TRANSFER
Tsunami Risk ANd Strategies For the European Region

Sixth Framework Programme

ASSESSMENT AND REDUCTION OF TSUNAMI RISK IN EUROPE

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Deliverable 4.3.3: A report on the results of a survey of the existing tide gauge infrastructure in Europe including a list of technical requirements for detecting tsunamis and a comparison with other requirements for the tide gauge system.

Work Package 4: Analysis of instrumental (seismic, geodetic and marine) signals and networks for the development of a TEWS.

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Project coordinator organisation name	Alma Mater Studiorum Università di Bologna
Organization name of lead contractor for this deliverable	NERC (26)
Prepared by	Philip Woodworth, NERC (26)

Dissemination level: PU

Contents

Annex 1:

"A Survey of European Sea Level Infrastructure" by Woodworth, Rickards and Perez which summaries the results of tables and provides requirements and recommendations for European tide gauge networks.

Introduction

The tables below are the result of a survey of the existing European sea level infrastructure undertaken as part of the European Union Tsunami Risk ANd Strategies For the European Region (TRANSFER) programme. They provide a list of European locations at which sea levels are measured as of December 2008 and indicate which recording and communication technologies pertain to each site. They is based primarily on knowledge of national tide gauge networks obtained from contacts at the various sea level agencies or from their web sites, and on information obtained through international activities such as Permanent Service for Mean Sea Level (PSMSL), Global Sea Level Observing System (GLOSS), European Sea Level Service (ESEAS) or Mediterranean and Black Sea GLOSS (MedGLOSS).

First versions of the tables were produced by the Proudman Oceanographic Laboratory (UK) together with Puertos del Estado (Spain) and then sent to a number of agency contacts for checking and updating. We are grateful to all who replied. However, in some cases, no replies were received from national contacts. Where possible, use was then made of the national reports to regular GLOSS Experts Meetings available at www.gloss-sealevel.org.

One notes that because the survey was initiated as part of TRANSFER, and is also a contribution to the North-eastern Atlantic, Mediterranean and Connected Seas Tsunami Early Warning and Mitigation System (NEAMTWS) activity of the Intergovernmental Oceanographic Commission (IOC), the tables necessarily have an emphasis on the availability of real time sea level information. Nevertheless, the insight obtained into the status of the European sea level infrastructure as a whole should also provide a basis for the further development of activities such as GLOSS which also have great interest in the availability of delayed mode sea level data.

One reservation concerning the survey is that tables such as we have compiled will always be incomplete. For example, it is clear that ports or coastal cities may operate private tide gauge networks, data from which may not be shared. Local authorities, river authorities, water companies etc. may also undertake some kinds of sea level recording of which we are unaware. A second reservation is that any survey will necessarily become out of date. However, we are confident that the tables do provide a reasonable overview of the main sea level recording activities in Europe at the present time, which can perhaps form a starting point for more extensive future surveys.

The columns of the tables have the following meanings:

Lon, Lat = Longitude and latitude of the station (note that coordinates taken from the PSMSL catalogue will be given to the nearest minute. Coordinates taken from other sources may be approximate only)

CCO, SCO = PSMSL country and station code(s) of that station (if in the PSMSL database)

GLO = GLOSS station code if a GLOSS station

AC = Authority code for the agency that owns and maintains the station as listed in http://www.pol.ac.uk/psmsl/pub/indexa.html. Others should be stated explicitly.

TYP = type of tide gauge technology:

F = float and stilling well
P = undersea pressure transducer
B = bubbler pressure gauge
A = acoustic gauge in a tube or well (and manufacturer)
AA = acoustic gauge in open air (and manufacturer)
R = radar gauge (and state whether pulse or FMCW radar and manufacturer)
Others should be stated explicitly

PUR = purpose for which the gauge was installed (more than one if necessary):

F = flood warning/coastal protection
G = national datums/geodesy
H = harbour operations/navigation
M = mean sea level/climate studies
T = tsunami studies
TI = tides
BS = bathymetric surveys
AC = altimeter calibration
Others should be stated explicitly

FRQ = time in minutes of recording period or sampling (this is not to be confused with FRS and FRT below)

WI = when installed:

1 = more than approximately 2 years (and hence any system problems resolved)
2 = less than about a year
3 = recent installation or planned imminent installation

RT = real time data available:

N = real time data available nationally at the web site given for the authority below
I = real time data available also internationally at one of the programme web sites given under IPR (i.e. ‘I’ also implies ‘N’ if ‘N’ not given exxplicitly).

IPR = international programmes to which real time data from the station are made available:

S = SLEAC (Sea Levels from the European Atlantic Coastline) real-time display www.sleac.org
NO = NOOS (North West Shelf Oceanographic Operational System) real-time display www.noos.cc
BO = BOOS (Baltic Oceanographic Operational System) real-time display www.boos.org

I = IBI-ROOS (Iberia-Biscay-Ireland Regional Operational Oceanographic System) www.ibi-roos.eu
M = MedGLOSS real time web display medgloss.ocean.org.il
G = GLOSS real time web site www.vliz.be/gauges/
N = NEAMTWS tsunami network www.vliz.be/gauges/

The www.vliz.be address refers to the displays at the IOC/IODE Ostende facility (an alternative address is www.iocsealevelmonitoring.org).

FRS = time in minutes of data resampled before transmission (i.e. averaged from the FRQ sampling). This could differ for RT = N or I and for different international programmes. If different, this should be stated explicitly.

FRT = time in minutes between transmissions. This could differ for RT = N or I and for different international programmes. If different, this should be stated explicitly.

LT = latency, the minimum time in minutes for which the real time data are available either nationally or internationally. This could differ for RT = N or I and for different international programmes. If different, this should be stated explicitly.

MET = method by which data are transmitted from the gauge to the national or international web sites. This could differ for RT = N or I and for different international programmes. If different, this should be stated explicitly.

DMF = delayed mode data availability flag. Data are freely available either:

N = nationally at the web site for the authority given below
G = GLOSS delayed mode centre (higher frequency)
E = present ESEAS archive (note, the ESEAS arrangements will change in 2009)
M = MedGLOSS focal centre
P = PSMSL (monthly means)

AD = ancillary data collected at the site including:

M = meteorological information
G = continuous GPS recording (also checked by comparison to the CGPS@TG list kept for GLOSS and TIGA in http://www.sonel.org)
Others should be stated explicitly

Information is included in tables in the following order:

Greenland
Iceland
Norway (including Svalbard and Jan Mayen)
Sweden
Finland
Russia (Baltic)
Estonia
Latvia

Lithuania
Poland
Germany
Denmark
Faroe Islands
Netherlands
Belgium
United Kingdom – National Network (including Channel Islands and Gibraltar)
United Kingdom – Isle of Man Network
United Kingdom – Channel Coastal Observatory
Ireland
France – SHOM
France (Corsica) – Observatoire Côte d'Azur
Spain - Puertos del Estado (including Canary Islands)
Spain - Instituto Espanol de Oceanografia (including Canary Islands and Ceuta)
Spain – Estarit Observatory
Portugal (including Madeira and Azores)
Italy – National Network (ISPRA, formerly APAT)
Italy - Trieste
Italy – Navy
Malta
Slovenia
Croatia
Montenegro
Albania
Greece – Hellenic Navy
Greece – "Gavdos" Network
Bulgaria
Romania
Ukraine
Russia – Black Sea
Georgia
Turkey
Cyprus
Lebanon
Israel
Egypt
Tunisia
Algeria
Morocco

Following these tables, we include a list of attributes of stations included in the NEAMTWS network, based on a survey focusing on the needs of the European and North African tsunami warning network compiled in January 2008, with minor updates in December 2008. This list may provide further useful information. However, note that some of the entries refer to planned installations rather than existing ones.

Greenland

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
GREENLAND																		
THULE	-68.863	76.543				*	P	G,M	5	1	I	G	5	5	5	MPLS	G,E	M,G
QAQORTOQ	-46.035	60.718	980	045	-	*	P	G,M	5	1	I	G	5	5	5	ISDN	G,E	M,G
SCORESBYSUND (ILLOQQOTOORMIIT)	-21.962	70.484				*	P	G,M	5	1	I	G	5	5	5	MPLS	G,E	M,G

(*) AC: DTU Space, Technical University of Denmark, Juliane Maries vej 30, 2100 Copenhagen, Denmark

Real time data from the above three stations owned by the Technical University of Denmark are available on the GLOSS real time web site www.vliz.be/gauges. All three are Aanderaa WLR7 pressure gauges and have co-located CGPS. Locations of other permanent GPS stations in Greenland may be inspected at www.polenet.org/gnet_time/gnet_map.htm.

Information provided by Per Knudsen and Ole Bjerregaard Hansen (Technical University of Denmark).

Iceland

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
ICELAND																		
REYKJAVIK	21 56 W	64 09 N	010	001	229	55	P	GH	10 (*)	1	NI	SGN					NGP	M,G

(*) FRQ: Note that 1 minute values are sent to www.vliz.be/gauges

FRS to LT parameters: these will presumably be as implied by FRQ=10 with minimal additional introduced latency.

From 1992 the Icelandic Maritime Administration (IMA) has installed a number of tide gauges around Iceland in cooperation with harbor masters in the following harbors:

Akranes	22 06W	64 19N									N							
Olafsvik	23 42W	64 54N									N							
Patreksfjordur	24 00W	65 35N									N							
Skagastrond	20 20W	65 49N									N							
Dalvik	18 31W	65 58N									N							
Husavik	17 21W	66 02N									N							
Hvanney	15 11W	64 14N									N							
Skinneyjarhofdi	15 29W	64 13N									N							
Vestmanneyjar	20 13W	63 27N									N							
Azorlakshofn	21 22W	63 51N									N							
Grindavik	22 26W	63 50N									N							
Sandgerdi	22 43W	64 02N									N							
Keflavik	22 33W	64 00N									N							

Some of the tide gauges have not been leveled to the Chart Datum or the datums have not been checked regularly. The tide gauges are real time and are mainly used by the fisherman in the area.

Information provided by Hilmar Helgason (Icelandic Hydrographic Department).

Norway (including Svalbard and Jan Mayen) – Norwegian Hydrographic Service

Comments on the table below:

TYP: We have a radar gauge (FMCW)in Hammerfest. It is a Range finder SM-94 manufactured by MIROS (Norway).
The tide gauge at Jan Mayen is analogue, and the water level in the well is not representative for the sea outside. MSL might be OK, but there is a lot of freshwater (groundwater) in the well.
The gauge at Mausundvær is not connected to the network. It used to be analogue, bud is now a pressure gauge.

PUR: All the Norwegian tide gauges (except Jan-Mayen and Mausundvær) are run and maintained in the same way, and the data quality is the same. They are used for all the purposes that is listed under "PUR" (maybe except tsunami studies).

RT: What is real time? We sample every second and calculate arithmetic means to get 1-minute values. These data are stored and transferred to our office every hour. On our web-site (http://vannstand.statkart.no/Engelsk/main.php) we make 10-minute values available, updated every hour. The one-minute data will be available to NEAMTWS.

AD: We measure air pressure at all the gauges, and the Norwegian Meteorological Institute has observations from most of the sites.

MET: GPRS means the mobile phone network and ISDN the telephone network.

Plans are in place for upgrades at Bear Island and Ny Alesund.

Information provided by Tor Torresen (NHS).

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
JAN MAYEN																		
JAN MAYEN	08 43 W	70 55 N	012	001	230	04	F(analogue)	G		1								
SVALBARD (NHS)																		
NY-ALESUND	11 56 E	78 56 N	025	021		04	F	G H	1s	1	N		1	60	60	ISDN	NEP	G
NORWAY (NHS)																		
VARDO	31 06 E	70 20 N	040	001	323	04	F	G H	1s	1	N		1	60	60	GPRS	NEP	G
HONNINGSVAG	25 59 E	70 59 N	040	015	275	04	F	G H	1s	1	N,I	G	1	60	60	GPRS	NEPG	G
HAMMERFEST	23 40 E	70 40 N	040	021		04	R	G H	1s	1	N		1	60	60	GPRS	NEP	
TROMSO	18 58 E	69 39 N	040	031		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	G
ANDENES	16 09 E	69 19 N	040	041	322	04	F	G H	1s	1	N		1	60	60	GPRS	NEPG	G
HARSTAD	16 33 E	68 48 N	040	061		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	
NARVIK	17 25 E	68 26 N	040	081		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	G
KABELVAG	14 29 E	68 13 N	040	091		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	
BODO	14 23 E	67 17 N	040	101		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	G
RORVIK	11 15 E	64 52 N	040	136	234	04	F	G H	1s	1	N,I	N	1	60	60	GPRS	NEPG	
TRONDHEIM	10 26 E	63 26 N	040	142		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	G
MAUSUNDVAER	08 40 E	63 52 N				04	P	G		1								G
HEIMSJO	09 07 E	63 26 N	040	151		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	
KRISTIANSUND	07 44 E	63 07 N	040	161		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	
ALESUND	06 09 E	62 28 N	040	191		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	
MALOY	05 07 E	61 56 N	040	211	235	04	F	G H	1s	1	N,I	G	1	60	60	GPRS	NEPG	
BERGEN	05 18 E	60 24 N	040	221		04	F	G H	1s	1	N,I	NO,S	1	60	60	GPRS	NEP	
STAVANGER	05 44 E	58 58 N	040	261		04	F	G H	1s	1	N,I	NO,S	1	60	60	GPRS	NEP	G
TREGDE	07 34 E	58 00 N	040	301	321	04	F	G H	1s	1	N,I	NO,S,N	1	60	60	GPRS	NEPG	G
HELGEROA	09 52 E	58 59 N	040	310		04	F	G H	1s	1	N,I	NO	1	60	60	GPRS	NEP	
OSLO	10 45 E	59 54 N	040	321		04	F	G H	1s	1	N		1	60	60	GPRS	NEP	
OSCARSBORG	10 37 E	59 40 N	040	331		04	F	G H	1s	1	N,I	NO	1	60	60	GPRS	NEP	
VIKER	10 57 E	59 02 N	040	341		04	F	G H	1s	1	N,I	NO	1	60	60	GPRS	NEP	

Sweden – SMHI

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
SWEDEN																		
KALIX	23 06 E	65 42 N	050			05	F	FGHM	1	1	NI	BO	10	60	15	MODEM	N	M
FURUOGRUND	21 14 E	64 55 N	050	201		05	F	FGHM	1	1	NI	BO	10	60	15	MODEM	NP	G
RATAN	20 55 E	64 00 N	050	191		05	F	FGM	1	1	NI	BO	10	60	15	MODEM	NP	G
SKAGSUDDE	19 01 E	63 12 N	050			05	F	GM	60	1	N		60	43200	43200	POST	N	M
SPIKARNA	17 32 E	62 22 N	050	183		05	F	FGHM	1	1	NI	BO	10	60	15	POST	NP	
FORSMARK	18 13 E	60 25 N	050			05	F	FGHM	1	1	NI	BO	10	60	15	MODEM	N	
STOCKHOLM	18 05 E	59 19 N	050	141		05	F	FGHM	1	1	NI	BO, N	10	60	15	MODEM	NP	G
LANDSORT NORRA	17 52 E	58 46 N	050			05	F	FGHM	1	1	NI	BO	10	60	15	MODEM	NP	M
MARVIKEN	16 50 E	58 33 N	050			05	F		1	1	NI	BO	10	60	15	MODEM	N	
VISBY	18 17 E	57 38 N	050				F	GM	60	1	N		60	43200	43200	POST	N	G
OLANDS NORRA UDDE	17 06 E	57 22 N	050	091		05	F	GM	60	1	N		60	43200	43200	POST	NP	MG
OSKARSHAMN	16 29 E	57 17 N	050			05	F	FGHM	1	1	NI	BO	10	60	15	MODEM	N	
KUNGSHOLMSFORT	15 35 E	56 06 N	050	081		05	F	FGH	1	1	NI	BO	10	60	15	MOD	NP	G

								M								EM		
SIMRISHAMN	14 21 E	55 33 N	050			05	F	FGH M	1	1	NI	BO	10	60	15	MOD EM	N	
SKANOR	12 50 E	55 25 N	050			05	F	FGH M	1	1	N		10	60	15	MOD EM	N	MG
KLAGSHAMN	12 54 E	55 31 N	050	051		05	F	FGH M	1	1	NI	BO	10	60	15	MOD EM	NP	
BARSEBACK	12 54 E	55 45 N	050			05	F	FGH M	1	1	NI	BO	10	60	15	MOD EM	N	G
VIKEN	12 35 E	56 09 N	050			05	F	FGH M	1	1	NI	NO, BO	10	60	15	MOD EM	N	
RINGHALS	12 07 E	57 15 N	050			05	F	FGH M	1	1	NI	NO, BO	10	60	15	MOD EM	N	
GOTEBORG - TORSHAMNEN	11 48 E	57 41 N	050	032	233	05	F	FGH M	1	1	NI	NO, BO, N	10	60	15	MOD EM	NP	MG
STENUNGSUND	11 48 E	58 05 N	050			05	F	GM	60	1	N		10	432 00	432 00	POS T	N	
SMOGEN	11 13 E	58 22 N	050	011		05	F	FGH M	1	1	NI	NO, BO, N	10	60	15	MOD EM	NP	G
KUNGSVIK	11 08 E	59 00 N	050			05	F	FGH M	1	1	NI	BO	10	60	15	MOD EM	N	G

I did try to fill in the table as much as possible. I had some problem to fill in the columns FRT and MET. For FRT: some stations are non-realtime reporting and data are accessed once a month (43200 min delay). Also the MET-column was a little bit tricky; I typed data delivery through MODEM (real-time stations) or POST (paper chart stations). Note that all our real-time stations also deliver paper charts through POST (paper charts are used as a backup at all our stations).
More information about the Swedish sea level network can be found at:
http://www.smhi.se/hfa_coord/BOOS/Sealevel_Stationinfo.html

Information provided by Thomas Hammarklint (SMHI).

