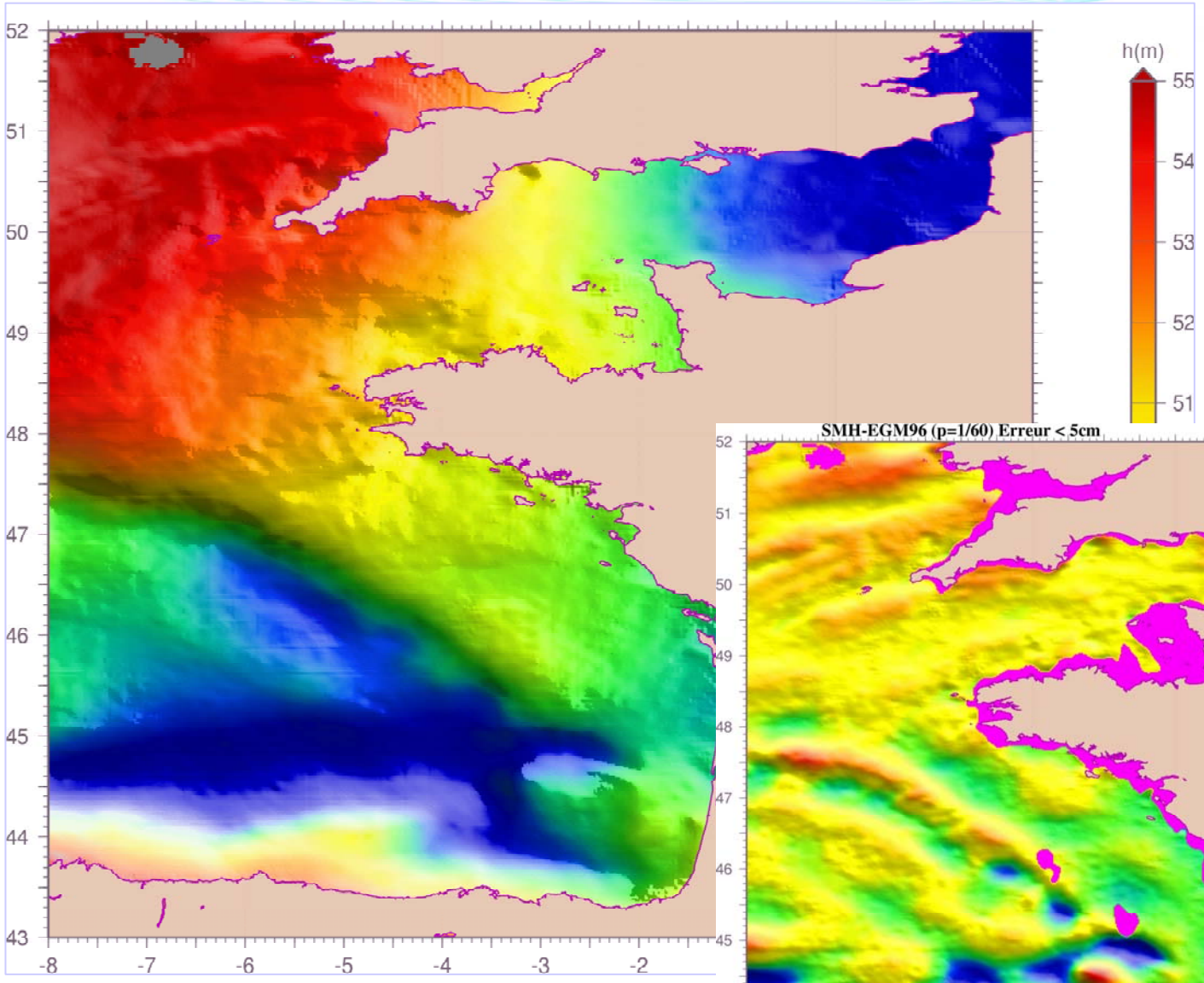
→ Hydrographic Mean Sea Surface has been computed

- Differences between MSS ans HMSS :
  - SHOM tidal model instead of a global model (differences up to 25 cm)
  - not connected to the geoid, because the geoid surface is different from the MSS
  - water levels not corrected from the inverse barometer effects, to be consistent with tide gauge processing

