

Seafloor absolute positionning : experiements and processing

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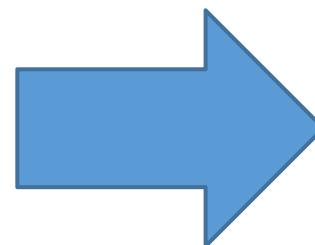
LIENSS/Université de LA ROCHELLE

IUEM/LGO BREST

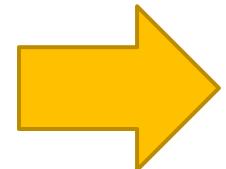
* Now @ *GeoForschung Zentrum, POTSDAM*

September 2018

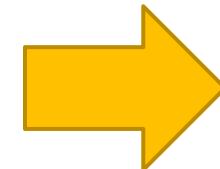




TIME
measure
 τ



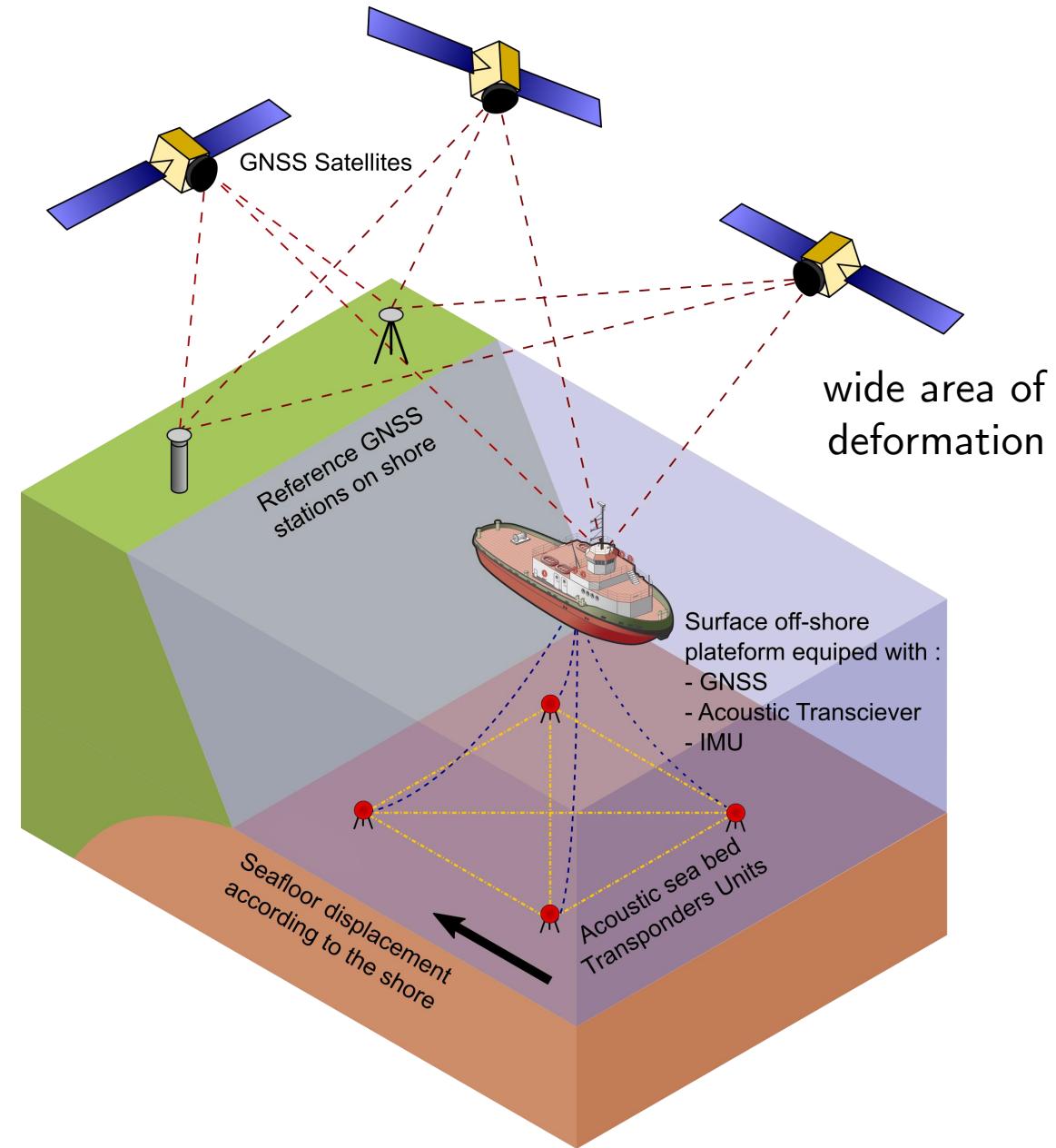
DISTANCE
 D



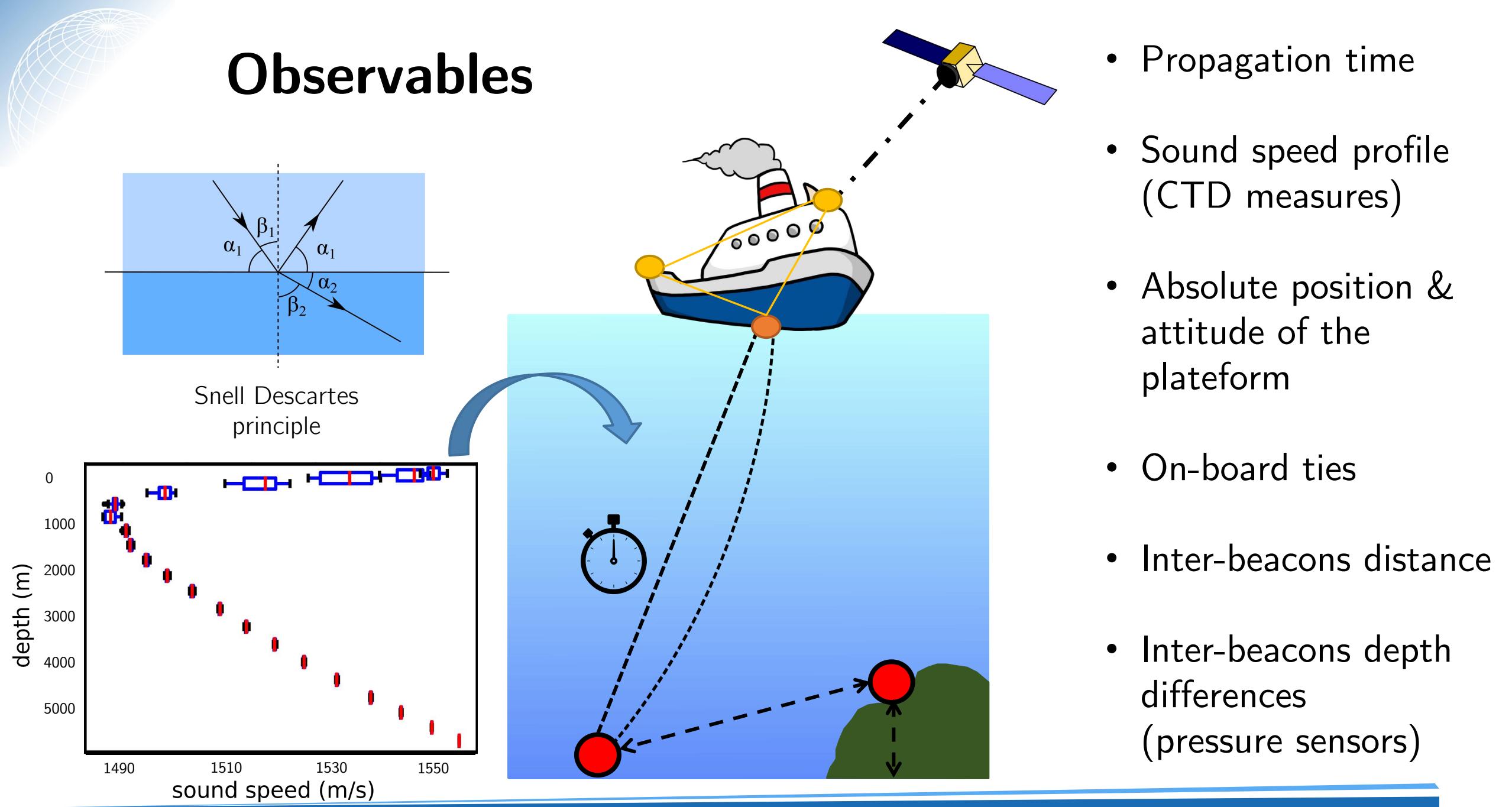
POSITION
 x, y, z

Absolute seafloor positioning

GNSS/Acoustics (GNSS/A)

