

## Monitoring of offshore barge motions An MRU/IMU comparison



using  
**two OCTANS**  
on board  
**ACERGY/Polaris**  
**Nigeria**  
**April-May**

**IMU** : Inertial Measurement Unit

**MRU** : Movements Recording Unit

During Greenfield offshore Nigeria operations, a monitoring of the Polaris motions has been performed using three types of instruments :

- two Ixsea-Octans-III : Octans\_238 & Octans\_690,
- one accelerometer : (called ACC),
- one IMU on board Polaris : MRU\_Jlay

Figure 1 shows the drawing of the Polaris barge. The first Octans unit (Oct-238) is located in the MétéoMer staff container-office, the second Octans unit (Oct-690) close to the J-lay tower winch. The MRU\_Jlay is located in a box installed on the bulkhead of the main walkway. The ACC accelerometer was fixed vertically close to the Octans\_238 unit in the container-office.

Octans is composed of three fiber optic gyroscompass (FOGs), three milli-g accelerometers and a real time computer. The vertical motion (Heave) is obtained by a double integration of the vertical acceleration. As the vertical acceleration is measured with a small bias due to the physical limitations of the sensors, this double integration, which represents vertical position can diverge very quickly. OCTANS uses a high-pass filter to compute the heave, surge and sway outputs. The sampling output period is 500 ms (2 Hz). The SAFE filter covers most sea conditions, and provides an accurate motion measurement for swell periods up to 40 s. Therefore, OCTANS may not monitor low frequency barge motions. OCTANS is called an "Inertial Measurement Unit" (IMU). Accelerations are compensated from the earth gravity (accelerations are null when system is static). The resolution on acceleration output is restricted to  $10^{-2}$  m/s<sup>2</sup> and  $10^{-2}$  deg on rotation rate output

The stand alone ACC is composed of a data logger and three translational accelerometers arranged in a tri-axial configuration. Before the device can be used for acceleration measurement, the acceleration sensors need to be calibrated. During the operations, the sampling frequency was selected at 2 Hz too. The measurement resolution is determined by noise level (0.02 ms<sup>-2</sup> RMS)

The MRU-Jlay unit is composed of a set of accelerometers. The data are sampled at a rate period of 1.1 s.