Finland - FIMR

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
FINLAND																		
KEMI	24 31 E	65 40 N	060	001		06	F	FGHM	1	1	I	BO					P	
OULU/ULEABORG	25 25 E	65 02 N	060	011		06	F	FGHM	1	1							P	
RAAHE/BRAHESTAD	24 **24** E	64 40 N	060	021		06	F	FGHM	1	1							P	
PIETARSAARI/JAKOBSTAD until 15 Oct 2008	22 42 E	63 42 N	060	041		06	F	FGHM		1	I	BO					P	
PIETARSAARI/JAKOBSTAD temporary station	22 42 E	63 42 N	060			06	F	FGHM	1	2								
VAASA/VASA	21 34 E	63 **05** N	060	051		06	F	FGHM	1	1							P	G
KASKINEN/KASKO	21 13 E	62 **21** N	060	071		06	F	FGHM	1	1	I	BO					P	
MANTYLUOTO	21 28 E	61 36 N	060	101		06	F	FGHM	1	1							P	
RAUMA/RAUMO	21 26 E	61 08 N	060	121		06	F	FGHM	1	1							P	
TURKU/ABO	22 06 E	60 26 N	060	241		06	F	FGHM	1	1							P	
DEGERBY/FOGLO	20 23 E	60 02 N	060	281		06	F	FGHM	1	1	I	BO					P	G
HANKO/HANGO	22 59 E	59 49 N	060	331		06	F	FGHM	1	1							P	

HELSINKI	24 58 E	60 09 N	060	351		06	F	FGH M	1	1	I	BO					P	
HAMINA	27 11 E	60 34 N	060	361		06	F	FGH M	1	1							P	

Additional information:

1. Pietarsaari
The sea level station at Pietarsaari was closed down on 16th October 2008 because of the harbour construction. A temporary station is built 50 m off. Its type (TYP) is F and functioning fine. A new permanent station will be established in the near future.

2. FRQ
Measuring happens once a minute at every station.

3. RT
N: The curve of hourly observations for a preceding day and the curve of daily means for preciding 12 months are available at the national web site for all 13 stations. The first one is updated hourly, the latter daily. No numerical sea level data are available.
I: The hourly observations for the stations Kemi, Pietarsaari, Kaskinen, Degerby and Helsinki are available at the BOOS web site http://www.boos.org/ No numerical sea level data are available.

4. IPR
BOOS (see 3. I)

5. FRS
The only resampling before transmission is made for the curves of daily means for preciding 12 months at the national web site. A daily mean is an average of 24 hourly measurements.

6. LT
In principle once a minute is possible. The real time observations for other stations but Pietarsaari (because of the temporary situation) are available once a minute for navigation via Vessel Traffic Service.

7. MET
Hourly from the gauge to FIMR by telephone line. Once a minute transfer by using TCP/IP protocol.
N: From FIMR to national web site updating area by scp
I: From FIMR to BOOS by ftp

8. AD
Sea surface temperature data are collected at the other stations but Pietarsaari (because of the temporary situation).

Information provided by Hanna Boman (FIMR).

Russia – Baltic Sea

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
RUSSIA – BALTIC																		
KRONSTADT	29.763	59.995						F			I	BO						
ST. PETERSBURG	30.316	59.939						F			I	BO						

These stations are included in the BOOS near-real time web page (www.boos.org). However, we do not have detailed information about them.

The above refers to the St. Petersburg section of the Russian Baltic coast. The PSMSL catalogue shows that a gauge was operated at Pionersky in the Kaliningrad section of the Russian Baltic coast up to 1991 but we do not know of any gauge there since that one malfunctioned.

Estonia

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
ESTONIA																		
SILLAMAE	27.745	59.401									NI							
TALLINN	24 48 E	59 27 N									NI							
PALDISKI	24.059	59.352									NI							
LEHTMA	22.690	59.037									NI							
SORU	22.528	58.696									NI							
PARNU	25.183	58.094									NI							

These stations are displayed in http://on-line.msi.ttu.ee/kaart.php with 15 minute values They are also included in the BOOS near-real time web page (www.boos.org). However, we do not have detailed information about them. Information provided by Tarmo Kouts (Marine Systems Insititute, Tallinn University of Technology)

Latvia

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
LATVIA																		
DAUGAVGRIVA	24 02 E	57 03 N									I							G
KOLKA	22.589	57.743									I							

These stations are included in the BOOS near-real time web page (www.boos.org). However, we do not have detailed information about them.

Note that the PSMSL data bank contains a number of pre-World War II MSL records from the former Baltic States.

Lithuania

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
LITHUANIA																		
KLAIPEDA	21 08 E	55 42 N	080	161			F	FGHM	1	1	N,I	BO	1	60	65		NEP	MG

Note that Klaipeda is referred also to in the PSMSL data set as Memel (code 080/171) which is the pre-World War II name.

Note that the PSMSL data bank contains a number of pre-World War II MSL records from the former Baltic States.

Information provided by Eimuntas Parseliunas (Geodetic Institute, Vilnius Gediminas Technical University).

Poland

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
POLAND																		
GDANSK PORT PN	18 41 E	54 24 N	110	022		07	F,P	F	10	1	N		60	60	60		N	M
WLADYSLAWOWO	18 25 E	54 48 N	110	047		07	F,P	F	10	1	N		60	60	60		N	G
LEBA	17 33 E	54 46 N	110	052		07	F	F	10	1	N		60	60	60		N	M
USTKA	16 52 E	54 35 N	110	057		07	F	F	10	1	N		60	60	60		N	M
KOLOBRZEG	15 33 E	54 11 N	110	072		07	F	F	10	1	N		60	60	60		N	M
SWINOUJSCIE	14 14 E	53 55 N	110	092		07	F	F	10	1	N		60	60	60		N	M
HEL	18 48 E	54 36 N	110	042		07												

The first 6 of the Polish stations above are operated by the Institute for Meteorology and Water Management (IMWM). Mean sea level data from Hel and some other stations were also provided to the PSMSL by the IMWM up to 1970.

As for real time data, the IMWM used to provide real time data to the BOOS project from Gdansk, Leba and Ustka but that supply has lapsed. Real time data from Hel are provided to BOOS by the Maritime Institute in Gdansk.

Information provided by Marzenna Sztobryn (IMWM).

Germany - BSH

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
GERMANY BALTIC																		
KOSEROW	14 00 E	54 04 N	120	001		16	F	FHM	1	1	I	BO						G
SASSNITZ	13 39 E	54 31 N	120	004		16	F	FHM	1	1	I	BO						
ARKONA	13 26 E	54 41 N	120	007		08												
WARNEMUNDE	12 05 E	54 11 N	120	011		08												
WARNEMUNDE 2	12 05 E	54 11 N	120	012		16	F	FHM	1	1	I	NO						G
WISMAR BAUMHAUS	11 28 E	53 54 N	120	021		08												
WISMAR BAUMHAUS 2	11 28 E	53 54 N	120	022		16	F	FHM	1	1	N							G
TRAVEMUENDE	10 53 E	53 58 N	125	001		16	F	FHM	1	1	I	NO						
MARIENLEUCHTE	11 15 E	54 30 N	125	011		08	P	FM	1	1	N							
KIEL - HOLTENAU	10 08 E	54 20 N	125	021		16	F	FHM	1	1	I	NO						G
GERMANY NORTH SEA																		
LIST	8 26 E	55 01 N	140	001		16	F	FHM	1	1								
AMRUM (WITTDUEN)	8 23 E	54 37 N	140	002		16	F	FHM	1	1								
BUESUM	08 51 E	54 08 N	140	004		16	F	FHM	1	1								
HUSUM	9 04 E	54 29 N	140	006		16	F	FHM	1	1	I	NO						
CUXHAVEN	08 43 E	53 52 N	140	011	284	16	F	FHM	1	1	I	NO						
CUXHAVEN 2	8 43 E	53 52 N	140	012	284	16	F	FHM	1	1	I	NO						G
DAGEBULL	8 44 E	54 44 N	140	014		16	F	FHM	1	1								
BORKUM (SUEDSTRAND)	6 40 E	53 35 N	140	015		16	F	FHM	1	1	I	NO						G
BORKUM (FISCHERBALJE)	6 40 E	53 35 N	140	016		16	F	FHM	1	1	I	NO						

MELLUM PLATE	08 06 E	53 46 N	140	018		15	F	FHM	1	1								
BREMERHAVEN	08 34 E	53 33 N	140	021		08	F	FHM	1	1	I	NO						
BREMERHAVEN 2	8 34 E	53 33 N	140	022		16	F	FHM	1	1	I	NO						
HELGOLAND	07 52 E	54 09 N	140	031		16	F	FHM	1	1	I	NO						
HELGOLAND 2	07 52 E	54 09 N	140	032		16	F	FHM	1	1	I	NO						G
WILHELMSHAVEN	08 07 E	53 32 N	140	041		16	F	FHM	1	1								
NORDERNEY	7 09 E	53 43 N	140	051		16	F	FHM	1	1								
EMDEN	7 13 E	53 23 N	140	061		16	F	FHM	1	1								

Note that the table is incomplete as the BSH is not responsible for the maintenance of the official German tide gauges. It awaits information from the different federal maritime agencies. The table has been completed so far with BSH information.

Many details of German gauges can be found at www.pegelonline.wsv.de/gast/pegelinformationen.

Information provided by Patrick Goffinet and Barbara Wetzold, Bundesamt für Seeschifffahrt und Hydrographie (BSH).

Denmark – DMI

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
HIRTSHALS	09 58 E	57 36 N	130	101	-	61	P	F	10 (0.5)	1	N, I	NO,S ,N	0	10	0	TELE-LINE	NP	G
FREDERIKSHAVN	10 34 E	57 26 N	130	091	-	61	P	F	10 (0.5)	1	N, I	NO	0	10	0	TELE-LINE	NP	-
HANSTHOLM	08 36 E	57 07 N	130	111	-	61	P	F	10 (0.5)	1	N, I	NO,S ,N	0	10	0	TELE-LINE	NP	-
AARHUS	10 13 E	56 09 N	130	081	-	61	P	F	10 (0.5)	1	N, I	NO	0	10	0	TELE-LINE	NP	-
FREDERICIA	09 45 E	55 34 N	130	071	-	61	P	F	10 (0.5)	1	N	-	0	10	0	TELE-LINE	NP	-
ESBJERG	08 26 E	55 28 N	130	121	-	61	P	F	10 (0.5)	1	N, I	NO	0	10	0	TELE-LINE	NP	G
HOJER	08 40 E	54 58 N	130	-	-	61	P	F	10 (0.5)	1	N	-	0	10	0	TELE-LINE	N	-
FYNSHAV	09 59 E	55 00 N	130	062	-	61	P	F	10 (0.5)	1	N	-	0	10	0	TELE-LINE	NP	-
SLIPSHAVN	10 50 E	55 17 N	130	051	-	61	P	F	10 (0.5)	1	N, I	BO	0	10	0	TELE-LINE	NP	-
KORSOR	11 08 E	55 20 N	130	041	-	61	P	F	10 (0.5)	1	N, I	BO	0	10	0	TELE-LINE	NP	-
HORNBAEK	12 28 E	56 06 N	130	031	-	61	P	F	10 (0.5)	1	N, I	NO, BO	0	10	0	TELE-LINE	NP	-
KOBENHAVN	12 36 E	55 42 N	130	021	-	61	P	F	10 (0.5)	1	N	-	0	10	0	TELE-LINE	NP	G

RODBY	11 21 E	54 39 N	130	011	-	61	P	F	10 (0.5)	1	N	-	0	10	0	TELE-LINE	NP	-
GEDSER	11 56 E	54 34 N	130	001	-	61	P	F	10 (0.5)	1	N, I	BO	0	10	0	TELE-LINE	NP	G
TEJN	14 50 E	55 15 N	130	016	-	61	P	F	10 (0.5)	1	N, I	BO,N	0	10	0	TELE-LINE	NP	-
SKAGEN	10 36 E	57 43 N	130	-	-	H4	A	H	10 (2)	1	N, I	BO	0	10	0	E	N	-
GRENAA	10 56 E	56 25 N	130	-	-	H4	A	H	10 (2)	1	N	-	0	10	0	E	N	-
JUELSMINDE	10 01 E	55 43 N	130	-	-	H4	A	H	10 (2)	1	N	-	0	10	0	E	N	-
BALLEN	10 38 E	55 49 N	130	-	-	H4	A	H	10 (2)	1	N	-	0	10	0	E	N	-
BAGENKOP	10 40 E	54 45 N	130	-	-	H4	A	H	10 (2)	1	N	-	0	10	0	E	N	-
SJ. ODDE	11 22 E	55 58 N	130	-	-	H4	A	H	10 (2)	1	N	-	0	10	0	E	N	-
NORDRE ROSE FYR	12 41 E	55 38 N	130	-	-	H4	A	H	10 (2)	1	N	-	0	10	0	E	N	-
DROGDEN FYR	12 43 E	55 32 N	130	-	-	H4	A	H	10 (2)	1	N, I	BO	0	10	0	E	N	-
RODVIG	12 23 E	55 15 N	130	-	-	H4	A	H	10 (2)	1	N	-	0	10	0	E	N	-

Type A = Endress and Hausser (ultra sonic). Method E = Ethernet (ADSL in most cases)

Stations are only from DMI and FRV. That is 24 stations in total. There are many more Danish stations from the Danish Coastal Authority, and from local authorities. It could be discussed if the stations from the Danish Coastal Authority should be included, but the Coastal Authority is not geared to provide data to international programmes, so I chose not to include them.

For FRQ I have put the sampling interval, and in brackets the time length of the sampling.
Hope it is understandable.

Information from Vibeke Huess (DMI).

Faroe Islands

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
FAROE ISLANDS																		
TORSHAVN	06 46 W	62 01 N	015	011	237	61					I	S,N						G

The tide gauge at the Thorshavn operated by the Danish Meteorological Institute has been out of operation. However, we understand that the harbour authority in Thorshavn will set up a new station, and take over the responsibility for it. The new station will be at the same location as the old one, as they will re-use the DMI's old "station house" at the harbour. It is not clear if DMI can or will be responsible for sending data to PSMSL, as we will not be in control of the data quality.

Information from Vibeke Huess (DMI).

Netherlands - Rijkswaterstaat

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD

NETHERLANDS																		
DELFZIJL	06 56 E	53 20 N	150	001		17	F	FGH M	10	1	N		10	30	5	T	NP	MG
WEST-TERSCHELLING	05 13 E	53 22 N	150	011		17	F	FGH M	10	1	N		10	30	5	T	NP	MG
HARLINGEN	05 25 E	53 10 N	150	021		17	F	FGH M	10	1	N		10	30	5	T	NP	
DEN HELDER	04 45 E	52 58 N	150	031		17	F	FGH M	10	1	NI	NO, S	10	30	5	T	NP	M
IJMUIDEN	04 35 E	52 28 N	150	041		17	F	FGH M	10	1	N		10	30	5	T	NP	MG
HOEK VAN HOLLAND	04 07 E	51 59 N	150	051		17	F	FGH M	10	1	NI	NO, S	10	30	5	T	NP	M
MAASSLUIS	04 15 E	51 55 N	150	061		17	F	GM	10	1	N		10	30	5	T	NP	
HARINGVLIET	03 52 E	51 52 N	150	073		17	F	GM	10	1	N		10	30	5	R	NP	
BROUWERSHAVENSE GAT	03 49 E	51 45 N	150	082		17	F	FGM	10	1	N		10	30	5	R	NP	
ROOMPOT BUITEN	03 40 E	51 37 N	150	090		17	F	FGM	10	1	N		10	30	5	T	NP	
VLISSINGEN	03 36 E	51 27 N	150	101		17	F	FGH M	10	1	NI	NO	10	30	5	T	NP	MG
And many others, see 'waterstand' web site																		

Attached please find the requested information for the still existing Dutch gauges represented in the PSMSL list.
Hellevoetsluis and Stellendam buiten (both supplanted by Haringvliet 10), Brouwershaven (supplanted by Brouwershavense Gat) and Zierikzee (supplanted by Roompot buiten) were dropped from the list. It did not seem expedient to extend the list beyond the existing PSMSL gauges. Our country is very small and situated at the end of a shallow sea in a region with very little seismic activity. Therefore, the gauges are of little use for tsunami projects.

FRT : 30 min. is approximately the maximum latency of the web data (www.actuelewaterdata.nl); with the MFPS program (www.mfps.nl) the data are available earlier.

LT : the data are averaged over T-5 min. through T+5 min., therefore the minimum latency possible is 5 min.

MET : T = telephone connection, R = radar connection

Information provided by Koos Doekes (Help Desk Water, Rijkswaterstaat).

Belgium – Flemish Hydrography

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
BELGIUM																		
ZEEBRUGGE (LEOPOLD II-DAM)	03 12 E	51 21 N	160	011		69	F	F H M	1	1	N		5	5	15		P	
OOSTENDE	02 55 E	51 14 N	160	021		69	F	F H M	1	1	NI	NO,S	5	5	15		P	
NIEUWPOORT	02 44 E	51 09 N	160	031		69	F	F H M	1	1	N		5	5	15		P	
WANDELAAR – MOW 0 off-shore	03 03 E	51 24 N	160			69	R Wave guide	H	1	1	N		5	5	15			M
APPELZAK – MOW 2 off-shore	03 17 E	51 22 N	160			69	R Wave guide	H	1	1	N		5	5	15			
BOL VAN HEIST – MOW 3 off-shore	03 12 E	51 23 N	160			69	R Wave guide	H	1	1	N		5	5	15			
BOL VAN KNOKKE – MOW 4 off-shore	03 18 E	51 25 N	160			69	R Wave guide	H	1	1	N		5	5	15			
WESTHINDER –MOW 7 off-shore	02 26 E	51 23 N	160			69	F	H	1	1	N		5	5	15			M

The additional stations after the first 3 listed above are off-shore stations for navigation.
Information provided by Guido Dumon (Agency for Maritime and Coastal Services – Flemish Hydrography).

