Ocean gravimetry experiment at Shom

Quantum absolute gravimeter (Shom-Onera)

This instrument is based on the acceleration measurement of a free falling gas of ultra cold atoms thanks to atom interferometry.

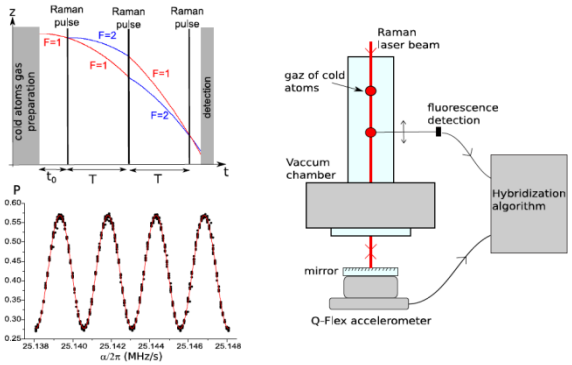
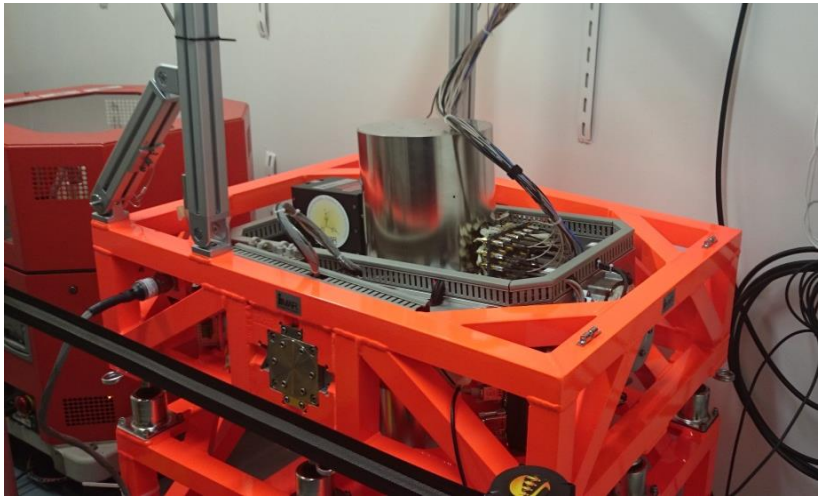
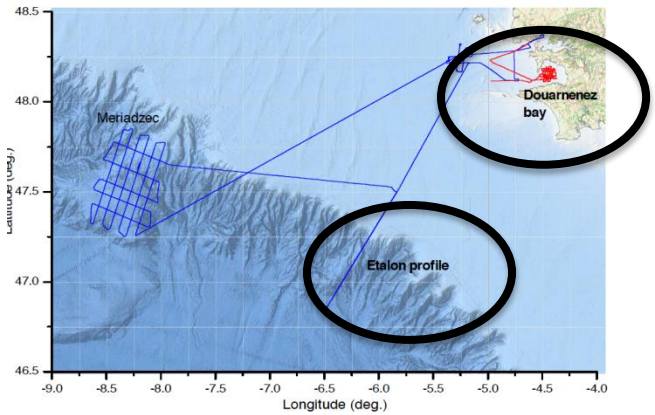


Figure 2 | Principle of the atom accelerometer. Top left: temporal sequence. Bottom left: typical interference fringes acquired in static condition for T=20ms. Right: scheme of the hybridized cold atom accelerometer.

