4th Tidal, Water Level and Currents Working Group Meeting

Shilla Stay Haeundae, Busan, Republic of Korea
8 - 11 April 2019

(Paragraph numbering is the same as the Agenda Item numbering and does not necessarily reflect the order in which matters were discussed. ISO three letter country codes have been used to identify individual participants)

1. Opening

1.1 The Chair, Dr Gwenaële Jan (France), welcomed all to the meeting. She thanked KHOA for hosting the two meetings and for the excellent organization. She encouraged all to take the opportunity to interact and engage across the two groups. She thanked the IHO and IOC Secretariats for promoting the idea of a collocated meeting and for then bringing it to fruition. She highlighted the important stage at which the S-104 and S-111 Production Specifications (PS) developments had reached and the need for input and discussion to take them forward. She thanked the IHO and IOC for arranging the beneficial opportunity of the joint meeting TWCWG and GLOSS creating prospects for greater international cooperation between the two groups of experts. She highlighted the need for tools to test use cases on surface current and water level product specifications and reminded all on the timeline for S-104 in the S-100 environment.

1.2 Mr Huh Yong, Director Oceanographic Forecast Division – KHOA, welcomed all on behalf of the KHOA. He then provided details of logistics and the general programme. He finished by highlighting the importance of standards and information commonality.

1.3 David Wyatt (IHO), on behalf the Secretary General of the IHO and Director Abri Kampfer (Director Programme 2), thanked the KHOA for hosting the meeting and providing a high level of support and excellent facilities. IHO provided a brief introduction presentation on the structure of the IHO, explaining where the TWCWG fitted into the information flow and the interaction between the various technical WGs and the HSSC. This generated a number of questions on the process for resolution and PS approvals.

He highlighted the work that had been progressed on the S-100 based PS since the last meeting (TWCWG3). He also noted the other work items, which were being progressed, encouraged all participants to remain engaged and to contribute to the collective efforts of the WG.

The Chair endorsed these sentiments and highlighted a need for continued active engagement by the TWCWG members during and between meetings to progress actions and WP items.

The Chair , noted the large number of participants – representing Australia (AUS), Brazil (BRA), Canada (CAN), Chile (CHL), China (CHN), Colombia (COL), Finland (FIN), France (FRA), Germany (DEU), India (IND), Indonesia (IDN), Japan (JPN), Netherlands (NLD), Norway (NOR), Perú (PER), Republic of Korea (KOR), South Africa (ZAF), Spain (ESP), Sweden (SWE), United Kingdom (GBR), USA (NOAA-OCS, NGA) and invited expert contributors from IOC of UNESCO, CCOM/JHC-UNH, JIMAR-UHSLC, LIENSs and LEGOS – see Annex A.

2. Administrative Arrangements

2.1 The Secretary introduced the Agenda which was adopted, Annex B. He reported that apologies for non-attendance had been received from Glen Rowe (NZL) and Greg Seroka (NOAA-OCS).

2.2 The draft timetable was introduced, it was explained that this was intended for guidance only and was not intended to be a rigid structure. Where necessary time spent on individual topics would be amended to allow an appropriate discussion; see list of documents at Annex C.

2.3 KOR provided a short brief covering the extracurricular activities and the visit to the KHOA offices and the Busan Tidal Station.

2.4 The Chair provided details of the interaction with other IHO subordinate bodies. She highlighted exchanges with NIPWG, DQWG, HDWG and the S-100WG. The Chair provided an update on the report to HSSC10 and highlighted the outcomes of the meeting relevant to the TWCWG. She highlighted the outstanding issues which need to be addressed, main focus was on the ongoing development of the S-104 and S-111 PS and the provision of compatible datasets by various TWCWG members. She also highlighted the work being undertaken on the development of the VRF within the NSHC TWG and the increased intersessional interaction with various external bodies, particularly the IOC GLOSS-GE. She noted the work being undertaken for data archaeology and the recovery of historical tide data. The challenges and problems raised to HSSC10 were noted, which included the need for more S-104 and S-111 compatible datasets to allow more widespread and varied testing of the draft PS.