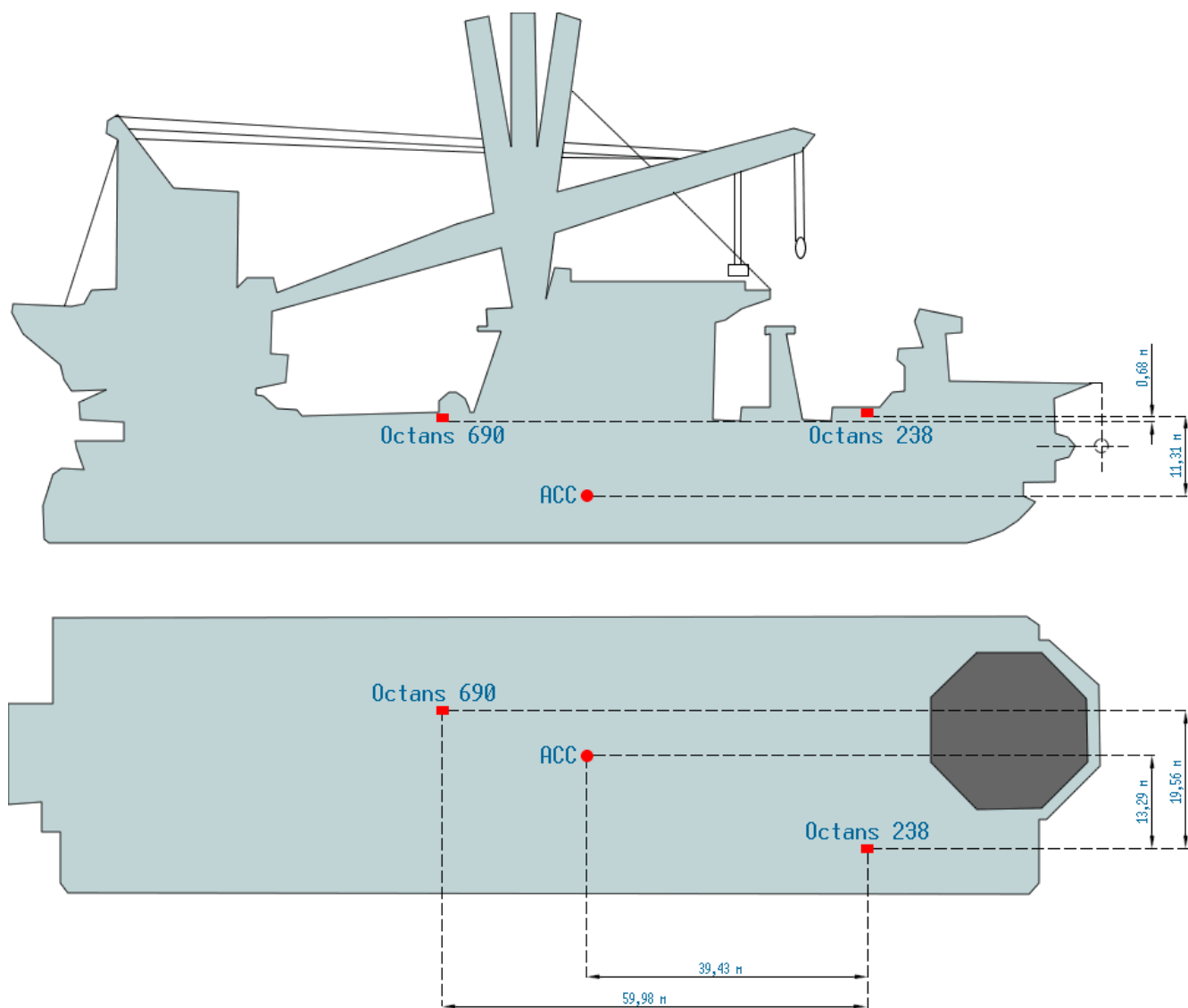


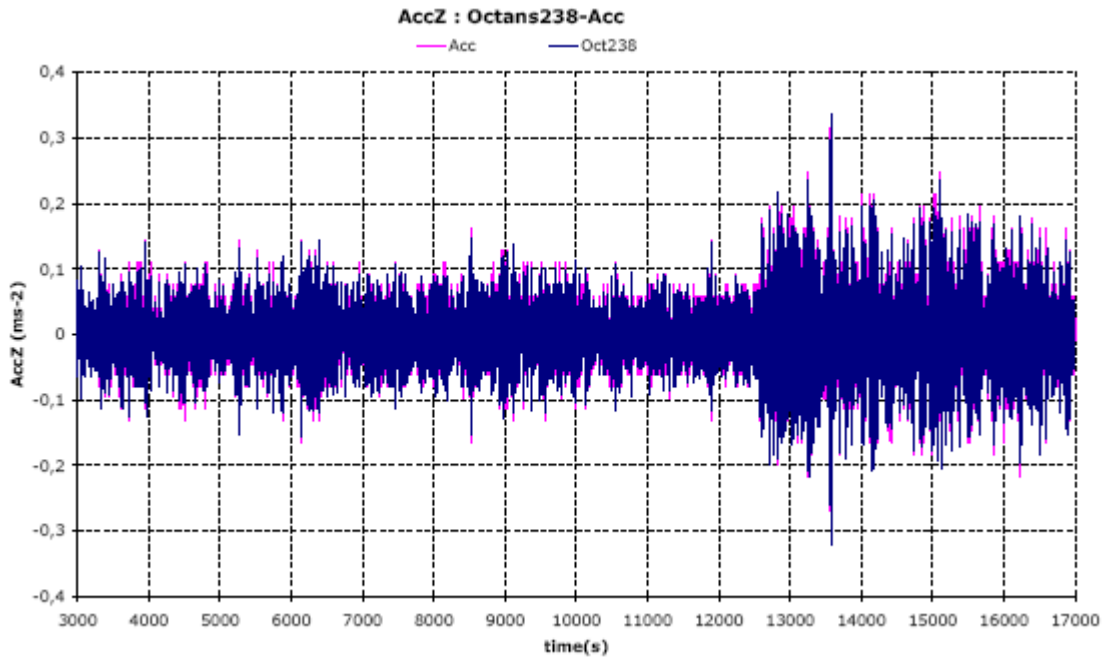
Figure 1 : Octans and MRU-Jlay locations.