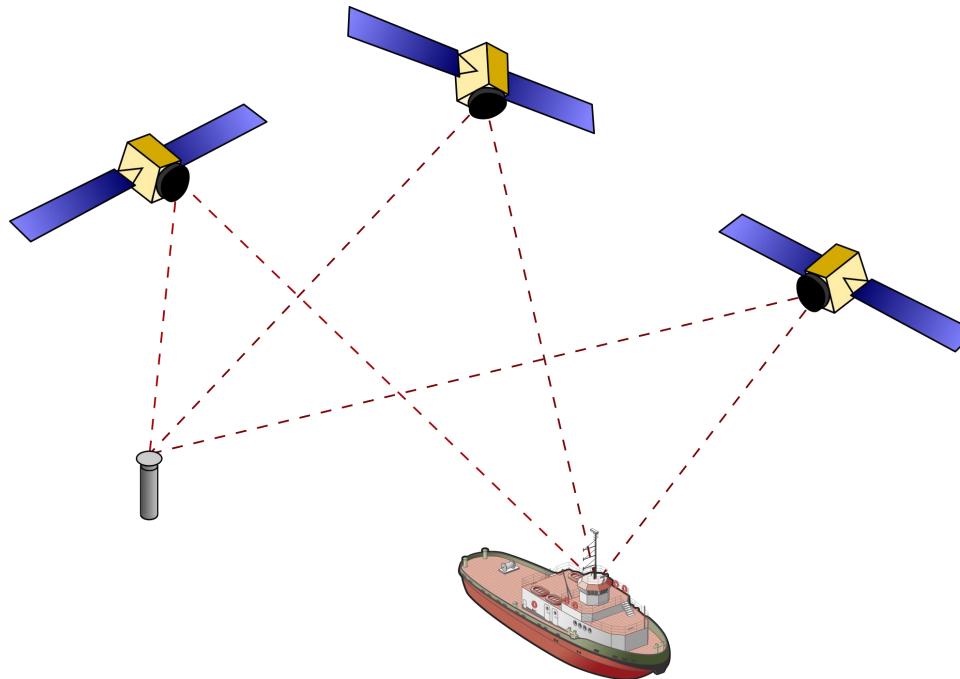


Observables





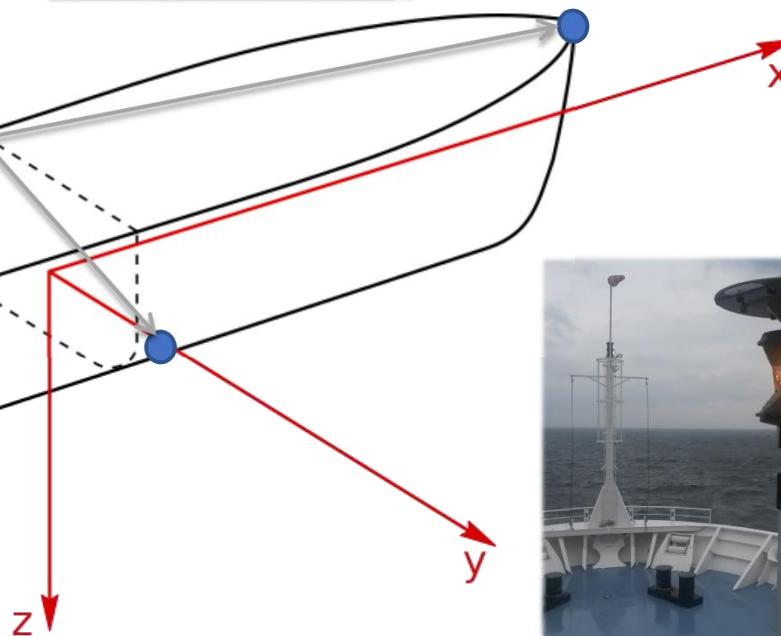
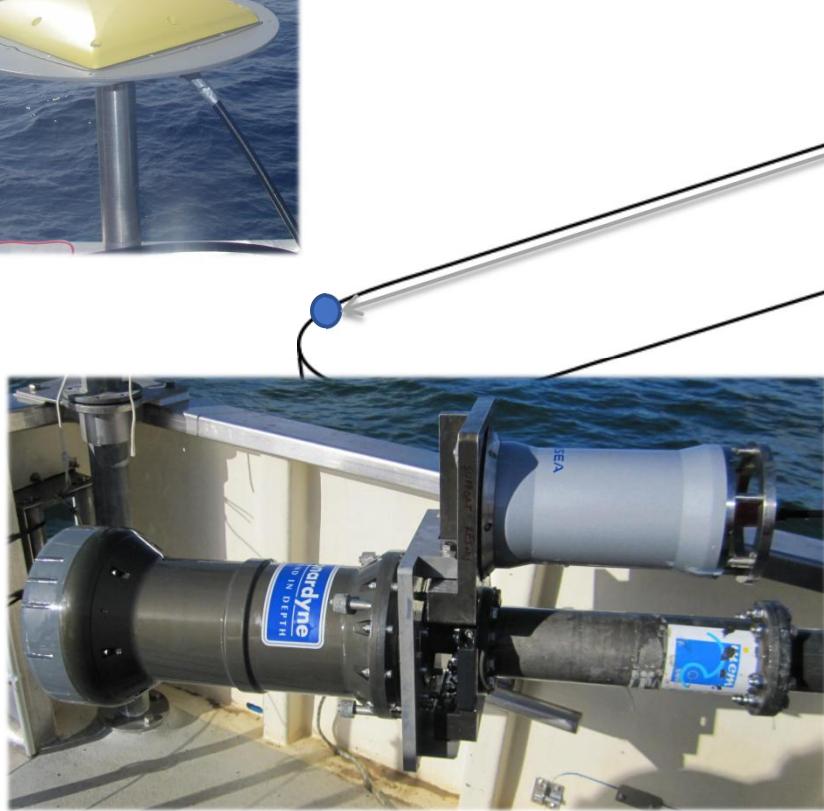
Surface Segment Experiments



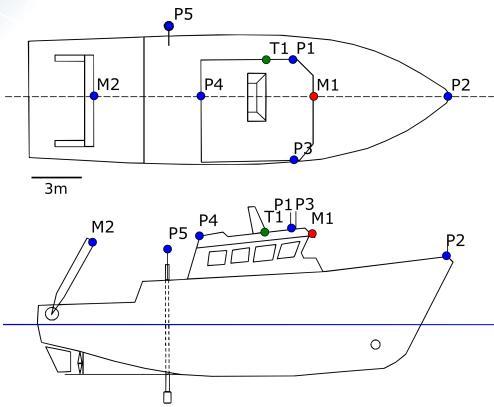
Topometric Ties (1/2)



