Introduction

In May 2007, within the monitoring activities carried out in cooperation with the Italian National Civil Protection Department (DPC) and within the European project NERIES (activity NAL), INGV deployed three Broad Band Ocean Bottom Seismometers (BBOBS) in the southern Ionian Sea, as shown in Fig. 2. The three OBSs, entirely developed at the Gabinetta INGV OBS Lab of the INGV National Earthquake Center (CNT), are part of a pool of eight ready to deploy instruments and they are the first Italian OBSs taking part in a long term experiment.

Preliminary data analysis

To better understand and monitor the earthquake processes in the European-Mediterranean region, hundreds of broad band seismic stations were installed in the past ten years, mostly on land. Nevertheless, the seismic monitoring of the European-Mediterranean region is difficult because many seismogenic areas are undersea. The resulting gaps in seismograph coverage produce a biased and incomplete image of the Mediterranean seismicity. The extension of the capabilities of the existing land-based infrastructure for a better approach to seismic risk assessment and management is a goal of NERIES project, activity NAL. For this reason, three INGV BBOBS were deployed in the southern Ionian Sea.

In this first campaign, we recovered more than 250 days of seismic and pressure recordings. Data from BBBOBS are often difficult to analyze for the different seismic noise level and shape, compared to land stations, and for the presence of seismic waves traveling only through the sea.

Generally sea floor and continental noise spectra are different because the ocean surface is an important source of broad band seismic noise. Fig. 3 shows the seismic and pressure noise PSD of 24 hours of signals from OBS A1, without seismic events. By comparison with the land High Noise Model (HNM) and Low Noise Model (LNM) of Peterson (1993). Spectra from our OBS seems to be shifted forward in frequency: seismic and pressure noise PSD have a very similar shape between them, showing a very high level noise below 0.03 Hz and in the band between 0.3 and 3.0 Hz. This noise level could involve a poor event detection for local and regional earthquakes. Low noise level in the bands 0.04 and 0.5 Hz provides windows for the detection of teleseismic events and local earthquakes, respectively. The minute frequency histogram of Fig. 4 shows the number of events recorded by OBS A1 and by the DPG of the OBS A3, for 0.2 magnitude intervals, and shows a large magnitude gap around 5 due to the seismic sources distribution around the OBS and magnitude recurrence.

During the almost nine months of the experiment, OBS A1 and A3 recorded altogether more than 300 local, regional and teleseismic events.

Fig. 7: Local and regional earthquakes recorded by OBS A1 and A3.

Fig. 8: Earthquakes with magnitude larger than 5 recorded by DPG and seismometer of OBS A1, and by the DPG of OBS A3.

OBS A1, and by the DPG of OBS A3.

Fig. 9: DPG recording of a Greek M 4.5 event with a low energy arrival after the T wave.

In Fig. 5 shows all the earthquakes with magnitude larger than 5 recorded by OBS A1 and A3, the third INGV BBOBS, deployed in southern Ionian Sea.

Fig. 10: Local event not reported by seismic networks bulletins network.

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Fig. 9: DPG recording of a Greek M 4.5 event with a low energy arrival after the T wave.

After P and S phases arrivals, a third phase is evident: this seismic wave, trapped in the channel known as T-wave, travels at very low phase velocity (about 1.5 km/s) and can be used to constrain the earthquake location, together with P and S waves.

Fig. 10: The three OBSs being deployed in the Ionian sea.

The instruments are equipped with:

- Nanometrics Trillium 120p seismometers (flat response between 120s and 7Hz) installed in a 17 inch pressure glass spheres on a Nautilus geoballs for the levelling.

- Cox-Webb Differential Pressure Gauge (bandwidth 150-2Hz after the preamplifier).

- 21 bits, 4 channels send Geolom-NLS digitizer setted at 100 m/s.

OBS A1 recorded a large volume of seismic data including local, regional and teleseismic events as described in the following paragraphs. OBS A3 had problems on the seismic installation. From our instrument, the only usable data are the ones recorded by the Differential Pressure Gauge. Finally, data from OBS A2, haven’t been analysed yet.

The area selected for the deployment is a region of high scientific interest for several reasons: i) there are no seismological data on the structure of the Ionian lithosphere (except for a few seismic reflection lines, see Scollo et al., 2001); ii) the rate and features of the seismicity in the area between the Hellenic-Malta fault system and the acquisitional territory of the Calabrian Arc are unknown. This experiment allows us to test the pressure waves detection system that will be implemented in the Tsunami Warning System that INGV is developing within the OCEANOS 2004 (North-East Atlantic, Mediterranean and connected sea) project.

Fig. 11: First seconds of an earthquake in Tanga (M S 5.5) with highlighted the P wave.