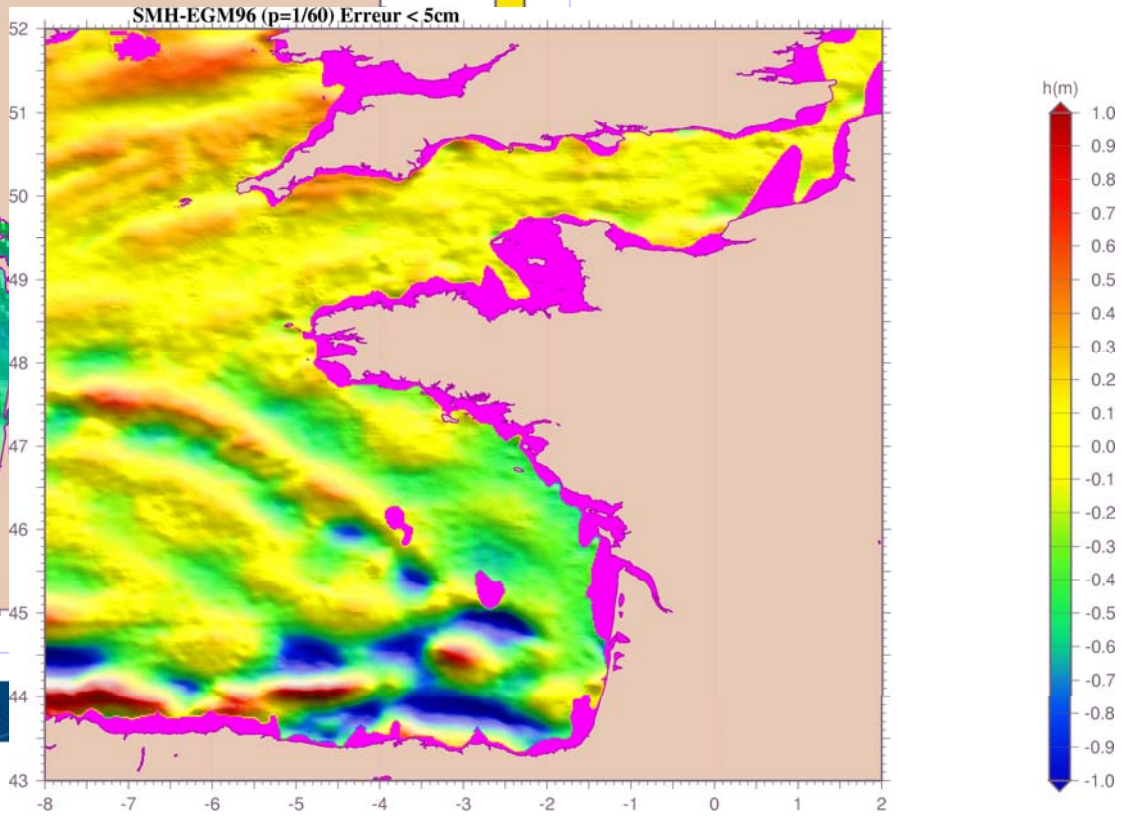
- Altimetry data were processed between 1992 and 2005, from Topex/Poseidon, ERS1, ERS2 and GFO