$\times 10$



Topometric Ties (2/2)



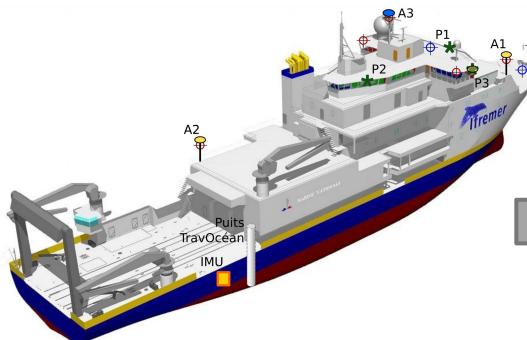
N/O *Tethys II* (25m)

1 station
2 sessions
at harbor



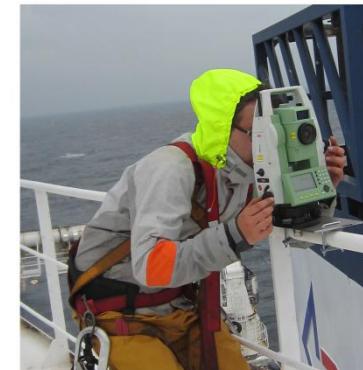
trigonometric
computation

**milimetric
repeatability
between both
sessions**



N/O *Pourquoi Pas ?*
(108m)