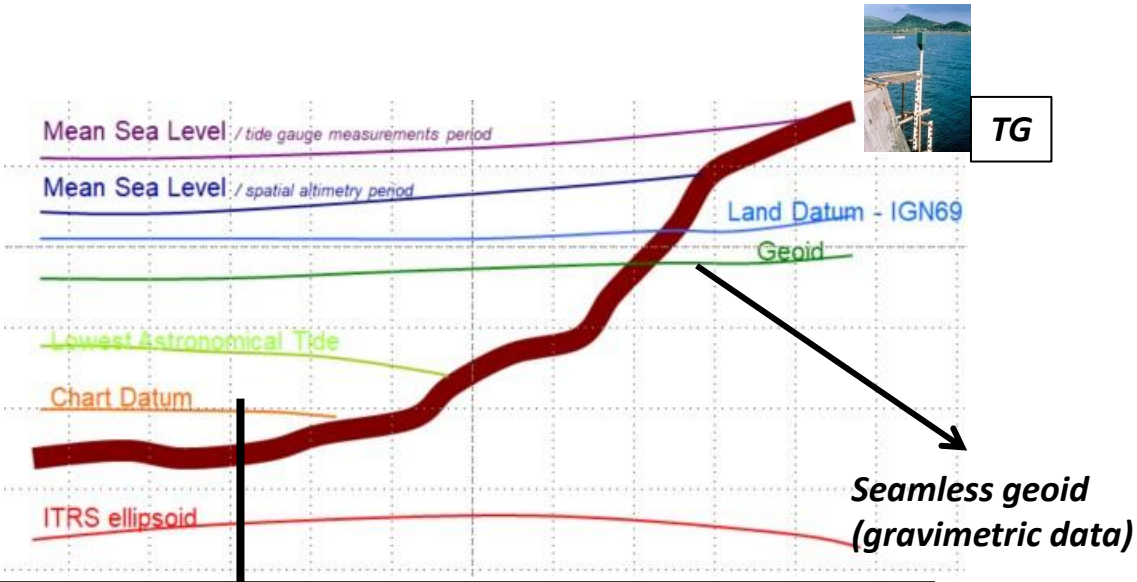




				Atom gravimeter	KSS32 gravimeter
	Etalon profile	Forward - Backward	Mean	0.4	1.8
			Std	0.5	0.9
accuracy		Forward - Reference	Mean	-0.2	1.2
			Std	0.5	1.1
		Backward - Reference	Mean	-0.6	-0.5
			Std	0.3	0.6
	Meriadzec	Crossing points difference	Error	0.9	1.0
	Douarnenez Straight Profiles	Forward - Backward	Mean	0.3	0.8
			Std	0.2	0.8
		Crossing points difference	Error	0.4	1.0
precision	Douarnenez Circular profiles (8 nd)	Crossing point difference with regular profile	Mean	0.2	1.0
			Std	0.5	1.0
	Douarnenez Circular profiles (11 nd)	Crossing point difference with regular profile	Mean	0.3	2.8
			Std	0.6	2.9

Credit:result of a survey with cold atom gravimeter; lequentrec-Lalancette et al., 2017, IAG Kobe, Jap)

Hydrographic purposes at Shom



TG

Seamless geoid (gravimetric data)

Tide gauges: limits between continental level and sea levels

Tide Gauges (TG)

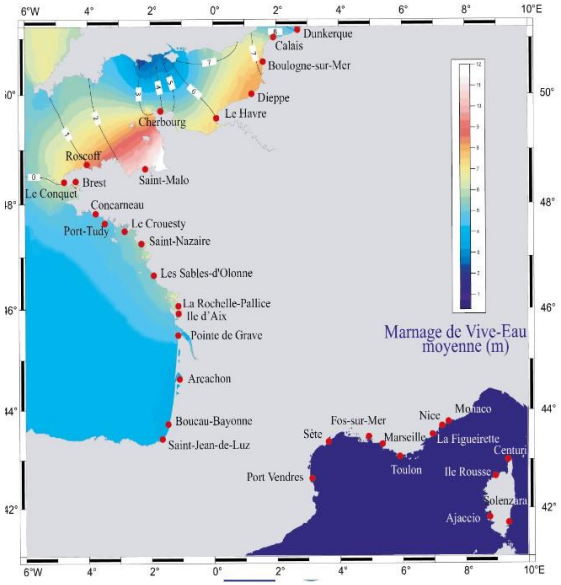
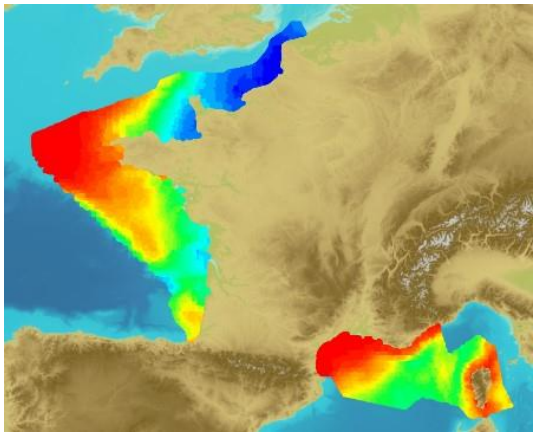


Chart datum / ITRS



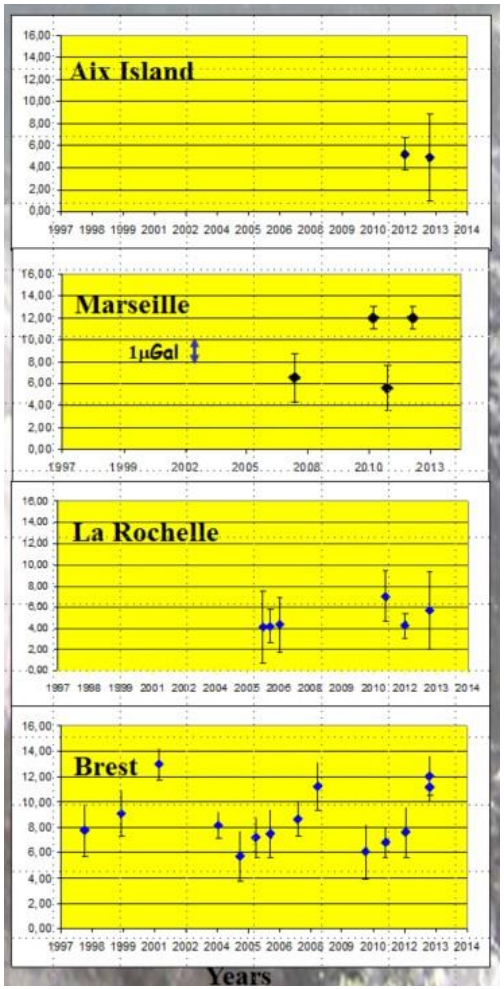
Tide gauges, leveling and absolute gravimetry: SHOM has been appointed for tide gauge observations in metropolitan France as national referent and, in this capacity, leads the tide gauges network REFMAR/RONIM. The institute contributes strongly to SONEL system whose objective is to monitor the vertical movements of tide gauges using GNSS from the IR ILICO seashore and coastal research infrastructure and to the International Gravimetric Bureau (BGI) for absolute gravimetry stations.

