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Oceanographic conditions in the NEMO region during the KM3NeT project (April 2006–May 2009)

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ABSTRACT

An intense observational activity was conducted in the NEMO region, western Ionian Sea, 40 nm south-east of Capo Passero (Sicily), in the framework of the KM3NeT project. Several oceanographic cruises were performed from 2006 to 2009 and current measurements carried out. The new data describe the present status of the deep layer and its evolution after the occurrence of a notable change that affected the Eastern Mediterranean water masses and circulation during the 1990's. In particular, they evidence the presence of a newly formed water mass in the abyssal layer of the Ionian Sea, coming likely from the Adriatic. Deep currents in the region are quite energetic, as already known, and highly variable both spatially and in strength. They are organized in a cyclonic circuit, with a prevalent north-west direction corresponding to the NEMO site.

1. Introduction

The Ionian Sea collects in its abyssal plain the dense water formed in the Eastern Mediterranean. The Adriatic Sea was the main source of deep water up to the end of the 1980's. Afterwards, an important climatic variation occurred, the so called "Eastern Mediterranean Transient" (EMT), which had an impact on the whole Eastern Mediterranean and a new source started producing a new type of dense water in the Aegean Sea. The Aegean water was warmer, saltier and denser than the one formed previously in the Adriatic Sea, so it filled the deepest layers of the Ionian [1]. Around 1995 the Aegean source weakened and the Adriatic became an active source again, producing new water whose temperature and salinity were higher compared with the pre-EMT period [2,3].

In the framework of the KM3NeT project, an intense observational activity has been conducted by CNR-ISMAR in the Ionian Sea, mainly south-east of Capo Passero (Sicily), one of the three candidate sites to host an abyssal neutrino telescope. The activity was comprehensive of six hydrographic cruises, two years of continuous current measurements at the NEMO site and about one year of continuous measurements at two sites located about 20 nm north-east and north-west from NEMO.

The main results obtained during the experiment are presented and discussed in this paper.

2. Data and methods

Six cruises were conducted with the Italian R/V *Urania* from April 2006 to May 2009, during which standard CTD data, dissolved oxygen (DO) and light transmission profiles were acquired from the sea surface to the bottom using a multiparametric probe (SBE911 plus). The probe sensors were calibrated in the laboratory before the cruise, and the DO sensor was calibrated after the cruises using the values obtained from the chemical analysis of water samples collected at selected depths.

The continuous measurements include hourly records of currents at a depth of 3100 m at three sites, one (KC1) in the NEMO position, and the others, KC2 and KC3, about 20 nm northwestward and northeastward, respectively (see the map inset in Fig. 2). Measurements started in May 2007 and lasted until May 2009 in KC1, while in KC2 and KC3 they ended in March 2008.

3. Results

3.1. Hydrology

During the cruise of July 2007, measurements were distributed over a wide area of the northwestern Ionian Sea, including the NEMO site. A section connecting NEMO and NESTOR covered almost synoptically the central Ionian basin from Sicily to Greece, giving an almost complete zonal view of the basin (see the map inset in Fig. 1). For the first time, the two Ionian neutrino sites and

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the central Ionian basin were subjected to the same measurements and methodologies during a unique period, thus avoiding the necessity of intercalibration of data acquired at different times and with different instruments.

The physical–chemical properties from 1800 m to the bottom along this section (Fig. 1) show distinct water masses, with significant differences both in temperature and in salinity. A clear gradient can be observed in correspondence to the meridional ridge, which separates the central and the eastern deeps. On the western side, below 2000 m, a marked stratification is found with warmer and saltier water (potential temperature,θ, of 13.42 °C and salinity, S, around 38.734) under a fresher and slightly colder layer ($S\sim38.72$, $\theta\sim13.4$ °C), both extending their influence upto the central abyssal plane. Both waters are probably of Adriatic origin, but the higher oxygen content close to the bottom (4.7 ml/l) suggests that the most recent Adriatic water is warmer and saltier than before the EMT [3]. On the eastern side, the higher salt content and the higher temperature evidence the presence of Cretan water in the deep column, mainly concentrated between 2000 and 3000 m of depth ($S\sim38.75$ and $\theta\sim13.51$–13.53 °C). The oxygen content is almost homogeneous, with only small variations between 4.6 ml/l at 2500 m and 4.55 ml/l at the bottom. No evidence of newly formed water is therefore found in this part of the basin.