United Kingdom – National Network (Proudman Oceanographic Laboratory)

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
UK NATIONAL NETWORK(POL)																		
LERWICK	01 08 W	60 09 N	170	001	236	66	B	FHM	15	1	N,I	NO, S,G	15	15	15			G
WICK	03 05 W	58 26 N	170	005		66	B	FM	15	1	N,I	NO, S	15	15	15			
ABERDEEN	02 05 W	57 09 N	170	011		66	B	FM	15	1	N,I	NO, S	15	15	15			G
LEITH	03 10 W	55 59 N	170	032		66	B	FHM	15	1	N,I	NO	15	15	15			
NORTH SHIELDS	01 26 W	55 00 N	170	053		66	F	FHM	15	1	N,I	S	15	15	15			G
WHITBY	00 37 W	54 29 N	170	056		66	B	FHM "EA"	15	1	N,I	NO	15	15	15			
IMMINGHAM	00 11 W	53 37 N	170	061		66	B	FM	15	1	N,I	NO	15	15	15			
CROMER	01 18 E	52 56 N	170	066		66	B	FM "EA"	15	1	N,I	NO, N	15	15	15			
LOWESTOFT	01 45 E	52 28 N	170	068		66	B	FHM	15	1	N,I	NO, S	15	15	15			G
FELIXSTOWE	01 19 E	51 56 N	170	071		66	B	FHM "EA"	15	1	N,I	NO	15	15	15			
HARWICH	01 17 E	51 57 N	170	073		66	B	FM	15	1	N		15	15	15			
SHEERNESS	00 45 E	51 27 N	170	101		66	B	FM	15	1	N,I	SO	15	15	15			G
DOVER	01 19 E	51 07 N	170	111		66	B	FM	15	1	N,I	NO	15	15	15			G
NEWHAVEN	00 04 E	50 47 N	170	119		66	B	FHM "EA"	15	1	N,I	NO, S	15	15	15			
PORTSMOUTH	01 07 W	50 48 N	170	131		66	B	FM "EA"	15	1	N		15	15	15			G

BOURNEMOUTH	01 52 W	50 43 N	170	146		66	B	FM	15	1	N,I	NO, S	15	15	15			
WEYMOUTH	2 27 W	50 37 N	170	150		66	B	FM	15	1	N		15	15	15			
DEVONPORT	04 11 W	50 22 N	170	157		66	B	FM	15	1	N,I	NO, S	15	15	15			
NEWLYN	05 33 W	50 06 N	170	161	241	66	B	FM “EA”	15	1	N,I	NO, S,G	15	15	15			G
ST. MARYS	06 19 W	49 55 N	170	163		66	B	FHM	15	1	N		15	15	15			
ILFRACOMBE	04 07 W	51 13 N	170	166		66	B	FM	15	1	N,I	NO, S	15	15	15			
HINKLEY POINT	03 08 W	51 13 N	170	168		66	P	FM “EA”	15	1	N,I	NO	15	15	15			
AVONMOUTH	02 43 W	51 30 N	170	171		66	P	FM	15	1	N		15	15	15			
NEWPORT	02 59 W	51 33 N	170	173		66	B	FM “EA”	15	1	N		15	15	15			
MUMBLES	03 59 W	51 34 N	170	179		66	B	FM “EA”	15	1	N		15	15	15			
MILFORD HAVEN	05 03 W	51 42 N	170	182		66	B	FM “EA”	15	1	N,I	NO	15	15	15			
FISHGUARD	04 57 W	51 55 N	170	184		66	B	FM “EA”	15	1	N,I	NO, S	15	15	15			
BARMOUTH	04 03 W	52 43 N	170	187		66	B	FM	15	1	N,I	NO	15	15	15			
HOLYHEAD	04 37 W	53 19 N	170	191		66	B	FM	15	1	N,I	NO, S	15	15	15			
LLANDUDNO	03 46 W	53 19 N	170	196		66	B	FM “EA”	15	1	N		15	15	15			
LIVERPOOL	03 01 W	53 27 N	170	214		66	B	FM	15	1	N,I	NO	15	15	15			G
HEYSHAM	02 55 W	54 02 N	170	225		66	B	FM “EA”	15	1	N,I	NO	15	15	15			
WORKINGTON	03 34 W	54 39 N	170	228		66	B	FM “EA”	15	1	N,I	NO, S	15	15	15			
PORT ERIN	04 46 W	54 05 N	170	233		66	B	FM	15	1	N		15	15	15			
PORTPATRICK	05 07 W	54 51 N	170	236		66	B	FM	15	1	N		15	15	15			
MILLPORT	04 56 W	55 45 N	170	241		66	B	FM	15	1	N		15	15	15			

ISLAY (PORT ELLEN)	6 12 W	55 38 N	170	244		66	B	FM	15	1	N		15	15				
TOBERMORY	06 04 W	56 37 N	170	246		66	B	FM	15	1	N		15	15	15			
ULLAPOOL	05 09 W	57 54 N	170	249		66	B	FM	15	1	N		15	15	15			
STORNOWAY	06 23 W	58 12 N	170	251	238	66	B	FHM	15	1	N,I	NO, S,G	15	15	15			G
KINLOCHBERVIE	05 03 W	58 27 N	170	255		66	B	FM	15	1	N		15	15	15			
PORTRUSH	06 40 W	55 12 N	170	261		66	B	FM	15	1	N		15	15	15			
BANGOR	05 40 W	54 40 N	170	281		66	B	FM	15	1	N							
POL HIGH RATE TSUNAMI SENSORS																		
LERWICK	01 08 W	60 09 N				66	P	T	10 sec	2	NI							
NEWLYN	05 33 W	50 06 N				66	P	T	10 sec	2	NI							
HOLYHEAD	04 37 W	53 19 N				66	B	T	10 sec	2	NI							

CHANNEL ISLANDS (POL)																		
ST HELIER (JERSEY)	02 07 W	49 11 N	180	002		66	B	FHM	15	1	N,I	NO, S	15	15				

GIBRALTAR																		
GIBRALTAR (POL)	05 21 W	36 08 N	215	001	248	10	R Ott Kalesto	HM	15	1	N,I	S,N,G	15	60	60			
GIBRALTAR (HYD OFFICE)	05 21 W	36 08 N	215	001	248		F											

Purpose "EA" indicates that the gauge was installed for the UK Environment Agency.

Many other gauges which are known to exist in ports (e.g. Port of London Authority, Mersey Docks, Guernsey harbour) have not been included above.

Information provided by David Smith (POL).

United Kingdom – Isle of Man Network (IoM Met Office)

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
ISLE OF MAN NETWORK (IoM MET OFFICE)																		
DOUGLAS	04 28 W	54 09 N					P	FH	1	1	N		1	10		Fib re	N	M
RAMSEY	04 22 W	54 19 N					P	FH	1	1	N		1	10		GSM	N	M
PEEL	04 42 W	54 14 N					P	FH	1	1	N		1	10		MPL S	N	
PORT ERIN (POL UK network gauge but data collected from separate transducers for IoM Met Office use)	04 46 W	54 05 N					B	FH	1	1	N		1	10		Fib re	N	M
PORT ST MARY	04 44 W	54 04 N					P	FH	1	1	N		1	10		Fib re	N	M
CASTLETOWN	04 39 W	54 04 N					P	FH	1	1	N		1	10		Fib re	N	M

The network of gauges established in recent years has been a collaboration between the Harbours Division and IoM Met Office, both sections of the IoM Department of Transport. As for data, we are currently building an SQL data base and hope to make near-real-time data available on our government website (www.gov.im) soon. I've included the POL gauge at Port Erin as a separate entry because we collect data from separate sensors on the pressure system at 1-minute intervals via our Department's own fibre network and use the data slightly differently (mainly for 'F&H' whereas POL use 15-minute averages via PSTN for 'F&M').
Information provided by Alan Hiscott (IoM Met Office).

United Kingdom – Channel Coastal Observatory

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
Channel Coastal Observatory																		
Herne Bay	01 06.93 E	51 22.92 N					X	F	10	1	N	web	10	10	2	B	N	M
Deal	01 24.56 E	51 13.43 N					Y	F	1	1	N	Web	10	10	2	B	N	M
Sandown, Isle of Wight	01 09.19 W	50 39.07 N					Y	F	1	1	N	Web	10	10	2	B	N	M
Lymington	01 30.43 W	50 44.42 N					X	F	10	2	N	Web	10	10	2	B	N	M
Swanage	01 56.95 W	50 36.56 N					Y	F	1	1	N	Web	10	10	2	B	N	M
West Bay	02 45.85 W	50 42.53 N					Y	F	1	1	N	Web	10	10	2	B	N	M
Teignmouth	03 29.53 W	50 32.63 N					Y	F	1	2	N	Web	10	10	2	B	N	M

Type X = Other, Stepgauge, Etrometa
Type Y = R (FMCW, Rosemount, WaveRadar Rex)
IPR – see www.channelcoast.org
Met B = Broadband

Just to confirm I have the various FRQ, FRS and FRT columns correct, the WaveRadars sample for 1 minute at 4Hz, with the average given as the tidal elevation at the start of the 1 minute burst. Measurements are made every 10 minutes. The Stepgauges burst is at 2.56Hz for 10 minutes, every 10 minutes. The time stamp for the 10 minute average is at the centre of the burst (with recorded tidal measurements on the hour and at 10 minute intervals). The gauges have been surveyed with a GPS control survey with 8 hour occupation.

I've put our website in the IPR column, but perhaps that should be for your designated websites only.

There are plans for the Regional Coastal Monitoring programmes to extend around England.

Information provided by Travis Mason (National Oceanography Centre Southampton).

Ireland – Marine Institute

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD

IRELAND NATIONAL NETWORK (MARINE INSTITUTE)																		
MALIN HEAD	07 20 W	55 22 N	175	011	239	34 MI	B	FM	1	130 320 08	N	N	6	60	15	GSM		T,P G
GALWAY	09 02 W	53 16 N	175	031		MI	B	FM	1	160 320 07	N		6	60	15	GSM		T
CASTLETOWNBERE (REPLACED CASTLETOWNSEND)	09 10 W	51 32 N	175	051	240	MI	B	FM	1	151 220 06	N,I	NO, S,N	6	60	15	GSM		M,T G
DUBLIN	06 13 W	53 21 N	175	071		MI	B	FM	1	130 220 07	N	N	6	15	15	GSM		T,P
BALLYGLASS	-9.89	54.25				MI	B	FM	1	300 420 08	N		6	60	15	GSM		T,P
DUNDALK	-6.39	54.01				MI	B	FM	1	040 420 08	N		6	60	15	GSM		T,P
HOWTH HARBOUR	-6.07	53.39				MI	B	FM	1	251 020 06	N,I	NO	6	60	15	GSM		T,P
INISHMORE	-9.67	53.12				MI	B	FM	1	160 420	N		6	60	15	GSM		T,P

										07								
KILLYBEGS PORT	-8.39	54.64				MI	B	FM	1	280 320 07	N		6	60	15	GSM		T,P
KISH BANK LIGHTHOUSE 1	-5.92	53.31				MI	B	FM	1	280 720 06	N		6	60	15	GSM		T,P
RIVER DODDER	-6.23	53.33				MI	B	FM	1	201 020 06	N		6	15	15	GSM		T,P
RIVER LIFFEY	-6.28	53.35				MI	R	FM	0.3	191 020 06	N		6	15	15	GSM		T,P
SKERRIES HARBOUR	-6.11	53.59				MI	B	FM	1	261 020 06	N,I	NO	6	60	15	GSM		T,P
SLIGO	-8.57	54.31				MI	B	FM	1	300 720 08	N		6	60	15	GSM		T,P
WEXFORD	-6.46	52.34				MI	B	FM	1	130 420 07	N		6	60	15	GSM		T,P
ARONMORE ISLAND	-8.49	54.98				MI	B	FM	1	230 520 08	N		6	60	15	GSM		T,P

Notes:

IPR: as far as we are concerned, all real-time data are open access to all.

MET: GSM transmissions use text messages.

WMF: The Marine Institute does not have any delayed mode data available as we are still setting up the system and are working on this.

AD: T means water temperature, P means atmospheric pressure.

To check - I monitor every 6 minutes and upload every 60, or in some cases every 15 minutes (the 15 minute stations feed immediately into a Dublin area municipal storm surge prediction system). I will probably migrate the others to 15 minute if my base station can take it.

A station in Cork - Ballycotton, will be installed early 2009. I am installing high precision temperature sensors at Malin Head (Next week) and Ballycotton (new year 2009) to permanently measure sea temperature to 4 dp.

Information provided by Guy Westbrook (Marine Institute).

France – SHOM

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
FRANCE (SHOM)																		
DUNKERQUE	02 22 E	51 03 N	190	001		18	R Pulse Krohne/Optiflex	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	N E P	M
CALAIS	01 52 E	50 58 N	190	011		18	R Pulse Krohne/BM100	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	N E P	M
BOULOGNE	01 35 E	50 44 N	190	021		18	R FMCW Krohne/BM70A	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	N E P	M
LE HAVRE	00 06 E	49 26 N	190	051		18	R FMCW Krohne/BM70A	H,F,TI, BS	1/60	2	NI	NO	1/4	1	5	Phone (PTSN) +ADSL/IP (RT) +FTP	N E P	M
CHERBOURG	01 37 W	49 39 N	190	061		18	R Pulse Krohne/Optiflex	H,F,TI, BS	1/60	2	NI	NO	1/4	1	5	Phone (PTSN) +ADSL/IP (RT) +FTP	N E P	M
ST. MALO	02 02 W	48 38 N	190	071		18	R FMCW Krohne/BM70A	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	N E P	M
ROSCOFF	03 58 W	48 43 N	190	086		18	R Pulse Krohne/BM100	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	N E P	M
LE CONQUET	04 47	48 22	190	089		18	R FMCW	H,F,TI, BS	1/60	1	NI	S,NO, ENSURF,	1/4	1	5	Phone (PTSN)	N E	M

	W	N					Krohne/BM70A					N (*)				+ADSL/IP (RT) +FTP	P	
BREST	04 30 W	48 23 N	190	091	242	18	R Pulse Krohne/BM100 A MORS/IEE	H,F,TI, BS	1/60	1	NI	NO, ENSURF	1/4	1	5	Phone (PTSN) +ADSL/IP (RT) +FTP	NEGP	MG
CONCARNEAU	3 54 W	47 42 N	190	096		18	R Pulse Krohne/Optiflex	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	NEP	M
PORT TUDY	03 27 W	47 39 N	190	103		18	F	H,F,TI, BS		1				60			P	
LE CROUESTY	2 53 W	47 32 N	190	105		18	R FMCW Krohne/BM70A	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	NEP	
ST. NAZAIRE	02 12 W	47 16 N	190	111		18	R Pulse Krohne/Optiflex	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	NP	M
LES SABLES D OLONNE	01 48 W	46 30 N	190	116		18	R Pulse Krohne/Optiflex	H,F,TI, BS	1/60	2			2	10	10080	Phone (PTSN) +FTP	NEP	M
LA ROCHELLE – LA PALLICE	01 13 W	46 09 N	190	121		18	R Pulse Krohne/Optiflex	H,F,TI, BS	1/60	2			2	10	10080	Phone (PTSN) +FTP	NEP	MG
PORT BLOC	1 04 W	45 34 N	190	126		18	R FMCW Krohne/BM70A	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	NEP	
BOUCAU-BAYONNE	01 31 W	43 31 N	190	139		18	A ENDRESS&HAUSER	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	NEP	
ARCACHON-EYRAC	1 40 W	43 23 N	190	140		18	R FMCW Krohne/BM70	H,F,TI, BS	1/60	2			2	10	10080	Phone (PTSN) +FTP	NEP	M

SOCOA/ST JEAN DE LUZ	01 41 W	43 24 N	190	141		18	R FMCW Krohne/BM70A	H,F,TI, BS	1/60	1			2	10	10080	Phone (PTSN) +FTP	N E P	M G
FRANCE MEDITERRANEAN (SHOM)																		
PORT VENDRES	03 06 E	42 31 N	230	006		18	R FMCW Krohne/BM70	F,M	1/60	2			2	10	10080	Phone (PTSN) +FTP	N E P	M
SETE	03 42 E	43 24 N	230	021		18	R Pulse Krohne/Optiflex	F,M,AC	1/60	2			2	10	10080	Phone (PTSN) +FTP	N E P	G
MARSEILLE (IGN)	05 21 E	43 18 N	230	051	205	18	F A MORS/Radarson	G,M	1/60	1			2	10	10080	Phone (PTSN) +FTP	N E G P	G
TOULON	05 55 E	43 07 N	230	061		18	R FMCW Krohne/BM70	F,M	1/60	2			2	10	10080	Phone (PTSN) +FTP	N E P	M
NICE	07 16 E	43 42 N	230	081		18	R FMCW Krohne/BM70	F,M	1/60	2	NI	ENSURF, N (*)	1/4	1	5	Phone (PTSN) +ADSL/IP (RT) +FTP	N E P	M
AJACCIO	8 46 E	41 55 N	232	001		18	A MORS/BEN	F,M,AC	1/60	1	I	N	2	10	10080	Phone (PTSN) +FTP	N E P	G
MONACO (Operated by SHOM for Monaco State)	07 25 E	43 44 N	233	011 012		18	A MORS/IEE	F,M	1/60	1	I	N	2	10	10080	Phone (PTSN) +FTP	N E P	

Additional information:

Main installations planned in 2009 (radar + real time) are Port Tudy, Marseille, Monaco and Dieppe.

WI is interpreted not for the installation of the station but of the last operational gauge type

(*) = Not yet available on www.vliz.be web site

MET: FTP are not anonymous, login and password are requested, either for real time or delayed mode:
- for delayed mode data (ftp.sonel.org): login and password are delivered online (www.sonel.org) and the data policy must be agreed (free access for research and education) ;
- for real time data (ftp.shom.fr): login and password are delivered by SHOM. These data were developed for operational uses (tsunami warning centres, operational surge forecast, ..). They have been made available for projects in which SHOM is involved or at least clearly acknowledged (NOOS, ENSURF, IBI ROOS..).

PTSN = Public Telephone Switched Network (modem)

France started a realtime network in June 2008 : 1 minutes sampling of 15 seconds means collected through ADSL are put on a ftp at SHOM (Brest, Le Conquet, Cherbourg, Le Havre) and will be extended in 2009 in the Mediterranean Sea to Monaco, Toulon and Nice tide gauges.

N: Realtime data have been made available to www.previmer.org, www.sonel.org and www.noos.cc.

Information provided by Guy Wöppelmann (University of La Rochelle) and Ronan Créach (SHOM).

France (Corsica) – Observatoire Côte d’Azur

Station Name H	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
CORSICA																		
HSENETOSA M3	08 48 E	41 32 N				OCA/CNES	P	A	10									M G
HSENETOSA M4	08 47 E	41 33 N				OCA/CNES	P	A	10									M G
HSENETOSA M5	08 47 E	41 33 N				OCA/CNES	P	A	10									M G
HSENETOSA M6	08 48 E	41 32 N				OCA/CNES	P	A	30									M G
HMACINAGGIO L1	09 27 E	42 57 N				OCA/CNES	P	A	15									
HCAPRAIA **TO BE INTALLED AGAIN IN 2009**	09 50 E	43 03 N				OCA/CNES/ENEA	P (R)	A	10									

H

H

PUR: A = Altimeter calibration
More information about our tide gauges:
- Corsica: Senetosa Cape (calibration site) and Macinaggio
    The tide gauges are operated by CNES and Observatoire de la Côte d'Azur with support of NOVELTIS
    Data are taken from the tide gauges every 3-4 months
    Data are not available from a web site but are available for all and we can upload them to any data base if needed
- Capraia:
    There were lots of failures and damages for the previous pressure gauge so it was decided to change it for a radar gauge with a NRT transmission. It is planned to be realized in 2009.
    The tide gauges will be operated by CNES, Observatoire de la Côte d'Azur and ENEA (Italy) with support of NOVELTIS
Information provided by Pascal Bonnefond (Observatoire Côte d'Azur).

