11th IHO-HSSC Meeting

Report of the Tides, Water Level and Currents Working Group

Submitted by:	Chairman, TWCWG
Related Documents:	Report of TWCWG4 meeting (available from IHO web site).
Related Projects:	None

Chair:	Gwenaële Jan, (Shom, France)
Vice-Chair:	Peter Stone (NOAA, USA)
Secretary:	David Wyatt, IHO
Member States:	Argentina, Australia, Brazil, Canada, Chile, China, Denmark, Ecuador, Egypt, Estonia, Finland, France, Germany, India, Indonesia, Italy, Japan, Netherlands, Korea Rep of, New Zealand, Norway, Peru, Poland, Portugal, Russian Federation, Singapore, South Africa, Spain, Sweden, Ukraine, UK, Uruguay, USA, Venezuela.
Expert Contributor:	CCOM-UNH, SPAWAR Atlantic, C-Map
Organisations:	IOC-GLOSS
	see Annex A for full details

Meetings Held During Reporting Period
TWCWG4 8-11 April 2019, Busan, Republic of Korea

Next Meeting
TWCWG5 Stavanger, Norway (2020)

Work Program
The TWCWG held its 4th meeting at the Shilla Stay Haeundae, Busan, Republic of Korea, from 8 to 11 April 2019 under the chairmanship of Dr Gwenaële Jan of France. The meeting was collocated with the 16th meeting of the Intergovernmental Oceanographic Commission of UNESCO (IOC) Global Sea Level Observing System (GLOSS) Group of Experts, which followed immediately. Opportunity was taken to hold a day of joint sessions. The meeting was attended by 47 delegates from 21 IHO Member States (Australia, Brazil, Canada, Chile, China, Colombia, Finland, France, Germany, India, Indonesia, Japan, Netherlands, Norway, Perú, Republic of Korea, South Africa, Spain, Sweden, UK and USA), Center for Coastal and Ocean Mapping/University of New Hampshire (CCOM-JHC/UNH) – USA, Joint Institute for Marine and Atmospheric Research (JIMAR) University of Hawaii Sea Level Center (UHSLC), Université de la Rochelle, laboratoire LIttoral ENvironnement et Sociétés (LIENSs), LIttoral ENvironnement et Sociétés/ Laboratoire d'Études en Géophysique et Océanographie Spatiales (LIENSs/LEGOS) , the Secretariat of the Intergovernmental Oceanographic Commission of UNESCO (IOC)and the IHO Secretariat.

Products specification: Significant time was set aside to progress the S-100 based product specifications, for which the TWCWG is responsible. S-111 edition 1.0 - *Surface Currents* - product specification was been published (December 2018).The results of producing test datasets S-111 were demonstrated. Prototype data sets for surface current HDF5 following S-111 were developed, produced and shared (TWCWG 2018). Visualization has been done by developing tools. These tools will be shared by Member States involved in this task (same team as in 2017). TWCWG stressed the difficulty to choose the different options for development the WG has without

guidelines from an S-100 strategy plan. S-100 Vice-chair, who participated in the meeting, provided a clear view on S-100 registry and S-100 viewer.
All participants were encouraged to create datasets compatible S-111 version 1.1.0 for testing and evaluation.
The draft S-104 product specification document progressed: Water level information for surface navigation. S-104 version 0.8.0 is planned for 2019-May. More Member States declared as volunteers for joining the products specifications effort in particular on S-104 (deadline to volunteer to S-104 is 2019- April 30). It is anticipated a draft Edition 1.0.0 S-104 to be presented to TWCWG5 for subsequent publication by HSSC in 2020. Effort on Show cases production, validation is put on product specification before submission to HSSC. The next step will consist in defining, selecting and prioritizing uses cases for both S-104 and S-111. The suggested timeline for producing use cases definition is 2019 September. This consists in setting use cases (definition of the show cases, development plan) reviewed and approved by TWCWG, producing results using HDF5 S-100 compatible. Tools S-100WG testbed documentation will provide a first template for writing S-104, S-111 show cases testbed plan.

I**HO standard for digital tide and tidal current tables**: The final draft was completed and is being submitted to HSSC-11 for Members Organization review and acceptance, see Annex C.
Inventory of tide gauges and current meters, and the list of Actual Tides On-line Links: Some inputs had been received and it was stressed to the working group members the importance of this work. This information was shared with the GLOSS members who found it to be helpful to the community. It was agreed to highlight these tools through Regional Hydrographic Commissions with the purpose of raising awareness and encouraging additional inputs. The IOC recommended that their Manuals and Guides No 14 - *IOC Manual on Sea Level Measurement and Interpretation* – and the IOC report on *Sea Level Measurements in Hostile Conditions* could be highlighted and linked at the head of the inventory list as an additional resource.

Tidal analysis methodologies using long term data: Extensive discussions were held concerning comparing tidal analysis methodologies using long term data sets and all members agreed that this work needed to be reinvigorated. Several members, including GLOSS-GE members, volunteered to develop a work plan with milestones to add new test data sets and conduct standardized analysis.

IHO Resolutions: It was agreed that the IHO resolutions, for which the TWCWG is responsible, needed comprehensive review and a group led by South Africa agreed to undertake the task and provide initial draft revisions for consideration at TWCWG5 See action J.2 Annex B to TWCWG Report to HSSC11. This action is in agreement with action J.1 :Maintain and extend the relevant IHO standards, specifications and publications. The IOC suggested that consideration of the wider use of tide, water level and current data beyond safety of navigation could be addressed, as well as the exchange of high frequency Real Time Data and historic data recovery could also be considered, as these have significance for sea level monitoring.

Presentations were given on establishing ellipsoidal heights on tidal benchmarks, geoidal and ellipsoidal mapping, harmonizing LAT to ellipsoidal relationships, patterns and Projections of High Tide Flooding using consistent impact thresholds (All presentations are online TWCWG web page).

Joint session with the GLOSS Group of Experts: The last day of the session was devoted to a joint session with the GLOSS Group of Experts. There were a number of presentations on topics of joint interest. The data archeology and archiving, obtaining ellipsoidal heights at benchmarks and ties to water level sensors. It was agreed that comparing tidal predictions generated as a result of analysis of common datasets by different analysis software, capacity building/development and historic data recovery and data archaeology were three areas in which there was a great deal of common activity and on which joint efforts should be focused.

The Tides, Water Level and Currents Capacity Building (CB) course was discussed and the contents reviewed. Methods for further development of these courses were agreed as well as identifying the need for closer liaison with the Regional CB Coordinators to assist in selecting appropriate candidates for future courses. From HSSC 10th, The English course material has been translated into French, Portuguese and Spanish so as to increase its availability as a CB resource. All the translated documents have been provided to TWCWG for review (April 2019). A significant discussion was heard on capacity building of IHO and how GLOSS GE could

assist with those efforts. The IOC agreed to provide details of their Capacity Development resources and the IOC Sea Level Monitoring Facility, which are available on the IOC website, for inclusion in the course material. Both groups agreed that greater partnering in capacity building would benefit both groups.

From IOC-GLOSS meeting, IHO-TWCWG has been sensitive to the current state of the coastal UK tide gauges network available at PSMSL (GLOSS ecosystem). A map of the current operational tide gauges stressed the critical status of the UK tide gauges network weakening the capacity to deliver water level and tide gauge maintenance. A concrete consequence is the increasing sea height error bar. The IOC highlighted the importance of encouraging and incentivizing national Hydrographic Offices to participate in the historic data recovery and data archaeology initiatives, as they hold substantial quantities of data of significant value in long term sea level monitoring.

TWCWG4 and GLOSS pair meeting highlighted three strong common points of interest: The data (measurements data, quality control, data management), the capacity building and data archeology actions. This synergy can in the future promote and strengthen the knowledge communication and cooperation. We thank IOC and IHO support for making the joint meetings a reality.

The draft Work Plan, attached at Annex B, was discussed and agreed.

Progress on HSSC Action Items

Problems Encountered
N/A

Any Other Items of Note
N/A

Conclusions and Recommended Actions
N/A

Justification and Impacts
N/A

Action Required of HSSC

The HSSC is invited to:

a. **Note** this report;
b. **Reappoint** the TWCWG to continue its work under its current Terms of Reference, see Annex C
c. **Endorse** the draft Work Plan at Annex B; and
d. **Approve** the draft IHO Resolution on Standard for Digital Tide and Tidal Current Tables, see Annex D.

