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NATIONAL UPDATE REPORT ON STATUS OF SEA LEVEL MONITORING IN ISRAEL

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1. 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 (Atlith 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 old data from Jaffa harbour, Ashdod port and Haifa port have been digitized by SOI.

2. Modern Digital Sea Level Measurement

a. Israel Oceanographic & Limnological Research, National Institute of Oceanography

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. From 1994 until 1999 IOLR carried out digital sea level measurements also at 3 locations in Haifa port, using Paroscientific pressure sensors connected to computer loggers, for the primary purpose of assistance to the port expansion planning.

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.

In September 2004, within the ESEAS-RI EC project, IOLR installed a MedGLOSS type station also in Ashdod port. Since December 27, 2007 a new MIROS microwave radar sea level gauge has been installed and operating in Haifa port at the mouth of the Qishon river. Data from this gauge are gathered on-site as well as provided in near real time via ftp to IOLR.

All IOLR stations except the new Haifa station, 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).

Thus the status of IOLR stations at the time of reporting 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. The 4th NRT station in Haifa port measures sea level at 2Hz continuously using the Miros radar sensor, gathering 1 minute averages, 6 minute averages and hourly averages. Release of the data to the web is under consideration.

The ICG/NEAMTWS selected to include in 2008 in its pilot sea level stations network also the Hadera GLOSS station number 80 operated by IOLR as well as a number of additional MedGLOSS sea level network stations installed in Portomaso (Malta), Paphos (Cyprus), Constanta (Romania) and Kacively (Ukraine) due to their low latency measurement capabilities and their real time data transmission capabilities. With financial aid of CIESM and IOLR we started the equipment upgrade for true real time data gathering under WINDOWS as well as the development of adequate software for true real time sea level data logging, processing and transmission (15 sec samples to be sent every 1 minute) via ftp. The real time clock equipment selected makes use of the CRIO National Instruments (NI) and additional NI hardware elements, and the software has been developed under the NI LABVIEW software development package, on dual processors laptop Dell computers. Both the equipment upgrade and the development of the new data acquisition, processing and dissemination software named “MedGLOSS RT” have been completed, including trial tests.

The integral installation of the equipment and new software are estimated to be accomplished during July 2007, after a training workshop will be carried out for the MedGLOSS stations operators. IOLR will install the same upgrade equipment/software at the Hadera station during or immediately after the training workshop, and by September 2009 also at the Ashdod and Eilat sea level monitoring stations. Thus, by September 2009 at least 2 Israeli Mediterranean Sea (potentially also the Haifa station as a 3rd one) and 1 Red Sea (Eilat) sea level stations will start delivering 1 minute bursts to the national tsunami warning center as well as to the regional NEAMTWS.

Furthermore, also with additional CIESM financial support, IOLR is developing of an additional software package for detection of tsunami and other sea level induced hazards using low latency sea level measurements, based on concept presented at the 10th GLOSS GE meeting. The in situ detection and warning software development, and its installation at the IOLR stations and at the NEAMTWS MedGLOSS real time stations is estimated to be completed in fall 2009.

The outcome of the sea level monitoring at the Hadera GLOSS station no. 80 updated until March 2009 is shown in Figure 1 below.