Spain – Puertos del Estado

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
SPAIN (PUERTOS DEL ESTADO)																		
BILBAO(1992-2007)	03 02 W	43 20 N	200	006		J3	A	FGHM	5	1	I	SI	5		60	Internet	NEP	
BILBAO (2007-)	03 03 W	43 21 N				J3	R(FMCW)	FGHMT	2HZ	2	I	SI	1		1	Internet	NEP	ww
SANTANDER(1992-2008)	03 47 W	43 28 N	200	013		J3	A	FGHM	5	1	I	I			60	Internet	NEP	
SANTANDER (2008-)	03 47 W	43 28 N				J3	R(FMCW)	FGHMT	2HZ	2	I	I	5		1	Internet	NEP	ww
GIJON (1992-2008)	05 42 W	43 34 N	200	022		J3	A	FGHM	5	1	I	SI	5		60	Internet	NEP	
GIJON (2008-)	05 42 W	43 34 N				J3	R(FMCW)	FGHMT	2HZ	1	I	SI	1		1	Internet	NEP	Ww
FERROL I	08 20 W	43 28 N				J3	R(FMCW)	FGHMT	2HZ	1	I	N	1		1	Internet	NEP	Ww
FERROL II	08 15 W	43 29 N				J3	R(FMCW)	FGHMT	2HZ	1	I	S	1		1	Internet	NEP	Ww
LA CORUNA (1992-2008)	08 23 W	43 22 N	200	032	243	J3	A	FGHM	5	1	I	I	5		60	Internet	NEP	
LA CORUNA (2008-)	08 23 W	43 22 N					R(FMCW)	FGHMT	2HZ	2	I	I	5		60	Internet	NEP	Ww
VILLAGARCIA (1997-2008)	08 46 W	42 36 N	200	036		J3	A	FGHM	5	1	I	I	5		60	Internet	NEP	
VILLAGARCIA (2008-)	08 46 W	42 36 N					R(FMCW)	FGHMT	2HZ	2	I	I	1		1	Internet	NEP	Ww
VIGO	08 44 W	42 15 N	200	042		J3	A	FGHM	5	1	I	SI	5		60	Internet	NEP	

HUELVA (1992-2008)	06 50 W	37 08 N	220	005		J3	A	FGHM	5	1	I	SNI	5		60	Internet	NEP	Ww
HUELVA (2008-)	06 50 W	37 08 N					R(FMCW)	FGHMT	2HZ	2	I	NI	1		1	Internet	NEP	
BONANZA	06 20 W	36 48 N	220	008		J3	A	FGHM	5	1	I	SI	5		60	Internet	NEP	
MALAGA	04 25 W	36 43 N	220	032		J3	A	FGHM	5	1	I	MS	5		60	Internet	NEP	
MOTRIL (2004-2007)	03 32 W	36 43 N				J3	P	FGH	5	1	I	N	5		60	Internet	NEP	
MOTRIL (2007-)	03 31 W	36 43 N					R(FMCW)	FGHMT	2HZ	2	I	N	1		1	Internet	NEP	Ww
ALMERIA	02 30 W	36 50 N				J3	R(FMCW)	FGHMT	2HZ	1	I	N	1		1	Internet	NEP	Ww, G
GANDIA	00 09 W	39 00 N				J3	R(FMCW)	FGHMT	2HZ	2	N		1		1	Internet	N	Ww
VALENCIA(1992-2007)	00 20 W	39 28 N	220	056		J3	A	FGHM	5	1	I	M					NEP	
VALENCIA (2007-)	00 19 W	39 27 N				J3	R(FMCW)	FGHMT	2HZ	1	I	M	1		1	Internet	NP	Ww, G
SAGUNTO	00 12 W	39 38 N				J3	R(FMCW)	FGHMT	2HZ	2	N		1		1	Internet	N	Ww
BARCELONA(1992-2007)	02 10 E	41 21 N	220	061		J3	A	FGHM	5	1	I	M					NEP	
BARCELONA (2007-)	02 10 E	41 20 N				J3	R(FMCW)	FGHMT	2HZ	2	I	MN	1		1	Internet	NEP	Ww
IBIZA (Balearic Isl)	01 27 E	38 55 N				J3	P	FGHM	5	1	I	M	5		60	Internet	NEP	G
MELILLA (N. Africa)	02 56 W	35 17 N				J3	R(FMCW)	FGHMT	2HZ	2	I	N	1		1	Internet	N	Ww
CANARY ISLANDS (Puertos del Estado)																		
LAS PALMAS	15 24	28 09				J3	A	FGHM	5	1	I	SI	5		60		NEP	

(1992-2008)	W	N																
LAS PALMAS 2008-)	15 25 W	28 08 N				J3	R(FMCW)	FGHMT	2HZ	2	I	SI	1		1	Internet	NEP	Ww
TENERIFE	16 14 W	28 29 N				J3	A	FGHM	5	1	I	SI	5		60	Internet	NEP	
GRANADILLA	16 31 W	28 05 N				J3	P	FGH	5	1	I	I	5		60	Internet	NP	M
ARINAGA	15 24 W	27 51 N				J3	P	FGHM	5	1	I	I	5		60	Internet	NP	M
HIERRO	17 54 W	27 47 N				J3	P	FGH	5	1	I	I	5		60	Internet	NP	M
FUERTEVENTURA	13 51 W	28 30 N				J3	P	FGHM	5	1	I	I	5		60	Internet	NP	M
LA PALMA	17 46 W	28 41 N				J3	R(FMCW)	FGHMT	2HZ	2	I	IN	1		1	Internet	N	Ww
LA GOMERA	17 06 W	28 05 N				J3	R(FMCW)	FGHMT	2HZ	2	I	SIN	1		1	Internet	N	Ww
ARRECIFE	13 32 W	28 58 N				J3	R(FMCW)	FGHMT	2HZ	2	I	IN	1		1	Internet	N	Ww

I inserted more comments in the description of the table that it seemed more reasonable for me. I also added stations from IEO and IGN (I hope they can fill in the details).

I am not sure which "acronym" has now our delayed mode data and for which stations. As for the last 3 years we have increased the number and upgraded several ones. I also added IBIROOS (I) as one of the international programs, as I send I think all our Atlantic stations to them for a year now.

Note: FRQ for Begoña is the minimum recording priod of the sensor (2Hz in this case). We store these data in situ and receive them later.

Ww means wind wave parameters from the radar gauge.

Information provided by Begoña Perez (Puertos del Estado).

Spain - IEO

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
SPAIN (IEO)																		
Comments: 1) RT: The data is transmitted once a day. In fact there is not real time transmission. 2) MET: T= Telephone call, F: File Transfer protocol, W: Web server. The procedure is: The data are transmitted to the data Centre by Telephone call (T). Then are transmitted to the IEO and Medgloss through FTP and the NEAMTWS get the data directly trough the IEO web server.																		
SANTANDER	03 48 W	43 28 N	200	011		68	FR	M	5	1	*N		5	1440	1440	TF	NGP	G
LA CORUNA	08 24 W	43 22 N	200	030	243	68	F	M	5	1	*NI	GN	5	1440	1440	TFW	NGP	G
VIGO	08 44 W	42 14 N	200	041		68	F	M	5	1	*N		5	1440	1440	TF	NGP	G
CADIZ	06 17 W	36 32 N	220	003		68	F	M	5	1	*N		5	1440	1440	TF	P	
TARIFA	05 36 W	36 00 N	220	021		68	F	M	5	1	*N		5	1440	1440	TF	NGP	
ALGECIRAS	05 26 W	36 07 N	220	011		68	FR	M	5	1							NGP	
CEUTA	05 19 W	35 54 N	340	008	249	68	F	M	10	1	*NI	MGN	10	1440	1440	TFW	NGP	G
MALAGA	04 25 W	36 43 N	220	031		68	F	M	5	1							NGP	G
PALMA DE MALLORCA	02 38 E	39 33 N	225	011		68	F	M	1	1	*NI	M	1	1440	1440	TF	NGP	G
ARRECIFE	13 34 W	28 57 N	370	004		68	F	M	10	1							P	
SANTA CRUZ DE LA PALMA	17 45 W	28 41 N	370	015		68	F	M	5	1	*N		5	1440	1440	TF	P	
PUERTO DE LA LUZ(LAS PALMAS)	15 25 W	28 08 N	370	045		68	F	M	10	1	*NI	GN	10	1440	1440	TFW	NGP	G

Information from Maria Jesus Garcia (IEO).

Spain – Estartit Observatory

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
SPAIN (ESTARTIT OBSERVATORY)																		
L'ESTARTIT	03 12 E	42 03 N	220	081		*	F	M	2hr	1								M,G

AC = Ports de la Generalitat (responsible person Mr. Josep Pascual).

A new float gauge was installed May 2008 after the old one was removed in October 2006. No real time data are available.

Information provided by Juan Jose Benjamin Martin (Universitat Politechnica de Catalunya).

Portugal (including Madeira and Azores)

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	**AD**
CONTINENTAL PORTUGAL																		
VIANA	08 50 W	41 41 N	210	010 011		41	F	G,TI	6	1								
LEIXOES	08 42 W	41 11 N	210	012		41	F,R	G,TI	6	1,3								
AVEIRO	08 45 W	40 39 N	210	013		41	F	G,TI	6	1								
FIGUEIRA DA FOZ	08 51 W	40 09 N					F	G,TI	6	1								
NAZARE	09 04 W	39 35 N					P	G,TI	6	1								
PENICHE	09 21 W	39 21 N					P,R	G,TI	6,1	1,3								
CASCAIS	09 25 W	38 41 N	210	021	246	21	F,A	G,M	6	1	I	S,N					G,P	G
LISBON	09 08 W	38 42 N	210	023		41	F,R	G,TI	6,1	1,3								
SESIMBRA	09 07 W	38 26 N					R,P	G,TI	1	1								M
SETROIA	08 54 W	38 30 N	210	026		41	---	G,TI		1	***NOT OPERATIONAL***							
SINES	08 53 W	37 57 N	210	028		41	F,R,P	G,TI	6,1,1	1								M
LAGOS	08 40 W	37 06 N	210	031		21	A,F	G,M	6	1								G
FAROBARA	07 52 W	36 59 N	210	041		41	P	G,TI	6	1								

MADEIRA																		
FUNCHAL	16 54 W	32 38 N	365	001	250	41	F	G,M ,TI	6	1							G,P	
CANICAL	16 44 W	32 44 N				AM 41	A,P	G,T I	1	2								
AZORES																		
SANTA CRUZ DAS FLORES	31 07 W	39 27 N	360	041	244	41	F,P	G,M ,TI	60, 6	1,2							G,P	
LAJES DAS FLORES	31 10 W	39 22 N				41	F	G,M ,TI	6	1								
HORTA	28 38 W	38 32 N	360	031		DP	R	G,M ,TI	4	2								
ANGRA DO HEROISMO	27 14 W	38 39 N	360	011		DP	R	G,M ,TI	4	2								
PONTA DELGADA	25 40 W	37 44 N	360	001 002	245	41	R,P	G,M ,TI	1	2	I	S,N					G,P	G
VILA DO PORTO	25 09 W	36 57 N				41	R,P	G,T I	1	1								M

Santa Cruz das Flores has recently been replaced by Lajes das Flores. Funchal station is being transferred to Caniçal.
R = Krohne radar gauge with a Druck pressure gauge backup.
Most gauges can be accessed by GSM for data downloads (typically every 2 days) but only a small number so far can be described as real time.
Information extracted from the Portugal national report to GLOSS in 2007, see www.gloss-sealevel.org.

AM = Madeira's Harbour Administration (APRAM – Administração dos Portos da Região Autónoma da Madeira)
DP = University of Azores, Departament of Oceanography and Fisheries
R: Khrone radar gauge in Sesimbra, Sines and Vila do Porto; Vega radar gauge in Ponta Delgada, Horta and Angra do Heroísmo.
A: Vitel acoustic gauge in Cascais and Lagos; Sutron acoustic gauge in Caniçal.
FRT: Tipically every 2 days data is downloaded through GSM; for pressure gauges a technician has to download data directly in the tide station (this happens every 3 months, approximatly).

Information provided by Jose Onofre (Instituto Hidrografico).

Italy – National Network (ISPRA, formerly APAT)

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
ITALIAN NATIONAL NETWORK																		
TRIESTE (APAT)	13 46 E	45 39 N					A,F	F,G	1	1	I	G						
VENEZIA DIGA SUD LIDO	12 23 E	45 21 N					A,F	F,G	10p	1	N							
ANCONA	13 29 E	43 35 N	270	030		23	A,F	F,G	10p	1	N							
RAVENNA	12.197	44.416					A,F	F,G	10p	1	N							G
ORTONA	14 24 E	42 21 N	270	026		23	A,F	F,G	10p	1	N							
VIESTE	16.173	41.882					A,F	F,G	10p	1	N							
BARI	18.869	41.126					A,F	F,G	10p	1	N							
OTRANTO	18 30 E	40 08 N	270	011		23	A,F	F,G	10	1	I	G						
TARANTO	17 16 E	40 26 N	270	006		22	A,F	F,G	10p	1	N							
CROTONE	17.127	39.081					A,F	F,G	10p	1	N							
REGGIO CALABRIA	15 39 E	38 06 N	250	061		23	A,F	F,G	10p	1	N							
MESSINA	15 34 E	38 12 N	260	001		22	A,F	F,G	10p	1	N							
CATANIA	15 08 E	37 30 N	260	031		23	A,F	F,G	10p	1	N							
PORTO EMPEDOCLE	13.527	37.287					A,F	F,G	10	1	I	G						
PALERMO	13 20 E	38 08 N	260	011		22	A,F	F,G	10p	1	N							
PALINURO	15.288	40.036					A,F	F,G	10p	1	N							
SALERNO	14.766	40.678					A,F	F,G	10p	1	N							
NAPLES	14 15 E	40 50 N	250	041 051 052		C5	A,F	F,G	10	1	I	G						
CAGLIARI	09 10 E	39 12 N	240	011		22	A,F	F,G	10p	1	N							G

CARLOFORTE	8.306	39.146					A,F	F,G	10p	1	N							
PORTO TORRES	8.410	40.835					A,F	F,G	10p	1	N							
CIVITAVECCHIA	11 49 E	42 03 N	250	031		22	A,F	F,G	10p	1	N							
LIVORNO	10 18 E	43 32 N	250	021		22	A,F	F,G	10p	1	N							
GENOVA (APAT)	08 54 E	44 24 N					A,F	F,G	10p	1	N							
IMPERIA	7.829	43.942					A,F	F,G	10	1	N							
PESCARA	14.214	42.465					A,F	F,G	10p	1	N							
ISOLE TREMETI	15.492	42.115					A,F	F,G	10p	1	N							
LAMPEDUSA	12.610	35.501					A,F	F,G	10p	1	N							G
VENICE (SIMN)																		
VENEZIA (PUNTA DELLA SALUTE)	12 20 E	45 26 N	270	054		K2		F,G		1	N							G
And 52 other stations in the lagoon. In addition CSPM operates 14 gauges in the lagoon																		
REGIONAL ADMIN OF CALABRIA																		
CETRARO	15.942	39.518						F		1	N							
CORIGLIANO	16.538	39.654						F		1	N							
ROCCELLA IONICA	16.402	38.323						F		1	N							
REGIONAL ADMIN OF ABRUZZO																		
PESCARA	14.214	42.465								1	N							
UNIV. BOLOGNA																		
PORTO CORSINI	12 17 E	44 30 N	270	035		23		F,G		1	N							G

TYP = A,F for the National Network means an ‘electronic ultrasound instrument with tubular guide and temperature compensation, and a secondary floating mechanic gauge with paper recording’.

FRQ = 10p means ‘probably 10 minutes’

The gauges shown for regional authorities are almost certainly real-time for local flood warning purposes. However, we do not have detailed information.

Information extracted primarily from Italian national report to the GLOSS Experts-10 Meeting in 2007, available at www.gloss-sealevel.org.

Italy - Trieste (CNR-ISMAR-TS)

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
TRIESTE (CNR-ISMAR-TS)																		
TRIESTE	13 46 E	45 39 N	270	061		23	F	FHM	1	2001	N,I	G		60		Radio	P	MG

Some notes:

FRQ=1 and WI=2001 refer to the electronic digital instument; there are also two mechanical instruments installed in the early 1960s and still working.

RT=Y refers to the fact that the near-real-time data can be found on the website of the regional civil protection, which takes care of the data transmission. This affects also LT, which I do not know exactly.

With FRS=<nothing> and FRT=60 I mean that instantaneous (non-resampled) data are transmitted every 60 minutes.

AD=MG: meteorological data are measured not at the tide gauge but about 500 m away; the distance has no effect on atmospheric pressure. A continuous GPS exists, operated by University of Bologna (S. Zerbini).

MET=radio. The real-time data are sent to the civil protection via radio (wireless).

Information provided by Fabio Raicich (Consiglio Nazionale delle Ricerche, Istituto de Scienze Marine, Trieste (CNR-ISMAR-TS)).

Italy – Italian Navy

Italy - Navy	***FI***	***LA***	***CCO***	***SC***	***GLO***	***AC***	***TYP***	***PUR***	***FRQ***	***WI***	***RT***	***IPR***	***FRS***	***FRT***	***LT***	***MET***	***DMF***	*AD*
GENOVA	08 54 E	44 24 N	250	011R	-	22	F	GM	1	1							P	MG
BRINDISI	17 56 E	40 38 N	270	014	-	22	F	GM	5	1							P	M

Information from Maurizio Demarte (Istituto Idrografico della Marina).

Malta

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
MALTA																		
VALLETTA	14 31 E	35 54 N	265	001		J1	F										P	
MELLIEHA BAY	14 21 E	35 59 N	265	002		K5	P										P	
PORTOMASO	14.494	35.921					P				N,I	M					M	

The Valletta gauge is the long established float gauge installation in the Grand Harbour operated by the Malta Martime Authority. So far as we know data are not real time.

The Mellieha Bay gauge is an Endeco Type 1029/1150 differential pressure tide gauge operated by the Physical Oceanography unit of the University of Malta – see http://www.capemalta.net/pounit/meteomarine.html. Data are not real time.

The Portomaso installation is one of several gauges installed as part of the MedGLOSS programme. It is a pressure gauge (Proscientific) and near real time data can be found at http://www.capemalta.net/pounit/levmalta.html

Information was extracted from http://www.capemalta.net/pounit/.