3 stations
11 sessions
at sea

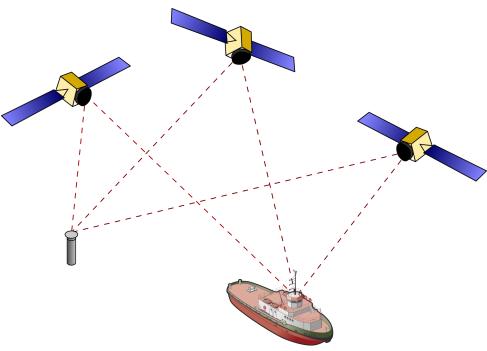


*Least
squares
compensation*

**3mm
formal
sigmas**

Very difficult operation

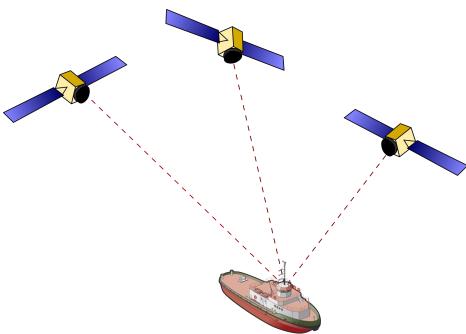
Kinematic GNSS benchmarking



Differential positioning

- TRACK
- RTKLIB

Reference station at 240km



PPP positioning

- GINS
- APPS (GIPSY)
- NRCAN-PPP

1σ planimetrics precision : ~ 20mm

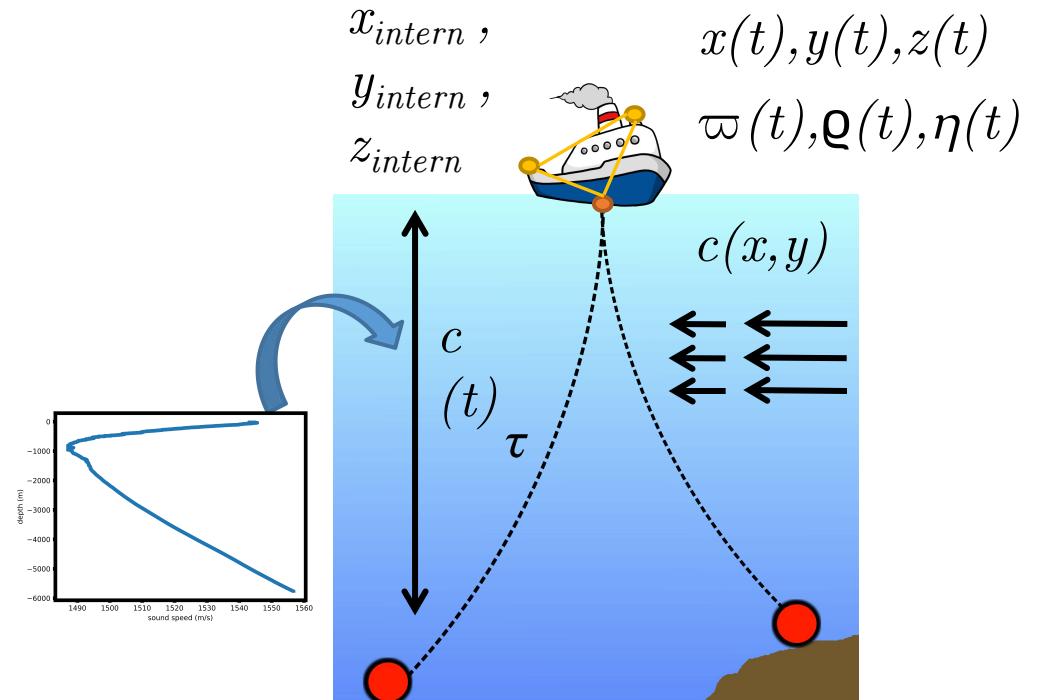
1σ altimetric precision : ~ 50mm



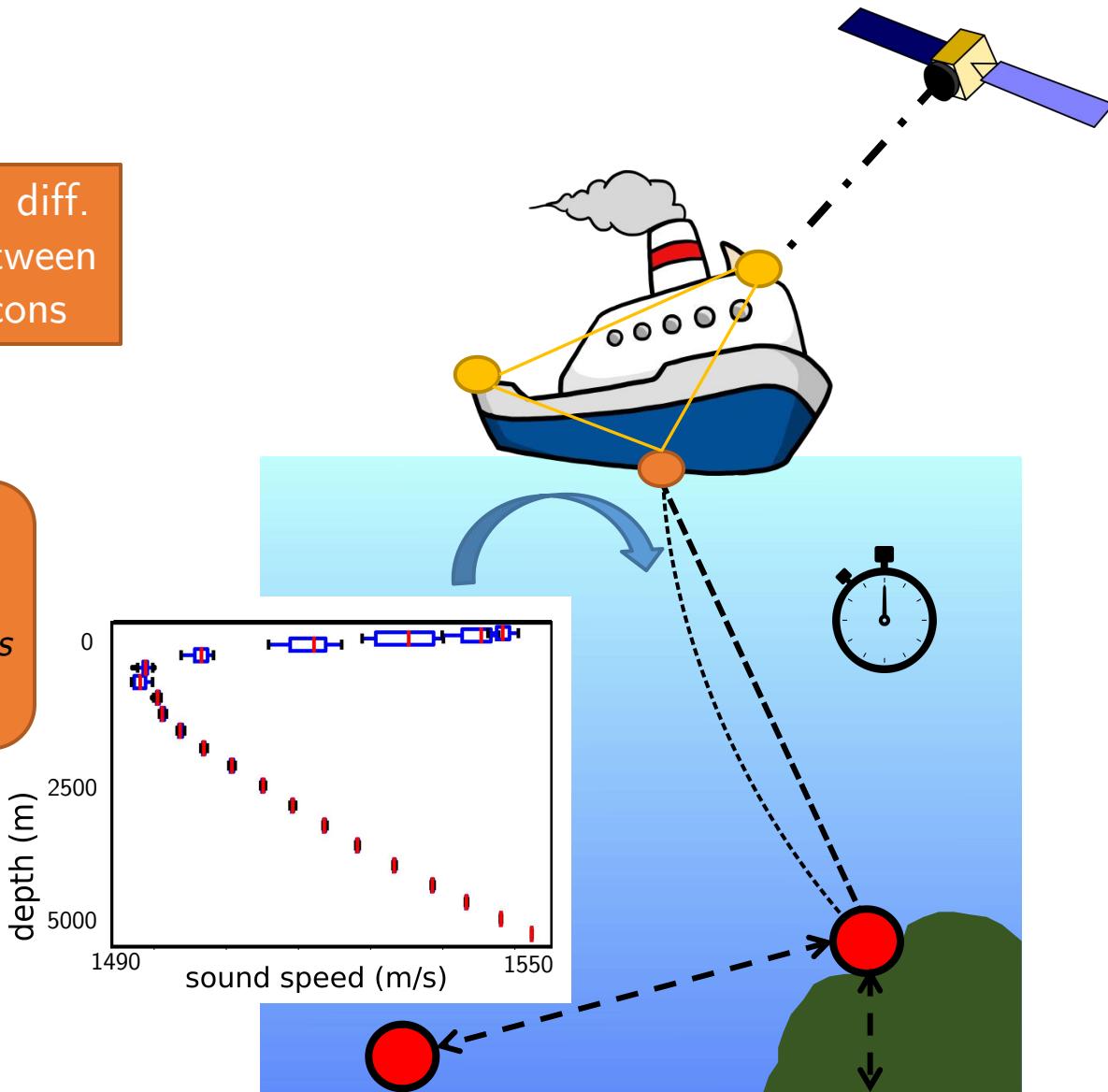
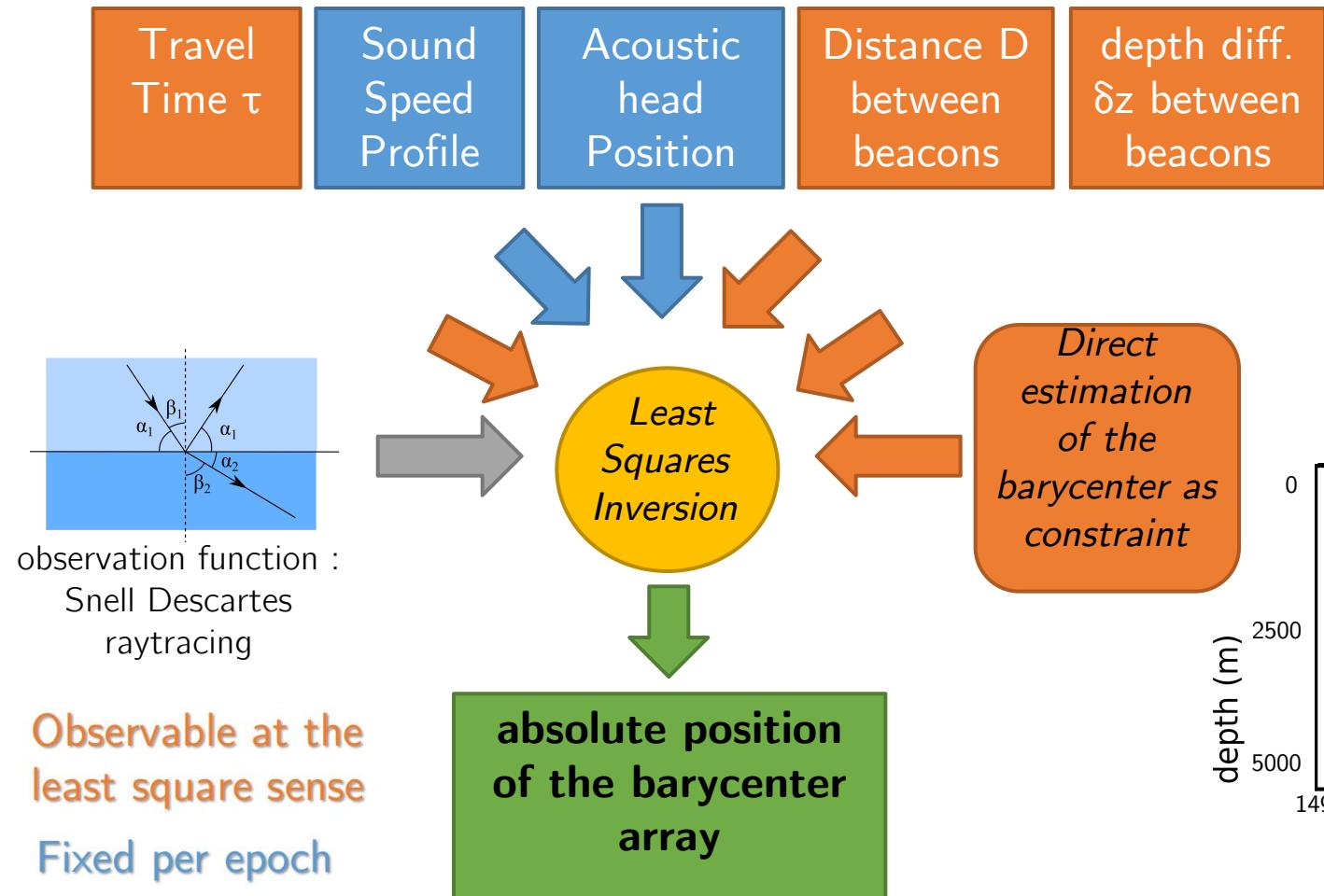
Error budget



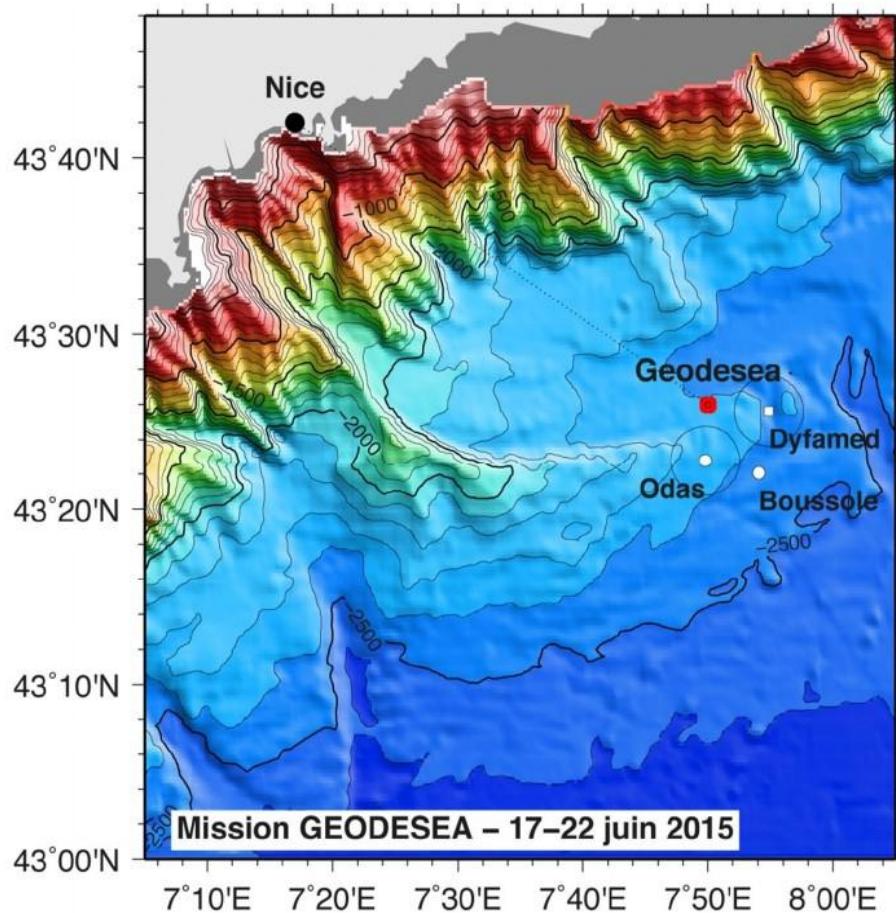
Nature	Error
Topometric Ties	
Kinematic absolute positioning	
Water column temporal variations	
Ocean spatial heterogeneities	