- HMSS and associated error computed in 2007

Hydrographic Mean Sea Surface

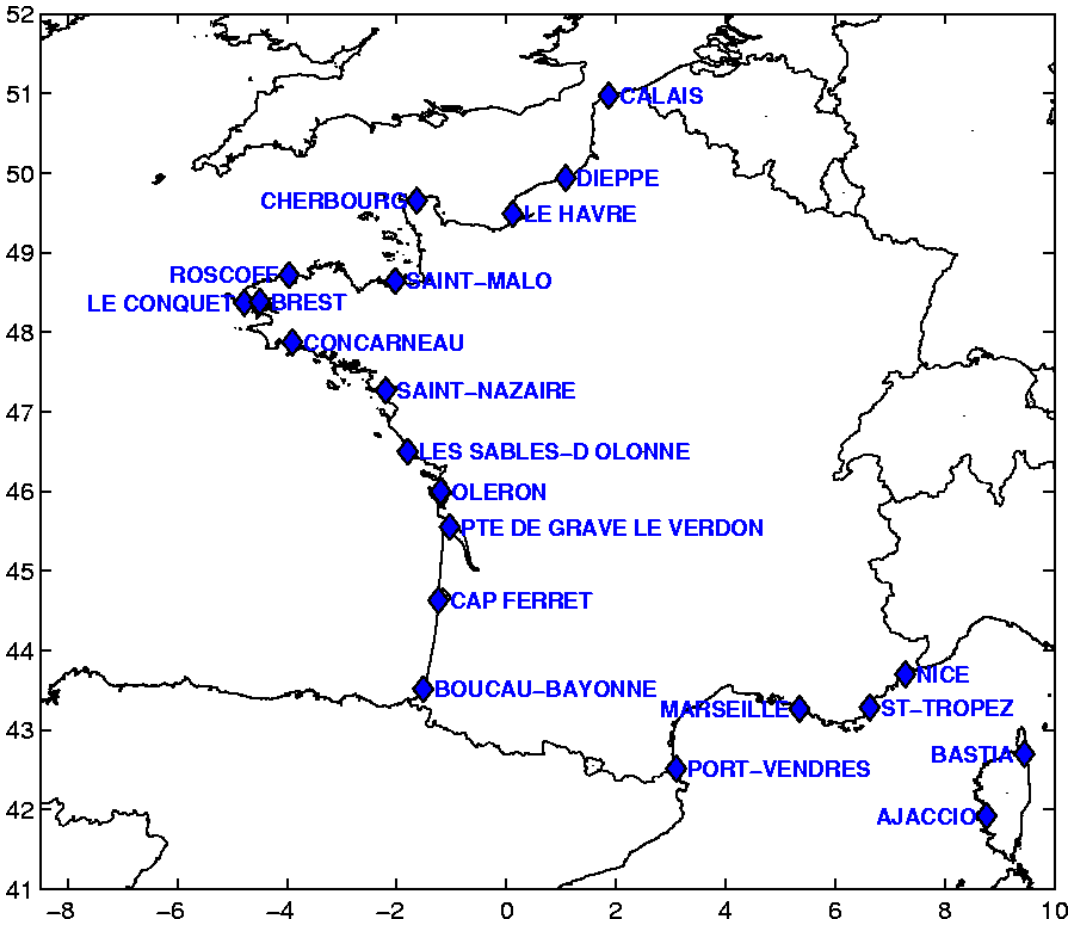


Error < 5 cm



Set-up of CD using spatial altimetry and GPS

Kinematic GPS Approach



GPS surveys campaign

2006-2008

Kinematic GPS Approach

For each site:

- Precise determination of CD at tide gauge : long GPS acquisition, at least 24h, 48h recommended

- GPS station installed as close as possible to the tide gauge

- Surveys conducted by SHOM ships or launches, fitted with a differential GPS

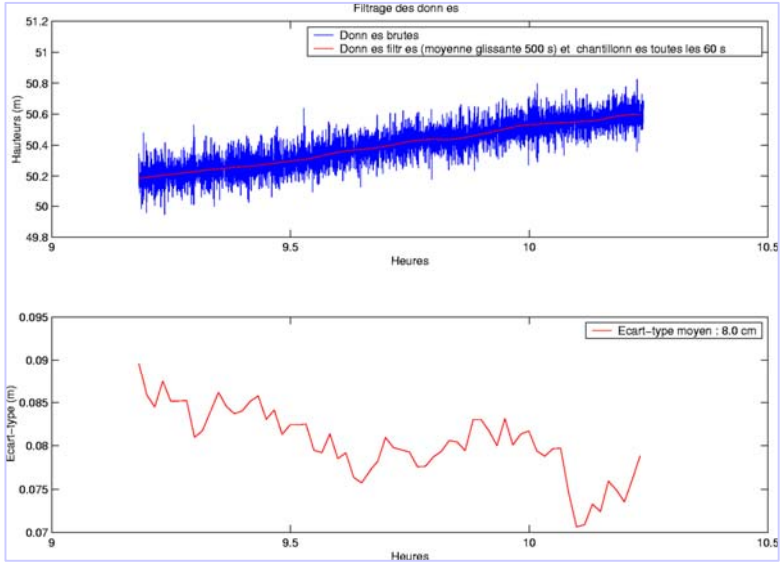
Kinematic GPS Approach

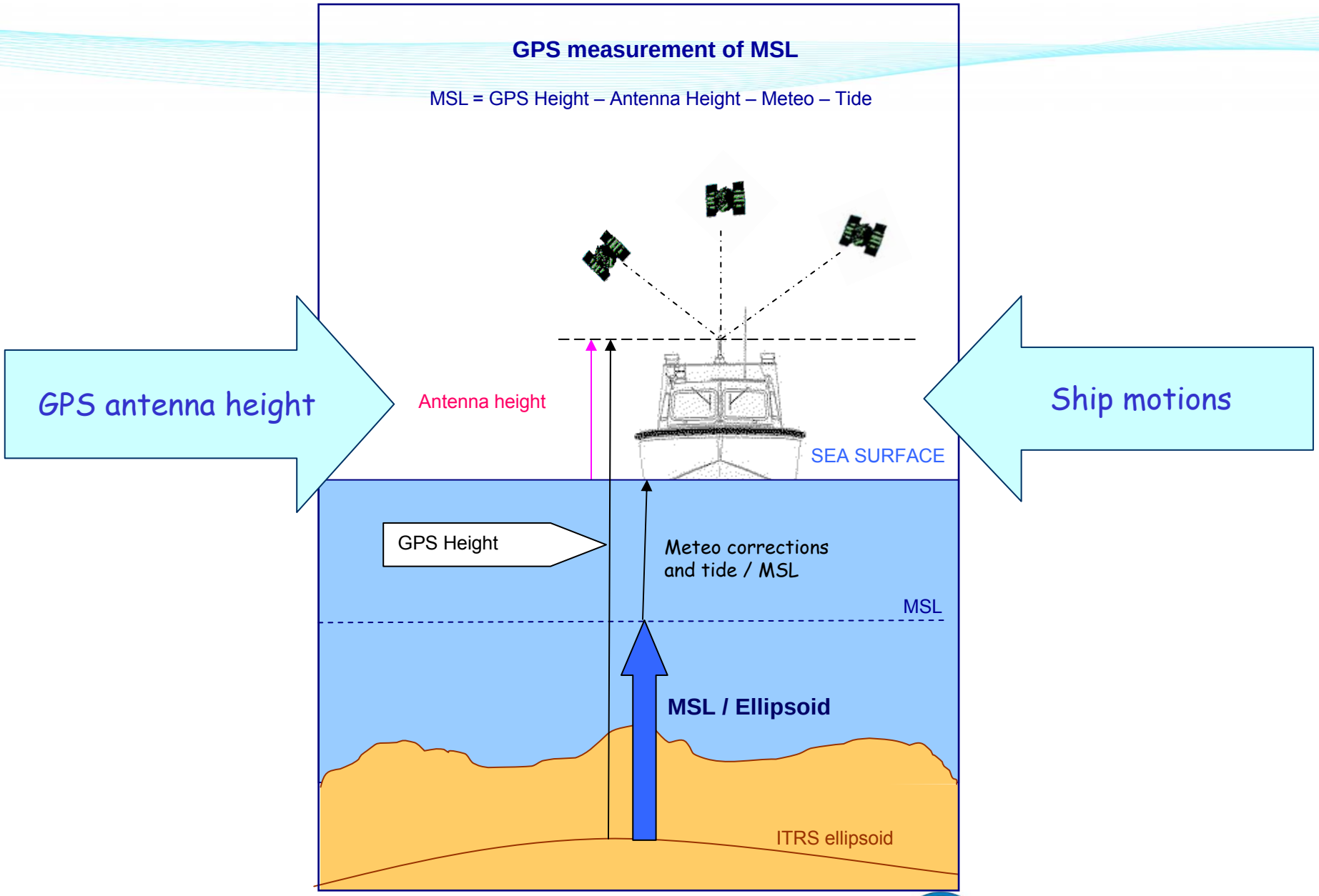
- Data post-processed and corrected (ship motions, meteorogical effects, tide and antenna height)