Slovenia

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
SLOVENIA																		
KOPER	13 43 E	45 33 N	279	003		J9	F,R	F,G,H,M ,(T)		1	N		10	30	15	ftp	N,E,P	M,G,

Tide gauge Koper is currently the only tide gauge in Slovenia. When we upgraded the Tide gauge Koper through the ESEAS RI project, the tide gauge Luka Koper, the location of which was nearby the t.g Koper, was cancelled.

Meteorological data are available at the tide gauge and also at the nearby Slovenian oceanographic buoy called VIDA (the owner is the National Institut of Biology/ Marine Biology Station Piran).

The GPS is located at tide gauge. We use one radar (Krohne) within the stilling inside the tide gauge building and another one outside the building. The tide gauge has operated at the same location from 1958. The times of sampling etc can be adapted to different applications.

Information provided by Igor Strojan (Environmental Agency of the Republic of Slovenia, EARS).

Croatia

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
CROATIA																		
DUBROVNIK	18 04 E	42 40 N	280	081		26	F	G,M,TI,BS	1	1		N	1	360	360	DAILY	E,P	
PLOČE	43 03 E	17 25 N	280			26	F	H,BS	1	1			1	360	360	DAILY		
SPLIT HARBOUR	16 26 E	43 30 N	280	031		26	F	G,M,TI,BS	1	1			1	360	360	DAILY	E,P	G
SPLIT MARJAN	16 23 E	43 30 N	280	021		28	F	G,M,TI,BS	1	1			1	60	60		P	
SPLIT MedGLOSS	16 26 E	43 30 N	280				P	F,H,M	0.5	1	I	M	60	360	360		M	M
ZADAR	15 14 E	44 07 N	280	013		26	F	G,M,TI,BS	1	1			1	360	360	DAILY	E,P	
BAKAR I	14 32 E	45 18 N	280	011		27	F	G,M,TI	1	1			1				E,P	
BAKAR II	14 32 E	45 18 N	280			27	R	F,M	1	1			1					
ROVINJ	13 38 E	45 05 N	280	006		26	F	G,M,TI,BS	1	1			1	360	360	DAILY	E,P	

Information provided by Srdjan Cupic (Hydrographic Institute of the Republic of Croatia) and Ivica Vilibic (Institute of Oceanography and Fisheries, Split).

Montenegro

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
MONTENEGRO																		
BAR	19 05 E	42 05 N	281	011		64	F	M	6	1								

Bar is the only gauge operational in Montenegro at the moment and does not provide real time information.

Authority code 64 = Hidrometeoroloski Zavod Crne Gore

Information provided by Aleksandar Jovicic (Hydro-Meteorological Service of Montenegro).

Albania

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*

ALBANIA																		
VALONA	19 23 E	40 30 N					A	M	10	1								

The Valona gauge was installed by ISPRA (formerly APAT), Italy in the frame of the ADRICOSM EXT project one or two years ago under a UNESCO contract. The gauge is managed by an Albanian Institute and the data are transmitted to Italy in quasi RT by cell phone if and when it works or every few months with a CD or by mail.

Information from Giovanni Arena, Head of Monitoring Networks (ISPRA, Higher Institute for Environmental Research).

Greece – Hellenic Navy

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
GREECE (HELLENIC NAVY)																		
PREVEZA	20 46 E	38 57 N	290	001		65	F	G,M	PCH*	1							E,P	
LEVKAS(LEYKADA)	20 42 E	38 50 N	290	004		65	F	G,M	15 MIN	1							E,P	G,SST**
POSIDHONIA	22 57 E	37 57 N	290	011		65	F	G,M	PCH	1							E,P	
PATRAI	21 44 E	38 14 N	290	014		65	F	G,M	PCH	1							E,P	
KATAKOLON	21 19 E	37 38 N	290	017		65	F	G,M	15 MIN	1							E,P	SST
KALAMAI	22 08 E	37 01 N	290	021		65	F	G,M	15 MIN	1(PCH) 2(DIGITAL)							E,P	SST
NORTH SALAMINOS	23 32 E	37 59 N	290	029		65	F	G,M	PCH	1							E,P	
PIRAIEVS	23 37 E	37 56 N	290	031		65	F	G,M	10 MIN	1							E,P	SST
KHALKIS SOUTH	23 36 E	38 28 N	290	033		65	F	G,M	PCH	1							E,P	
KHALKIS NORTH	23 36 E	38 28 N	290	034		65	F	G,M	PCH	1							E,P	
SKOPELOS	23 44 E	39 07 N	290	037		65	F	G,M	PCH	1							E,P	
THESSALONIKI	23 02 E	40 37 N	290	051		65	F	G,M	PCH	1							E,P	
KAVALLA	24 25 E	40 55 N	290	061		65	F	G,M	PCH	1							E,P	
ALEXANDROUPOLIS	25 53 E	40 51 N	290	065		65	F	G,M	15 MIN	1							E,P	SST
KHIOS	26 09 E	38 23 N	290	071		65	F	G,M	15 MIN	1							E,P	SST
SIROS	24 55 E	37 26 N	290	081		65	F	G,M	12 MIN	1							E,P	SST
LEROS	26 53 E	37 05 N	290	091		65	F	G,M	PCH	1							E,P	
SOUDHAS (SOYDA)	24 03 E	35 30 N	290	097		65	F	G,M	PCH	1							E,P	G
IRAKLION	25 08 E	35 20 N	290	101		65	F	G,M	PCH	1							E,P	
CORFU CITY (KERKIRA)	19 54 E	39 37 N	290	103		65	F	G,M	PCH	1							E,P	
SAMOS ISLAND	26 57 E	37 46 N	290	105		65	F	G,M	15 MIN	1							E,P	SST

RODHOS	28 14 E	36 26 N	290	110		65	F	G,M	PCH	1							E,P	

*PCH=PAPER CHART (ANALOGUE GAUGE) **SST=SEA SURFACE TEMPERATURE
Information from Theo Kadaras (Hellenic Navy Hydrographic Office).

Greece – "Gavdos" Network

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
GAVDOS (JCET/TUC)	24 07 E	34 51 N	290	-?-		JCET/TUC	A	GMT Cal/Val	1	1	NI	MN*	6	6	6	Internet	NM*	MG
KASTELI (JCET/NTUA)	23 38 E	35 31 N	290	-?-		JCET/NTUA	R	GMT Cal/Val	1	3	NI	MN*	1	1	1	Internet & METEOSAT	NM*	MG

I am attaching to this page further explanations for the two current sites on Crete. This is so that I can explain some of the entries and give you enough information to decide what is the most correct entry in each case, which may not be what I have decided myself.

The GAVDOS site is now operational and TUC (Tech. Univ. of Crete) has a web address which you can link to and capture the measurements as they are made in real time. This is not open to everyone yet but will be shortly when instrumentation is moved to a new tide gauge hut in collaboration with the Hellenic Navy Hydrographic Service (HNHS) and National Technical University of Athens (NTUA). The KASTELI site should have been operational a year ago but there have been many technical difficulties which are hopefully now resolved. So in my entries, I have entered answers that are "almost" true, and I put an asterisk next to them to indicate that "very soon" they will be as stated.

The GAVDOS AQUATRAK for example had a METEOSAT link and antenna since the first installation back in 2003. However, there were many problems. We shall perhaps now duplicate the OTT setup at Kasteli. I will keep you informed on the developments, as well as on the new sites that we are installing with float TGs in collaboration with NTUA. Our first one was installed last week at KARAVOSTASI in south Peloponnisos. There are 6 new sites planned, one of them co-located with KASTELI as back-up tide gauge, all with mobile phone dial-up connections. In addition, there are buoys that the Hellenic Center for Marine Research has deployed as part of the Poseidon III program which will complement the tide gauges.

Information provided by Erricos Pavlis (Goddard Space Flight Center).

Bulgaria

No recent information has been provided other than at present the National Institute for Meteorology and Hydrology, part of the Bulgarian National Meteorological Service, is responsible for sea level observations. THE FOLLOWING ARE HISTORICAL PSMSL ENTRIES FOR BULGARIA.

BOURGAS	27 29 E	42 29 N	295	021		J6												
NESEBAR	27 46 E	42 38 N	295	031		B9												
VARNA	27 55 E	43 11 N	295	051		J6												

Romania

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
CONSTANTZA	*28 40 E*	*44 10 N*	*297*	*021*		*K1*	*F*	*M*	*wee kly cha rt*	*1*	N	N	N	N	N	N	N	N

The above refers to an older float gauge which will probably not be real time. Constantza is known to have at least a new pressure gauge installed as part of the MedGLOSS programmme, as follows.

CONSTANTZA	28 40 E	44 10 N			Med GLO SS		P	M	6s*	1	I	M		60	7	**	M	M, GPS

FRQ: * 6 sec. but transmits hourly averaged values
MET: ** MedGLOSS method (tlephone dialup)
AD: M (air pressure) and GPS which will be installed shortly
In addition, we understand that the Romanian Navy has installed 3 new Aandera pressure gauges but at unknown locations.
Information provided by Viorel Malciu.

Ukraine

NO RECENT INFORMATION – THE FOLLOWING IS AN HISTORICAL PSMSL ENTRY

SEVASTOPOL	33 32 E	44 37 N	298	041		J7												

Ukraine also has a Paroscientific pressure gauge provided by the MedGLOSS programme as follows. The real time status is unclear:

KACIVELI	33.98	44.39					P	M			I	M						

Russia – Black Sea

NO RECENT INFORMATION – THE FOLLOWING ARE HISTORICAL PSMSL ENTRIES

TUAPSE	39 04 E	44 06 N	300	001	98	02												G

Georgia

NO RECENT INFORMATION – THE FOLLOWING ARE HISTORICAL PSMSL ENTRIES

SOKHUMI	41 01 E	42 59 N	305	011		G2												
POTI	41 41 E	42 10 N	305	021		G2												
BATUMI	41 42 E	41 38 N	305	031		G2												

Turkey – General Command of Mapping

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
TURKEY (Turkish Sea Level Monitoring System -TUDES)																		
TRABZON	39 44 E	41 00 N	310	011 013	-	87	A	G,M	0.5	1	-	-	15	Two times in a week	-	-	-	M
IGNEADA	28 01 E	41 53 N	310	018	-	87	A	G,M	0.5	1	-	-	15	15	-	-	-	M
AMASRA	32 14 E	41 26 N	310	026	-	87	A	G,M	0.5	1	-	-	15	Two times in a week	-	-	-	M
MARMARA EREGLISI	27 58 E	40 58 N	310	037	-	87	A	G,M	0.5	1	-	-	15	15	-	-	-	M
ERDEK	27 51 E	40 23 N	310	038	-	87	A	G,M	0.5	1	-	-	15	15	-	-	-	M,G
MENTES/IZMIR	26 43 E	38 26 N	310	042	-	87	A	G,M		1	-	-	15	Two times in a week	-	-	-	M,G
BODRUM	27 25 E	37 02 N	310	045 046	-	87	A	G,M	0.5	1	-	-	15	Two times in a week	-	-	-	M
ANTALYA	30 37 E	36 50 N	310	051 052	-	87	A	G,M	0.5	1	-	-	15	Two times in a week	-	-	E	M,G
ERDEMLI	34 15 E	36 34 N	310	071	-	87	A	G,M	0.5	1	-	-	15	15	-	-	-	M,G
SINOP	35 09 E	42 01 N	310		-	87	A	G,M	0.5	1	-	-	15	Two times in a week	-	-	-	M
ISKENDERUN	36 10 E	36 35 N	310		-	87	A	G,M	0.5	1	-	-	15	Two times in a week	-	-	-	M,G

We are planning to provide information about the Turkish tide gauges via the web site of GCM in the near future. See also the Turkey GLOSS National Report to the GLOSS Group of Experts in 2007 (see www.gloss-sealevel.org). The information in that is up to date, although we have an ongoing project which aims to establish new tide gauges which we mention in the report. I will inform you about the new tide gauges when this project finish.

Information provided by Hasan Yildiz (General Command of Mapping).

Cyprus

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
CYPRUS																		
PAPHOS	32 24 E	34 45 N				*	P	M	.5m	1	I	M	.5m	60m	60m		M,E	M
LIMASSOL	33 01 E	34 38 N				*	P	M,T		3	I	M					M,E	
LARNACA	33 38 E	34 55 N				*	P	M,T		3	I	M					M,E	

*Oceanography Center University of Cyprus

The table includes information regarding the Paphos Station that is currently under repair and will be upgraded to suit the NEAMTWS purposes, and information about the 2 planned sides (Limassol and Larnaca) for which the equipment (pressure gauge) is underway.

Information for stations operated by the Oceanography Center, University of Cyprus provided by George Zodiatis (University of Cyprus).

In addition, two tide gauges shown below are operational in the northern (presently Turkish) part of Cyprus, operated by the "Turkish Republic of Northern Cyprus Mapping Department". Information provided by Cemal Saadetoglu.

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
GIRNE	*33 20 E*	*35 20 N*	*312*	*010*	*-*	*K9*	*A*	*G,M*	*0.5*	*1*	*-*	*-*	*15*	*15*	*-*	*-*	*P*	*M*
GAZIMAGUSA	33 57 E	35 07 N	312	-	-	K9	A	G,M	0.5	2	-	-	15	15	-	-	-	M

In addition, we understand that a MedGLOSS pressure gauge is planned for installation in Cyprus in 2009.

Lebanon

We understand that two gauges are in the process of installation in Lebanon by the National Scientific Research Council but have no further detailed information.

Israel – IOLR and SOI

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
ISRAEL (IOLR)																		
HADERA	34 52 E	32 28 N	320	016	80	H1	P	F,G M,T	0.2 0.5	1	I,N	M,N	1; 60	1: 60	1: 60	GPRS	M,P	M,G
ASHDOD	34 38 E	31 50 N	320	031		H1	P	F,G M	0.5	1	I	M	60	60	60	GPRS	M	
HAIFA-QISHON	35 02 E	32 49 N	320			H1	R	F,M H,T	0.2	2	N,I	M,N	1: 60	1: 60	1	GPRS	N, M	
ISRAEL (SOI)																		
ASHKELON MARINA	34 33 E	31 41 N	320			K3	F	G	5	1					N		N	
ASHDOD	34 38 E	31 50 N	320			K3	R	G	5	1					N		N	
TEL AVIV MARINA	34 46 E	32 05 N	320			K3	F	G	5	1					N		N	
ACRE MARINA	35 04 E	32 55 N	320			K3	F	G	5	1					N		N	

The Survey of Israel (SOI) instruments are not real time. The real time data of Israel Oceanographic and Limnological Research (IOLR) can be inspected at http://isramar.ocean.org.il/hadera/ and /ashdod/.

Real time data from the Hadera station will start to be provided in real time (every 1 minute)to the NEAMTWS network in late February 2009. Yellow markings indicate not yet implemented items, to be implemented in late Feb. 2009. Hadera station will include then a second Paroscientific pressure gauge, which will gather 15 sec averages of sea level and transmit the data each 1 minute to MedGLOSS server and to the NEAMTWS centers (temporarily to Ostende).
The Haifa-Qishon river mouth station is operational since 29/12/2007. It is a Miros radar sensor, sending data via cellular modem directly to Internet and from there to IOLR. The new real-time Hadera station data will be also sent every 1 minute via cellular modem to Internet using ftp to MedGLOSS and NEAMTWS regional centers. Identical setups are under preparation for the MedGLOSS stations at Portomaso-Malta,

Paphos-Cyprus, Constanta-Romania and Kacively-Ukraine. These are expected to also start their real time sea level data transmission every 1 minute by the end of February 2009. Same data transmission method as for Hadera will be implemented for these stations, except at Portomaso, where Internet ADSL is already available at the station.

Information from Dov Rosen (IOLR).

Egypt

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*

EGYPT																		
ALEXANDRIA	29 55 E	31 13 N	330	071		91	F,R	GMT	1	3	I	O	1	15	15	Met		G
MARSA MATROUH	27.217	31.333					P											

The radar gauge indicated at Alexandria is an OTT Kalesto which is being installed at the time of writing. When installed, IPR = ON will indicate data contributed to the ODINAfrica programme and NEAMTWS, and MET = Met will indicate Meteosat transmissions.

Information partly from Woodworth, P.L., Aman, A. and Aarup, T. 2007. Sea level monitoring in Africa. African Journal of Marine Science, 29(3), 321-330. doi:10.2989/AJMS.2007.29.3.2.332.

Libya

No recent tidal measurements have been conducted in Libya and we do not know of plans to make any.

Information from the Libyan National Meteorological Centre.

Tunisia – Centre Hydrographique et Océanographique de la Marine Nationale

Station Name	Lon	Lat	CCO	SCO	GLO	AC	TYP	PUR	FRQ	WI	RT	IPR	FRS	FRT	LT	MET	DMF	AD
TUNISIA																		
BIZERTE	9 52 E	37 18 N					F											
LA GOULETTE	10 18 E	36 49 N					F											
KELIBIA	11 06 E	36 51 N					F											
SOUSSE	10 38 E	35 49 N					P											
SFAX	10 46 E	34 44 N					F											
ZARZIS	11 07 E	33 30 N					F											
CAP BON	11.088	36.896									N							

The float gauges shown are OTT R16 systems while the pressure gauge is an YSI XSI XLM 600. All provide hourly data which is downloaded weekly for analysis. No real time data.

This information was extracted from Tunisia report to GLOSS Experts – 10 meeting in 2007.
See www.gloss-sealevel.org.

Cap Bon and another gauge in Tunisia are known to have real-time capability but data are not exchanged internationally.

Algeria

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
ALGERIA																		
ANNABA	7.7571	36.9007					F					N						
ALGIERS	3.0597	36.7755					F					N						
ORAN	-0.635	35.6977					F					N						

The Algerian Hydrographic Office has float gauges at Annaba, Algiers and Oran but data are not shared internationally. It has plans for 2 real-time systems.

Information from Woodworth, P.L., Aman, A. and Aarup, T. 2007. Sea level monitoring in Africa. African Journal of Marine Science, 29(3), 321-330. doi:10.2989/AJMS.2007.29.3.2.332.