Credit: Creation of vertical reference surfaces at sea using altimetryand GPS, Pineau-Guillou et al., 2012

tide gauge Absolute gravimetry (Shom)

Loading effects induced by ocean dynamics were published in 2001 and 2008 [45], and oceanic loading has been showed to lead to periodic height variations of almost 20 cm at high tides [46] in Brest. For absolute gravimetry measurements, a synthetic analysis is still in progress at SHOM with the support of the EOST (Ecole et Observatoire des Sciences de la Terre de l'Université de Strasbourg) and of the University of Montpellier.

Gravity measurements at tide gauges between 1998 and 2013



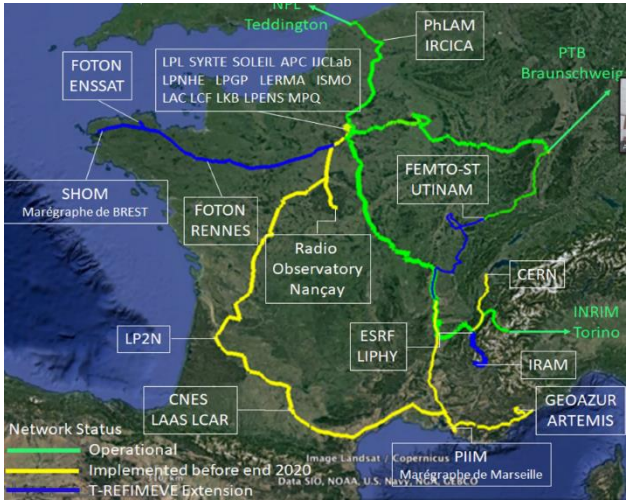
Gravimètre absolu FG5

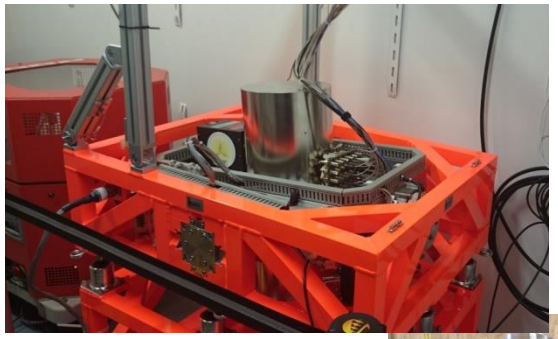
Gravimètre absolu A10

Credit: lequentrec-Lalancette et al., Absolute gravity at tide gauge stations: french experiment ;IAG, Postdam, 2013

Shom projects : Roymage (Syrte-IPGP-IGN-Shom) & Refimeve

REFIMEVE NETWORK: Shom will receive fiber

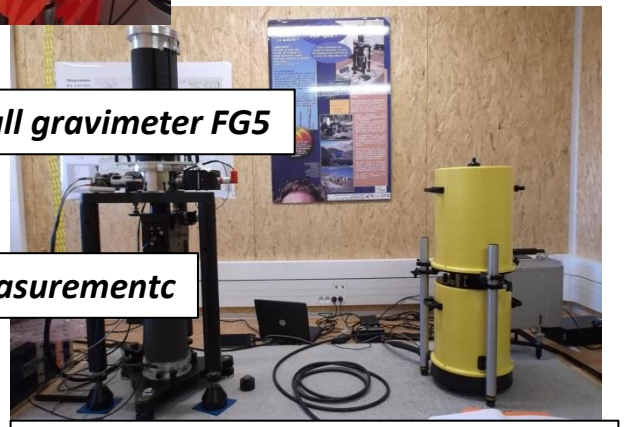




Marine quantum gravimeter (Onera-Shom) (on vessel)

Mechanical free fall gravimeter FG5

Terrestrial measurementc



Mechanical free fall gravimeter A10

The development of an Ytterbium atomic clock combined with the extension of the REFIMEVE network in Marseille, Brest will allow, by bringing quantum measurements close to the coasts, to study and define more precisely the reference level (variations of the geoid and its link with the mean surface of the ocean). In the ANR Roymage Shom will establish the methodology of absolute gravimetric measurement for the time transfer experiment involving clock and fiber network near tide gauges and along the tracks (Jussieu tower) (WPs)

Unpublished: proposal Roymage & Refimeve