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A comparison between two permanent broad band ocean bottom seismometers in the western Mediterranean Sea

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The aim of this work is to compare two permanent broad band ocean bottom seismometers (OBS) in terms of noise conditions by taking to account their similar instrumentation types, but their very different site characteristics. Both OBS stations have Güralp CMG-3T three component broad band sensors and differential pressure gauges (DPG).

The first sensor operates since August 2005 under the framework of a research project that aims to improve the knowledge of the seismicity and seismic risk in the Tarragona region (north eastern Spain). This pioneering project in Spain is being carried out by the Institut Geològic de Catalunya (IGC) and the Observatori de l'Ebre, in collaboration with the Spanish oil company Repsol Investigaciones Petrolíferas, and is being financed by the Ministerio de Educación y Ciencia (CASABLANCA REN2003-06577), FEDER funding, the IGC and the Institut Cartogràfic de Catalunya. The OBS is installed inside the security perimeter of the Casablanca oil platform, which is located 40 km offshore Tarragona. The sensors are submerged at about 400 m to the SW of the oil platform at about 150 m in depth. Data are digitized on-site and are transmitted through a submarine cable to the platform, where they are recorded. In July 2007 some improvements were made: i) the OBS was completely buried and the DPG was moved about 10 m away from the OBS; and ii) via satellite signal transmission was implemented, which allowed to have continuous and real time data in Barcelona so that the OBS could be integrated into the Catalan Seismic Network.

The second seismometer operates in the frame of the Antares neutrino telescope project developed in Liguria Sea. Geoazur is carrying out the project of deployment of a broad band seismological instrument in the aim of developing the permanent sea floor observation knowledge necessary to characterize Ligurian Sea seismicity and seismic risk along French Riviera coast (SE France). The operation was facilitated by the deployment of an opto-electrical cable to provide power and data transmission from the coast to a recording point at 2550 m in depth and 15km south to Porquerolles Island in the frame of the Antares neutrino telescope project. The program was founded in the 2002-2006 CPER (State-Region Research plan) by PACA region and CNRS/INSU and in the Antares collaboration which is responsible of all the marine operations on the site. The OBS and the DPG were set up by the ROV "Victor" from Ifremer (French Research Institute for Exploitation of the Sea) and partially buried; levelling and orientation were performed directly on the site. The instrument was running from April 2005 to April 2007. In April 2006 the sensor was completely buried. Data transmitted in quasi real time to Geoazur were integrated to the regional data center. In April 2007 the sensor was retrieved and reinstalled with data transmission protocol modification in October 2008. A water leak detected in December forced to cut the alimentation in January 2009.

Because both sensors have not operated over the same time period, two different periods have been analysed: 2006 for the Antares OBS and 2008 for the Casablanca's one. In this way we are able to make a comparison of the noise behaviour by observing also the seasonal evolution. As observed on most of the ocean floor observatories, the noise is quite large on all components for both OBS. In general, the Antares OBS shows a better behaviour than the Casablanca OBS, due to the more favourable site conditions. Both OBS have been reinstalled to ameliorate some site condition deficiencies, which has basically affected the low frequency band, between 0.008

and 0.07 Hz. After the reinstallations, the noise conditions have improved at least 10 dB. A comparison of the power spectral density (PSD) curves for both stations concerning the periods after the reinstallations of the OBS show that, at low frequencies, the vertical component PSD curve for the Casablanca OBS is about 20 dB higher than the Antares PSD curve. However, both fall in between Peterson's new high (NHNM) and low (NLNM) noise models. The PSD of the horizontal components for the Casablanca OBS in the same frequency band is higher than that of the vertical component and is also higher than the NHNM. For the Antares OBS the PSD curves of the horizontal components are higher than the Antares vertical component PSD curve, but they lie inside the margins marked by Peterson's models.

On the microseismic band, between 0.07 and 2 Hz, quieter PSD curves for the Antares OBS than for the Casablanca's one are observed. Nevertheless, the primary microseismic peak is not seen on the Antares PSD curves, whereas it can be observed on the vertical component PSD curve for the Casablanca OBS. As for the secondary microseimic peak, it is much better defined on the Antares PSD curves than for the Casablanca case for all components.

Finally, at high frequencies between 2 and 50 Hz, high noise levels are observed for all components and both OBS.