# 1 - Octans & Acc

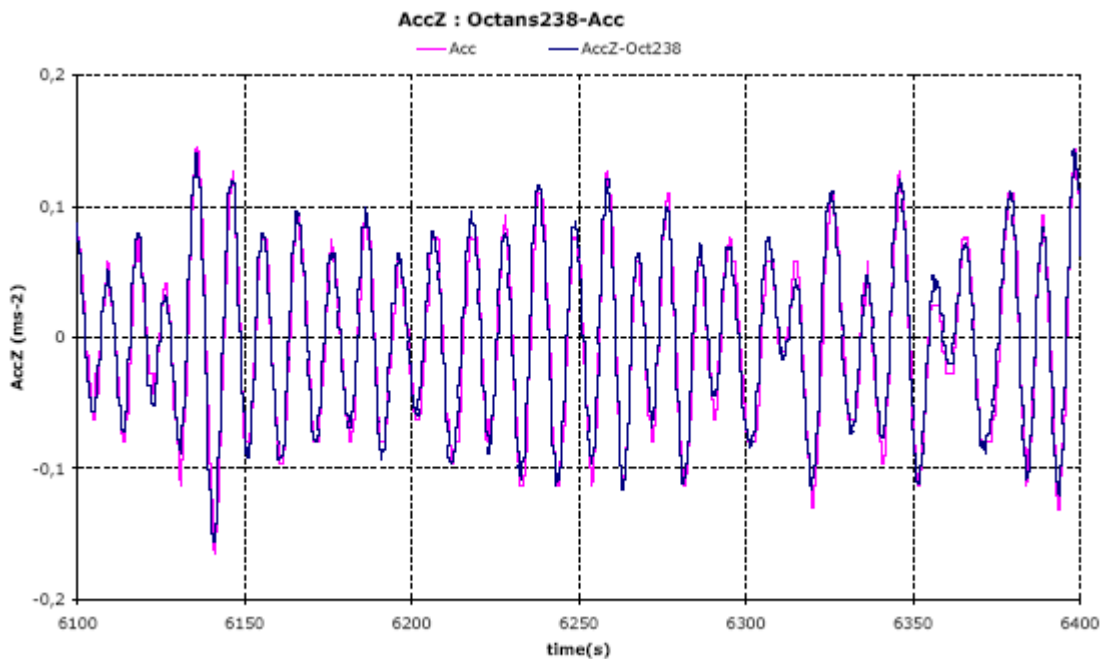
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## 1.1 – Derived acceleration from Octans 238 heave signal

Vertical acceleration is derived from OCTANS heave time series. Figures 2a and 2b show vertical acceleration time series (ms<sup>-2</sup>) measured by the Acc2H\_01 accelerometer and those processed from Octans\_238 heave at the location of the OCTANS unit.