→ MSS related to ITRS ellipsoid

- Precision and “consistency” of the survey

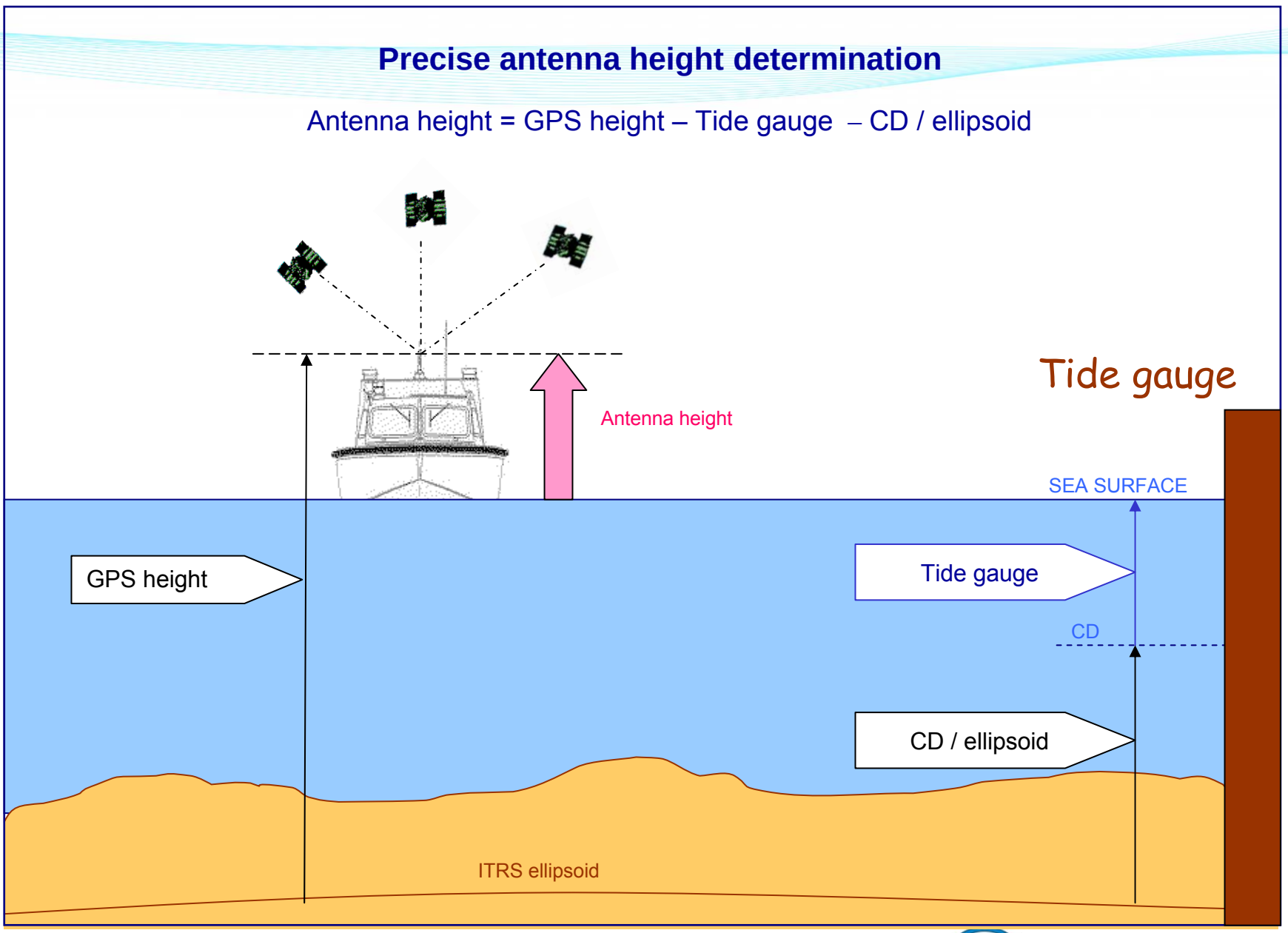
→ 5 cm precision and centimetric consistency