Morocco

Station Name	*Lon*	*Lat*	*CCO*	*SCO*	*GLO*	*AC*	*TYP*	*PUR*	*FRQ*	*WI*	*RT*	*IPR*	*FRS*	*FRT*	*LT*	*MET*	*DMF*	*AD*
MOROCCO (MEDITERRANEAN)																		
NADOR	2 55 W	35 12 N					R											
AL HOCEIMA	3 55 W	35 15 N					A											
MOROCCO (ATLANTIC)																		
TANGER	5 45 W	35 48 N					R											
KENITRA	6 40 W	34 16 N					R											
MOHAMMADIA	7 20 W	33 43 N					R											
JORF LASFAR	8 38 W	33 07 N					R											
SAFI	9 17 W	32 20 N					R											
AGADIR	9 36 W	30 26 N					R											
TAN TAN	11 06 W	28 26 N					R											
LAAYOUNE	13 12 W	27 09 N					R											
DAKHLA	15 57 W	23 43 N					R											
CASABLANCA	07 36 W	33 36 N	350	021		19	A											

The radar gauges shown above are operated by the Direction des Ports et du Domaine Public Maritime (DPDPM). They are VegaPuls 65 radar gauges and provide 10 minute data which are downloaded periodically (not real time). The acoustic gauges are MORS HT 200 systems operated by the Agence Nationale de la Conservation Foncière du Cadastre et de la Cartographie (ANFCC). It is not clear what frequency of data are obtained. Not real time. Tide gauges are also operated by the Service Hydrographique et Océanographie de la Marine Royale (SHOMAR)) and the Direction de la Météorologie Nationale (DMN). However, we have no details of their operations.

This information extracted from Morocco report to GLOSS Experts – 10 meeting in 2007. See www.gloss-sealevel.org.

We understand that IOC have arranged for a real time system (radar gauge and Meteosat telemetry) to be installed in Casablanca in the near future.

Status of Proposed Sea Level Stations for NEAMTWS Based on Best Available Information (as of January 2008, small updates December 2008)

	Station Name	Coordinates	Country	Basin/Sea	Current status	Type of sensor	Current Sample (min)	Transmission interval (min)	Type of transmission	Network
1	Kacively	44º.42N,34º.05E	Ukrania	Black Sea	3	Pressure	0.5	60	PSTN/Internet	MedGLOSS
2	Constantza	44º.17N,28º 40'E	Romania	Black Sea	3	Pressure	0.5	60	PSTN/Internet	MedGLOSS
3	Paphos	34º.45N,32º .24E	Cyprus	E. Mediterr.	3	Pressure	Under repair/upgrade	60	PSTN/Internet	MedGLOSS-ESEAS
4	**Hadera**	**32º.47N, 34º 53'E**	**Israel**	**E. Mediterr.**	**2**	**Pressure**	**0.5**	**60**	**GSM-modem/Internet**	**MedGLOSS-ESEAS**
5	Ashdod	31º48'N,34º38'E	Israel	E. Mediterr.	2	Pressure	0.5	60	GSM-modem/Internet	MedGLOSS-ESEAS
6	**Gavdos**	**34º 51'N, 24º.12E**	**Greece**	**E. Medterr.**	**2**					
7	NWCrete	35º30'N,23º39'E	Greece	E. Mediterr.	4	Pressure	0.5	0.5	Satel/Internet	NATNEG
8	WCrete	35º18'N,23º31'E	Greece	E. Mediterr.	4	Pressure	0.5	0.5	Satel/Internet	NATNEG
10	Porto Maso	35º 55'N, 14º.52E	Malta	C. Mediterr.	3	Pressure	0.5	60	GSM/Internet	MedGLOSS-ESEAS
11	Dubrovnik	42º39'N, 18º04'E	Croatia	Adriatic	3	Pressure	10	10		MedGLOSS-ESEAS
12	Napoli	40º50'N, 14º16'E	Italy	C. Mediterr.	3		15s-1min	5-15min		
13	Imperia	43º53'N, 08º01'E	Italy	C. Mediterr.	3		15s-1min	5-15min		
14	Carloforte	39º09'N, 08º 18'E	Italy	C.	3		15s-1min	5-15min		

				Mediterr.						
15	Calabria	38º07’N, 15º39’E	Italy	C. Mediterr.						?
16	Porto Empedocle	37°17’N, 13°31'E	Italy	C. Mediterr.	3		15s-1min	5-15min		
17	Otranto	40º 09'N, 18º30'E	Italy	Adriatic	3		15s-1min	5-15min		
18	**Ajaccio**	**41º56’N, 08º46’E**	**France**	**W. Mediterr.**	**3**	**Acoustic**	**10**	**None**	**None**	**ESEAS**
19	**Le Conquet**	**48º22’N,04º46’W**	**France**	**Atlantic**	**2**	**Radar**	**1s**	**None**	**ADSL**	**ESEAS**
	Monaco	43º44’N, 07º25’E	Monaco	W. Mediterr.	3	Acoustic	10	None	None	
20	**Barcelona**	**41º21’N,02º10’E**	**Spain**	**W. Mediterr.**	**2**	**Acoustic**	**5**	**60**	**GSM**	**MedGLOSS-ESEAS**
21	Ibiza	38º55’N,01º27’E	Spain (Balearic Islands)	W. Mediterr.	3	Pressure	5	60	GSM	MedGLOSS-ESEAS
	Mahón	39º52’N, 04º18’E	Spain (Balearic Islands)	W. Mediterr.	4	Radar	1	1	Internet	
22	**Almería**	**36º50’N,02º29’W**	**Spain**	**W. Mediterr.**	**1**	**Radar**	**1**	**1**	**Internet**	
23	**Huelva**	**37º08’N,06º50’W**	**Spain**	**S. Atlantic**	**1**	**Radar**	**1**	**1**	**Internet**	**ESEAS**
24	**Ferrol**	**43º17’N,08º08’W**	**Spain**	**S. Atlantic**	**1**	**Radar**	**1**	**1**	**Internet**	
25	**La Gomera**	**28º03’N,17º05’W**	**Spain (Canary Islands)**	**S. Atlantic**	**1**	**Radar**	**1**	**1**	**Internet**	
	Arrecife-Lanzarote	**29º01’N,13º31’W**	**Spain (Canary Islands)**	**S. Atlantic**	**4**	**Radar**	**1**	**1**	**Internet**	
26	**Melilla**	**35º17’N,02º56’W**	**Spain**	**W. Mediterr.**	**1**	**Radar**	**1**	**1**	**Internet**	
27	Lagos	37º07’N,08º34’W	Portugal	S.	2	Acoustic/Aquatr	6		Internet	GLOSS

				Atlantic						
28	**Cascais**	**38º41'N,09º25'W**	**Portugal**	**S. Atlantic**	**2**	**Acoustic/Aquatr**	**6**	**6**	**Internet**	**GLOSS**
	Sines	**37º57'N,08º53'W**	**Portugal**	**S. Atlantic**	**2**	**Radar**	**1s**		**ADSL**	
	Ponta Delgada	37º45'N,25º42'W	Portugal (Azores)	W. Atlantic	3					GLOSS
	Funchal	32º39'N,16º54'W	Portugal (Madeira)	W. Atlantic	3	Acoustic				
29	Newlyn	50º06'N,05º33'W	U.K.	Atlantic	2	Bubbler	15	15	Internet	GLOSS-ESEAS
30	**Holyhead**	**53º19'N,04º37'W**	**U.K.**	**Irish Sea**	**1**	**Bubbler/Pressure**	**1**	**1**	**Internet-broadband telf**	
31	Cromer	52º56'N,01º18'E	U.K.	North Sea	2	Bubbler	15	15	Internet	
32	**Lerwick**	**60º09'N, 1º10'W**	**U.K. (Shetland Islands)**	**North Atl.**	**1**	**Bubbler/Pressure**	**1**	**1**	**Internet-broadband telf**	
33	Gibraltar	36º09'N,05º22'W	U.K.	Gibral. St.	2	Radar	15	60	PSTN/Internet	MedGLOSS-ESEAS
	Malin Head	55º20'N,07º14'W	Ireland	N. Atlantic	3					
	Castletownbere	51º39'N,09º54'W	Ireland	N.Atlantic	3					
	Dublin Bay	53º22'N,05º59'W	Ireland	Irish Sea	3					
	Clare Island	53º47'N,09º58'W	Ireland	N.Atlantic	3					
34	**Rorvik**	**64º52'N,11º15'E**	**Norway**	**N. Atlantic**	**3**	**Float**	**1**	**1**	**GSM/Internet**	**GLOSS**
35	Tregde	58º00'N,07º34'E	Norway	North Sea	3	Float	1	1	GSM/Internet	GLOSS
	Torshavn	62º01'N,06º44'W	Denmark-Faroe Isl	N. Atlantic	3	Float	15			GLOSS
36	Hanstholm	57º07'N,08º36'E	Denmark	North Sea	3		10	10	Internet	
37	**Tejn**	**55º19'N,15º11'E**	**Denmark**	**Baltic Sea**	**3**		**10**	**10**	**Internet**	
38	Smogen	58º22'N,11º13'E	Sweden	North Sea	3	Float	10	60	PSTN modem	

	Reykjavik	64º07'N,21º54'W	Iceland	N. Atlantic	1	Pressure	1		Internet	GLOSS
	Oran	35º43'N,00º38'E	Algeria	S. Mediterr.	4	Radar	1	1		
	Algiers	36º46'N,03º04'E	Algeria	S. Mediterr.	4	Radar	1	1		
39	Annaba	36º54'N,07º47'E	Algeria	S. Mediterr.	4	Radar	1	1		
40	Djidjelli	36º49'N,05º43'E	Algeria	S. Mediterr.	4	Radar	1	1		
41	**Alexandria**	**31º16'N,29º57'E**	**Egypt**	**E. Mediterr**	**4**	**Radar/Pressure**	**1**	**15**	**Meteosat/GTS**	**ODINAFRICA**
42	Cape Bon	37º04'N,11º04'E	Tunisia	S. Mediterr	4					ODINAFRICA
43	Gulf of Gabés	34º43'N,10º46'E	Tunisia	S. Mediterr.						ODINA FRICA
44	Bodrum	37º01'N,27º27'E	Turkey	Aegean Sea						
45	Sinop	41º43'N,34º50'E	Turkey	Black Sea						
46	Beirut	33º54'N,35º31'E	Lebanon	E. Mediter	4					
47	Koper	45º33'N,13º43'E	Slovenia	Adriatic	2	Radar	10	30	Internet	ESEAS

Notes:
Current status: 1-upgrade completed, 2- upgrade underway, 3- requires upgrade, 4- planned new installation
Coloured: completely new installations

ANNEX 1

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A Survey of European Sea Level Infrastructure

P.L. Woodworth and L.J. Rickards
Proudman Oceanographic Laboratory and British Oceanographic Data Centre,
6 Brownlow Street, Liverpool L3 5DA, U.K.

B. Perez
Puertos del Estado, Avda. del Partenón, 10, Campo de las Naciones,
28042 Madrid, Spain

Correspondence to: P.L. Woodworth (plw@pol.ac.uk)

Abstract.

This paper summaries findings from a survey of European sea level infrastructure (tide gauges, telemetry methods, ancillary information) conducted at the end of 2008 on behalf of the Tsunami Risk ANd Strategies For the European Region (TRANSFER), Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS), European Sea Level Service (ESEAS) and Global Sea Level Observing System (GLOSS) projects and programmes. Approximately 476 strategic tide gauges were found to be operational at this time, of which about three-quarters have near-real time data telemetry of various kinds. Around half of the gauges take part in real-time international data exchange. The NEAMTWS network can be considered to be good shape in that most of its sites for which a gauge exists will be capable of meeting required standards in the near future. On the other hand, NEAMTWS (and the European and North African network in general) contains major gaps along the North African coastline and on European Mediterranean and Black Sea coasts which require new installations. The paper also summaries standards for the various sea level programmes, and reviews existing European infrastructure in the form of data centres and web sites.

1. Introduction

Sea levels have been measured in Europe for many hundreds of years. Early measurements tended to consist of the heights and times of high tide only (e.g. Woodworth, 1999; Wöppelmann et al., 2008). However, following the introduction of the first automatic tide gauge at Sheerness in the Thames estuary (Palmer, 1831), it became possible to record the full tidal curve. This innovation led to important developments in studies of tides, storm surges and mean and extreme sea levels, and in practical applications such as a coastal surveying and harbour operations.

The Sheerness installation included a float in a stilling well, with the vertical motion of the float recorded on a paper chart fixed to a rotating drum controlled by an accurate clock (Pugh, 1987). This method was subsequently adopted at many other sites worldwide, and for well over a century this was the standard method for measuring sea levels. Even today, the technology remains a practical one, although at most sites the paper chart recorders have long been replaced by digital encoders connected to data loggers.

In the second half of the twentieth century, a number of other methods were developed for measuring sea level changes (IOC, 2004, 2006a). Tide gauges based on the measurement of sub-surface pressure, or on the time of flight of an acoustic or radar pulse between a transducer and the sea surface, proved to be both reliable and cost-effective. In particular, the new technologies did not require stilling wells, which can involve complicated installation arrangements, especially in high tidal areas. The result was that many agencies replaced their conventional float gauges with one or more of the alternative technologies, at the expense sometimes of introducing subtle systematic errors between measurements by the different techniques.

Along with the developments in tide gauge technology, corresponding progress has taken place in techniques for the transmission of the sea level data to centres, especially for the monitoring of water levels as part of flood warning systems. For example, the devastating floods in the UK and Netherlands in 1953 initiated the use of national telephone-based (dial up) transmission methods (e.g. see www.pol.ac.uk/ntslf/tgi/ for an example from the UK) which were eventually extended to make possible regional data exchange (e.g. see mention of NOOS and BOOS below). Nowadays, many European and other agencies routinely employ such telephonic (dial up or broadband) or internet telemetry, complemented in some cases by satellite techniques (e.g. Holgate et al., 2008a,b).

The availability of near real-time sea level information enables the utilisation of the data by a wide range of new users engaged in what is now called ‘operational oceanography’, of which flood warning is only one important example (Flather, 2000). More ready access to the data has also had the benefit of allowing faults to be recognised faster than hitherto, leading eventually to improvements in the data sets available to ‘delayed mode’ activities such as scientific research.

The result of these many years of developments is that Europe has an inhomogeneous collection of tide gauges and telemetry methods. Some of the equipment and methods are state-of-the-art, with advanced tide gauges installed and their information transmitted to centres in near real-time. However, the equipment in other countries remains little different from that of the early twentieth century and in some cases there is no real-time data transmission at all. There is inconsistency also in personal appreciation of the importance of international data exchange and the consequent necessary improvements to telemetry.

It has been evident for some time that European sea level infrastructure varies considerably between regions, and this recognition led to the initiation of a survey by the European Sea Level Service (ESEAS) of the tide gauges employed by various agencies across Europe. However, an additional factor in this discussion was introduced following the Sumatra tsunami of December 2004, the subsequent realisation that parts of Europe could be at risk from tsunamis (e.g. Kerridge, 2005), and the recognition that much of the existing European tide gauge infrastructure is inadequate (or at least not optimal) for monitoring tsunamis. That inadequacy is a consequence primarily of the unsuitable sea level sampling adopted by most tide gauges, but also inherent in the technologies themselves and in their associated telemetry methods.

In 2006, a European Commission (EC) project called Tsunami Risk ANd Strategies For the European Region (TRANSFER) was started to address many of the questions to do with regional tsunami risk. In addition, the Intergovernmental Oceanographic Commission (IOC) set up an International Coordination Group (ICG) for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS). The opportunity was taken of these new developments to undertake a new survey of existing European sea level infrastructure, the earlier survey by ESEAS anyway not having been completed.

The resulting survey, providing details of the infrastructure at each site in continental Europe together with North Africa, Greenland, Iceland and Atlantic islands, can be found in www.pol.ac.uk/psmsl/author_archive/european_tide_gauge_survey_2008/. It indicates which recording and communication technologies pertain to each measurement site as of December 2008 and consists of a set of tables with fields listed in Appendix 1.

A first version of the survey was produced by the Proudman Oceanographic Laboratory (UK) together with Puertos del Estado (Spain), based on information obtained through our involvement in international activities such as ESEAS, Permanent Service for Mean Sea Level (PSMSL), Global Sea Level Observing System (GLOSS), or Mediterranean GLOSS (MedGLOSS). Some countries provide regular national reports to the meetings of the GLOSS Group of Experts and these proved to be most useful sources of information for the survey (www.gloss-sealevel.org). Important additional sources included the web sites of individual national agencies (see a list in www.pol.ac.uk/psmsl/programmes/).

It was necessary at the outset that the range of the survey would have to be limited to the main tide gauge stations in each country, those stations being the most useful to IOC and EC programmes such as GLOSS or TRANSFER. Many countries possess possibly 100s of installations of what might be called ‘tide gauges’, often simple pressure sensors for local water management, located in rivers estuaries and coastal waters, or sensors for harbour operations. It was clear that our survey could not attempt to compile a complete list of such equipment in each country, and that such lists, even if complete, would not be particularly useful for our purposes.

Our first version was sent to the many European national contacts for the above-mentioned programmes, so that it could be checked and updated. In many cases, updates were provided within a few days. We are grateful to all of our contacts who replied and contributed thereby to its overall value. Maps summarising findings are presented below.

One notes that because the survey was initiated as part of TRANSFER and NEAMTWS, it necessarily had an emphasis on the availability of real time sea level information. Nevertheless, the insight obtained into the status of the European sea level infrastructure as a whole should also provide a basis for the further development of activities such as GLOSS which also have great interest in the availability of delayed mode sea level data.

2. Summary Maps from the Survey

The survey suggests that approximately 476 tide gauge stations (strategic stations as emphasized above) are currently operational in Europe, North Africa, Greenland, Iceland and Atlantic islands (Figure 1), with the greatest density of recording in NW Europe and lowest density in North Africa and parts of the Black and Baltic Seas. Many stations are located on North and Irish Sea coasts, where there are well-established requirements for continuous monitoring of water levels for flood warning.

Approximately three-quarters of these stations (329) are capable of reporting sea level information to a national centre in near-real time, meaning within an hour or so, thereby providing a continuous monitor of water levels to national agencies and making the data useful for validation of operational flood forecast models (Figure 2). A subset of these real-time stations make their data available to one or more international programmes (NOOS, BOOS, IBIROOS, MedGLOSS, SLEAC or GLOSS, see brief descriptions of these programmes below). Figure 3 shows the 181 stations in this subset. This map can be seen to be essentially the same as that of 223 real-time stations included in the EuroGOOS SEPRISE demonstrator project (Gorringe, 2007, and see below for brief description of SEPRISE), if one considers that the SEPRISE exercise included national data from more stations in some countries (notably Norway and Netherlands) than presently contribute to the various programmes. It is clear from comparison of Figure 3 to Figures 1 and 2 which countries have the weakest engagement with the international programmes.