Tides, Water Level and Surface Currents Working Group (TWCWG) – Updated 8 March 2019

COUNTRY	NAME AND ADDRESS	TELEPHONE FAX & e-mail
ARGENTINA	**Enrique D'Onofrio**	Tel : +?? Fax : +?? e-mail: mareas@hidro.gov.ar
AUSTRALIA	**Zarina Jayaswal** Deputy Director of Tides and Geodetic Control Australian Hydrographic Service Locked Bag 8801 Wollongong NSW 2500 Australia	Tel : +61 2 4223 6654 Fax : +61 2 4223 6599 e-mail: Zarina.Jayaswal@defence.gov.au tides@defence.gov.au
BELGIUM	**Hans Poppe** Vlaamse overheid Agentschap Maritieme Dienstverlening en Kust Afdeling Kust	Tel : +32(0)59/55.42.62 Fax : +?? e-mail: hans.poppe@mow.vlaanderen.be
BRASIL	**César Henrique de Oliveira Borba** Survey Division - Tidal Section Rua Barao de Jaceguai, s/n° Niteroi – Rio de Janeiro 24048-900 Brazil	Tel: +55 21 2189-3027 Fax: +55 21 2189-3237 e-mail: cesar.borba@marinha.mil.br
BRAZIL	**Leandro Machado Cruz** Brazilian Navy Hydrographic Center (CHM) Numerical Prediction Division Rua Barão de Jaceguai, s/n° Niteroi – Rio de Janeiro 24048-900 Brazil	Tel: +55 21 2189-3609 Fax: +55 21 2189-3105 e-mail: leandro.machado@marinha.mil.br
CANADA	**Neil Dangerfield**, BSc Multidisciplinary Hydrographer Science Branch Small Craft Acquisitions Committee (Pacific) Canadian Hydrographic Service (Pacific) | Institute of Ocean Sciences| P.O. Box 6000, Sidney, B.C. V8L 4B2 Canada	Tel: +1 250-363-6755 Fax: +1 250-363-6323 e-mail: Neil.Dangerfield@dfo-mpo.gc.ca
CANADA	**Phillip MacAulay** Multidisciplinary Hydrographer 7 Bolton Terr Dartmouth, Nova Scotia B2Y 2Z2 Canada	Tel: +1 Fax: +1 e-mail: Phillip.macaulay@dfo-mpo.gc.ca
CHILE	**Carlos Zúñiga** Head, Department of Oceanography Hydrographic and Oceanographic Service of the Chilean Navy Errázuriz 254 Playa Ancha Valparaíso Chile	Tel: +56 32 2266671 Fax: +56 32 2266542 e-mail: oceanografia@shoa.cl

CHILE	**Juan Fierro** Head, Coastal Dynamic Division Hydrographic and Oceanographic Service of the Chilean Navy Errázuriz 254 Playa Ancha Valparaíso Chile	Tel: +56 32 2266676 Fax: +56 32 2266542 e-mail: oceanografia@shoa.cl
CHILE	**Julio Castro** Head, Currents Section Hydrographic and Oceanographic Service of the Chilean Navy Errázuriz 254, Playa Ancha, Valparaíso, CHILE.	Tel: +56 32 2266695 Fax: +56 32 2266542 e-mail: oceanografia@shoa.cl
CHINA	**Wang Zhiyun** Senior Engineer Shanghai Maritime Safety Administration Hydrography Department No 82-7 Gong Qing Road Shanghai China	Tel : + 86 021 6567 2645 Fax : + 86 021 6568 2653 e-mail: wzy@shmsa.gov.cn wzy.tc@yahoo.com.cn
COLUMBIA	**Diego Armando Pulido Nossa** Barranquilla – Atlántico Vía 40 calle 58 esquina Bogotá D.C.	Tel : + 57 3225406505 Fax : + e-mail: diego.pulido@armada.mil.co dpulido@d imar.mil.co
DENMARK	**Mads Hvid Ribergaard** Danish Meteorological Institute Lyngbyvej 100 2100 Copenhagen Ø Denmark	Tel : +45 39 15 73 06 Fax : +45 39 27 10 80 e-mail: mhri@dmi.dk
ECUADOR	**Jorge Guillermo Nath Nieto** Naval Oceanographic Institute-INOCAR Av. 25 de Julio Vía Puerto Marítimo Base Naval Sur Guayaquil Ecuador	Tel : +593 42 481300 Ext. 2221 Fax : +593 42 485166 e-mail: jorge.nath@inocar.mil.ec inocar@inocar.mil.ec
EGYPT	**Mohamed I. Mohasseb** Egyptian Naval Hydrographic Office Shobat Al Misaha Al Baharia Ras El Tin Alexandria Egypt	Tel : + 20 10 144 8673 Fax : e-mail: mohamedmohasseb@live.com
ESTONIA	**Tõnis Siilanarusk** Head of Cartography Department Estonian Maritme Adminstration Valge 4 11413, Tallinn Estonia	Tel : +372 5043815 Fax : +372 6205606 e-mail: tonis.siilanarusk@vta.ee
ESTONIA	**Peeter Väling**	Tel : +372 5043815 Fax : +372 6205606 e-mail: peeter.valing@vta.ee
FINLAND	**Jyrki Mononen** Hydrographic Office Finnish Transport and Communications Agency P.O. Box 320 00059 TRAFICOM Finland (Opastinsilta 12A)	Tel: + 358 (0)29 534 6744 Mob: + 358 (0)40 059 1422 e-mail: jyrki.mononen@traficom.fi

FRANCE	**Gwenaële Jan** (Chair TWCWG) Senior expert on tides and currents SHOM 13 rue du Chatellier CS 92803 29228 BREST CEDEX 2, FRANCE	Tel : +33 2 56 31 23 29 Fax : +33 2 98 22 08 99 e-mail: gwenaele.jan@shom.fr
GERMANY	**Stephan Dick** Head of Division 'Forecasting Services' Federal Maritime and Hydrographic Agency (BSH) Bernhard-Nocht-Str 78 20359 Hamburg Germany	Tel: +49 (0) 40 3190-3100 Fax: +49 (0) 40 312224 email: stephan.dick@bsh.de
IHO	**David Wyatt** International Hydrographic Organization 4B Quai Antoine 1er BP445 MC 98011 MONACO Cedex Principauté de Monaco	Tel: + 377 93 10 81 06 Fax: + 377 93 10 81 40 e-mail: adso@iho.int
INDIA	**Maheshwar P Gupta** National Hydrographic Office 107-A, Rajpur Road Post Box No. 75 Dehradun - 248 001 Uttarakhand India	Tel : +91-135-2746290 -95 Fax : +91-135-2748373 e-mail: inho@navy.gov.in e-mail: ia-inho-navy@nic.in
INDONESIA	**Rosyid** Head of Marine Environment Division Indonesian Hydrographic and Oceanographic Office Jl.Pantai Kuta V No. 1. Jakarta. 14430 Indonesia	Tel: +6221 6471 4810 (or 4809) Fax: +6221 6471 4819 (or 4809) e-mail: info@idho.org
ITALY	**Lorenzo Papa** Italian Hydrographic Office	Tel: +39 102 443363 Tel: +39 102 443205 Fax: +39 102 61400 e-mail: lorenzo_papa@marina.difesa.it papa@fisica.unige.it
ITALY	**Paola Picco**	Tel: +39 102 ?? Tel: +39 102 ?? Fax: +39 102 ?? e-mail: paola.picco@persociv.difesa.it
JAPAN	**Katsuhiro Kusunoki** Director Environmental and Oceanographic Research Division Hydrographic and Oceanographic Department Japan Coast Guard 3-1-1, Kasumigaseki, Chiyoda-ku, Tokyo 135-8932 Japan	Tel: +81 3 3595 3605 Fax: +81 3 3595 3637 e-mail: analysis@jodc.go.jp