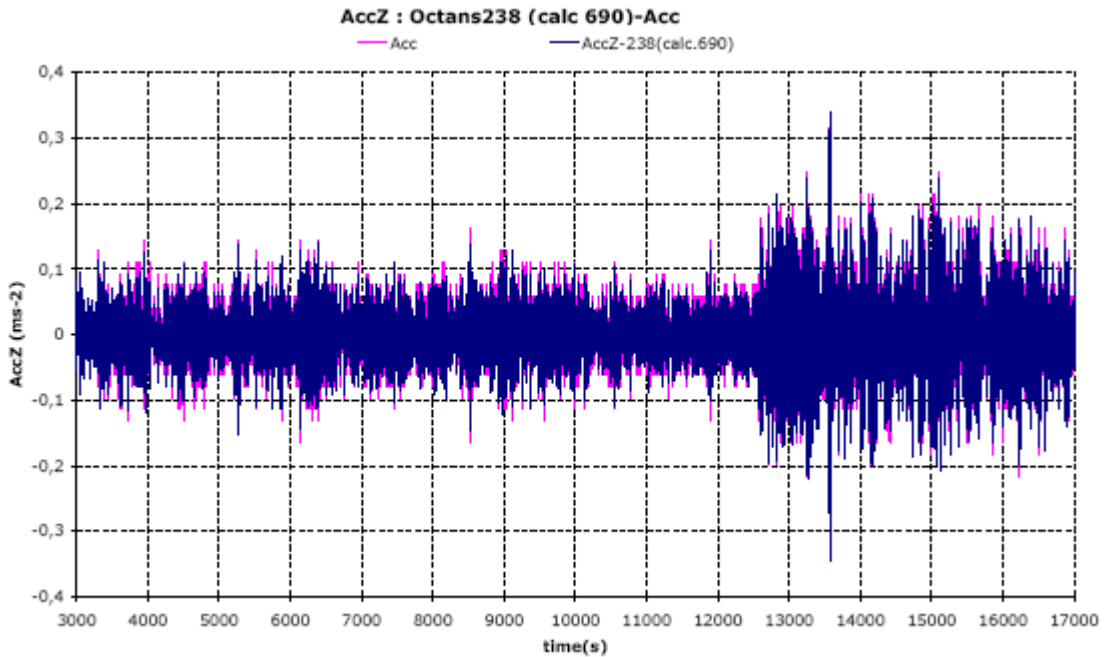
**Figure 2a** : Vertical acceleration time series (ms<sup>-2</sup>) measured by the Acc and processed from Octans-238 heave signal.



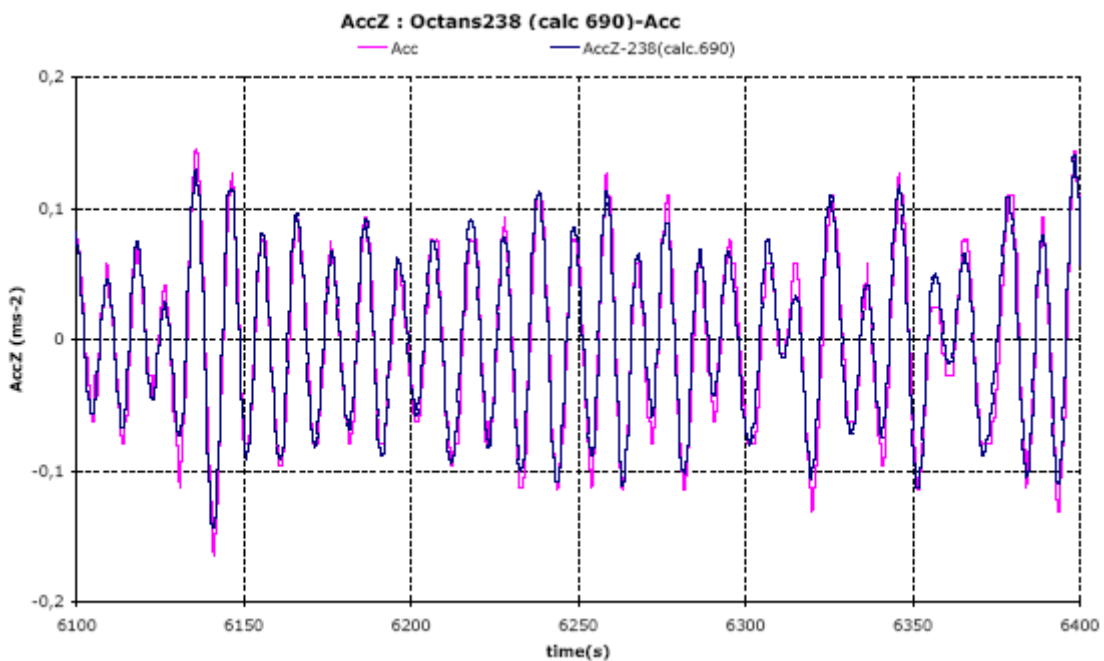
**Figure 2b** : Vertical acceleration time series (ms<sup>-2</sup>) measured by the Acc and processed from Octans-238 heave signal.