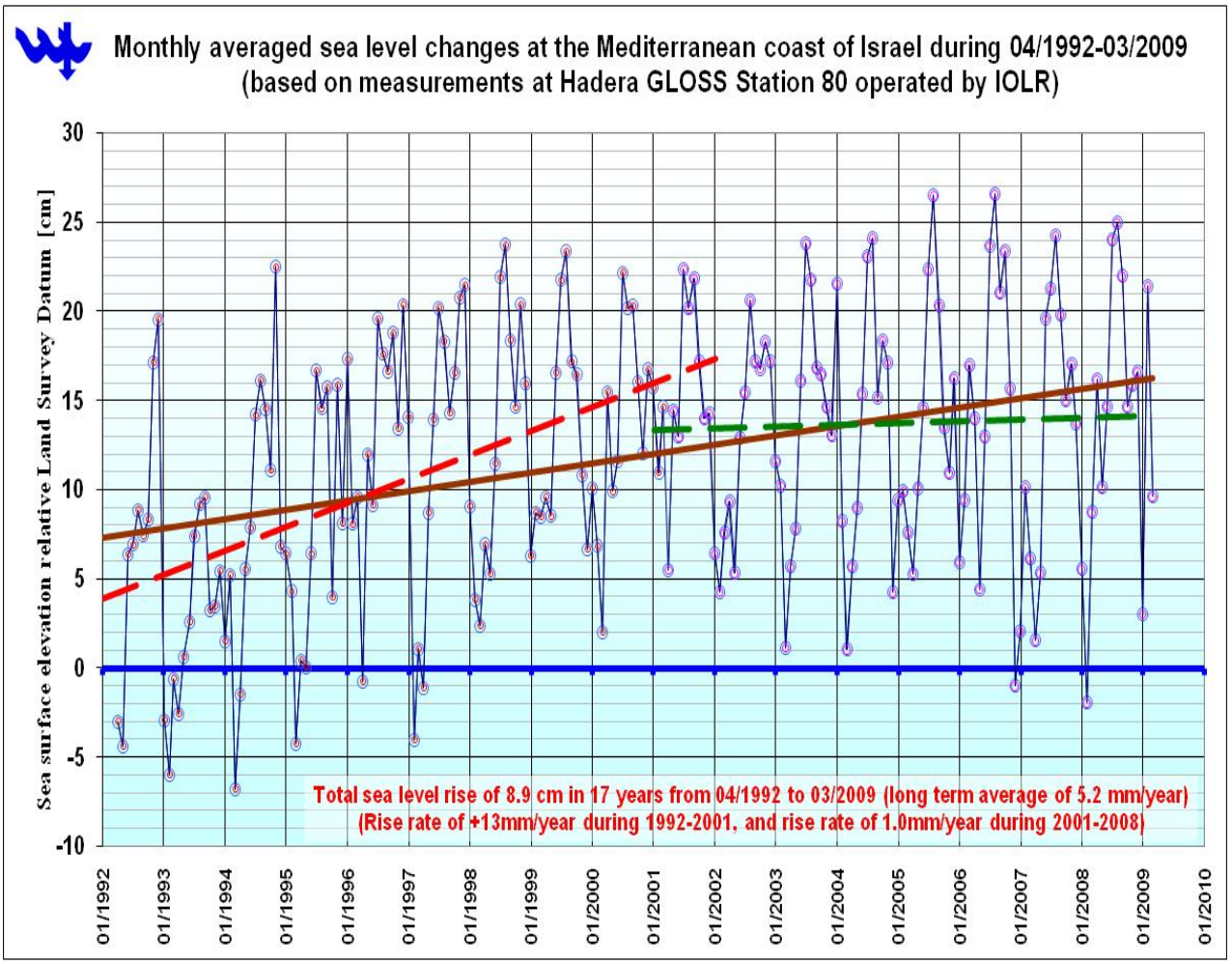

Figure 1 – Sea level long term changes at Hadera GLOSS Station No. 80, off Israel coast

b. Survey of Israel, Research Department

Since 1996, SOI started upgrading of its sea level 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 was operated by SOI during March 2001 till September 2004 in Haifa port. Since November 2004 SOI moved the measurement to a new station in Acre marina, based on Ott Thalimedes sytem (float+ shaft encoder and logger).

c. Specificities of the Israeli sea level stations

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 Table 1 and the general location of the stations are shown in Figure 2.

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
	Haifa port, Qishon mouth	IOLR	Microwave Radar	Miros SM-094/10W Range Finder	Wireless Internet	0.5	1	1
	Acre marina	SOI	Float+Shaft encoder	Ott Thalimedes	Logger, weekly	60	5	10
Red	Elat IUI pier	IOLR+IUI	Water & Atm Pressure	Paroscientific Digiquartz	Modem hourly	0.5	0.5	1
	Elat anchorage	SOI	Float+Shaft encoder	Ott Thales	Logger, monthly	5	5	10

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Figure 2 – Location map of present Sea level monitoring stations in Israel