Inversion Method



1st mission : The *GEODESEA* Mission

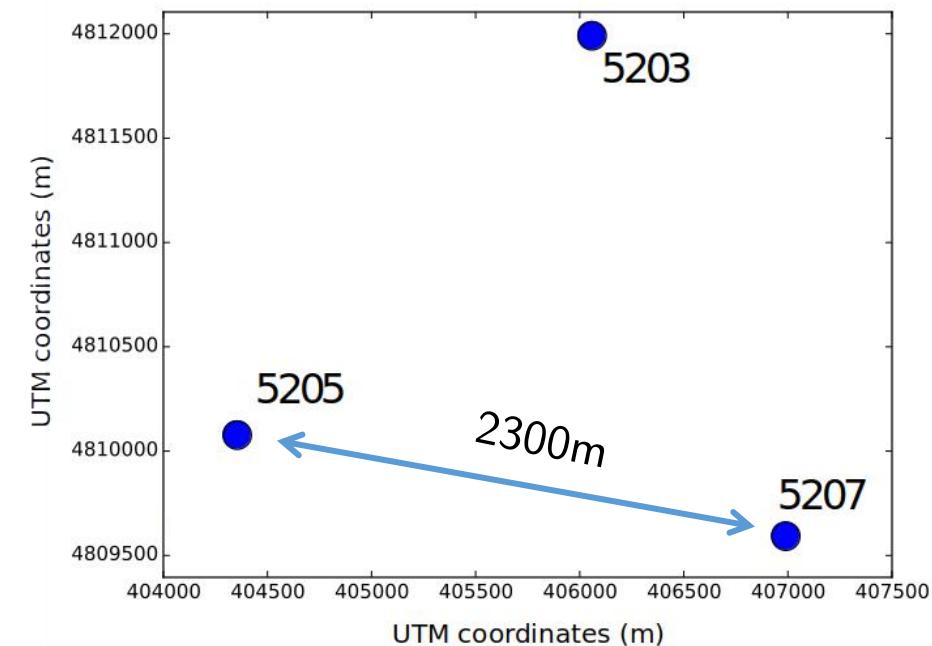


- 17-22 June 2015
- N/O *Téthys II*
- IUEM/LDO, LIENSs & Sonardyne collaboration
- 37 h 20 of acquisitions (13500 exploitable pings)

Underwater Segment (1/2)



3 Sonardyne Compatt
Transponders



ca. 2300m deep



Surface Segment



Acoustic Head + IMU

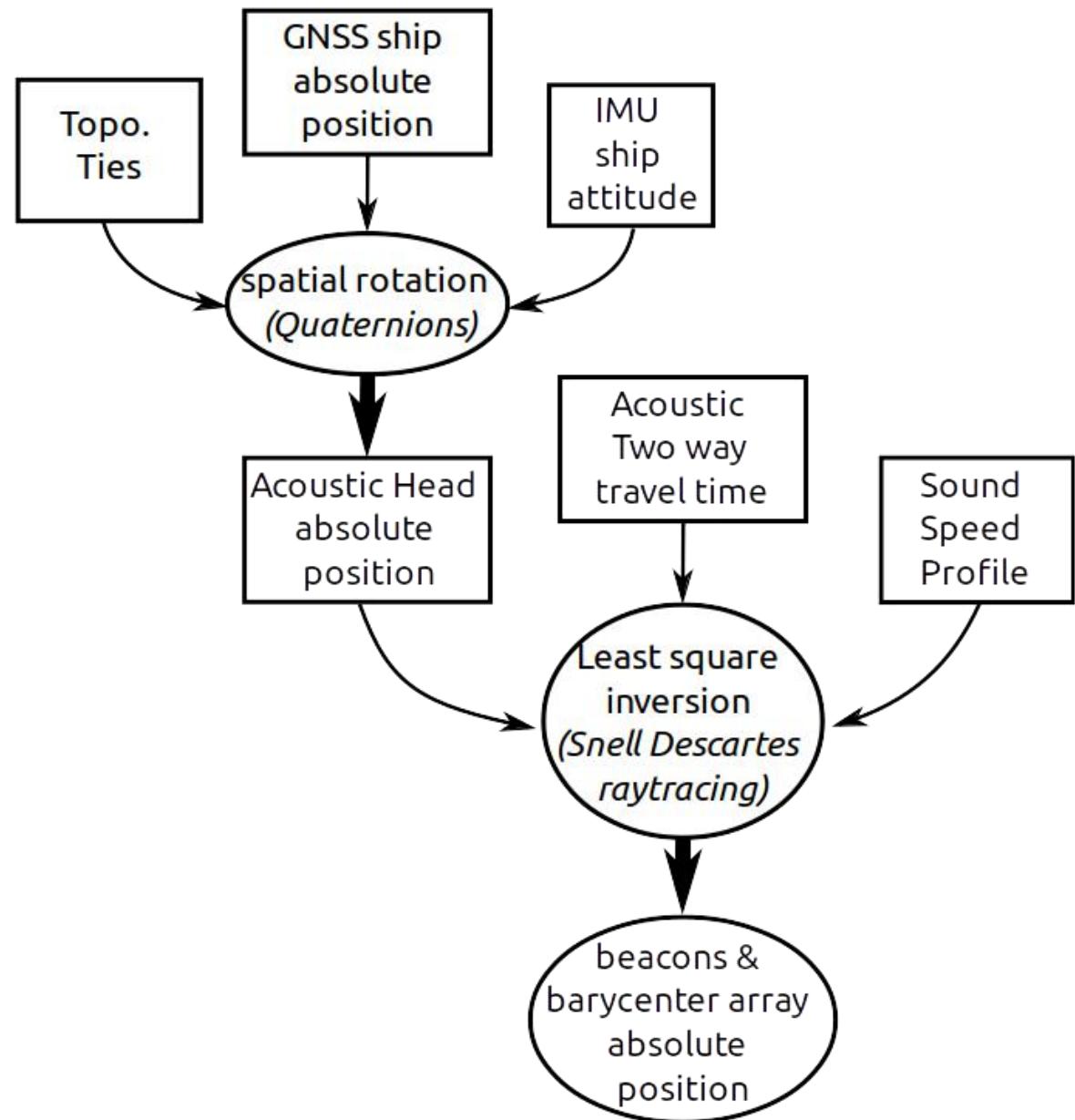
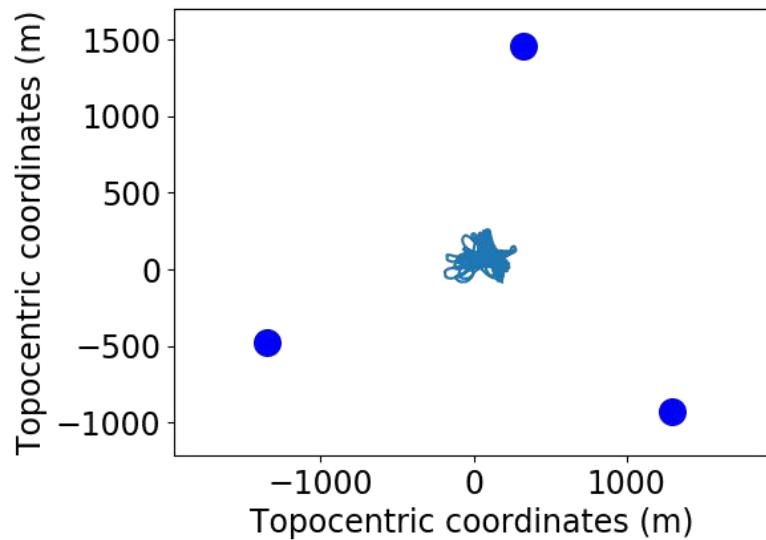