### 1.2 – Derived acceleration from Octans 690 heave signal at Octans 238 location

The calculation procedure on external monitoring points has been validated in a first part ([www.meteomer.fr/valid\\_deports\\_EN.html](http://www.meteomer.fr/valid_deports_EN.html)). This OCTANS capability has been developed to avoid installing an Octans unit on a hardly accessible spot. The following figures show vertical acceleration time series (ms-2) measured by the Acc and those processed by Octans\_690 heave at the location of the Octans\_238 unit.



**Figure 3a : Octans\_238 location** : vertical acceleration time series (ms-2) measured by the Acc and processed from Octans-690 heave signal.

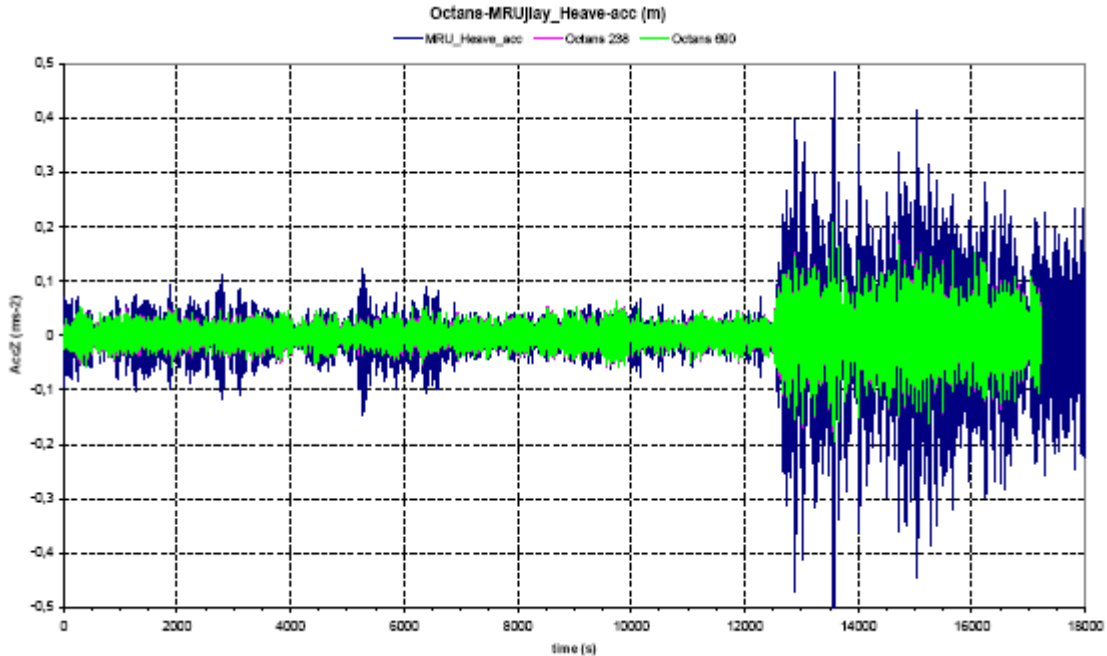


**Figure 3b : Octans\_238 location** : zoom on the vertical acceleration time series (ms-2) measured by the Acc and processed from Octans-690 heave signal.

