

Sea Level Monitoring in Mexico

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In Mexico there are currently several sea level monitoring networks: the CICESE network (CICESE is a research center), the Mexican Navy network and the UNAM network (National University of Mexico).

CICESE network

CICESE network is mainly focused in the northwestern part of the country. They have been collaborating with the University of Hawaii to install and maintain some sites, including Cabos, Manzanillo, and one in Acapulco. They plan to reinstall soon, in collaboration with the University of Hawaii, the stations in Socorro Island and Guadalupe Island. They also have sites in the Baja California peninsula which will be upgraded in the short period (Fig. 1).

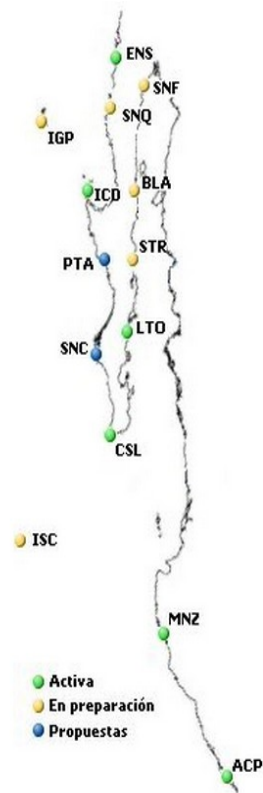


Figure 1. CICESE network distribution. Active (green), in preparation (yellow) and proposed (blue).

The Mexican Navy network

The Mexican Navy have a network with 40 sites, 17 in the Gulf of Mexico and the Caribbean Sea, and 23 in the Pacific Ocean. The network began in 1999 with 30 sites, in 2001 there were installed 3 stations, 5 in 2010 and during 2011 two were rehabilitated. Stations measure sea level using pressure sensors and sea temperature.



Figure 2. Distribution of Mexican Navy sea level stations. (black) sites with satellite telemetry, (blue) sites with internal Navy network communication, (no color) sites without telemetry, (red) sites with float sensor without telemetry, and (green) planned sites.



Figure 3. Example of the Mexican navy station showing solar panel and trimble antenna, transmitter and datalogger including atmospheric pressure compensator.

The Mexican Navy are working in the implementation a national tsunami warning center which will be hosted by them with the collaboration of other institutions in particular those with sea level networks. Table tides and calendars are elaborated each year by the Mexican Navy.

UNAM sea level Network

Background

The Universidad Nacional Autónoma de México hosts the National Sea Level Service since 1952. It had a network that grew up to 16 permanent

sites in the early 70's, by the end of 2006, only Veracruz was working and partially Acapulco. Most of the sites that were working during late 80's were not working since the 90's and in many of them there were not shelters or any UNAM equipment. There was also a considerably amount on non digitized mareograms, most of them from the late 80's, with around 900 months of data waiting to be digitized. In addition, international collaboration with the *Global Sea Level Observing System (GLOSS)* and PSMSL was very weak and the calendars and tide tables were not published.

Since late 2006 a diagnostic of the situation was done and we have being working in three basic issues: reconstruction of the network, digitalization of mareograms and data base organization and website development and collaboration with international and national organizations.

Current situation

Currently there have been rehabilitated 22 sites, 13 in the Gulf of Mexico and Caribbean (Tuxpan, Veracruz, Frontera, Desemb-Grijalva, Ciudad del Carmen, Campeche, Celestún, Sisal, Progreso, Telchac, Puerto Morelos, Isla Mujeres and Cozumel) and 9 in the Pacific (Puerto Chiapas, Salina Cruz, Huatulco, Acapulco, Zihuatanejo, Lázaro Cárdenas, Puerto Vallarta, Mazatlán and La Paz) (Fig. 4). Between the last GLOSS meeting and this one, 13 sites were rehabilitated. Now 14 sites are transmitting, via ftp, to IOC-Sea Level Center. The network was reconstructed with the minimal equipment, which was a float sensor with integrated datalogger and a transmitter, Internet or 3G. In addition no-breaks and in some sites solar panels. Currently there are several limitations since leveling is still needed in several sites, there are not meteorological sensor are installed, except for

Veracruz, nor electronic switches for better calibration. There are several shelters that are very deteriorated and this have been a priority in this period. New or reconstructed shelters are in Veracruz, Pto. Vallarta, Zihuatanejo, Sisal, Celestun, Pto. Chiapas, Pto. Morelos and Telchac. The sites have float and/or radar sensors, 4 sites have GPS, two thanks to the University of La Rochelle, four GOES transmitters are currently being installed in Progreso, Veracruz, Salina Cruz and Acapulco. For the near future the purpose is to upgrade most of the stations with radar, datalogger, solar panels and GOES transmitters.

Table 1. UNAM stations rehabilitated since 2007.