GNSS in the extension



CTD Probe
1/2 time a day

Processing



Results

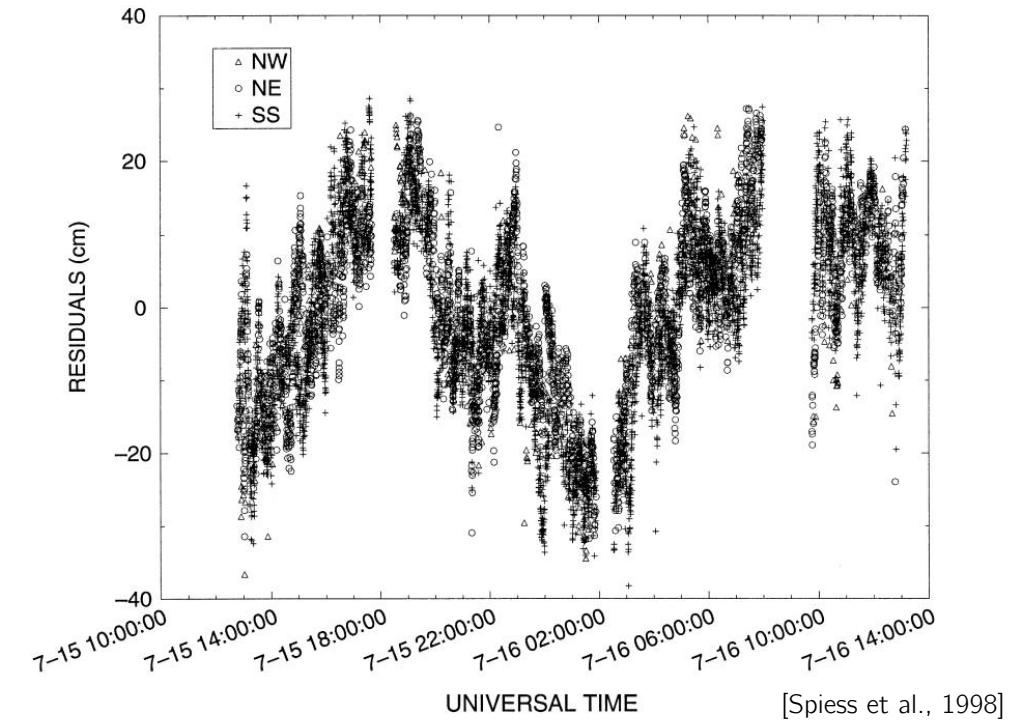
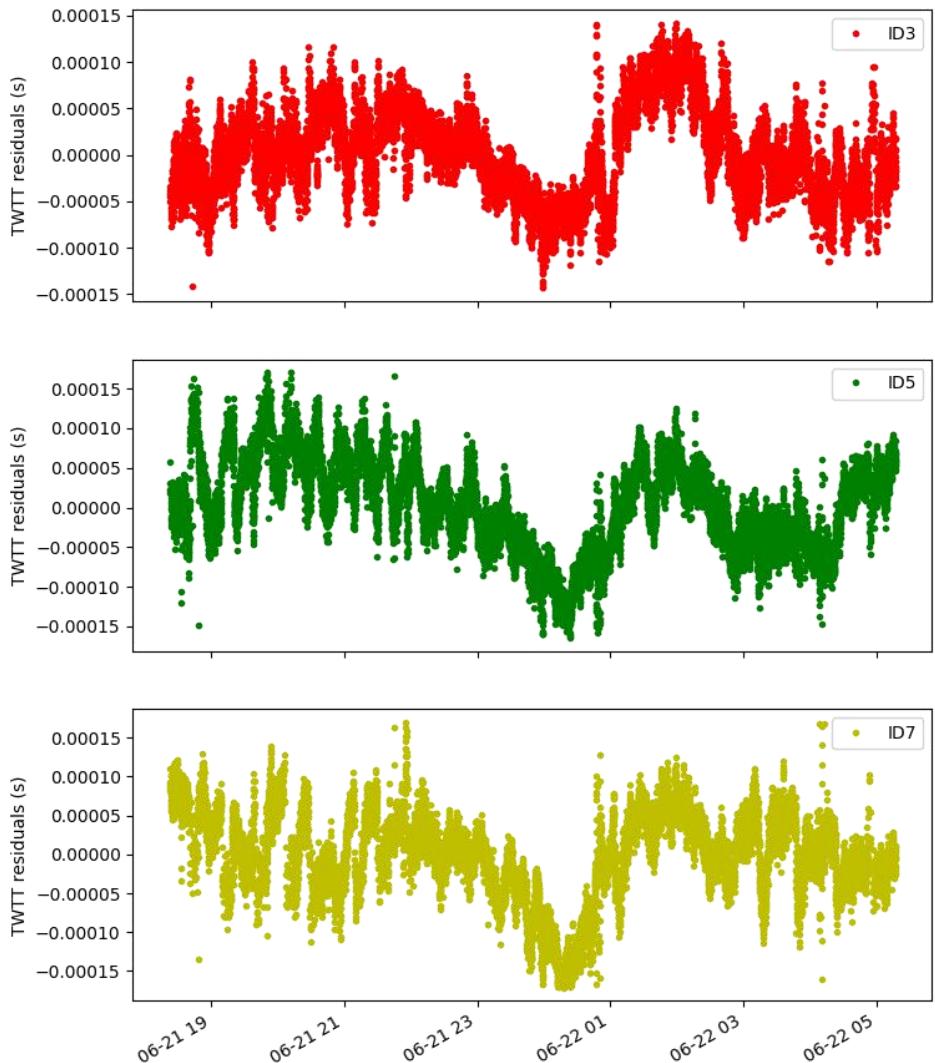
Used session : 21th June, 10h of acquisition, 13500 pings

Point	5203	5305	5307	Barycentre
Local N (m)	1459.5193	-478.5392	-926.6242	18.1187
Local E (m)	329.0651	-1348.9036	1293.2587	91.1401
Local D (m)	2407.1061	2383.5635	2375.9380	2388.8692
σ_N (m)	0.0124	0.0122	0.0120	0.0086
σ_E (m)	0.0109	0.0103	0.0104	0.0074
σ_D (m)	0.0068	0.0072	0.0072	0.0050
ITRF X (m)	4592277.2989	4593843.1724	4593793.7191	4593304.7301
ITRF Y (m)	632238.9572	630760.6447	633420.8986	632140.1668
ITRF Z (m)	4362678.0733	4361287.0891	4360966.9901	4361644.0509
Latitude (deg)	43.45493980	43.43748810	43.43345360	43.44196128
Longitude (deg)	7.83888250	7.81814770	7.85079410	7.83594147
Hauteur (m)	-2400.3357	-2376.8086	-2369.1451	-2382.2740

Coordinates of the 3 beacons and the barycenter in local and global frames, and formal standard deviations