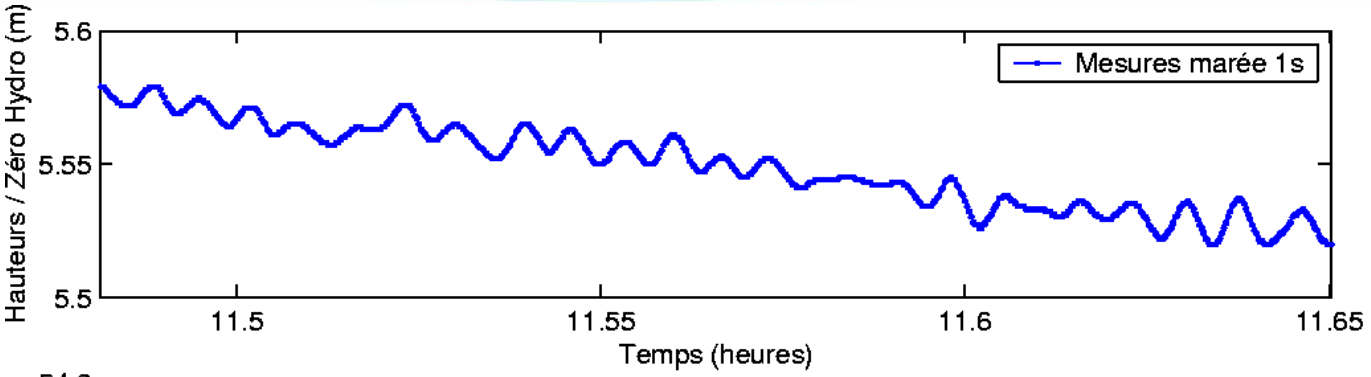

GPS measurement of MSL
MSL = GPS Height – Antenna Height – Meteo – Tide
GPS antenna height
Antenna height
Ship motions
SEA SURFACE
GPS Height
Meteo corrections
and tide / MSL
MSL
MSL / Ellipsoid
ITRS ellipsoid