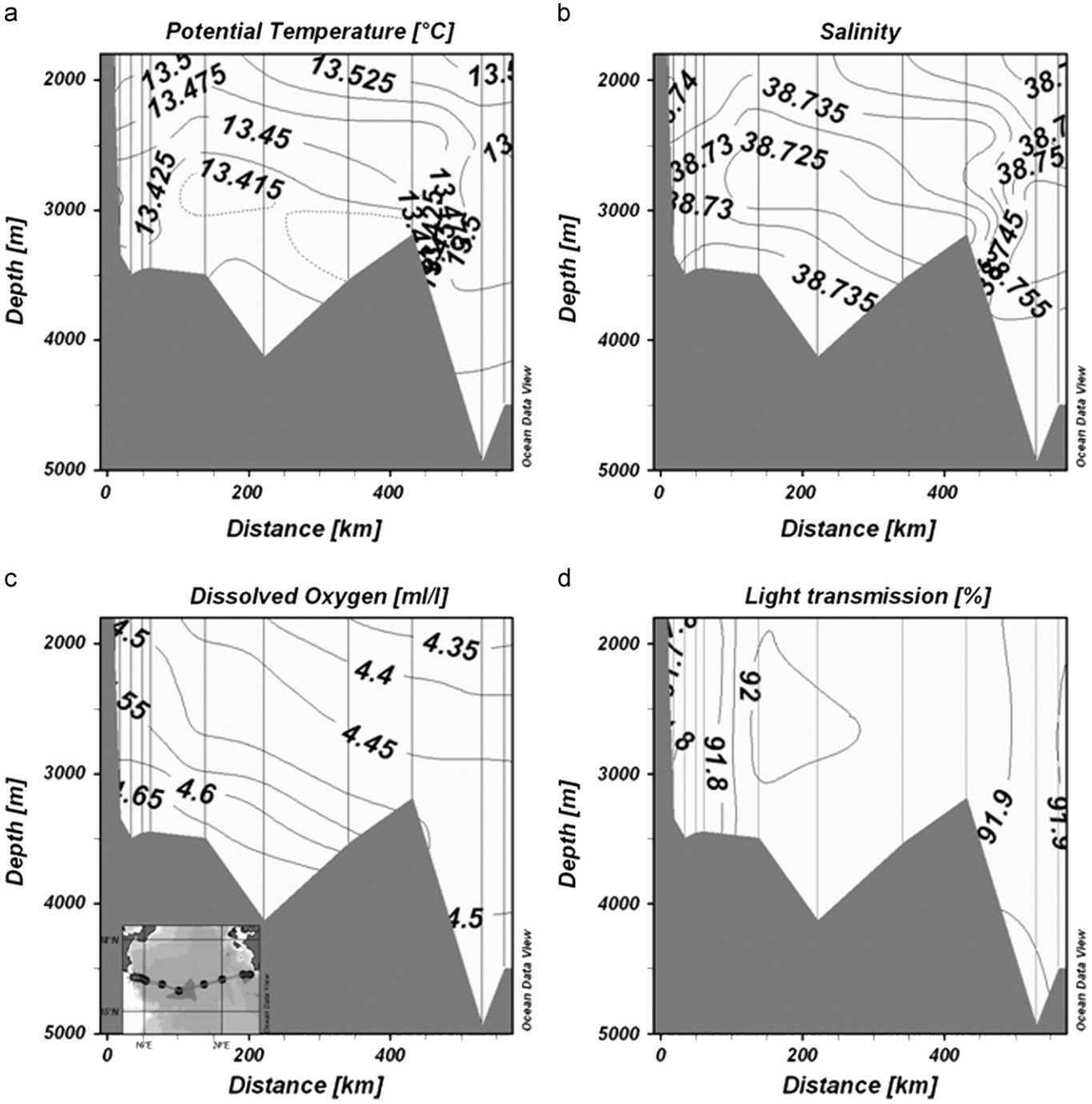

Fig. 1. Vertical section of potential temperature (°C), salinity, light transmission (%), dissolved oxygen content (ml/l) in July 2007 between 1500 m depth and the bottom.