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NEMO-SN1 (Western Ionian Sea, off Eastern Sicily): A Cabled Abyssal Observatory with Tsunami Early Warning Capability

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ABSTRACT

The NEMO-SN1 (NEutrino Mediterranean Observatory - Submarine Network 1) seafloor observatory is located in the central Mediterranean, Western Ionian Sea, off Eastern Sicily Island (Southern Italy) at 2100 m water depth, 25 km from the harbour of the city of Catania. It is a prototype of cabled deep-sea multiparameter observatory, and the first operating with real-time data transmission in Europe since 2005. NEMO-SN1 is also the first-established node of EMSO (European Multidisciplinary Seafloor Observatory, http://emso-eu.org), one of the European large-scale research infrastructures. EMSO will address long-term monitoring of environmental processes related to marine ecosystems, climate change and geo-hazards. NEMO-SN1 will perform geophysical and environmental long-term monitoring by acquiring seismological, geomagnetic, gravimetric, accelerometric, physico-oceanographic, hydro-acoustic, bio-acoustic measurements to study earthquake and tsunami generation, and to characterize ambient noise which includes marine mammal sounds, and environmental and anthropogenic sources. NEMO-SN1 is also equipped with a prototype tsunami detector, based on the simultaneous measurement of the seismic and bottom pressure signals and a new high performance tsunami detection algorithm. NEMO-SN1 will be a permanent tsunami early warning node in Western Ionian Sea, an area where very destructive earthquakes have occurred in the past, some of them tsunamigenic (e.g., 1693, M=7.5; 1908, M=7.4).
Another important feature of NEMO-SN1 is the installation of a low frequency-high sensibility hydrophone and two (scalar and vector, respectively) magnetometers. The objective is to improve the tsunami detection capability of SN1 through the recognition of tsunami-induced hydro-acoustic and electro-magnetic precursors.

KEY WORDS: Tsunami, Detection, Precursors and Early Warning, Abyssal Multidisciplinary Observatories.

INTRODUCTION

In the last decade monitoring of marine deep environment has been an important target for the European Community. Several projects were funded to establish the first nucleus of a European long term marine monitoring network. This network is a fundamental step for the extension at sea of physical, biological, chemical and environmental observations which have many applications, in particular in global change studies and for the mitigation of extreme events.
An important component of marine networks are abyssal multidisciplinary observatories for deep sea real time, long term- multi parametric data acquisition. The first European node, the Submarine Network-1 (SN1), has operated in the Ionian Sea 25 km offshore Catania at about 2100 m depth, from 2005 till 2008.
NEMO-SN1 has been upgraded within the Listening Deep Ocean demo mission of European Seas Observatory NETwork (ESONET-LIDO) project funded by EU and the Submarine Multidisciplinary Observatory project funded by Italian Government (SMO-FIRB), with new instrumentation and capabilities, in particular with a real time Tsunami wave detector and a new acquisition and control software. The observatory has completed the onshore and will be redeployed in the same location in the next months. The deployment site of SN1 is of a key site for geophysical, oceanographical and bio-acoustical studies.
The prototype tsunami detector installed on SN1, called Tsunameter, has been previously tested in the Gulf of Cadiz for about two years in the framework of NEAREST EU project (NEAR shore sourcES of Tsunamis: toward an early warning system, http://nearest.bo.ismar.cnr.it). Moreover, the observatory has been equipped to study acoustic and magnetic tsunami precursors [*Chierici et al.*, 2010; *Toh et al.*, 2011]. All the data acquired by the instruments on board SN1 are sent in real time to the land station. This abyssal observatory is the first permanent EMSO [Favali and Beranzoli, 2009] node and the first permanent tsunami detection station in the Mediterranean, and hopefully the first seed of a future Mediterranean Tsunami Early Warning System.

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The scientific objectives of the NEMO-SN1 observatory cover a wide range of research activities in deep sea: high energy astrophysics, physical oceanography, bio-acoustics, environmental sciences, geophysics and geo-hazards [Favali et al., 2011]. The SN1 site is