"Assessment of an "off-shore" high frequency kinematic GPS methodology on the ground tracks 104 and 028 of Jason-2 satellite in the Drake Passage (DP). "

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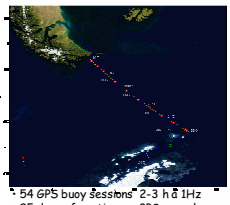
I would like to dedicate this work in the memory of my supervisor Dr. Yves Menard

Abstract

The geodetic campaign that took place in the DP from Jan 14, 2006 – 08 Feb, 2006 aboard the German research vessel POLARSTERN (AWI) has been a very successful mission in collecting a wide range of GPS and marine gravity data all along JASON-1 ground track n° 104. The same campaign was recently repeated from Mar 21, 2009 – 09 Apr, 2009 along 028 and 104 JASON-2 ground tracks. The current experiment comprises a Cal/Val geodetic approach and it aims to validate altimetric sea surface time-series (SSH), significant wave heights (SWH) , sea state biases (SSB) and mean dynamic topography (MDT) profiles, with respect to a kinematic high frequency GPS methodology for measuring sea state and sea surface height. Furthermore we aim at giving recommendations for future "offshore" Cal/Val activities on the ground tracks of altimeter satellites such as JASON-2 , SWOT, ALTIKA etc. and an in-situ validation method of the mean surface profile of the geostrophic currents and absolute transports.
We show results from the 2009 campaign which comprise observations from 4 GPS receivers aboard the research vessel POLARSTERN , 1 radio altimeter OPTIWAVE 7300C and a MKIII (University of Tasmania) GPS buoy for the RV's floating line (FL) determination. The error budget of the GPS methodology comprises effects like the "squat phenomenon" and attitude variations linked to the ship's dynamic movements. The GPS high frequency SSH profiles are processed using two kinematic software GINS (CNES) and CSRS PPP software (NRC).

2006 2009



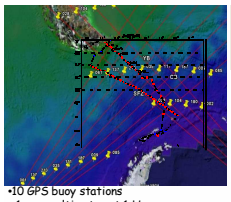


Figure 1 : (Left) The 2006 Drake campaign along the 104th ground track of JASON-1. GPS stations along the Moorings (M1 to M10) and the CTD sections are drawn.
(Right) the 2009 campaign along 104th and 028th ground tracks of JASON-2.

• 54 GPS buoy Sessions" 2-3 h @ 1Hz
• 25 days of continuous GPS vessel sessions at 1Hz from 2 receivers
• uncalibrated marine gravimetry profile

•10 GPS buoy stations
• 1 sonar altimeter at 1 Hz
• 17 days of continuous GPS vessel sessions at 1Hz from 4 receivers
• calibrated, marine gravimetry profile

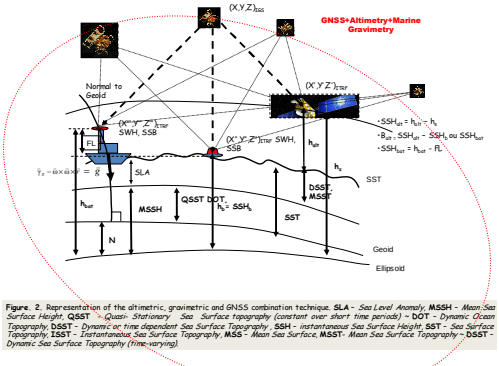
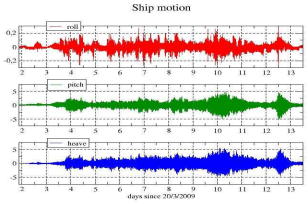
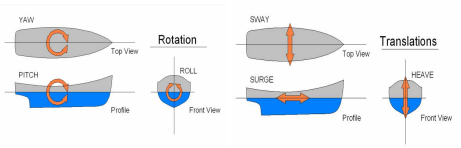


Figure. 2. Representation of the altimetric, gravimetric and GNSS combination technique. **SLA** - *Sea Level Anomaly*, **MSSH** - *Mean Sea Surface Height*, **QSST** - *Quasi- Stationary Sea Surface topography (constant over short time periods)* ~ **DOT** - *Dynamic Ocean Topography*, **DSST** - *Dynamic or time dependent Sea Surface Topography* , **SSH** - *instantaneous Sea Surface Height*, **SST** - *Sea Surface Topography*, **LSST** - *Instantaneous Sea Surface Topography*, **MSS** - *Mean Sea Surface*, **MSST**- *Mean Sea Surface Topography* - **DSST** - *Dynamic Sea Surface Topography (time-varying)*