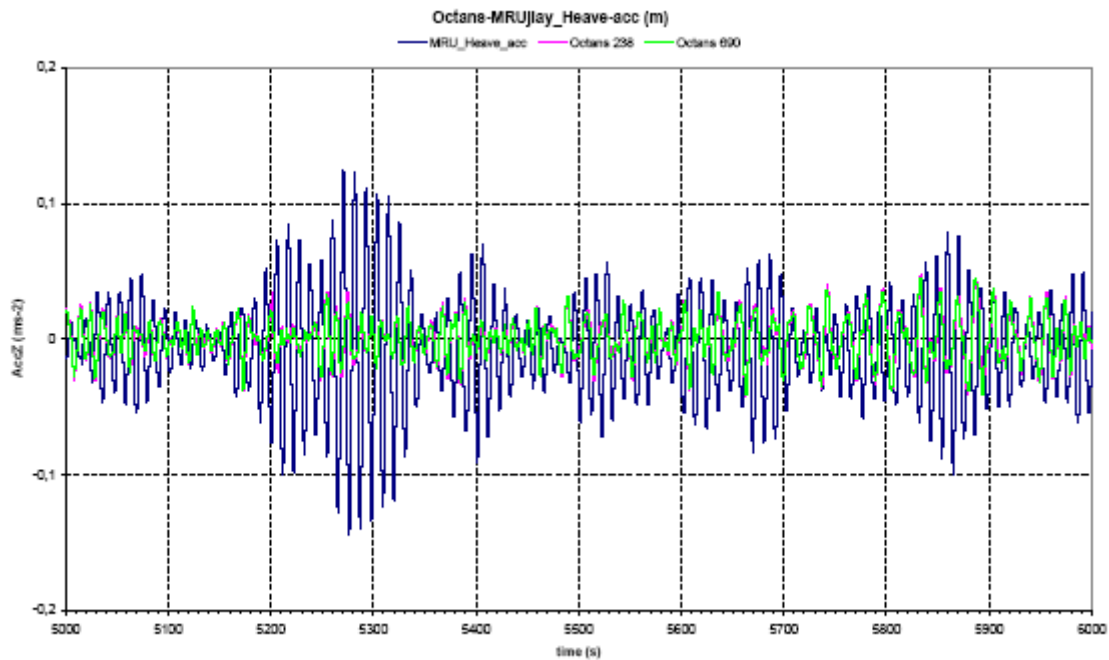
## 2 - Octans et MRU Jlay (AccZ)

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OCTANS vertical accelerations are derived from the time series computed on a external monitoring point located at the MRU\_Jlay unit.



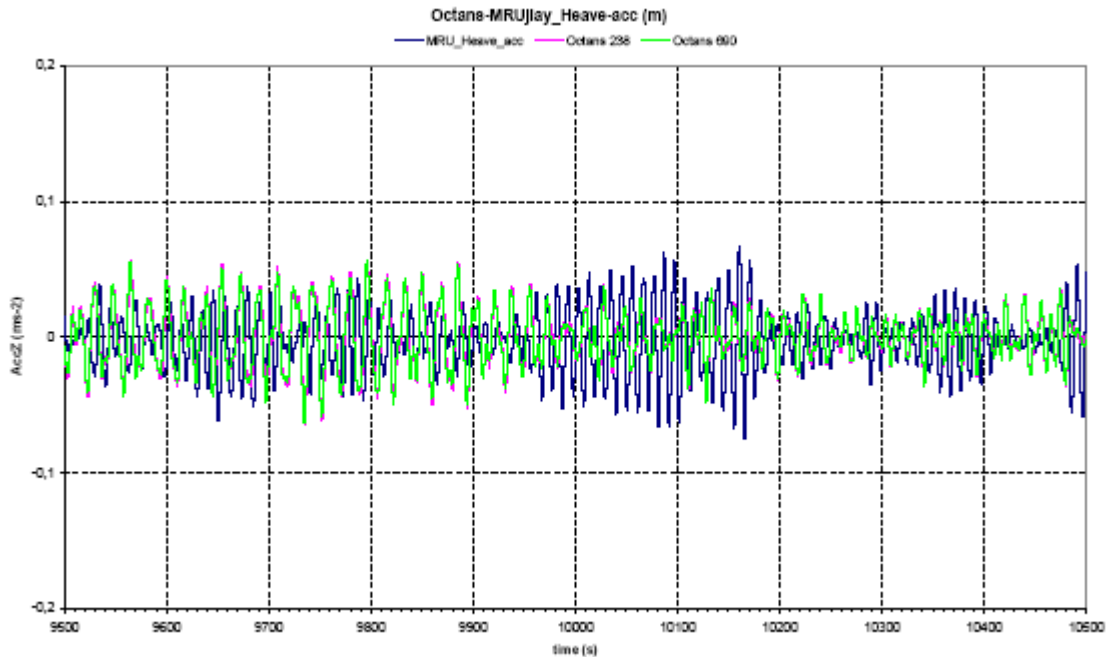
**Figure 4a** : MRU-Jlay location : vertical acceleration time series (ms-2) computed by both the Octans-238 & 690 units and measured by the MRU device .