NETHERLANDS	**Ronald Kuilman** Hydrographer and Tidal Specialist Netherlands Hydrographic Service Van Alkemadelaan 786 2597 BC Den Hague Netherlands P.O. Box 10 000 1780 CA Den Helder Netherlands	Tel: +31 70 316 28 45 Fax: +31 70 316 28 43 e-mail: rb.kuilman@mindef.nl
NEW ZEALAND	**Glen Rowe** New Zealand Hydrographic Authority Land Information New Zealand Level 7 Radio New Zealand House 155 The Terrace PO Box 5501 Wellington 6145 New Zealand	Tel: +64 4 460 0569/0110 Fax: +64 4 498 3837 e-mail: growe@linz.govt.nz
NORWAY	**Hilde Sande** Oceanography Group Norwegian Hydrographic Service Lervigsveien 36, N-4014 Stavanger Norway	Tel: +47 51858815 Fax: +47 51858701 e-mail: hilde.sande@kartverket.no
NORWAY	**Oda Roaldsdotter Ravndal** Oceanography Group Norwegian Hydrographic Service Lervigsveien 36, N-4014 Stavanger Norway	Tel: +47 51858853 Fax: +47 51858701 e-mail: oda.roaldsdotter.ravndal@kartverket.no
PERÚ	**Diego Gago** Head of Oceanography Department Directorate of Hydrography and Navigation Avda. Gamarra No. 500 Chucuito CALLAO 1 Peru	Tel: +51 1 613 6751/63 6767 Ext. 6460 Fax: + Email: dgago@dhn.mil.pe
PERÚ	**Gerardo Macedo** Head of the National Tsunami Warning Center Direccion De Hidrografia y Navegacion Directorate of Hydrography and Navigation Avda. Gamarra No. 500 Chucuito CALLAO 1 Peru	Tel: +51 1 613 6751/63 6767 Ext. 6462 Fax: + e-mail: gmacedo@dhn.mil.pe
PERU	**Fernando Vegas** Direccion De Hidrografia y Navegacion Directorate of Hydrography and Navigation Avda. Gamarra No. 500 Chucuito CALLAO 1 Peru	Tel: +51 1 613 6751/63 6767 Fax: + e-mail: fvegas@dhn.mil.pe
PERU	**Carol Estrada** Direccion De Hidrografia y Navegacion Directorate of Hydrography and Navigation Avda. Gamarra No. 500 Chucuito CALLAO 1 Peru	Tel: +51 1 613 6751/63 6767 Fax: + e-mail: cestrada@dhn.mil.pe

PERU	**Gonzalo Agurto Barragán** Direccion De Hidrografia y Navegacion Directorate of Hydrography and Navigation Avda. Gamarra No. 500 Chucuito CALLAO 1 Peru	Tel: +51 1 613 6751/63 6767 Fax: + e-mail: gagurto@dhn.mil.pe gonzaloagurtob@gmail.com
POLAND	**Włodzimierz Krzymiński** Head Department of Oceanography and Baltic Monitoring. Institute of Meteorology and Water Management National Research Institute, Maritime Branch in Gdynia, Waszyngtona 42, 81-342 Gdynia Poland	Tel: + 48 58 6288131 Fax: +48 58 6288163 e-mail: wlodzimierz.krzyminski@imgw.pl
POLAND	**Beata Kowalska** Deputy Head of Hydrological Forecasting Office Institute of Meteorology and Water Management National Research Institute Maritime Branch in Gdynia Waszyngtona 42 81-342 Gdynia Poland	Tel: + 48 58 6288147 Fax: +48 58 6288163 e-mail: beata.kowalska@imgw.pl
PORTUGAL	**Joana Reis** Tidal Section Instituto Hidrográfico (Portuguese Hydrographic Service) Oceanography Division – Tides Rua das Trinas, 49 1249-093 Lisboa Portugal	Tel: + 351 21 094 30 52 Fax: + 351 21 094 32 99 e-mail: joana.reis@hidrografico.pt
PORTUGAL	**Marina Silveira De Serpa** Tidal Section Instituto Hidrográfico (Portuguese Hydrographic Service) Oceanography Division – Tides Rua das Trinas, 49 1249-093 Lisboa Portugal	Tel: + 351 21 094 ?? Fax: + 351 21 094 ?? e-mail: marina.serpa@hidrografico.pt
REPUBLIC OF KOREA	**Jin-Kwang Bouk** Korea Hydrographic and Oceanographic Administration #351 Haeyang-ro Yeongdo-gu Busan 606-806 Republic of Korea	Tel: + 82 51 400 4222 Fax: + 82 51 400 4192 e-mail: jinkwang@korea.kr
REPUBLIC OF KOREA	**Sung-Yong Park** Korea Hydrographic and Oceanographic Administration #351 Haeyang-ro Yeongdo-gu Busan 606-806 Republic of Korea	Tel: + 82 51 400 4233 Fax: + 82 51 400 4192 e-mail: yong0528@korea.kr

REPUBLIC OF KOREA	**Do-Seong Byun** Korea Hydrographic and Oceanographic Administration #351 Haeyang-ro Yeongdo-gu Busan 606-806 Republic of Korea	Tel: + 82 51 400 4390 Fax: + 82 51 400 4192 e-mail: dsbyun@korea.kr
REPUBLIC OF KOREA	**Ji-Min Ko** Korea Hydrographic and Oceanographic Administration #351 Haeyang-ro Yeongdo-gu Busan 606-806 Republic of Korea	Tel: +82 51 400 4382 Fax: +82 51 400 4192 e-mail: jmko124@korea.kr infokhoa@korea.kr
RUSSIAN FEDERATION	**Igor Bonakov**	Tel: + ?? Fax: + ?? e-mail: unio_main@mil.ru
SINGAPORE	**Weng Choy Lee**	Tel: + ?? Fax: + ?? e-mail: lee_weng_choy@mpa.gov.sg
SOUTH AFRICA	**Ruth Farre** Superintendent Tidal Information South African Navy Hydrographic Office Private Bag X1, Tokai, 7966 Republic of South Africa	Tel: +27 21 787 2403 Fax: +27 21 787 2233 E-mail: ruth.farre@sanavy.co.za hydrosan@iafrica.com
SPAIN	**Cdr. José Ramón Torres** Spanish Hydrographic Office Plaza San Severiano 3 11007 – Cadiz Spain	Tel: +34 956 599401 Fax: +34 956 545 347 e- mail: jtorgarc@fn.mde.es oceano@fn.mde.es
SPAIN	**Cdr. Salvador Espinosa** Spanish Hydrographic Office Plaza San Severiano 3 11007 – Cadiz Spain	Tel: +34 956 599401 Fax: +34 956 545 347 e- mail: sespinosa@fn.mde.es oceano@fn.mde.es
SWEDEN	**Lars Jakobsson** Swedish Maritime Administration (SMA) Hydrographic Office Geodetic expert SE-60178 Norrköping Sweden	Tel: + 46 708 191093 (phone + text) Fax: + 46 11 238945 e-mail: lars.jakobsson@sjofartsverket.se
SWEDEN	**Thomas Hammarklint** Swedish Maritime Administration (SMA) Sea Level Expert Hydrographic Office Lindholmspiren 5 SE-41756 Göteborg Sweden	Tel: +46 10 478 5459 Fax: + 46 11 238945 e-mail: thomas.hammarklint@sjofartsverket.se
UKRAINE	**Mykola Golodov** Deputy Head of State Hydrographic Service of Ukraine Gagarina str.23 Kiev 02660 Ukraine	Tel: + 38 44 2924624 Fax: + 38 44 2924624 e-mail: navinf@rambler.ru

UNITED KINGDOM	**Chris Jones** Head of Tides The U.K. Hydrographic Office Admiralty Way Taunton, Somerset, TA1 2DN United Kingdom	Tel : +44 (0) 1823 337900 ext. 3504 Fax : +44 (0) 1823 284077 e-mail: christopher.jones@ukho.gov.uk
URUGUAY		sohmaom@adinet.com.uy
UNITED STATES	**Kurt Hess** NOAA 1305 East-West Highway Station 6515 Silver Spring MD 20910 USA	Tel: +1 301 713 ?? Fax: +1 301 71 3 ?? e-mail: kurt.hess@noaa.gov
UNITED STATES	**Doug Roush**	Tel: +1 ?? Fax: +1 ?? e-mail: NGAMaritimeTWCWG@NGA.mil
UNITED STATES	**Peter Stone** (Vice-Chair TWCWG) Technical Director NOAA/NOS/Centre for Operational Oceanographic Products and Services 1305 East-West Highway Office 6645 Silver Spring MD 20910 USA	Tel: +1 240-533-0546 Fax: +1 301 71 3 ?? e-mail: Peter.stone@noaa.gov
UNITED STATES	**Carl Kammerer** NOAA 1305 East-West Highway Station 6515 Silver Spring MD 20910 USA	Tel: +1 301 713 ?? Fax: +1 301 71 3 ?? e-mail: carl.kammerer@noaa.gov
VENEZUELA (Armada de Venezuela)	**Carlos Murillo** Direccion Hidrografia y Navegación 1A P/Anicie 23 de Enero Observatorio Naval Cagigal Venezuela	Tel: +85 212 5558000 Fax: e-mail: dhn@ifxnw.com.ve carlosmurillo@hotmail.com
VENEZUELA (Armada de Venezuela)	**Bill Ramon Abrew** Direccion Hidrografia y Navegación 1A P/Anicie 23 de Enero Observatorio Naval Cagigal Venezuela	Tel: +85 212 5558000 Fax: e-mail: jocendoc@dhn.mil.ve jbbill@hotmail.com
VENEZUELA (Armada de Venezuela)	**Edward Méndez Araujo** Direccion Hidrografia y Navegación 1A P/Anicie 23 de Enero Observatorio Naval Cagigal Venezuela	Tel: +85 212 4518666 Fax: +85 426 517 8157 e-mail: mendezaraujo@gmail.com
GLOSS		Contact: Thorkild Aarup (t.aarup@unesco.org)
Expert Contributor	**Briana Sullivan** Centre for Coastal and Ocean Mapping, University of New Hampshire, Durham, NH, USA	Tel: +1-978-378-0072 Fax: +1-978-862-0839 e-mail: Briana@ccom.unh.edu

	Edward Weaver W R Systems, Ltd. 2500 Almeda Avenue, Suite #214 Norfolk, VA 23513	Tel: +1 757 858 6000 ext 225 Fax: +1 757 858 6058 e-mail: eweaver@wrsystems.com

TWCWG WORK PLAN 2020-21

Objective

a) To monitor developments related to tidal and water level observation, analysis and prediction and other related information including vertical and horizontal datums;

b) To develop and maintain the relevant IHO standards, specifications and publications for which it is responsible in liaison with the relevant IHO bodies and non-IHO entities;

c) To develop standards for the delivery and presentation of navigationally relevant current information; and

d) To provide technical advice and coordination on matters related to tides, water levels, currents and vertical datum.