***No apriori information on
beacons depth in this experiment***

Residual analysis

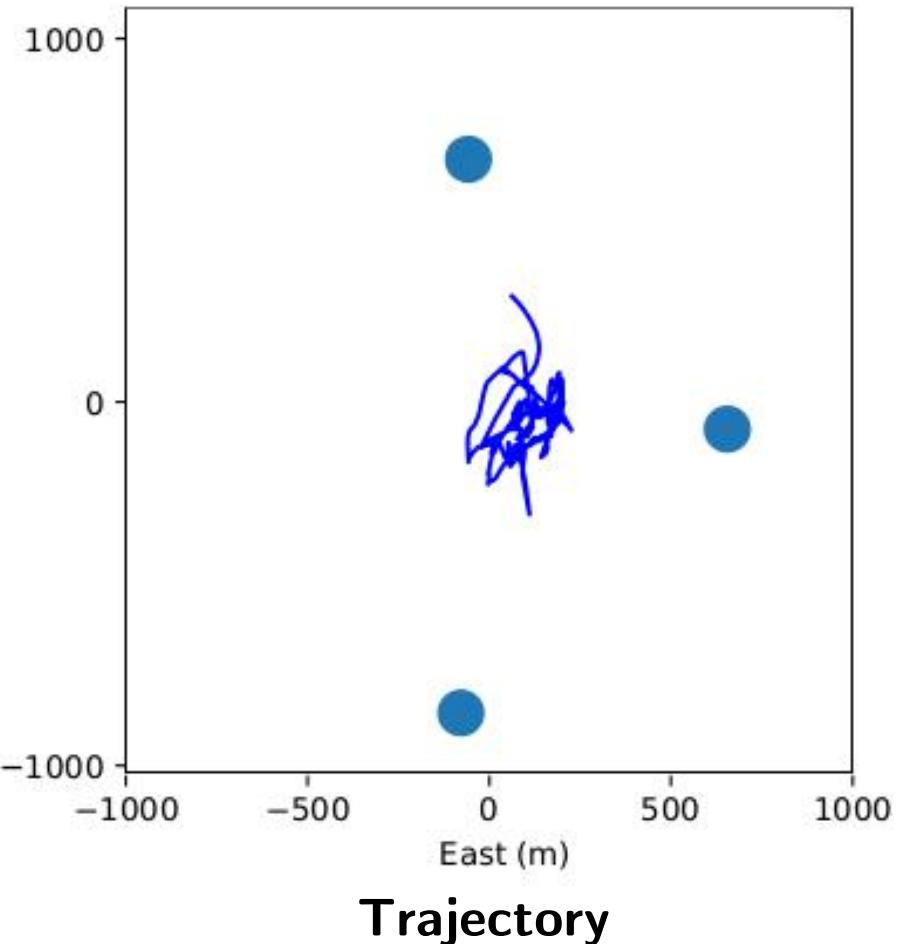


2nd mission : DIVACOU/CANOPUS Campaign



- CANOPUS Project : Collaboration between iXblue, IFREMER, CNRS/IUEM-LDO/LIENSs & Télécom Bretagne
- N/O Europe, 10-16 May 2017 off Toulon
- Test of the new generation of seafloor beacons
- 2 days dedicated to geodetic protocol

DIVACOU/CANOPUS Results



pings bruts / utilisées / ratio période et durée d'observation	Jour 2 : 15 mai $\approx 8:00-6:00(J+1)$ TU, 22h
Balise 1	8896 / 8699 (97,79 %)
Balise 3	11131 / 11060 (99,36 %)
Balise 4	7570 / 7566 (99,95 %)

Available pings

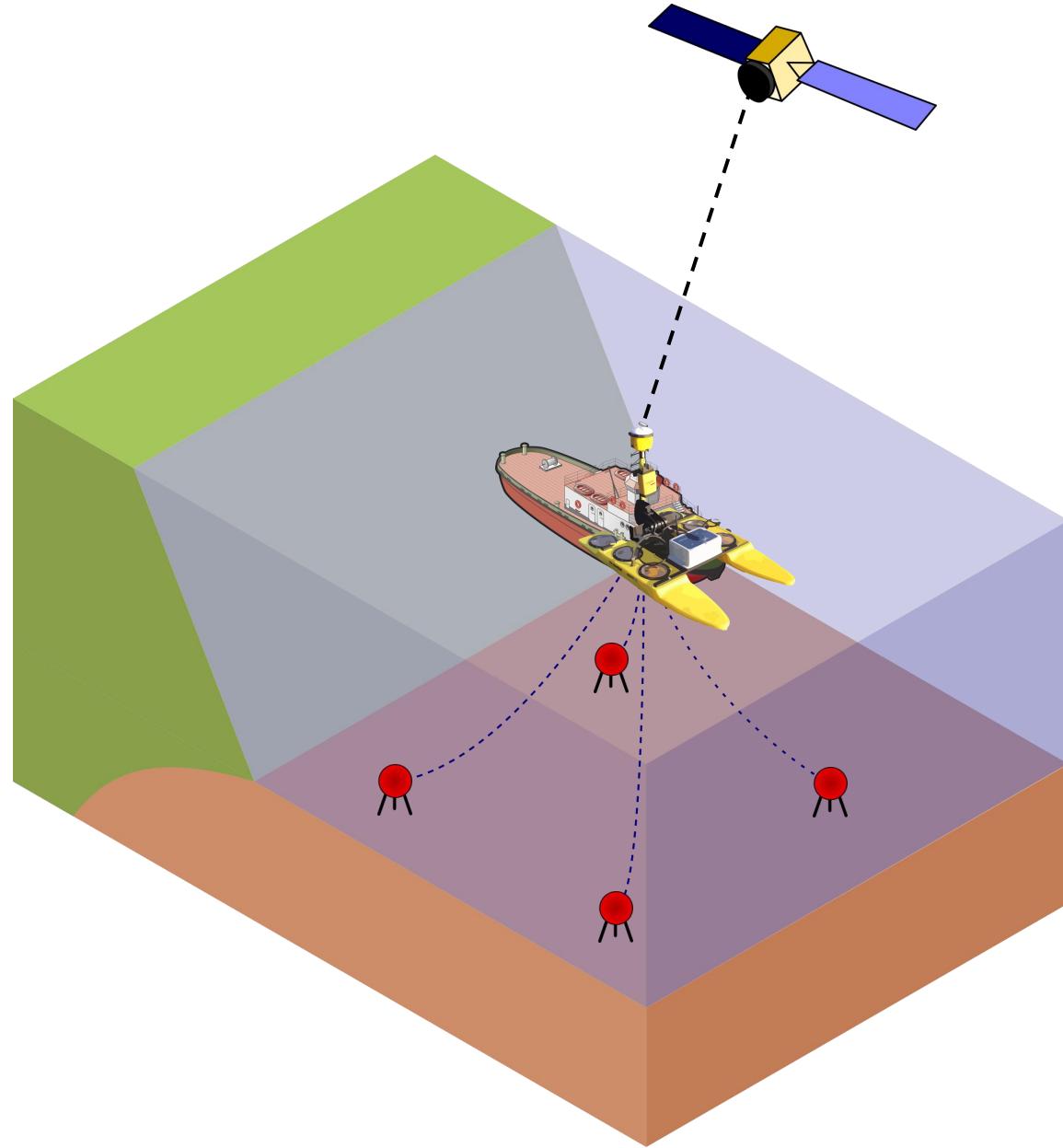
Sigmas (<i>barycentre, B1, B3, B4</i>)		
East	North	Down
0.10419864	0.08643241	0.04830886
0.1682498	0.14039302	0.07593201
0.11943442	0.10225967	0.05384505
0.15016492	0.1209041	0.07310497

Formal Sigmas (m)



Key points & perspectives

- development of an inversion method
- On-board experiment ⇒ Minimization of the surface platform (Need of an ASV)
- **A better consideration of the sound speed variations in the inversion**