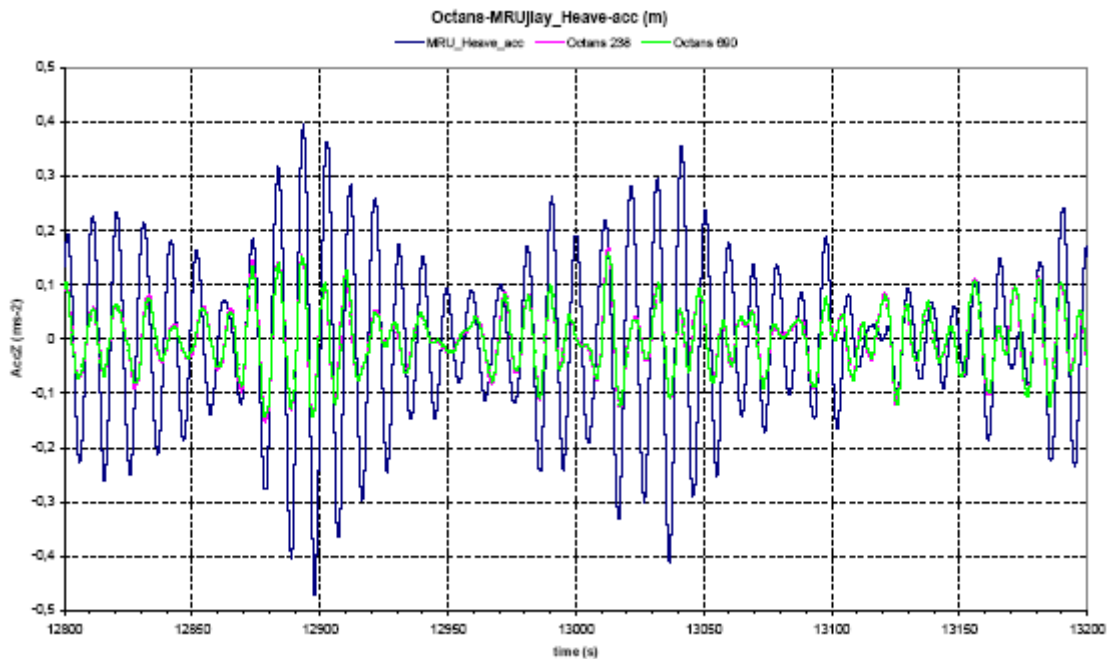
**Figure 4b** : MRU-Jlay location : zoom on the vertical acceleration time series (ms-2) computed by both the Octans-238 & 690 units and measured by the MRU device .

One can see a large discrepancy between MRU device and both Octans signals. This feature is probably issued :

- from the sampling method : the MRU data logger reads an instantaneous value at the sampling rate and supplies a mean value over the sampling period as the Octans does;
- from a deficient calibration.



**Figure 4c** : MRU-Jlay location : zoom on the vertical acceleration time series (ms-2) computed by both the Octans-238 & 690 units and measured by the MRU device .



**Figure 4d** : MRU-Jlay location : zoom on the vertical acceleration time series (ms-2) computed by both the Octans-238 & 690 units and measured by the MRU device .