Operational flood warning originated in agencies with responsibilities for coastlines prone to high water levels due to tides and storm surges. In this application, water levels need be sampled only at sufficient temporal resolution to be able to monitor the tide and surge (e.g. every 15 minutes), and the associated telemetry only need be capable of transmitting data in a timescale useful for validation of the performance of operational tide-surge numerical models (e.g. 15 minute or hourly transmissions). More exacting requirements for high frequency sea level recording and for data telemetry are associated with tsunami monitoring (see discussion of NEAMTWS standards below).

Figure 4 shows the NEAMTWS network required to be in place by the end of the decade (this is a slightly updated map to that shown in Figure 2-5 of IOC, 2007). It indicates sites at which a gauge (of any type) exists and sites for which a new installation is required. Requirements include a number of new gauges in North Africa and in other parts of the Mediterranean and Black Seas. Of the existing sites, our survey has shown that many of them already meet the NEAMTWS standards or will shortly (e.g. via upgrades to MedGLOSS gauges), and of those which do not, the main factor concerns sampling frequency. In particular, all Italian, all Danish and one UK site in the NEAMTWS network employ sampling of 10-15 minutes which must be improved upon, while most Greek sites must also be converted to real-time.

The survey also concerned itself with whether data from gauges were being made available to the international programmes in delayed mode. For example, Figure 5 shows the 213 European stations for which data have been contributed to the PSMSL in recent years (since 2005). There are some similarities between this map and that of Figure 3, in indicating which countries have (or have not) a commitment to international programmes.

The figures in this paper give only an overview of the findings of the survey, and the interested reader is invited to inspect the survey web page itself to obtain more detailed information.

3. GLOSS and Tsunami (NEAMTWS) Standards

Any survey is inevitably a backward-looking exercise. If it is to be useful, it should be capable of identifying deficiencies which must be addressed by future investment. In this section, we review the standards to be expected of any future European network, so that agencies can compare their existing infrastructure with future requirements.

The IOC GLOSS programme was established in the 1980s with the aim of providing worldwide sea level data primarily for oceanographic and climate studies (e.g. to increase the quantity and quality of mean sea level data to the PSMSL), and also to provide a ‘core network’ around which densified regional networks could be established (e.g. MedGLOSS) for more local applications. GLOSS also stressed the many practical applications that could accrue from high quality sea level data.

The original GLOSS standards can be summarized as requiring a tide gauge to measure to an accuracy of 1 cm or better in all weather conditions, and with a recording frequency of 1 hour or more frequent (IOC, 1997, 2006a). The latter requirement is now easily met at most sites, with recording at periods of 6, 10 or 15 minutes now common. However, GLOSS also calls for great attention to the geodetic control of the sea level data, with minimum requirements for local benchmarks and levelling.

During discussions following the Sumatra tsunami, it became clear that recommendations for future GLOSS stations, or upgrades to existing stations, had to take account of the need to use the same sites for tsunami applications. Therefore, most opinion in the GLOSS Group of Experts, based primarily on experience in the Pacific, became focused on providing a primary ‘sea level sensor’ for most GLOSS-related purposes, together with a vented pressure sensor sampling at one minute or more frequently, with less rigour for geodetic datum control for the latter (e.g. Kilonsky, 2006). This approach was also followed for deployments in Africa and other locations as part of the Indian Ocean Tsunami Warning System (Woodworth et al., 2007). In these cases, the equipment employed at most sites consists of a radar tide gauge, providing sea level data of most use to tidal studies and research into sea level changes due to climate change. In addition, the station is equipped with a sub-surface pressure sensor which functions as a backup to the radar gauge and as the main 'tsunami sensor'. A final important component is the satellite transmission equipment which sends real-time data back to centres in Ostende (Belgium) and Hawaii (USA) and to any other centre which can access the Global Telecommunications System.

The stated requirements for NEAMTWS are similar (IOC, 2006b). They specify GLOSS type equipment capable of 1 cm accuracy and 1 minute sampling or better, together with 1 minute transmissions for stations within 1 hour of tsunami travel and/or 100 km from the tsunami generation area. NEAMTWS also makes recommendations on redundancy of equipment, power supplies etc.

It seems to us that at this point a tide gauge agency must consider how their sites can best be developed to meet the requirements of the several programmes. For example, a site might have a tide gauge which meets GLOSS standards, with telemetry adequate for regional storm surge applications (which tends to mean delivery of near real-time data within approximately 30 minutes). In this case, an enhancement to the station by means of addition of a relatively inexpensive tsunami gauge (e.g. pressure gauge, following the examples given above for the Pacific and Africa) and faster telemetry may provide a most effective option for future development. On the other hand, it is possible to purchase tide gauge systems capable of sampling adequately rapidly for tsunami applications and with the long-term stability required for GLOSS. When equipped with suitable telemetry, such single systems should, in principle, be capable of meeting all requirements. Consequently, for a new station this option, although relatively high cost, may be the most efficient.

Therefore, in our opinion, one must beware of some of the statements for tide gauges to meet 'multi-hazard' applications as, for example, a simple sensor perfectly adequate for tsunamis could never be considered suitable for GLOSS. Rather, it must be the station, rather than any one particular instrument, which should be considered as providing the multi-hazard functionality.

4. Web Sites and Data Banks

Web sites and data banks can be considered as fundamental components of the European sea level infrastructure. Web sites provide real time information, together with access to catalogues of delayed mode data. In addition, web sites can provide a wealth of other information including metadata, training information and software packages. Data banks provide the essential roles of long term storage of information and quality control of the data gathered. In this section, we review briefly some of these infrastructure assets.

Permanent Service for Mean Sea Level (www.pol.ac.uk/psmsl) – the PSMSL was established in 1933 and operates under the auspices of the International Council for Science (ICSU) (Woodworth and Player, 2003). It has a global responsibility to collect, analyse and distribute mean sea level data from tide gauges and presently holds over 57000 station-years of information. For many years it was the only body engaged in international (including European) sea level data exchange.

Global Sea Level Observing System (www.gloss-sealevel.org) - the PSMSL is also charged, along with the British Oceanographic Data Centre (BODC), with maintaining the data bank for delayed mode, 'higher frequency' sea levels (i.e. hourly values or more frequent) from nominated GLOSS sites. There are over 30 such GLOSS sites in the wider European region.

European Sea Level Service (www.eseas.org) – some tide gauge agencies in Europe have regularly contributed 'higher frequency' sea level data to an ftp site at the ESEAS Central Bureau maintained by the Norwegian Mapping Authority. However, at the time of writing the method used for obtained data available to ESEAS is being changed to the use of a web portal which will access data from national web sites. This should provide access to more data (and to fewer copies of the same data) and will more clearly show that ownership resides with national agencies. The portal will be operated by BODC.

National sea level agency web sites and data banks – most agencies now have such web sites, a list of which is maintained by the PSMSL (www.pol.ac.uk/psmsl/programmes/).

North West Shelf Operational Oceanographic System (NOOS) (www.noos.cc) – NOOS is the North Sea area component of the EuroGOOS programme, an association of agencies established to further the goals of the Global Ocean Observing System (GOOS). Real time data are contributed by national agencies using ftp boxes from which data can be 'pulled' by the NOOS server at the Danish Meteorological Institute (DMI). The web site provides an almost complete overview of real-time sea level coverage in the area.

Baltic Operational Oceanographic System (BOOS) (www.boos.org) – BOOS is the Baltic area component of EuroGOOS and provides similar access to real-time data from that area. The BOOS web site is also maintained by the DMI.

Iberia-Biscay-Ireland Regional Operational Oceanographic System (IBIROOS) - IBIROOS is the European South West Atlantic Shelf component of EuroGOOS and is presently under development. The real-time data from the region will be accessible at the www.ibi-roos.eu web site maintained by IFREMER (l'Institut Francais de Recherche Pour l'Exploitation de La Mer). The in-situ data portal of IBIROOS, including sea level stations, will be the responsibility of Puertos del Estado, and will be developed within the MyOcean EC project.

Sea Levels of European Atlantic Coasts (SLEAC) (www.sleac.org) – SLEAC provides access to the Atlantic coast stations which also contribute to the individual EuroGOOS web sites. It was established by POL and the DMI in order to stimulate real time data exchange from throughout the Atlantic coastline, with a view towards the future needs of an Atlantic tsunami warning centre, rather than the focus on NOOS and BOOS which has been more appropriate for storm surge work.

MedGLOSS (www.medgloss.org.il) – MedGLOSS is a joint programme of IOC and the CIESM (Commission pour l'Exploration Scientifique de la mer Méditerranée). Its web site provides real time and delayed mode data for several Mediterranean stations.

Sustained, Efficient Production of Required Information Services (SEPRISE) (www.eurogoos.org/sepdemo/) – SEPRISE is a Specific Support Action funded by the EC within the 6th Framework Programme to further operational oceanographic services within EuroGOOS. It also provides access to real-time data from regional EuroGOOS activities as well as from national web sites. At present, SEPRISE has the status of a demonstrator project only.

IOC Sea Level Station Monitoring Facility (www.ioc-sealevelmonitoring.org) - this service developed from a collaboration between Flanders Marine Institute (VLIZ) and the ODINAfrica (Ocean Data and Information Network for Africa) programme of IOC, with the service initially focused on operational monitoring of sea level measuring stations in Africa. The service has since been expanded to a global station monitoring service for real time sea level from GLOSS stations, and for stations in the regional tsunami warning systems in the Indian Ocean, North East Atlantic and Mediterranean (NEAMTWS), Pacific and the Caribbean. Provision of low frequency and high frequency research quality sea level data is not the main aim of this service. Such data are available from the GLOSS, PSMSL and ESEAS data banks mentioned above and from the University of Hawaii Sea Level Center (www.soest.hawaii.edu/UHSLC/).

5. Evolution of the European Infrastructure

The duty of programmes such as GLOSS, NEAMTWS etc. is to specify clearly their needs for network coverage and the technical requirements for sea level stations. There may then be a number of technical solutions to meet these requirements, which differ depending on additional national requirements, environmental conditions, and even local experience and preferences. Consequently, it seems to us that the European sea level infrastructure need not evolve in a completely uniform way. However, it will be necessary to require that the accuracy, frequency and latency of data do indeed have some uniformity, and of course that data be available from throughout the regional coastline.

It is clear from Figures 1-3 and 5 (as it has been clear for many years e.g. Baker et al., 1997) that the main gaps in recording are from North Africa and Black Sea, although the coherence of sea level changes in the latter might obviate the need for the same density of recording as elsewhere. In North Africa, a new gauge is being installed at Alexandria under the auspices of the ODINAfrica and GLOSS programmes of IOC. That will extend an Alexandria sea level record that started in 1944. The Spanish Institute of Oceanography (IEO) operates the only other long-standing tide gauge on the North African coast, at Ceuta in Spanish North Africa (also since 1944). Puertos del Estado has recently established a tide gauge station in the Spanish North Africa harbour of Melilla to NEAMTWS and GLOSS standards. However, although tide gauges are known to exist in Tunisia, Algeria and Morocco (Woodworth et al. 2007, with that information included in our survey), there are no gauges in these countries that provide sea level data to the international scientific community, and/or provide data meeting the tsunami requirements of NEAMTWS, between Egypt and Spanish

North Africa. Filling these gaps in recording must be a major priority of the various European and international programmes.

It is clear that there is also much to do in developing the collaborative regional sea level programmes (ESEAS and MedGLOSS), so that data reaches users most efficiently and that communities can be formed to make maximum use of the resulting data sets. As regards tsunami monitoring (NEAMTWS), a major need at the moment is for the identification of a European warning (or watch) centre (or centres). Without that focus, it is inevitable that most agencies will not assign priority to enhancing their existing sea level stations to meet tsunami requirements.

6. Summary

This report has summarized the main findings of a recent survey of the European sea level infrastructure. The survey has shown that European assets vary considerably from country to country in their tide gauge hardware and telemetry methods. In particular, new investment is needed to fill gaps in the European and North African networks (especially in parts of the European Mediterranean and Black Sea coasts and the North African coastline itself) and to make data available in real time for hazard warning such as that needed for tsunami monitoring.

The availability and exchange of real-time data for operational flood warning purposes is good in most parts of North West Europe (approximately three-quarters of all gauges in the survey having real time capability). Infrastructure in tide gauges and telemetry for NEAMTWS is also good, or will be upgraded in the near future, for those stations where a gauge (of any type) already exists. Moreover, sites for which sea level sampling is at present insufficient for tsunami purposes should be capable of improvement with relatively modest investment. However, gaps in the network remain where there are no existing gauges of any type, geographically similar to those referred to above.

In spite of the gaps, Europe does already have considerable investment in tide gauge infrastructure (476 stations identified in Figure 1). However, it is clear from other figures in this report that the benefits of much of this investment are not being maximized by means of the fullest possible international engagement. The authors of this report have spent many years engaged in European sea level research, and we know that this deficiency is primarily a consequence of the restricted mind-set of certain national agencies, rather than of any aspect of hardware infrastructure. Until these personnel deficiencies are corrected by national recruitment of individuals with enthusiasm for international programmes, then there will continue to be gaps in those programmes.

Finally, we must repeat that the information collected in the survey will inevitably be limited. As mentioned above, it is clear that many ports or coastal local authorities will operate their own tide gauge networks, which we will not know about and data from which will not be shared widely. River authorities, water companies etc. will also undertake some kinds of sea level recording which will not have been reflected in the survey. A second reservation is that the information that we have collected is bound to become out of date within a few years, suggesting that the survey should be repeated at regular intervals. Nevertheless, we are confident that the survey does provide a reasonable overview of the main sea level recording activities in Europe at the present time, and especially of those tide gauge sites most relevant to IOC and EC programmes. Consequently, the present exercise should provide a useful starting point for more extensive surveys in the future, should they be considered necessary.

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Figure Captions

1. All tide gauge stations represented in the survey (some Greenland stations are outside the limits of the map).

2. Tide gauge stations capable of reporting sea level in near-real time to a national centre.

3. Tide gauge stations which contribute near-real time sea level data to one of the international programmes.

4. The NEAMTWS tsunami network proposed to be operational in the near future. Red sites indicate stations with an existing tide gauge (of any type) while yellow sites indicate that new installations are required.

5. Tide gauge stations which have contributed recent (2005 or more recent) mean sea level information to the PSMSL.

Appendix 1

The results of the survey can be found at www.pol.ac.uk/psmsl/author_archive/european_tide_gauge_survey_2008/. The survey consists of tables for each sea level authority, with the columns of the tables having the following meanings:

Lon, Lat = Longitude and latitude of the station (note that coordinates taken from the PSMSL catalogue will be given to the nearest minute. Coordinates taken from other sources may be approximate only)

CCO, SCO = PSMSL country and station code(s) of that station (if in the PSMSL database)

GLO = GLOSS station code if a GLOSS station

AC = Authority code for the agency that owns and maintains the station as listed in http://www.pol.ac.uk/psmsl/pub/indexa.html. Others should be stated explicitly.

TYP = type of tide gauge technology:

F = float and stilling well
P = undersea pressure transducer
B = bubbler pressure gauge
A = acoustic gauge in a tube or well (and manufacturer)
AA = acoustic gauge in open air (and manufacturer)
R = radar gauge (and whether pulse or FMCW radar and manufacturer)
Others should be stated explicitly

PUR = purpose for which the gauge was installed (more than one if necessary):

F = flood warning/coastal protection
G = national datums/geodesy
H = harbour operations/navigation
M = mean sea level/climate studies
T = tsunami studies
TI = tides
BS = bathymetric surveys
AC = altimeter calibration
Others should be stated explicitly

FRQ = time in minutes of recording period or sampling (this is not to be confused with FRS and FRT below)

WI = when installed:

1 = more than approximately 2 years (and hence any system problems resolved)
2 = less than about a year
3 = recent installation or planned imminent installation

RT = real time data available:

N = real time data available nationally at the web site given for the authority below
I = real time data available also internationally at one of the programme web sites given under IPR (i.e. ‘I’ also implies ‘N’ if ‘N’ not given explicitly).

IPR = international programmes to which real time data from the station are made available:

S = SLEAC (Sea Levels from the European Atlantic Coastline) real-time display www.sleac.org
NO = NOOS (North West Shelf Oceanographic Operational System) real-time display www.noos.cc
BO = BOOS (Baltic Oceanographic Operational System) real-time display www.boos.org
I = IBI-ROOS (Iberia-Biscay-Ireland Regional Operational Oceanographic System) www.ibi-roos.eu
M = MedGLOSS real time web display medgloss.ocean.org.il
G = GLOSS real time web site www.ioc-sealevelmonitoring.org
N = NEAMTWS tsunami network www.ioc-sealevelmonitoring.org

FRS = time in minutes of data resampled before transmission (i.e. averaged from the FRQ sampling). This could differ for RT = N or I and for different international programmes. If different, this should be stated explicitly.

FRT = time in minutes between transmissions. This could differ for RT = N or I and for different international programmes. If different, this should be stated explicitly.

LT = latency, the minimum time in minutes for which the real time data are available either nationally or internationally. This could differ for RT = N or I and for different international programmes. If different, this should be stated explicitly.