Tasks

A	Maintain the list of standard tidal constituents (IHO Task 2.8.4)
B	Compare the tidal predictions generated as a result of analysis of a common data set using different analysis software
~~C~~	~~Develop, maintain and extend a Product Specification for digital tide and tidal current tables (IHO Task 2.3.4)~~
D	Develop, maintain and extend a Product Specification for dynamic surface currents in ECDIS (S-111) (IHO Task 2.3.4)
E	Develop, maintain and extend a Product specification for dynamic water level in ECDIS (S-104) (IHO Task 2.3.4)
F	Liaise with S-100WG on water level and current matters relevant to ECDIS applications (IHO Task 2.3.5)
G	Liaise with industry experts on the development of product specifications for water level and currents
H	Prepare and maintain an inventory of water level gauges and current meters used by Member States and publish it on the IHO/TWCWG web site (IHO Task 2.8.5)
I	Review and maintain the Actual Tides and Currents On-Line links as published on the IHO TWCWG website
J	Maintain and extend the relevant IHO standards, specifications and publications as required (IHO Tasks 2.8.4 and 2.1.8)
K	Conduct the at least annual meetings of TWCWG and its sub-group(s) and project team(s) (IHO Tasks 2.1.2.7)
L	Develop and maintain material for course on Tides, Water Levels and Currents

Work item	**Title**	**Priority** H-high M-medium L-low	**Next milestone**	**Start Date**	**End Date**	**Status** P-planned O-ongoing C-completed S-Superseded	**Contact Person(s)**	**Related Pubs / Standard**	**Remarks**
A.1	Maintain the list of standard tidal constituents	M		-	Permanent	O	Chris Jones* All		Review current list of published tidal constituents
B.1	Compare the tidal predictions generated as a result of analysis of a common data set using different analysis software.	M		-	Permanent	O	Hilde Sande Borck * All		Select Common data set Analyse using different software Predict common set of tides Compare results
~~C.1~~	~~Develop, maintain and extend the standard for digital tide and tidal current tables~~	~~H~~	~~Prepare final draft Standard~~	~~2009~~	~~2016~~ ~~2017~~ ~~2018~~ ~~2019~~	~~O~~ C	~~Peter Stone*~~ ~~Chris Jones~~ ~~Zarina Jayaswal~~		
D.1	Develop and maintain a product specification for dynamic application of surface currents in ECDIS (S-111)	H		2013	~~2017~~ ~~2018~~ 2019	O	Kurt Hess* + List of involved and active members : report TWCWG4 Erin Nagel Stephan D, Luis Becker, Gwenaële Jan, Japan, Ronald Kuilman		Joint project team is established as required. Liaise with S-100WG (see F.1) Liaise with industry experts (see G.1)

Work item	**Title**	**Priority** H-high M-medium L-low	**Next milestone**	**Start Date**	**End Date**	**Status** P-planned O-ongoing C-completed S-Superseded	**Contact Person(s)**	**Related Pubs / Standard**	**Remarks**
E.1	Develop and maintain a product specification for dynamic application of water levels in ECDIS	H	Develop draft Product Specifications (S-104) for water level information for surface navigation in S-100.	2009	~~2017~~ ~~2018~~ ~~2019~~ 2020	O	Zarina Jayaswal* Glen Rowe Jimin Ko + Llist of MS involved : TWCWG4 report		Joint project team is established as required. Liaise with S-100WG (see F.1) Liaise with industry experts (see G.1)
F.1	Liaise with S-100WG on water level and current matters relevant to ECDIS applications	H		-	Permanent	O	Gwenaële Jan Kurt Hess Zarina Jayaswal		Joint project team is established as required.
G.1	Liaise with industry experts on the development of product specifications for water levels and currents	H		-	Permanent	O	All		
H.1	Maintain an inventory of water level gauges and current meters used by Member States and publish it on the IHO/TWCWG web site.	H		-	Permanent	O	David Wyatt* All		Initial inventory from TWCWG members available on IHO web site.

Work item	Title	Priority H-high M-medium L-low	Next milestone	Start Date	End Date	Status P-planned O-ongoing C-completed S-Superseded	Contact Person(s)	Related Pubs / Standard	Remarks
I.1	Review and maintain the Actual Tides and Currents On-Line links as published on the IHO/TWCWG website	L		-	Permanent	O	David Wyatt* All		
J.1	Maintain and extend the relevant IHO standards, specifications and publications	M		-	Permanent	O	Gwenaële Jan* Peter Stone All	S-60 User's Handbook on Datum Transformations involving WGS 84	See IHO CL10/2017 dated 1/02/2017
J.2	Maintain IHO resolutions	H		2019	2020	O	Ruth Farre* All	IHO Resolutions in M-3	
L.1	Develop and maintain material for CB course on Tides and Tide gauges	H	Complete translate of course material into Spanish and Portuguese by 2018 in liaison with Regional CB Coordinator requirements	-	Permanent	O	Ruth Farre* Peter Stone Zarina Jayaswal Gwenaële Jan Cesar Borba José Ramón Torres García		Adapt currently available course material to create a course suitable for delivery in support of CBSC requests

Meetings (Task K)

Date	Location	Activity
25-29 April 2016	Niterói, Brazil	TWCWG-1
8-12 May 2017	Victoria, Canada	TWCWG-2
16-20 April 2018	Viña del Mar, Chile	TWCWG-3
8-12 April 2019	Busan, Republic of Korea	TWCWG-4
25-28 May 2020	Stavanger, Norway	TWCWG-5
tbc 2021	Cape Town, South Arica (tbc)	TWCWG-6

Chair: Gwenaële Jan (France) Email: gwenaele.jan@shom.fr
Vice Chair: Peter Stone (USA) Email: peter.stone@noaa.gov
Secretary: David Wyatt (IHO) Email: adso@iho.int

Tides, Water Level and Currents Working Group (TWCWG)

Terms of Reference and Rules of Procedure

References: *6th HSSC Meeting (Viña del Mar, Chile, November 2014)*
7th HSSC Meeting (Busan, Republic of Korea, November 2015)

1. Objective

e) To provide technical advice and coordination on matters related to tides, water levels, currents, relevant oceanographic data and vertical datum, including integrated water level/current data models.

f) To support the development and maintenance of related specifications in liaison with the relevant IHO bodies and non-IHO entities;

g) To develop and maintain the IHO publications for which the WG is responsible.

2. Authority

This WG is a subsidiary of the Hydrographic Services and Standards Committee (HSSC). Its work is subject to HSSC approval.

3. Composition and Chairmanship

a) The WG shall comprise representatives of IHO Member States (MS), Expert Contributors (EC), observers from accredited NGIO, and a representative of the IHO Secretariat. A membership list shall be maintained and posted on the IHO website.

b) EC membership is open to entities and organizations that can provide a relevant and constructive contribution to the work of the WG.

c) The Chair and Vice-Chair shall be a representative of a MS. The election of the Chair and Vice-Chair shall be decided at the first meeting after each ordinary session of the Assembly and shall be determined by vote of the MS present and voting.

d) If a secretary is required it should normally be drawn from a member of the WG.

e) If the Chair is unable to carry out the duties of the office, the Vice-Chair shall act as the Chair with the same powers and duties.

f) ECs shall seek approval of membership from the Chair.

g) EC membership may be withdrawn in the event that a majority of the MS represented in the WG agrees that an EC's continued participation is irrelevant or unconstructive to the work of the WG.

h) All members shall inform the Chair in advance of their intention to attend meetings of the WG.

i) In the event that a large number of EC members seek to attend a meeting, the Chair may restrict attendance by inviting ECs to act through one or more collective representatives.

