

## **NATIONAL UPDATE REPORT ON STATUS OF SEA LEVEL MONITORING IN ISRAEL**

Dov S. ROSEN

Israel Oceanographic & Limnological Research, National Institute of Oceanography, Haifa, Israel

### **Historic Review**

Sea level monitoring on the Mediterranean coast of Israel has been measured on a routine basis since soon after the establishment of the State of Israel in 1948. Prior measurements were conducted during the British Mandate probably since 1928, in relation to the construction of the Haifa port in 1928-1931, where a reference bench mark was set-up. The British tide gauge bench mark (TGBM) established by the British to refer the Land Survey Datum to the MSL established also by the British Mandate authorities, was sometime later moved to a new TGBM established in Jaffa harbour, and measurements were conducted there during the 1930's and 1940's. These data could not be found (unless they are in somewhere in the British Army archives) and are most probably lost forever.

Sea-level data were gathered since then in Israel by a number of authorities for certain periods and certain locations as follows: Ports and Railways Authority (PRA) (Haifa port and Ashdod port on the Mediterranean coast, and Elat port in the Gulf of Aqaba (Red Sea)), Meteorological Service (Haifa port, Elat port), Survey of Israel (Israel's Mapping Authority) (Ashkelon marina, Ashdod port, Jaffa harbour (shifted since 1996 to Tel-Aviv marina), Haifa port, Acre marina) Elat anchorage), Geological Survey Institute (Atlit anchorage), Israel Oceanographic and Limnological Research (Ashdod port, Hadera offshore terminal, Haifa port, Eilat IUI pier).

During the 1950's and 1960's (monthly averages) at Jaffa harbour (1955-1959, 1962-1967) were transmitted to PSMSL and thus are found in its archive. Also monthly average values of sea-level data gathered at Haifa port (1956-1959, 1965-1976) and from Ashdod port (1958-1980) were found archived there from data sent by PRA. Yearly reports of measured hourly values of sea-levels were published by the IPRA during the period 1958-1984. However, only some of those of the 1960's and 1970's included sea-levels gathered at Haifa port, while all the reports included hourly sea-levels gathered at Ashdod port (and some also at Elat port).

Since the 1950's measurements were carried out at Jaffa more or less routinely, but most of the data in the 1950's, being recorded on charts, have been lost. Since 1957, following the decision to build a deep water port at Ashdod, sea level measurements started being gathered by the Israel Ports Authority (IPA) there, first in a stilling basin of the electric power plant and upon completion of Ashdod port in 1965 inside the port, shifted in 1968 to a new location in the port. Since April 1985, the Ports and Railways Authority (PRA) Survey and Hydrographic Division, responsible for the preparation of the yearly hydrographic reports was dismantled, and the paper charts of the gathered data remained unprocessed (and some got lost). All the stations were equipped with float tide gauges of OTT type located in stilling wells. In 1990 the Survey of Israel (SOI) started gathering and processing these data. The initial gathering was analogue with manual processing of the data which included recording of only the daily highs and lows, without recording of the time at which they occurred. The data from Jaffa harbour, Ashdod port and Haifa port are being digitized by SOI.

### **Digital measurements**

In 1992, in reaction to the forecasted climate change and sea level rise and the need for reliable data on sea level changes on the Israeli coast, IOLR established a modern digital near-real time sea level station at Hadera off shore coal unloading terminal. The station was built as per the

recommendations of the IOC GLOSS Group of Experts on a stable site located offshore the wave induced super-elevation zone and included in addition to the measurement of the sea level with accuracy and resolution better than 1 mm also monitoring of the atmospheric pressure, waves, currents, sea water temperature and wind. This station became in 1994 GLOSS primary network Station No. 80 – Hadera. Since 1994 until 1999 IOLR also carried out digital sea level measurements in Haifa port in regards to the port expansion, and is in the process of establishing a new permanent station in the port. Finally, in July 2000 IOLR installed, in cooperation with the Inter-Universitary Institute Elat Biological Laboratory (IUI) and SOI a digital sea level station at the pier of the IUI, near the border with Egypt. Since 2003 this station is maintained by IOLR and IUI only. All IOLR stations are based on Paroscientific Digiquartz absolute pressure sensors, Setra atmospheric pressure sensors of equivalent accuracy and GPS timing (used also in the MedGLOSS stations set-up by IOLR within MedGLOSS). In September 2004, within the ESEAS-RI EC project, IOLR installed a MedGLOSS type station also in Ashdod port.

Thus the present status of IOLR stations is of 3 NRT stations measuring sea level by integrated samples over 0.5 minute intervals and storing them on onsite computers. Updates of the measured data are transmitted via telephone lines hourly to IOLR, from where they are sent via ftp to the Israel Marine Data Center (ISRAMAR maintained by IOLR) where they are displayed in graphic format. Starting March 01, 2005, the digital hourly data will be available for downloading for scientific use directly from ISRAMAR web site.

In July 2007 IOLR plans to install a sea level station in Haifa port based on the Miros radar based sea level measuring system.

Within the ICG/NEAMTWS pilot network of sea level stations, IOLR is developing software for true real time sea level data logging, processing and transmission ( every 1 minute) via GTS and BGAN satellite network. The Ashdod, Hadera and Haifa stations are planned to be integrated in this real time national network, whereas meanwhile only the Hadera station will participate in the international pilot network.

Since 1996, SOI started upgrading of stations from Ott float type with chart recorder to float combined with Ott Thales shaft encoder and data logger.

The first was installed at Tel-Aviv marina in 1996, followed by shaft encoders with float gauges (Ott Thales) at a new station in Ashkelon marina and at Elat anchorage in 2000, followed by a similar change in Ashdod port since 2001, which however was discontinued in February 2002, and renewed since January 2004 by the installation of a Kalesto radar sensor at a new position in the port. A Kalesto radar owned by PRA was operated by SOI during March 2001 till September 2004 in Haifa port. Since November 2004 SOI installed a new station in Acre marina, based on Ott Thalimedes sytem (float+ shaft encoder and logger).

The properties of the present Israel sea level monitoring stations operated by IOLR and SOI, both committed to continued long-term monitoring are shown in the table below and the general location of the stations is shown in Figure 1 on next page:

Sea	Site	Responsible Institution	Measuring Method	Sensor Name	Data Transfer	Sampling Rate (sec)	Averaging over (min)	Accuracy (mm)
Mediterranean	Ashkelon marina	SOI	Float+Shaft encoder	Ott Thales	Logger, weekly	5	5	10
	Ashdod port	IOLR	Water & Atm Pressure	Paroscientific Digiquartz	Modem hourly	0.5	0.5	1
	Ashdod port	SOI	Radar	Ott Kalesto	Logger, weekly	20	5	1
	Tel Aviv marina	SOI	Float+Shaft encoder	Ott Thales	Logger, weekly	5	5	10
	Hadera coal pier	IOLR	Water & Atm Pressure	Paroscientific Digiquartz	Modem hourly	0.5	0.5	1
	Acre marina	SOI	Float+Shaft	Ott	Logger,	60	5	10

			encoder	Thalimedes	weekly			
Red	Elat IUI pier	IOLR+IUI		Paroscientific Digiquartz	Modem hourly	0.5	0.5	1
	Elat anchorage	SOI	Float+Shaft encoder	Ott Thales	Logger, monthly	5	5	10

### **Acknowledgements**

The contribution of information on SOI activities by Yossii Melzer, Head of Research Department of Survey of Israel and the information provided at SOI web site is gratefully acknowledged.



Figure 1 – Location map of present Sea level monitoring stations in Israel