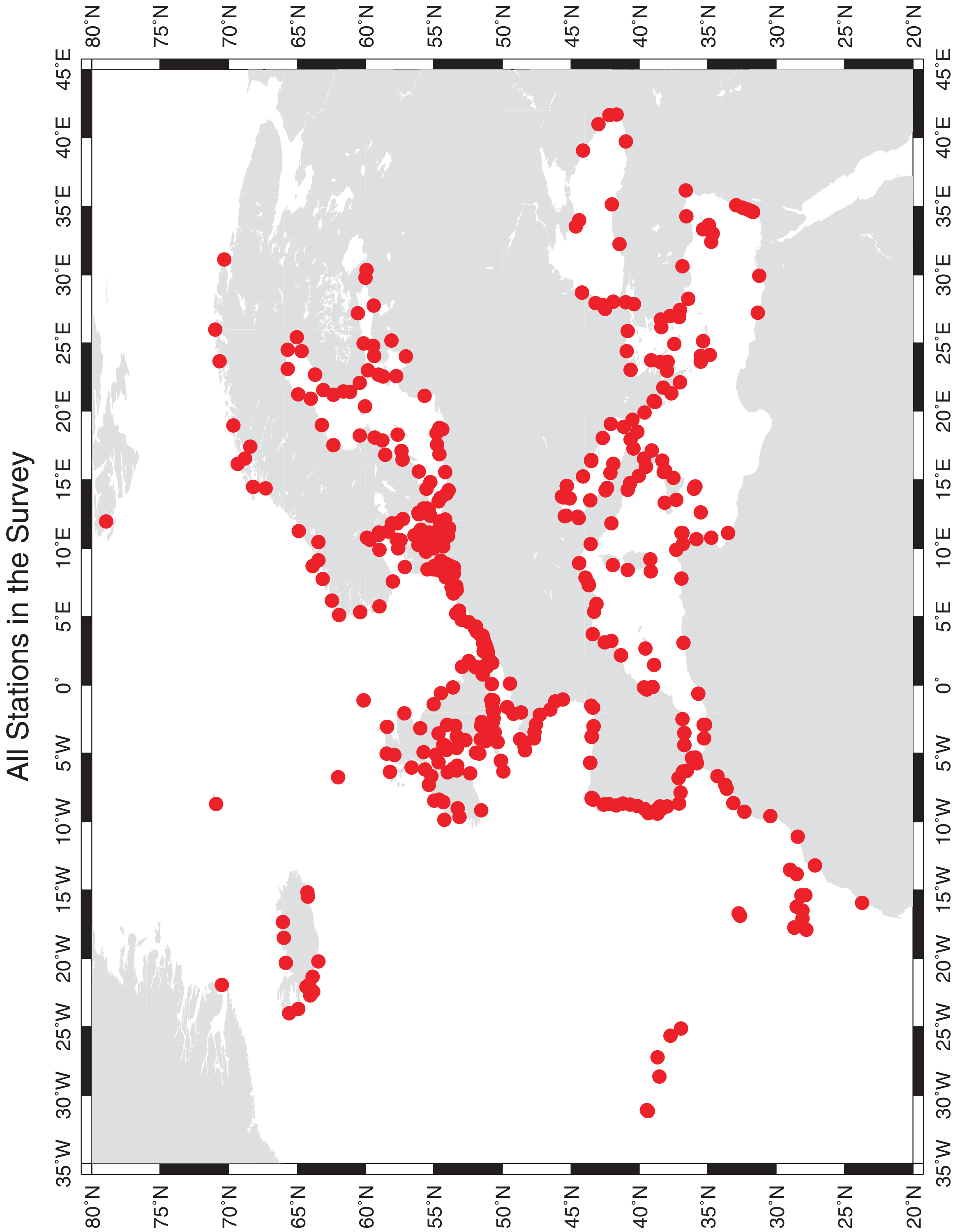
MET = method by which data are transmitted from the gauge to the national or international web sites. This could differ for RT = N or I and for different international programmes. If different, this should be stated explicitly.

DMF = delayed mode data availability flag. Data are freely available either:

N = nationally at the web site for the authority given below
G = GLOSS delayed mode centre (higher frequency)
E = present ESEAS archive (note, the ESEAS arrangements will change in 2009)
M = MedGLOSS focal centre
P = PSMSL (monthly means)

AD = ancillary data collected at the site including:

M = meteorological information
G = continuous GPS recording (also checked by comparison to the CGPS@TG list kept for GLOSS and TIGA in http://www.sonel.org)
Others should be stated explicitly


All Stations in the Survey
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75°N
70°N
65°N
60°N
55°N
50°N
45°N
40°N
35°N
30°N
25°N
20°N
45°E
40°E
35°E
30°E
25°E
20°E
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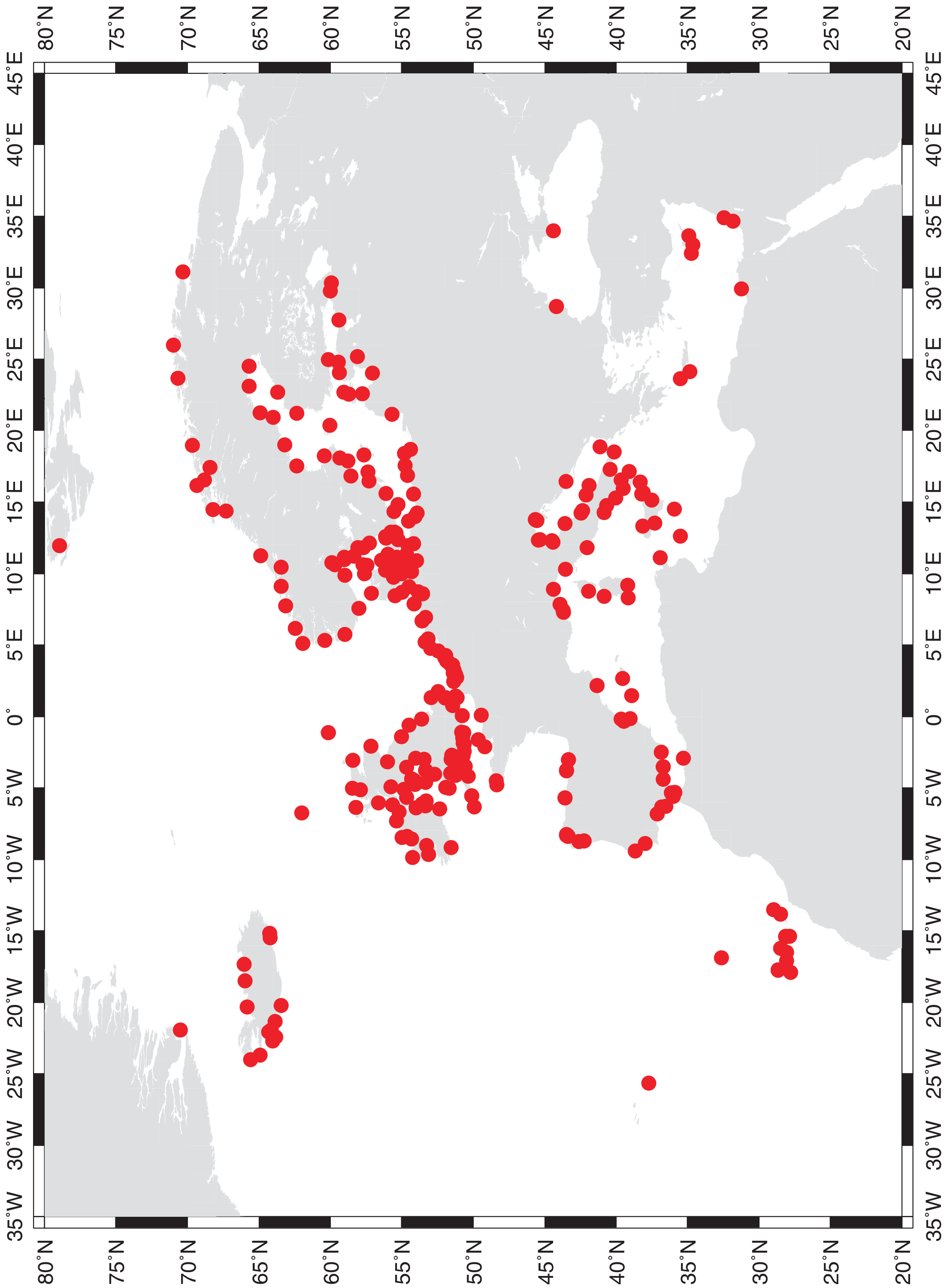
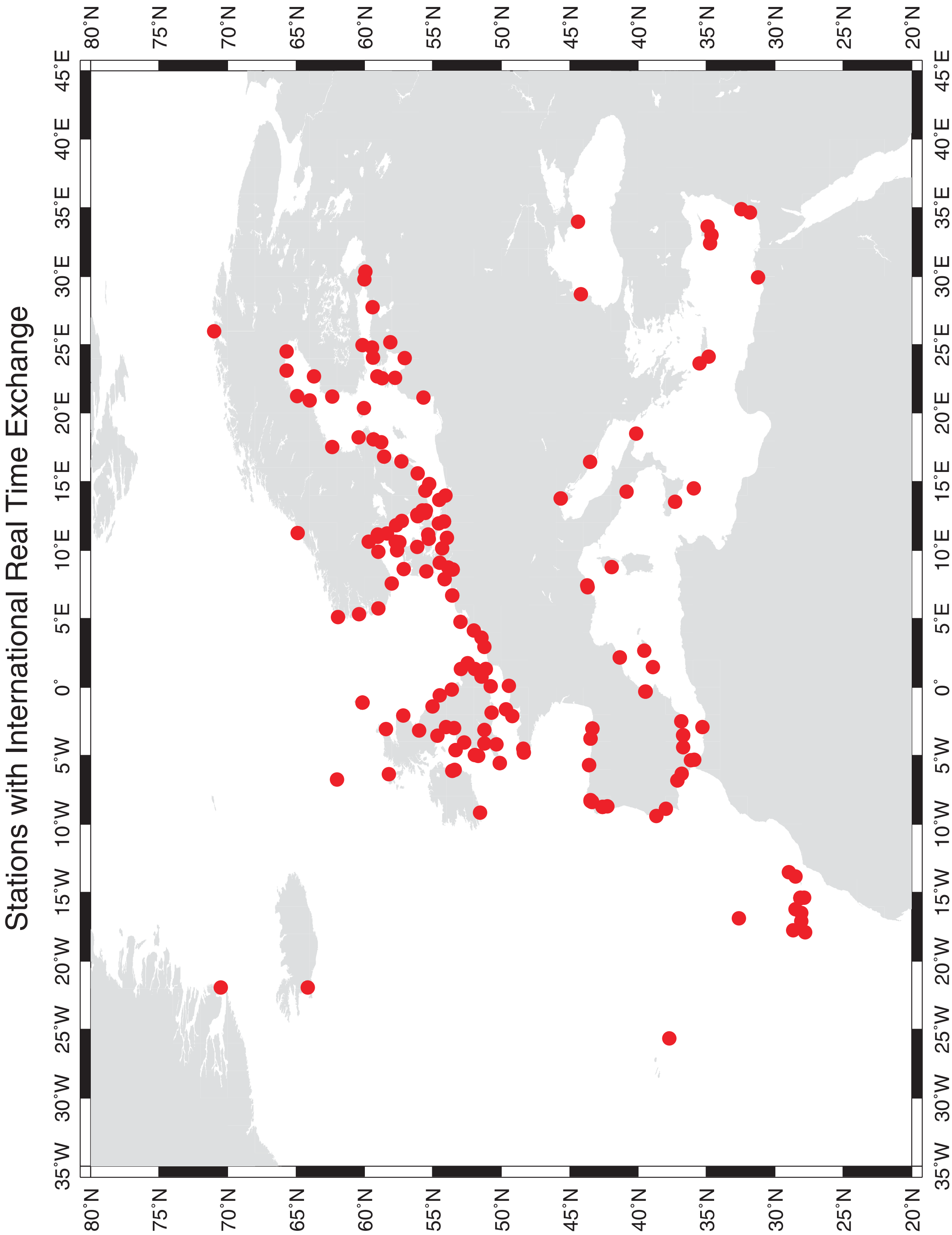
35°W

Stations with Real Time Capability




Stations with International Real Time Exchange
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70°N
65°N
60°N
55°N
50°N
45°N
40°N
35°N
30°N
25°N
20°N
35°W
30°W
25°W
20°W
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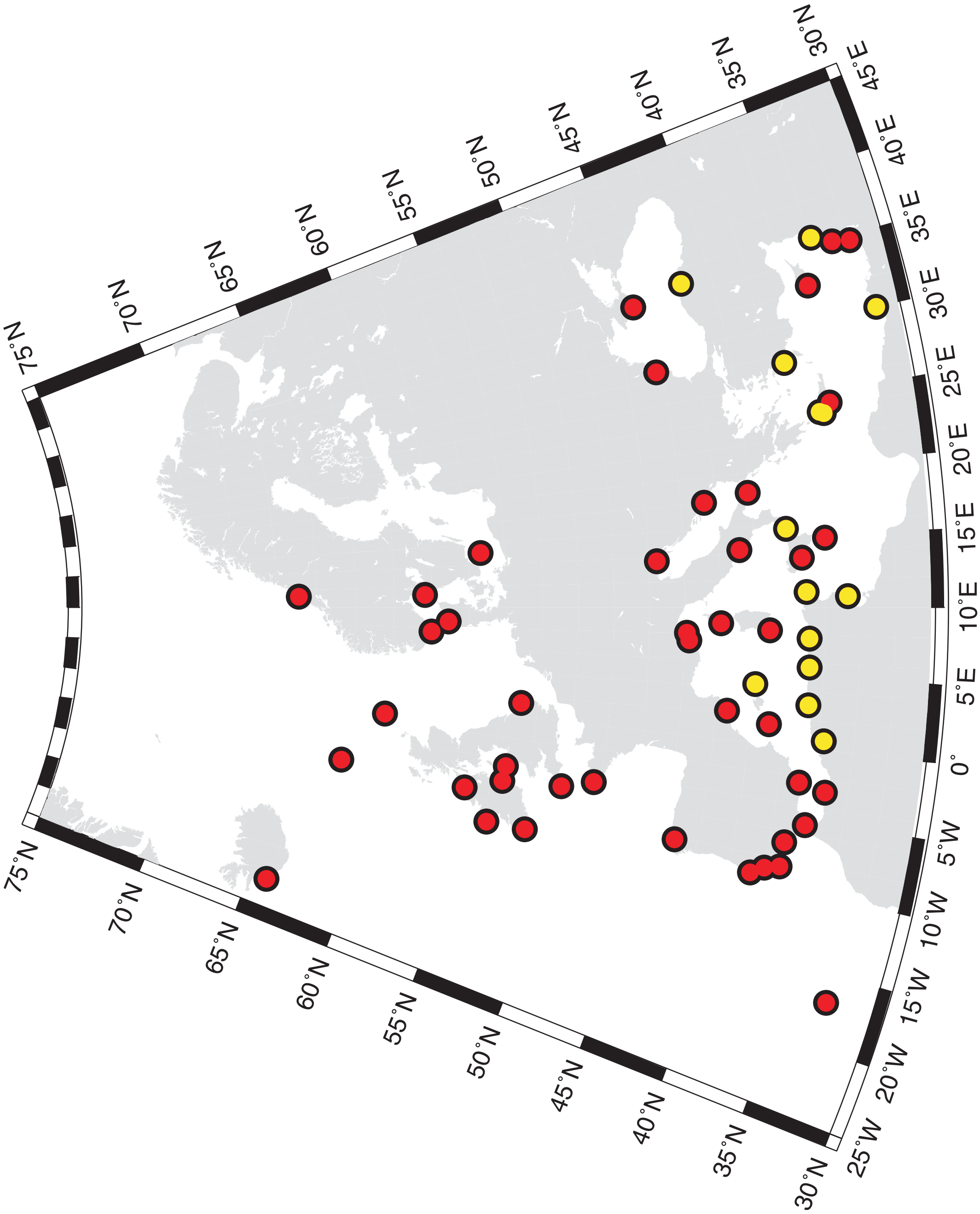
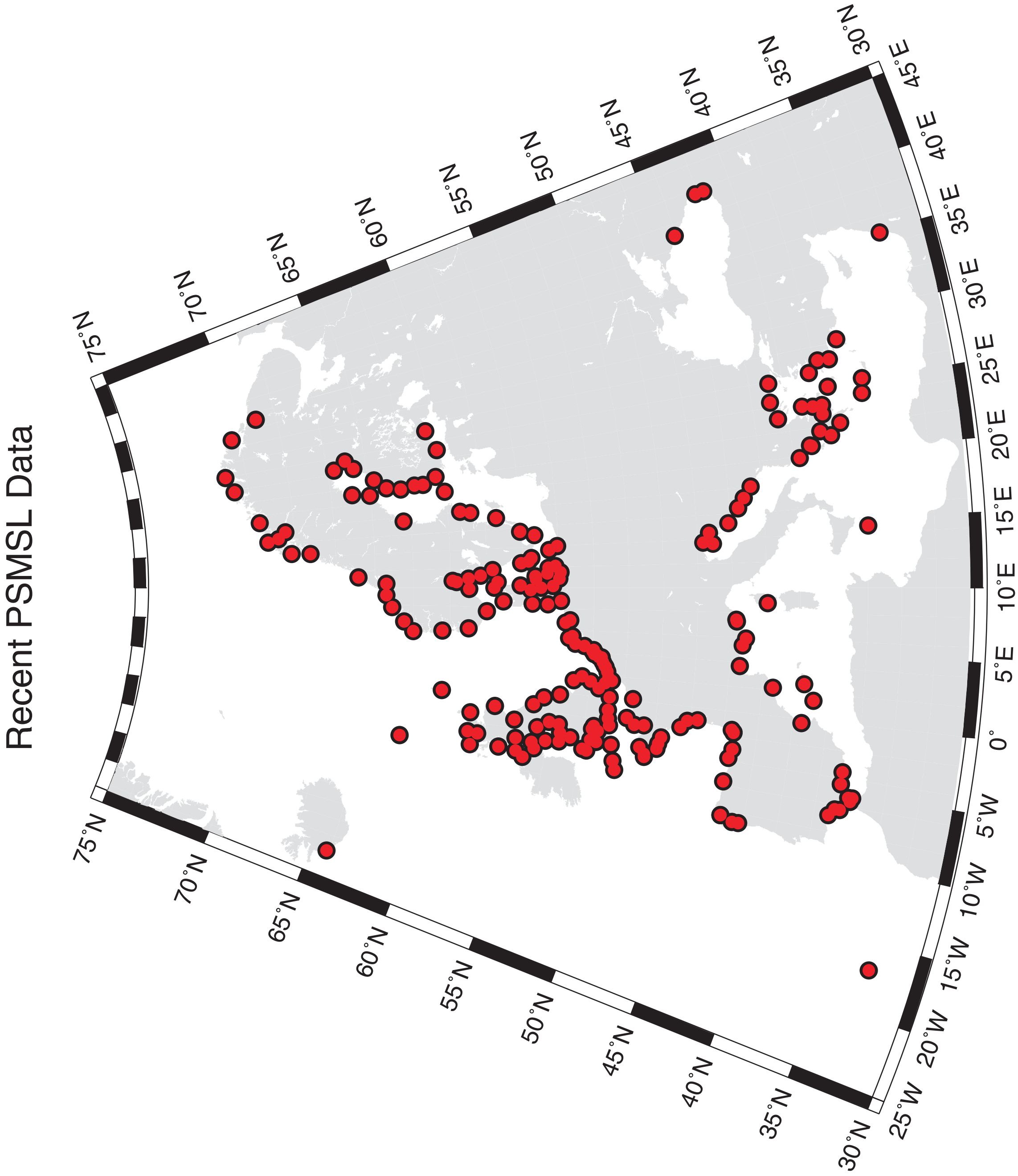


NEAMTWS Network


Recent PSMSL Data
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70°N
65°N
60°N
55°N
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45°N
40°N
35°N
30°N
45°E
40°E
35°E
30°E
25°E
20°E
15°E
10°E
5°E
0°
5°W
10°W
15°W
20°W
25°W