4. Procedures

a) The WG should:

(i) monitor and develop the use of tidal, water level, current information and relevant oceanographic data including integrated water level/current data models;

(ii) advise on the use of vertical datums;

(iii) advise on tidal, water level and current observation, analysis and prediction;

(iv) advise on matters concerning exchange, distribution and use of tidal, water level, current

information and relevant oceanographic data related data/information;

(v) study principles and contribute to the development of improved methods for conveying tidal, water level, current information and relevant oceanographic data to mariners and other users;

(vi) keep under review the relevant IHO publications and resolutions in order to advise HSSC on their updating;

(vii) draft or revise guidance document(s), resolutions and specifications as appropriate and as instructed by HSSC; and

(viii) consider new related topics as instructed by HSSC and advise HSSC accordingly.

b) The WG should work by correspondence, teleconferences, group meetings, workshops or symposia. The WG should meet about once a year. When meetings are scheduled, and in order to allow any WG submissions and reports to be submitted to HSSC on time, WG meetings should not normally occur later than nine weeks before a meeting of the HSSC.

c) Decisions should generally be made by consensus. If votes are required on issues or to endorse proposals presented to the WG, only MS may cast a vote. Votes at meetings shall be on the basis of one vote per MS represented at the meeting. Votes by correspondence shall be on the basis of one vote per MS represented in the WG.

d) The date and venue of group meetings shall normally be announced by the Chair at least six months in advance.

e) The draft record of meetings shall be distributed by the Chair (or the secretary) within six weeks of the end of meetings and participants' comments should be returned within three weeks of the date of despatch. Final minutes of meetings should be posted on the IHO website within three months after a meeting.

f) Sub-working groups and project teams may be created by the WG or proposed to HSSC to undertake detailed work on specific topics. The terms of reference and rules of procedure of the sub-working groups and project teams are determined or proposed by the WG as appropriate.

g) The WG should liaise with other IHO bodies, international organizations and industry to ensure the relevance of its work.

h) The WG should prepare annually a report on its activities and a rolling two-year work plan, including expected time frame.

TITLE	Reference	Last amendment (CL or IHC)	1st Edition Reference
Digital Tide and Tidal Current Tables.	**XX/2019**	**Draft**	**Ver 2.0**

NOTE: Items in red still need clarification and approval by the working group members.

1 It is resolved that member Hydrographic Organizations (HO) may choose to publish their tide and tidal current tables in either paper format or digitally. If digitally, they can be distributed either through the HO's web site, or representative complement or via portable media such as a DVD.

General Guidelines for Digital Tide and Tidal Current Tables

2 It is resolved that digital tide and tidal current tables should adhere to all the same requirements as existing paper tide and tidal current tables as specified in IHO Programme 2 "Hydrographic Services and Standards" Section 2.2 – Tides and Water Levels

3 It is resolved that the issuing office should provide documentation on how to install or read the electronic tables, minimum computer specifications how to obtain product support and general information on the Digital Tide and Tidal Current Tables. This information should be provided in either hardcopy written form (for example, on a separate sheet of paper or on the cover of the disk or other media), or electronically in a plain ASCII text 'readme.txt' type of file. This file should also include user license and/or condition of use information.

4 It is resolved that the issuing office should provide its formal name, mailing address; web url and point of contact information on the cover of the media. It should also provide information on the production of the tables (including both address and website), information on how to obtain annual updates, and how to obtain interim updates or errata information.

5 It is resolved that the digital tide and tidal current tables should include a statement concerning the standing of the digital tables as meeting the applicable maritime regulations, either SOLAS and/or local country carriage requirements.

Formats for Digital Tide and Tidal Current Tables

6 It is resolved that there shall be two allowable formats for digital tide and tidal current tables.

A. Scanned Images of Tide and Tidal Current Tables: This format consists of scanned images of the paper tide tables. This format should have the following attributes.

B. Electronically generated Tide and Tidal Current Predictions: This format consists of software and a user interface that calculates tide and tidal current predictions from stored harmonic constituents or time and range offsets.

Detailed Specifications for Digital Tide Tables – Scanned Images of Tide Tables:

7 It is resolved that Scanned Images of Tide Tables should follow the following specifications.

a. Should be a faithful reproduction of all the pages of printed tide tables.

b. The images should be formatted in a widely available, common format. Examples formats include, but not limited to, PDF, tiff, Jpeg, Gif. If PDF files are provided, then information on how to download Adobe© Reader must be provided.

c. If multiple books are published, then each book should be located within its own folder and clearly identified.

d. No modification of the scanned images is permitted by users.

Detailed Specifications for Digital Tide Tables – Electronically Generated Tide Predictions

8 It is resolved that Electronically Generated Tide Predictions should follow the following specifications:

a. Station Selection: It is recommended that station selections can either be map based or list based, and should be organized by water body.

b. Station Information: It is recommended that the following information be included with each station;
Station Name and Number (or ID) as appropriate
Body of Water Descriptor (if appropriate)
Latitude and Longitude (degrees:min:sec and tenths? or decimal equivalent using GIS convention with western and southern hemispheres as being negative latitude and longitude)
Horizontal and Vertical Datum convention
Location Map with nearby prediction stations identified
URL to station or data portal.

c. It is recommended that Earth-Moon-Sun Astronomical Calendar Information (Tabular and/or integrated with graphical data output) be included.

d. It is recommended that Sunrise/Sunset Calendar Information (Tabular and/or integrated with graphical data output)

e. It is recommended that the default reference datum is the Chart Datum used by the Country furthermore, it is recommended that the user have the ability to reference predictions to other tidal datums supported by the HO (such as LAT, HAT, MHW, MSL) and user identified datums such as a national geodetic or ellipsoidal datum or other coastal engineering or threshold datums that are pertinent.

f. It is recommended that data displays and tables can be toggled to both in Metric or English units, with default depending upon country

g. It is recommended that the time displayed is the legal local time as default, with user selected option for UTC/GMT, daylight savings time, etc. Legal time includes daylight savings time if applicable. Furthermore, when time zone information is displayed it should follow the convention that negative time zone offsets are used for east longitude and positive offsets for west longitude.

h. It is recommended that the following tide prediction source metadata information be provided;
Harmonic Constituents or Time and Range Correction to Reference Station,
Dates of Harmonic Analyses time series used to create the set of Harmonic Constituents used in the prediction,
Dates of the observations used to create time and height corrections (for nonharmonic based predictions) to a reference Station,
Links to the list of the Harmonic Constituents used in the Prediction. Furthermore, the display of the Harmonic Constituents should adhere to the IHO National Tidal Constituent Banks Resolution 2/1977 as amended 42/2000 A6.8
The name of the Harmonic Analysis program used to generate the harmonic constituents.

i. It is recommended that the HO provide and display tidal sea level amplitude prediction with a minimum of 4 decimals precision (for metric system) if possible.

j. It is recommended that users have the ability to obtain output in common formats such as PDF, TXT, XML, CSV, S-112 single point formats

k. It is recommended that additional information be provide special warning explaining areas of anomalous tidal conditions, special datums, or tidal based hazards to navigations (dual high or low waters, tidal bores, river flow dependencies and river datums, frequent non-tidal conditions, etc..)

l. It is recommended, when applicable, that estimates of uncertainty in the predicted times and heights of high and low waters be provided to users.

Detailed Specifications for Graphical Display of Electronic Tide Predictions

9 It is resolved that the predictions have the ability to obtain graphical and tabular output for desired time period (either historical and into the future) and should contain the following attributes with the objective not to prescribe a specific graphical view but rather to identify common elements that transcend all types of graphs:

a It is recommend that the predictions can be displayed as discrete points or a continuous curve using a curve fit routine to times and heights of high and low waters or to the time series values.

b It is recommended that all axes should be clearly labelled

c It is recommended that time series data should have a minimum, 1- hour increments

d It is recommended that times and heights of predicted high and low tides should be provided

e It is recommended that the default datum should be the same as chart datum for the location of the prediction

f It is recommended that the tidal height units default should be the same as the HO's printed tables

g It is recommended that the display should include station information (as defined above)

h It is recommended that the display include the name and/or the insignia of the source authority organization

i It is recommended that the display should have the option to view the tide prediction numerical values used to create the graphic.

j It is recommended that the display of the graphical data should be able to be adjusted to suit daytime, twilight, and night time viewing

Detailed Specifications for Digital Tidal Current Tables

10 It is resolved that Digital Tidal Current Tables can be in the same two formats as Digital Tide Tables and the same requirements that apply to digital tide tables pertain to tidal current tables.

11 It is resolved that electronically generated Tidal Current Predictions do have additional specifications as identified:

a It is recommended that the depth of prediction be included in the metadata and include a the descriptor that the depth is either from the surface down or from the bottom up

b It is recommended, if applicable, flood and ebb current direction (referenced to True North) be presented.