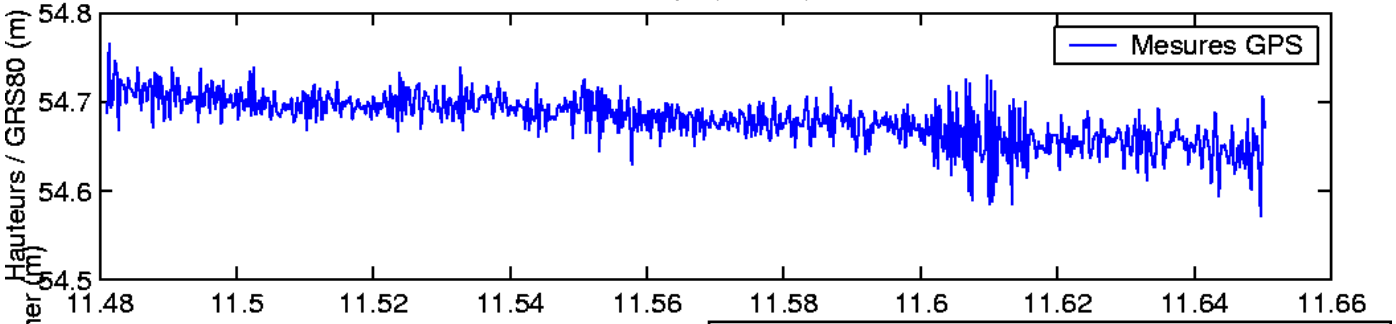
Precise antenna height determination

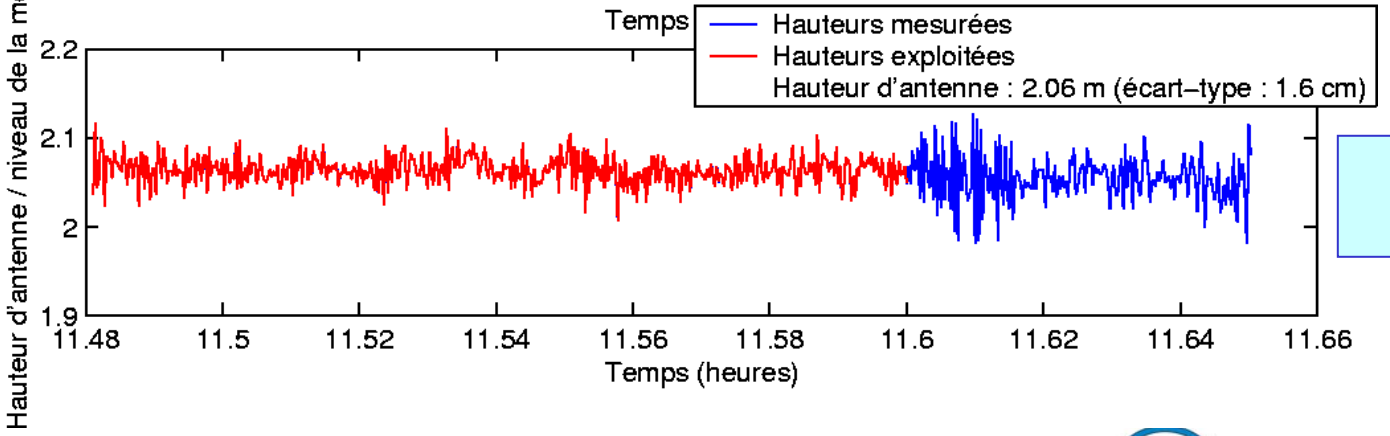
Antenna height = GPS height – Tide gauge – CD / ellipsoid