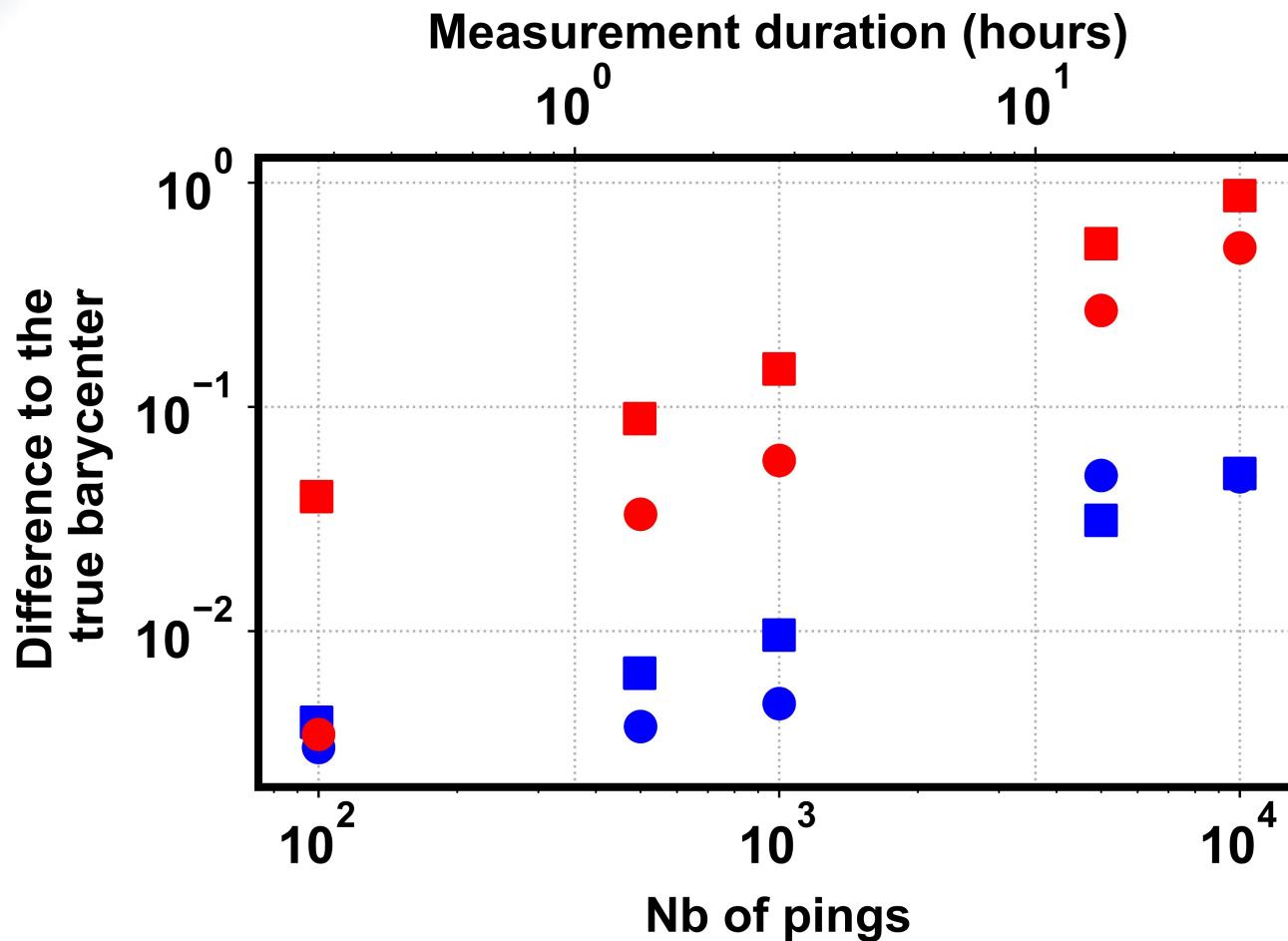




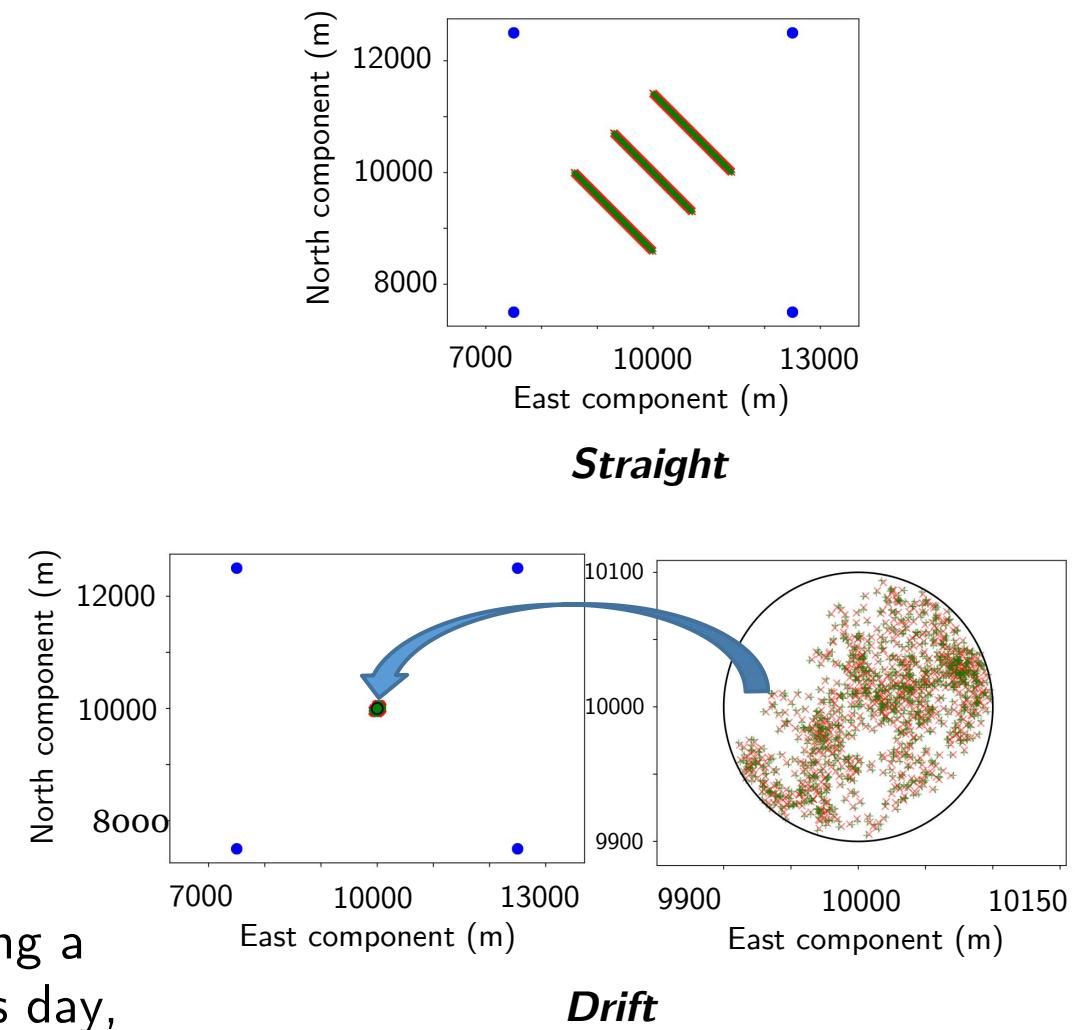
Thank you for your attention



Temporal Sound Speed Variation Influence



Barycenter restitution accuracy for different simulations, using a calm (blue) or variable (red) for different restitution strategies day, with stationary/drifting (\bullet) or straight lines trajectory (\blacksquare)



Sound Speed Update