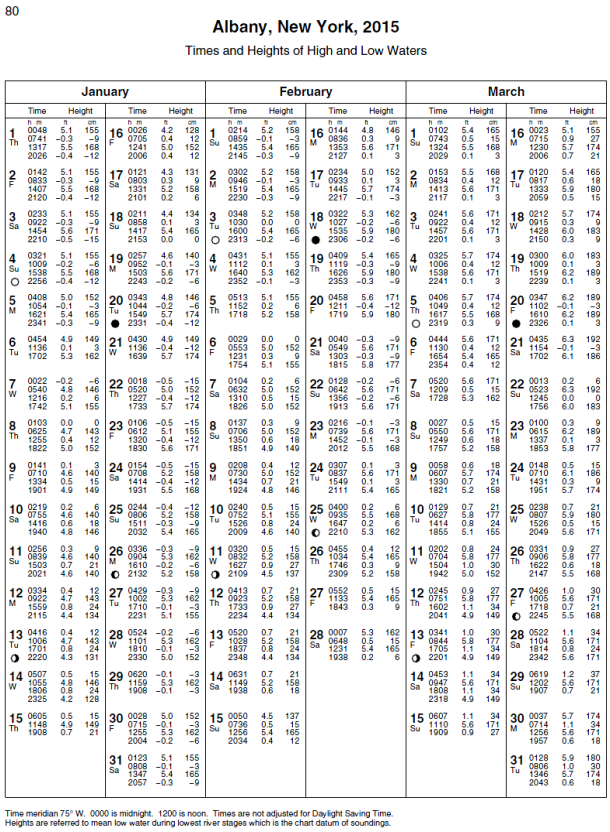
c It is recommended that for graphical display of tidal currents the default speed units should be knots

d It is recommended that for graphical display of tidal currents the default direction units should be degrees (referenced to true north).

Below are examples of Digital Tide Tables. I do not know if they can be included in the IHO Resolution.