Precise antenna height determination

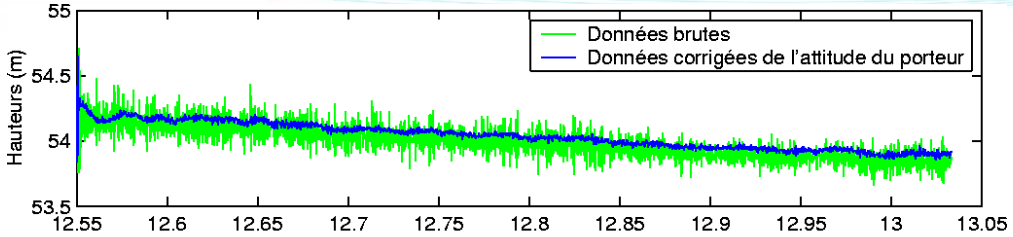


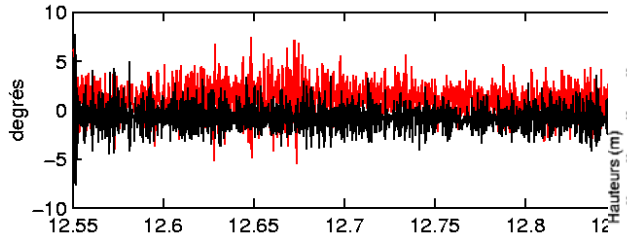


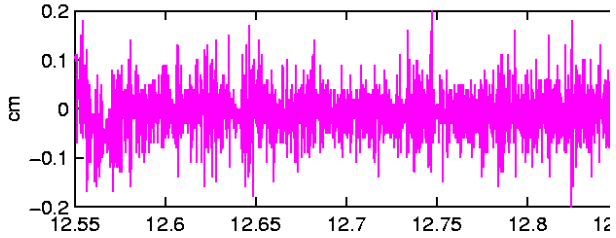


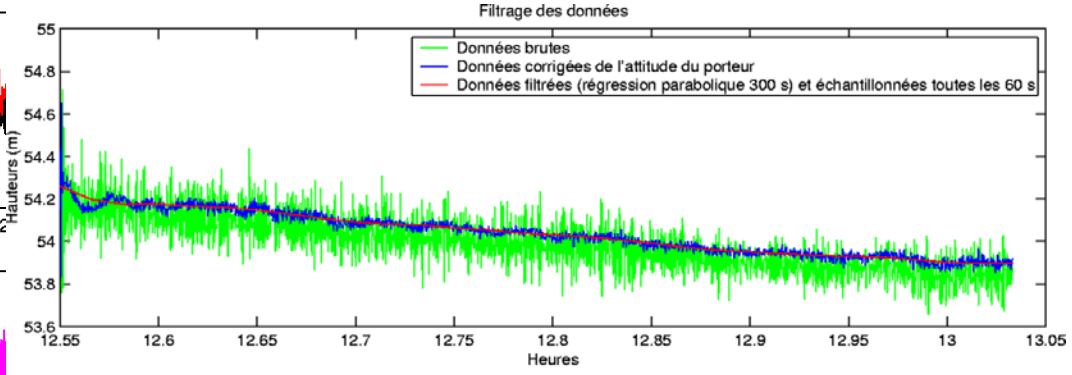
1 cm / knot

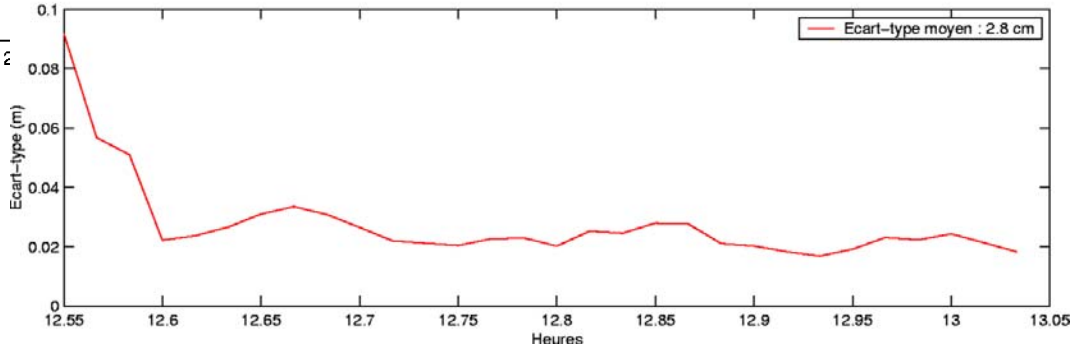
Ship motions



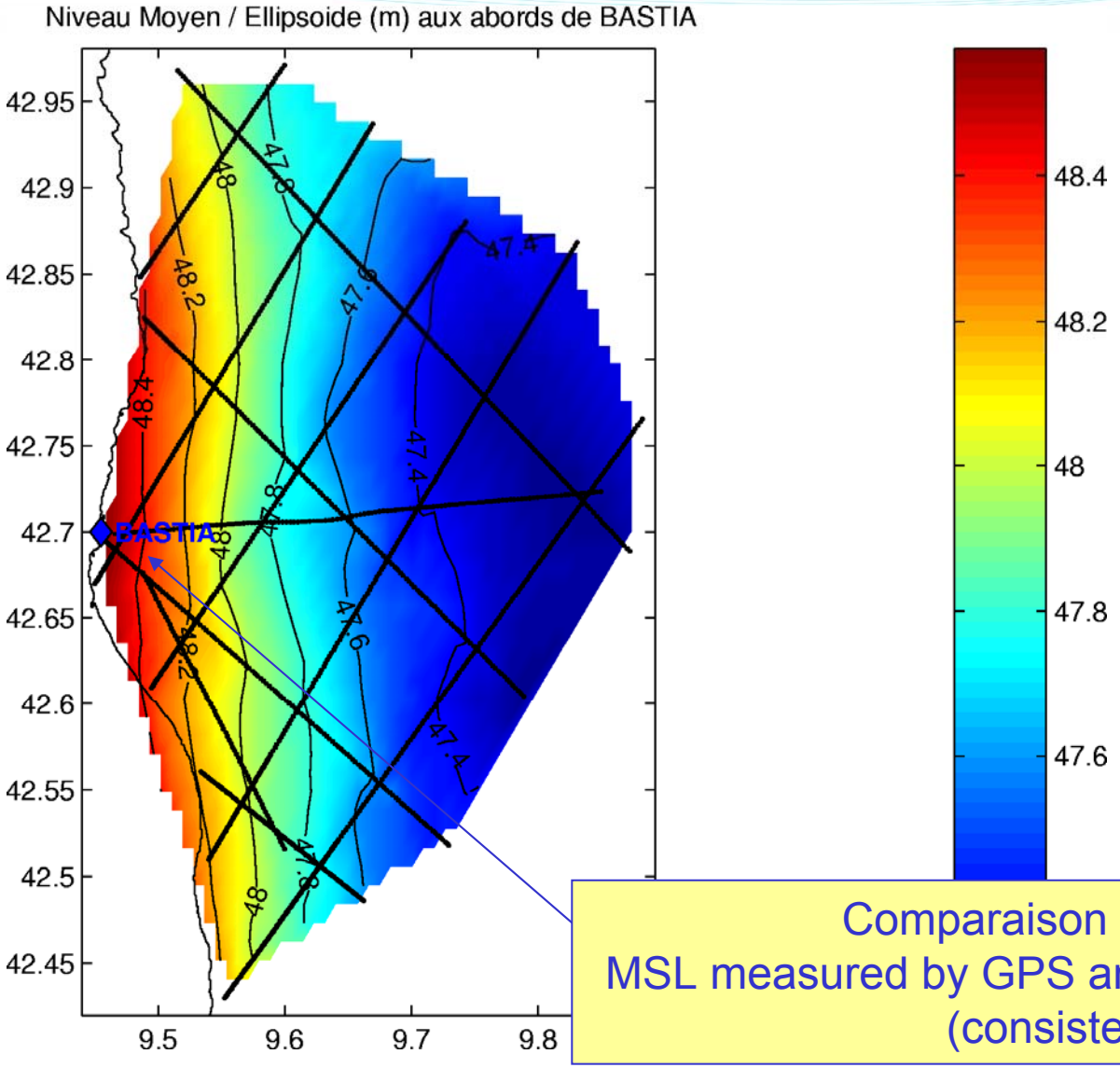








MSS measured by GPS around Bastia



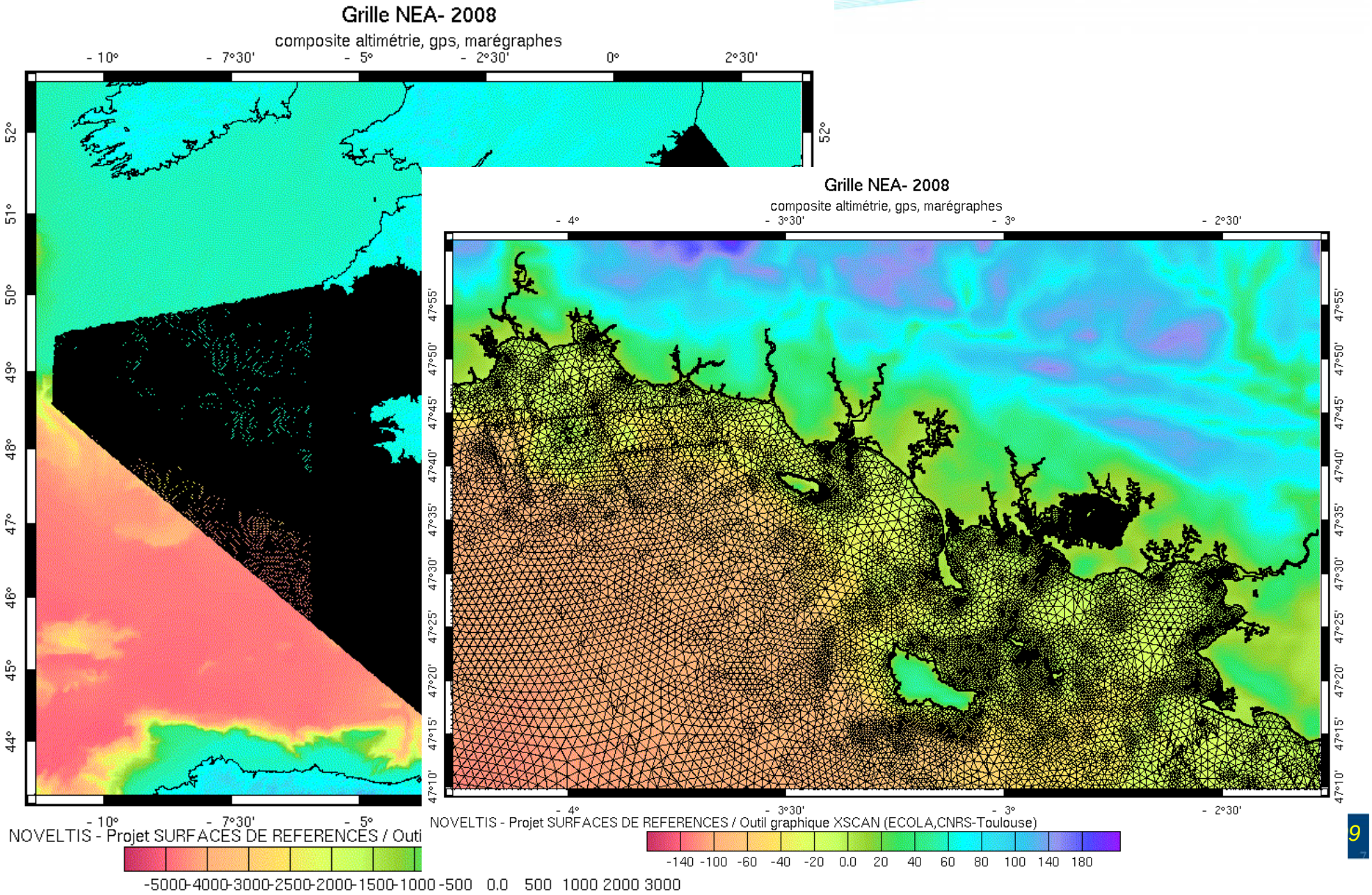
- MSL from 47.3 to 48.5 m
- Non linear variation

- Survey precision
  Mean : 3 cm (std : 2 cm)

- Survey consistency
  GPS Measurement : 48,571 m
  Tide gauge MSL : 48,576 m
  < 1 cm

Comparaison between
MSL measured by GPS and MSL at tide gauge
(consistency)

Grid


Grille NEA- 2008
composite altimétrie, gps, marégraphes
- 10°
- 7°30'
- 5°
- 2°30'
0°
2°30'
52°
51°
50°
49°
48°
47°
46°
45°
44°
NOVELTIS - Projet SURFACES DE REFERENCES / Outi
-5000 -4000 -3000 -2500 -2000 -1500 -1000 -500 0.0 500 1000 2000 3000
Grille NEA- 2008
composite altimétrie, gps, marégraphes
- 4°
- 3°30'
- 3°
- 2°30'
47°55'
47°50'
47°45'
47°40'
47°35'
47°30'
47°25'
47°20'
47°15'
47°10'
NOVELTIS - Projet SURFACES DE REFERENCES / Outil graphique XSCAN (ECOLA,CNRS-Toulouse)
-140 -100 -60 -40 -20 0.0 20 40 60 80 100 140 180

Towards a CD surface in 2009

- 2008-2009 :
  - Interpolation of altimetry + GPS + tide gauge
  - Estimation of the precision

- 2009 : reference surfaces in hydrography available
  - CD
  - MSL
  - LAT
  - ITRS ellipsoid
  - Geoid
  - IGN69 (french terrestrial reference system)

- 2009-2010 : software allowing users to change easily from one vertical reference to another

Thank you for your attention…