	Site	In collaboration with	Sensors	Sensor brand	Data transmission	Rehabilitated in year /GPS
1	La Paz, B.C.S.	API	Float	Thalimedes/OTT	Internet	2008
2	Mazatlán, Sin.	UNAM	Float	Thalimedes/OTT	Internet	2008
3	Puerto Vallarta, Jal.	API	Radar Float	RLS/OTT Thalimedes/OTT	3G	2011
4	Lázaro Cárdenas, Mich.	API	Float	Thalimedes/OTT	3G	2008/Yes (Kostoglodov)
5	Zihuatanejo, Gro.	API Fonatur	Radar Float	RLS/OTT Thalimedes/OTT	3G	2011
6	Acapulco, Gro.	Club de Yates	Float	Thalimedes/OTT	3G	2007/Yes (Kostoglodov)
7	Huatulco, Oax.	API Fonatur	Radar	RLS/OTT	3G	2011
8	Salina Cruz, Oax.	API	Float	Thalimedes/OTT	3G	2008/Yes (Kostoglodov)
9	Puerto Madero, Chis.	API	Float	Thalimedes/OTT	3G	2008
10	Tuxpan, Ver.	UNAM	Float	Thalimedes/OTT	3G	2009
11	Veracruz, Ver.	ENM	Float and radar meteorology	Thalimedes/OTT Kalesto OTT	3G GOES	2008 2011/Yes (Univ. La Rochelle)
12	Frontera, Tab.	API	Float	Thalimedes/OTT	3G	2010
13	Desembocadu	API	Float	Thalimedes/OTT	no	2010

	ra Grijalva, Tab.					
14	Cd.Carmen, Camp.	API	Float	Thalimedes/OTT	3G	2010
15	Campeche, Camp.	API	Float	Thalimedes/OTT	3G	2011
16	Celestún, Yuc.	II-UNAM/A PI	Float	Thalimedes/OTT	3G	2010
17	Sisal, Yuc.	II-UNAM	Radar	RLS/OTT	3G	2011
18	Progreso, Yuc.	API	Radar	Sutron	3G GOES (M. Merrefield)	2011/Yes (Univ. La Rochelle)
19	Telchac, Yuc.	II-UNAM	Float	Thalimedes/OTT	3G	2011
20	Puerto Morelos, Q. Roo.	UNAM	Float	Thalimedes/OTT	Internet	2007/Yes (Cabral)
21	I. Mujeres, Q. Roo	API	Float	Thalimedes/OTT	3G	2009
22	Cozumel, Q. Roo	API	Presión	Hobo	no	2010

API – Administración Portuaria Integral; ENM - Escuela Náutica Mercante

Sites to be rehabilitated in the near future (2011-2012).

1.- Tampico, Tamps.

4.- Calica, Q. R.

2.- Coatzacoalcos, Ver.

5.- Dos Bocas, Tab.

3.- Cozumel, Q. R.



WORKING



TO BE REHABILITATED



Figure 4. Location of UNAM sites. In red sites already working, yellow those that will be rehabilitated in the near future and purple (probable site to be rehabilitated).

Database and website

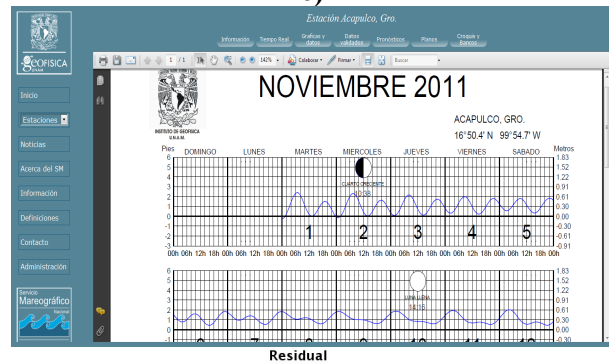
The website have been upgraded including near real time data, tide tables, tide calendars, historical database, general information about the tides and particular information about the tides of each place.

a)

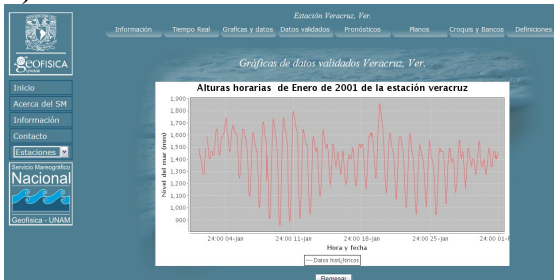
b)



c)



d)



e)

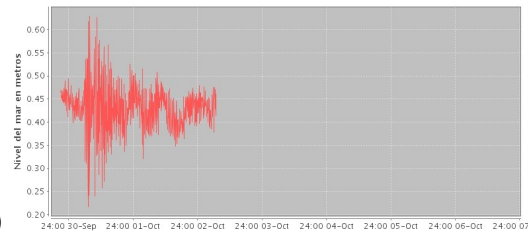


Figure 4.- a) Initial page of the UNAM sea level service website, b) near real time data and residual, c) example of tide calendar, d) example of graph of historical data, and e) residual showing the 2009 September 30 tsunami registered in Acapulco.



PTO. CHIAPAS, CHIS.
CASETA MAREOGRAFICA
RECONSTRUIDA



CD. DEL CARMEN, CAMP.
CASETA MAREOGRAFICA REMODELADA



MAZATLAN, SIN.
CASETA MAREOGRAFICA
RECONSTRUIDA



TUXPAN, VER.
CASETA MAREOGRAFICA
QUE REQUIERE
RECONSTRUCCION



VERACRUZ, VER.
CASETA MAREOGRAFICA
RECONSTRUIDA Y EQUIPADA CON
SENSORES DEL NIVEL DEL MAR
REDUNDANTES, METEOROLÓGICOS Y
GPS DE ALTA PRECISIÓN



SALINA CRUZ, OAX.
EQUIPO INSTALADO:
MAREOGRAFO, EQUIPO DE
COMUNICACIÓN Y GPS



TUXPAN, VER.
MEDICIONES GPS DE
OCUPACION



ACAPULCO, GRO.
ESTACION MAREOGRAFICA CON GPS DE
ALTA PRECISIÓN



CD. DEL CARMEN, CAMP.
NIVELACION DIFERENCIAL DE
BANCOS DE NIVEL