USA - NOAA Example

Scanned Tide Table



80

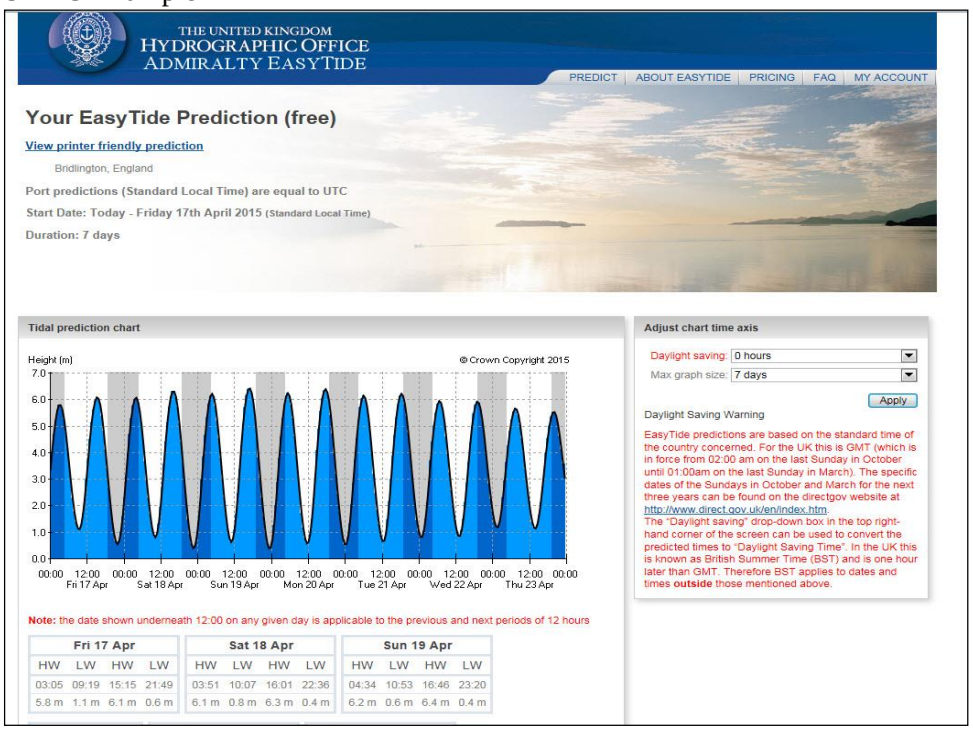
Albany, New York, 2015

Times and Heights of High and Low Waters

January				February				March			
Time	Height	Time	Height	Time	Height	Time	Height	Time	Height	Time	Height
h m	ft cm	h m	ft cm	h m	ft cm	h m	ft cm	h m	ft cm	h m	ft cm
1 0048 5.1 155 Th 0741 -0.3 -9 1317 5.5 168 2026 -0.4 -12	16 0026 4.2 128 F 0705 0.4 12 1241 5.0 152 2006 0.4 12	1 0214 5.2 158 Su 0859 -0.1 -3 1435 5.4 165 2145 -0.3 -9	16 0144 4.8 146 M 0836 0.3 9 1353 5.6 171 2127 0.1 3	1 Su 0102 5.4 165 0743 0.5 15 1324 5.5 168 2029 0.1 3	16 M 0023 5.1 155 0715 0.9 27 1230 5.7 174 2006 0.7 21
2 0142 5.1 155 F 0833 -0.3 -9 1407 5.5 168 2120 -0.4 -12	17 0121 4.3 131 Sa 0803 0.3 9 1331 5.2 158 2101 0.2 6	2 0302 5.2 158 M 0946 -0.1 -3 1519 5.4 165 2230 -0.3 -9	17 0234 5.0 152 Tu 0933 0.1 3 1445 5.7 174 2217 -0.1 -3	2 M 0153 5.5 168 0834 0.4 12 1413 5.6 171 2117 0.1 3	17 Tu 0120 5.4 165 0817 0.6 18 1333 5.9 180 2059 0.5 15
3 0233 5.1 155 Sa 0922 -0.3 -9 1454 5.6 171 2210 -0.5 -15	18 0211 4.4 134 Su 0858 0.1 3 1417 5.4 165 2153 0.0 0	3 0348 5.2 158 Tu 1030 0.0 0 1600 5.4 165 2313 -0.2 -6	18 0322 5.3 162 W 1027 -0.2 -6 1535 5.9 180 2306 -0.2 -6	3 Tu 0241 5.6 171 0922 0.4 12 1457 5.6 171 2201 0.1 3	18 W 0212 5.7 174 0915 0.3 9 1428 6.0 183 2160 0.3 9
4 0321 5.1 155 Su 1009 -0.2 -6 1538 5.5 168 2256 -0.4 -12	19 0257 4.6 140 M 0952 -0.1 -3 1503 5.6 171 2243 -0.2 -6	4 0431 5.1 155 W 1112 0.1 3 1640 5.3 162 2352 -0.1 -3	19 0409 5.4 165 Th 1119 -0.3 -9 1626 5.9 180 2353 -0.3 -9	4 W 0325 5.7 174 1006 0.4 12 1538 5.6 171 2241 0.1 3	19 Th 0300 6.0 183 1009 0.1 3 1519 6.2 189 2239 0.1 3
5 M 0408 5.0 152 1054 -0.1 -3 1621 5.4 165 2341 -0.3 -9	20 Tu 0343 4.8 146 1044 -0.2 -6 1549 5.7 174 2331 -0.4 -12	5 Th 0513 5.1 155 1152 0.2 6 1718 5.2 158	20 F 0458 5.6 171 1211 -0.4 -12 1719 5.9 180	5 Th 0406 5.7 174 1049 0.4 12 1617 5.5 168 2319 0.3 9	20 F 0347 6.2 189 1102 -0.1 -3 1610 6.2 189 2326 0.1 3
6 Tu 0454 4.9 149 1136 0.1 3 1702 5.3 162	21 W 0430 4.9 149 1136 -0.4 -12 1639 5.7 174	6 F 0029 0.0 0 0553 5.0 152 1231 0.3 9 1754 5.1 155	21 Sa 0040 -0.3 -9 0549 5.6 171 1303 -0.3 -9 1815 5.8 177	6 F 0444 5.6 171 1130 0.4 12 1654 5.4 165 2354 0.4 12	21 Sa 0435 6.3 192 1154 -0.1 -3 1702 6.1 186
7 W 0022 -0.2 -6 0540 4.8 146 1216 0.2 6 1742 5.1 155	22 Th 0018 -0.5 -15 0520 5.0 152 1227 -0.4 -12 1733 5.7 174	7 Sa 0104 0.2 6 0632 5.0 152 1310 0.5 15 1826 5.0 152	22 Su 0128 -0.2 -6 0642 5.6 171 1356 -0.2 -6 1913 5.6 171	7 Sa 0520 5.6 171 1209 0.5 15 1728 5.3 162	22 Su 0013 0.2 6 0523 6.3 192 1245 0.0 0 1756 6.0 183
8 Th 0103 0.0 0 0625 4.7 143 1255 0.4 12 1822 5.0 152	23 F 0106 -0.5 -15 0612 5.1 155 1320 -0.4 -12 1830 5.6 171	8 Su 0137 0.3 9 0706 5.0 152 1350 0.6 18 1851 4.9 149	23 M 0216 -0.1 -3 0739 5.6 171 1452 -0.1 -3 2012 5.5 168	8 Su 0027 0.5 15 0550 5.6 171 1249 0.6 18 1757 5.2 158	23 M 0100 0.3 9 0615 6.2 189 1337 0.1 3 1853 5.8 177
9 F 0141 0.1 3 0710 4.6 140 1334 0.5 15 1901 4.9 149	24 Sa 0154 -0.5 -15 0708 5.2 158 1414 -0.4 -12 1931 5.5 168	9 M 0208 0.4 12 0750 5.0 152 1434 0.7 21 1924 4.8 146	24 Tu 0307 0.1 3 0837 5.6 171 1549 0.1 3 2111 5.4 165	9 M 0058 0.6 18 0607 5.7 174 1330 0.7 21 1821 5.2 158	24 Tu 0148 0.5 15 0710 6.1 186 1431 0.3 9 1951 5.7 174
10 Sa 0219 0.2 6 0755 4.6 140 1416 0.6 18 1940 4.8 146	25 Su 0244 -0.4 -12 0806 5.2 158 1511 -0.3 -9 2032 5.4 165	10 Tu 0240 0.5 15 0752 5.1 155 1526 0.8 24 2009 4.6 140	25 W 0400 0.2 6 0935 5.5 168 1647 0.2 6 2210 5.3 162	10 Tu 0129 0.7 21 0627 5.8 177 1414 0.8 24 1855 5.1 155	25 W 0238 0.7 21 0807 5.9 180 1526 0.5 15 2049 5.6 171
11 Su 0256 0.3 9 0839 4.6 140 1503 0.7 21 2021 4.6 140	26 M 0336 -0.3 -9 0904 5.3 162 1610 -0.2 -6 2132 5.3 158	11 W 0320 0.5 15 0832 5.2 158 1627 0.9 27 2109 4.5 137	26 Th 0455 0.4 12 1034 5.4 165 1746 0.3 9 2309 5.2 158	11 W 0202 0.8 24 0704 5.8 177 1504 1.0 30 1942 5.0 152	26 Th 0331 0.9 27 0906 5.8 177 1622 0.6 18 2147 5.5 168
12 M 0334 0.4 12 0922 4.7 143 1559 0.8 24 2115 4.4 134	27 Tu 0429 -0.3 -9 1002 5.3 162 1710 -0.1 -3 2231 5.1 155	12 Th 0413 0.7 21 0923 5.2 158 1733 0.9 27 2234 4.4 134	27 F 0552 0.5 15 1133 5.4 165 1843 0.3 9	12 Th 0245 0.9 27 0751 5.8 177 1602 1.1 34 2041 4.9 149	27 F 0426 1.0 30 1005 5.6 171 1718 0.7 21 2245 5.5 168
13 Tu 0416 0.4 12 1006 4.7 143 1701 0.8 24 2220 4.3 131	28 W 0524 -0.2 -6 1101 5.3 162 1810 -0.1 -3 2330 5.0 152	13 F 0520 0.7 21 1028 5.2 158 1837 0.8 24 2348 4.4 134	28 Sa 0007 5.3 162 0648 0.5 15 1231 5.4 165 1938 0.2 6	13 F 0341 1.0 30 0844 5.8 177 1705 1.1 34 2201 4.9 149	28 Sa 0522 1.1 34 1104 5.6 171 1814 0.8 24 2342 5.6 171
14 W 0507 0.5 15 1055 4.8 146 1806 0.8 24 2325 4.2 128	29 Th 0620 -0.1 -3 1159 5.3 162 1908 -0.1 -3	14 Sa 0631 0.7 21 1149 5.2 158 1938 0.6 18		14 Sa 0453 1.1 34 0947 5.6 171 1808 1.1 34 2318 4.9 149	29 Su 0619 1.2 37 1202 5.6 171 1907 0.7 21
15 Th 0605 0.5 15 1148 4.9 149 1908 0.7 21	30 F 0028 5.0 152 0715 -0.1 -3 1255 5.3 162 2004 -0.2 -6	15 Su 0050 4.5 137 0736 0.5 15 1256 5.4 165 2034 0.4 12		15 Su 0607 1.1 34 1110 5.6 171 1909 0.9 27	30 M 0037 5.7 174 0714 1.1 34 1256 5.6 171 1957 0.6 18
	31 Sa 0123 5.1 155 0808 -0.1 -3 1347 5.4 165 2057 -0.3 -9				31 Tu 0128 5.9 180 0806 1.0 30 1346 5.7 174 2043 0.6 18

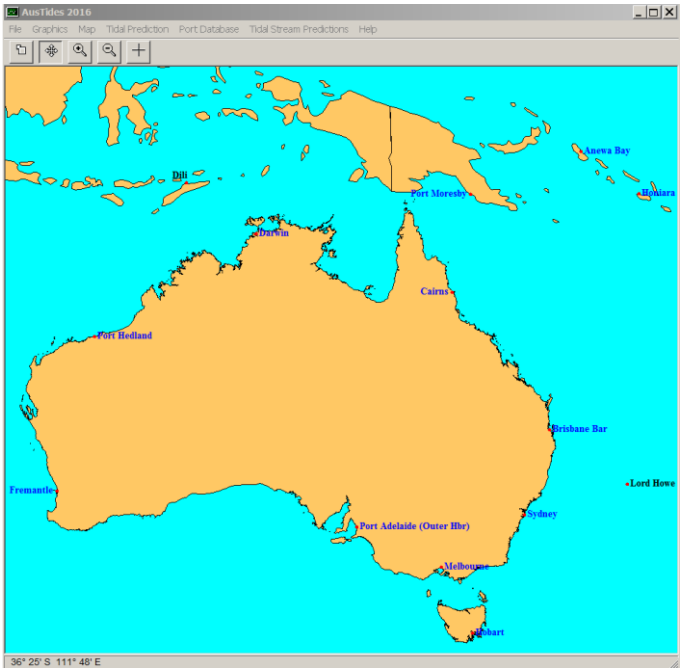
Time meridian 75° W. 0000 is midnight. 1200 is noon. Times are not adjusted for Daylight Saving Time.
Heights are referred to mean low water during lowest river stages which is the chart datum of soundings.