The Floating Line (FL) calibration (Fig. 2)

The FL of the RV "Polarstern" is defined as :

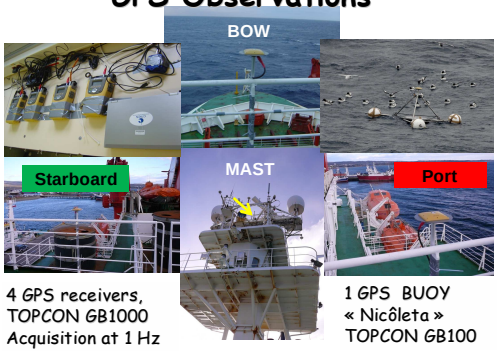
$$FL = h_{bat} - h_b + FL_b \Rightarrow \quad SSH_{bat} = h_{bat} - FL \quad (1)$$

Where h_b and h_{bat} are the ellipsoidal heights of the buoy and ship GPS-antenna phase center respectively and FL_b is the buoy's floating line.
In the next step we can associate the ship's GPS antenna height to the geoid and the MDT through (Fig. 2) :

$$h_{bat} = N + FL + \zeta_t + \zeta_c + v \quad (2)$$

Where: N is the geoid undulation, ζ_t is the time dependent sea surface topography and ζ_c is the QSST and *v* is errors.

GPS Observations

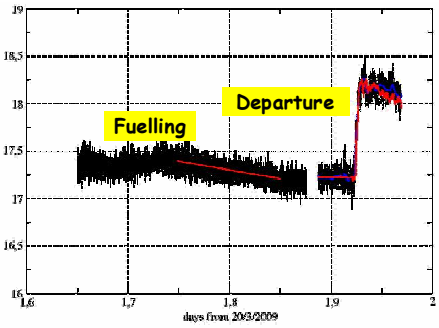


4 GPS receivers, TOPCON GB1000 Acquisition at 1 Hz

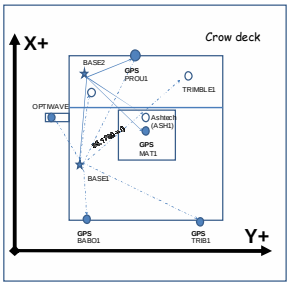
1 GPS BUOY « Nicôleta » TOPCON GB100

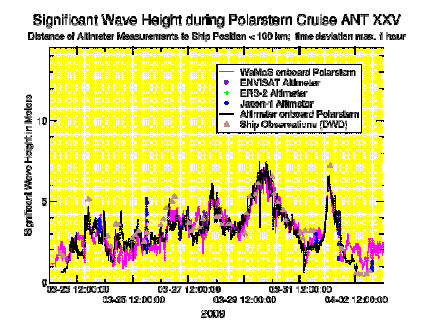
Sonar Observations

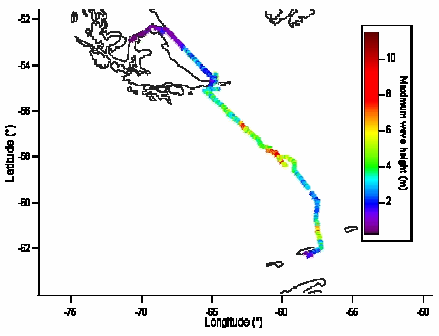
•OPTIWAVE 7300 C Radio Altimeter
•24 GHz emission frequency
•80 m of max meas. range
•3mm of precision



Local ties by optical observations

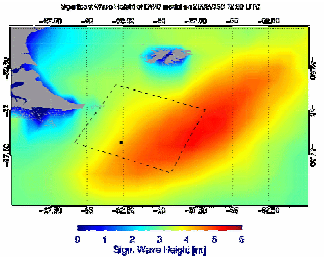


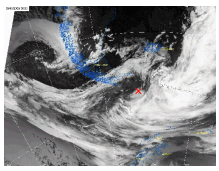


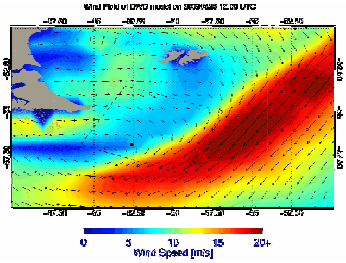


Gravity ties

- KSS31 onboard gravimeter
- CG5 Scintrex portable gravimeter*(IRD)*







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