UKHO Example



Australian Example

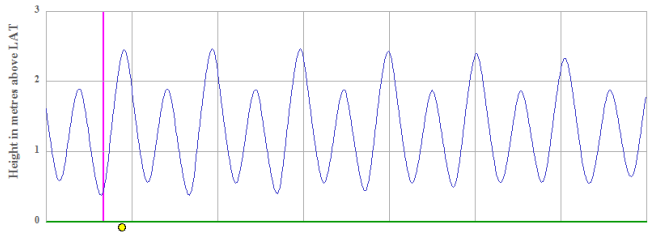
Up-date: 15 April 2019



BRISBANE BAR

Local Standard Time Zone: -10:00 U.T. | **27° 22' S 153° 10' E** | **Year 2016**

PREDICTION DATUM below MSL: 1.31 (m) | **Port 59980**



16:00 0.4m

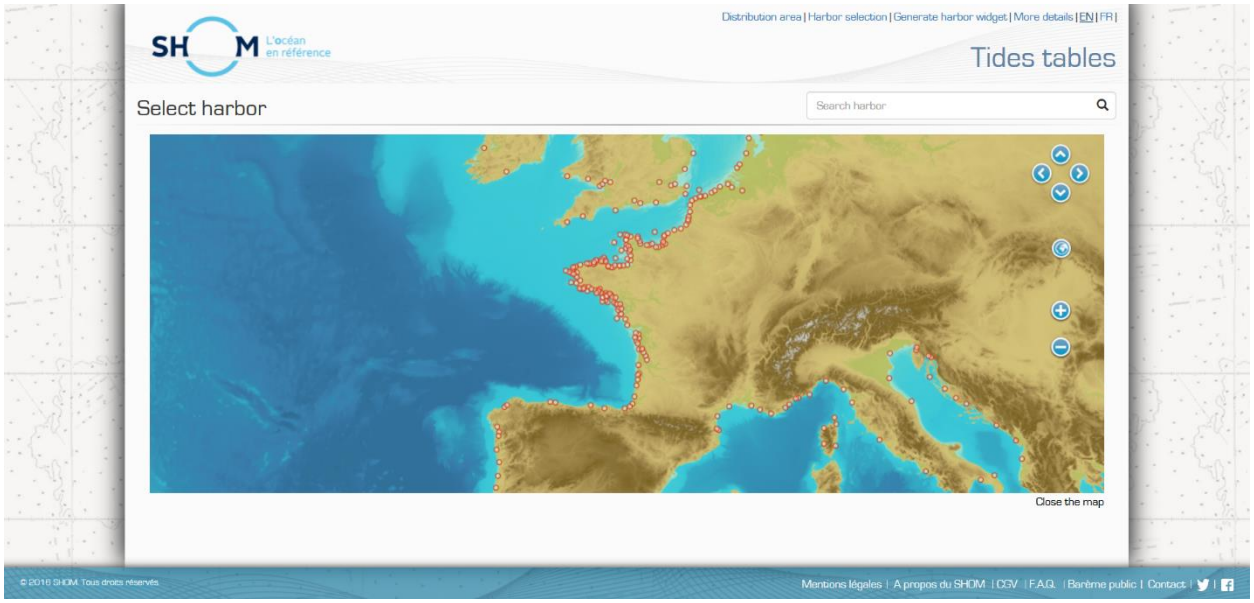
Jun 20 Mo		21 Tu		22 We		23 Th		24 Fr		25 Sa		26 Su	
Time	m	Time	m	Time	m	Time	m	Time	m	Time	m	Time	m
0343	0.6	0423	0.6	0503	0.5	0543	0.5	0624	0.5	0024	2.4	0109	2.3
0911	1.9	0951	1.9	1032	1.9	1115	1.9	1200	1.9	0707	0.5	0755	0.5
1520	0.4	1557	0.4	1635	0.4	1713	0.4	1755	0.5	1250	1.9	1347	1.9
2150	2.4	2227	2.5	2304	2.5	2343	2.4			1843	0.6	1939	0.6

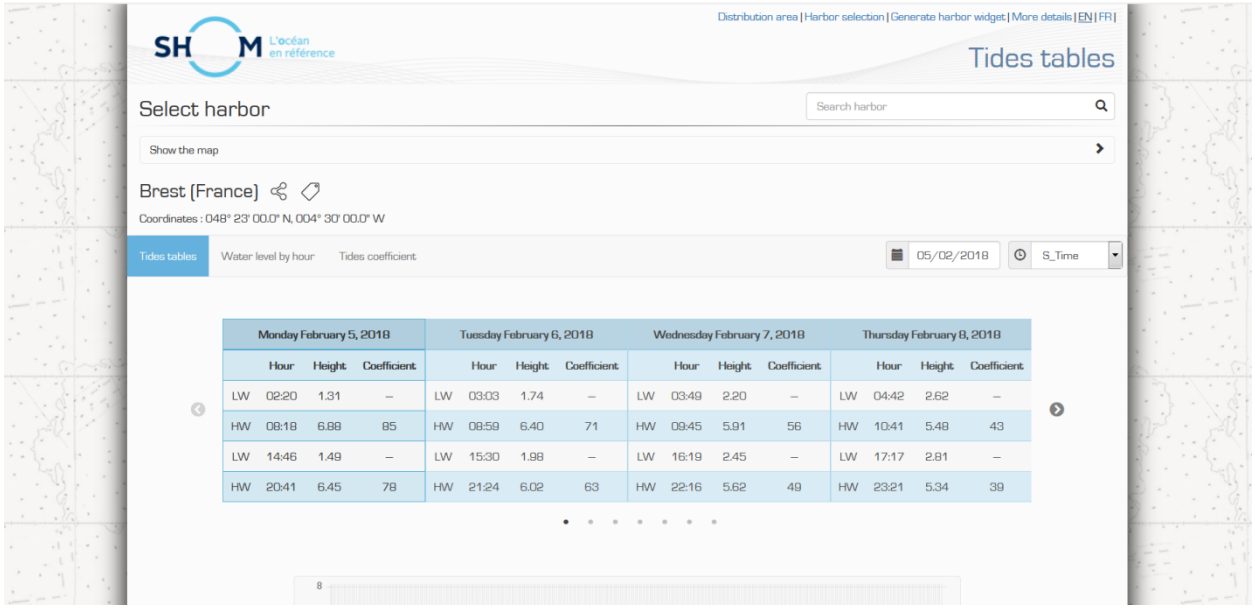
Moon phases supplied by Sydney Observatory

No account is taken of Daylight Saving Time

These predictions are identical to those published in ANTT and can thus be used as an official navigational publication.
Prediction Datum is LAT, which may not be Chart Datum. Correction to Chart Datum can be found at:
Level / To Chart Datum Corrections and Zero of Predictions Window.

Example from SHOM (France)





Monday February 5, 2018				Tuesday February 6, 2018				Wednesday February 7, 2018				Thursday February 8, 2018			
	Hour	Height	Coefficient		Hour	Height	Coefficient		Hour	Height	Coefficient		Hour	Height	Coefficient
LW	02:20	1.31	–	LW	03:03	1.74	–	LW	03:49	2.20	–	LW	04:42	2.62	–
HW	08:18	6.88	85	HW	08:59	6.40	71	HW	09:45	5.91	56	HW	10:41	5.48	43
LW	14:46	1.49	–	LW	15:30	1.98	–	LW	16:19	2.45	–	LW	17:17	2.81	–
HW	20:41	6.45	78	HW	21:24	6.02	63	HW	22:16	5.62	49	HW	23:21	5.34	39


8
6
4
2
0
hauteur d'eau (m)
4m
05:05 - 3.95m
11:40 - 3.96m
17:35 - 3.98m
23:55 - 3.96m
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
23:55
Standard time
You can display the water level to a given hour (Water level option) or the hours according to a treshold (Treshold option).
Click on the chart to put a line (keep the mouse pressed to move the line) or enter a value in the following field
Water level
Treshold
None
4
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DQWG14-05D

Paper for Consideration by Data Quality Working Group

Data Quality – a shared interest between chart producer and user

Submitted by:	DQWG - Chair
Executive Summary:	Informative paper describing the need for positional data quality within the marine environment.
Related Documents:	DQWG ToR, Global Positioning System Standard Positioning Service Performance Standard (www.gps.gov), IERS Technical Note No.36, www.igs.org, S-52 Presentation Library Ed.4.0.2, correspondence from shipping industry, S-102 Ed.2.0.0, S-44 Ed 5.0.0, IMO Resolution A893.(21) Annex 25 Guidance for voyage planning, HSSC10/47
Related Projects:	S-97, Satellite derived bathymetry, Crowd sourced bathymetry, S-1xx standards, high density ENC's.

Introduction / Background

A principal aim of the IHO is to ensure that all the world's seas, oceans and navigable waters are surveyed and charted. The mission of the IHO is to create a global environment in which States provide adequate and timely hydrographic data, products and services and ensure their widest possible use. This paper will demonstrate the need for data quality, mainly focussed on positional accuracy, to achieve these goals.

Analysis/Discussion

Positional Accuracy is defined as the accuracy of the position of features within a spatial reference system. It consists of three data quality elements:

- absolute or external accuracy – closeness of reported coordinate values to values accepted as or being true;
- relative or internal accuracy – closeness of the relative positions of features in a dataset to their respective relative positions accepted as or being true;
- gridded data positional accuracy – closeness of gridded data spatial position values to values accepted as or being true.

1. ENC production

Hydrographic Offices produce and distribute Electronic Navigational Charts (ENC's). These are critical to the safety of navigation and life at sea, environmental protection, including the protection of vulnerable marine ecosystems, and the economics of the global shipping industry. ENC's provide data and information that can be used for sustainable fisheries activities and other sectoral uses of the marine environment, the delimitation of maritime boundaries and environmental protection. Under the International Convention for the Safety of Life at Sea, 1974, ships on international voyages are required to carry an electronic chart display and information system. So what positional accuracy levels have to be achieved to reach these goals?

2. End user perspective

From the end user perspective, the positional accuracy of the ENC has to be at least as good as the primary positioning, navigation and timing device used. Otherwise, a false sense of security will arise when its position is displayed on screen with a less accurate ENC. The US government has since 1978 provided a space-based radionavigation system owned by the US government and operated by the US Air Force. An unlimited number of users with a civil or military GPS receiver can determine accurate time and location, in any weather, day or night, anywhere in the world. The accuracy from satellite to end user (user range error) has improved over the years from 30m to 7m (95% confidence interval). The resulting horizontal positional uncertainty (95% CI) for the user position is now in the range from 30m to 5m depending on the type and age of the GPS receiver used. New systems like GLONASS, Galileo and Beidou may improve its position and/or redundancy.