2.5 The Action List from TWCWG3 was reviewed, it was noted that the majority outstanding items were covered in the agenda for the meeting and it was agreed these should be taken under their appropriate agenda item. The Secretary reiterated the need for all those leading on actions to keep the Chair, vice-Chair and IHO informed of progress and completions, so that the Action List can be kept up-dated intersessionally. A new list of Action Items would be prepared for the meeting, Annex D.

The Secretary encouraged all to contribute to the progress of agenda item actions and to regularly check the website for new items and information.

3. Product Specification Presentations

3.1 S-104 update and progress report. Zarina Jayaswal (AHO) provided a presentation on the recent progress on the S-104 PS since TWCWG3. She provided examples of the difference the provision of high density data made to the available navigable water and the flexibility available by using ENCs focused on the navigation channel rather than maintain traditional paper sheet size and orientation. She asked whether there was a requirement to provide graphic displays of Predicted, Observed and Forecast values. Jyrki Mononen (TRAFICOM) asked for clarification on the use of the null value, Thomas Hammarklint (SMA) noted that the range 0.2 to -0.2 was too large for use in the Baltic Sea area. CCOM-JHC/UNH highlighted the need to consider the interoperability issues at this stage of development and how the data and objects will be displayed in an ECDIS on an ENC and presented to the mariner. Stephen Dick (BSH) highlighted the issue of zones in which there are no data available and the problems defining polygons for areas of influence. Vice-Chair requested clarification on the data format for provisions of data through AIS as well as the HDF5 format. From the breakout session, it was decided that the value for 'steady' state of water level should be set by HOs and therefore remove from the S-104 PS text, the value 0.2 m.

The Chair highlighted the question of portraying 'null' values, she asked if there was any input from other WGs so that the approach was harmonized. NOAA-OCS noted that the -1 value was used for both land and missing data, and this value was set in the metadata. He noted that S-111 did allow for the use of time series, and that the same value for missing data (-1) would also be used there. On the question of the provision of graphic displays of Predicted, Observed and Forecast values, CCOM-JHC/UNH suggested investigating use case examples and decide which was the most suitable. Phillip MacAulay (CHS) noted that real time was used and the metadata indicated from where the data came. It was also noted that multiple forecasts could be generated for the same location. CCOM-JHC/UNH suggested it was a DQ issue to resolve. Vice-Chair noted that observations were used to create the forecasts, he suggested mariners should understand the differences between a prediction and a forecast. CCOM-JHC/UNH noted that there was a need to package up the product for use by multiple users, Vice-Chair noted that the primary customer and focus was the commercial users. IHO highlighted the development process was now designed to obtain the widest possible stakeholder, HO, manufacturer and user feedback before the operation version was published.

The Chair asked what was the considered product of S-104 and what were the differences and similarities with S-129. Vice-Chair S-100WG noted that neither was reliant on each other, although they were related. He also noted that portrayal was not mandatory, it was important to develop the data model and the data format. The Chair asked all to start providing datasets in S-104 formats to allow testing and further development of the PS. **Action 1 - All** NOAA-OCS asked whether the dataset format would be against S-104 Edition 0.0.8. Hilde Borck (NHS) highlighted that work had started on collaboration to include S-111 and S-104 in the demonstrator project (https://s102.no/) which can lead to helpful test or user cases.

3.2 S-111 update and progress report. Kurt Hess (NOAA-OCS) provided a presentation on the recent progress on the S-111 Product Specification and Data. He provided a brief overview of the S-111 PS and the background on the development. He highlighted the progress since TWCWG3, the current work and the next stages. He noted that during review of datasets, a number of errors had been identified which would be corrected and issued as clarifications for the TWCWG members to review on completion of the TWCWG4. The question of the 10MB file size limit was raised and whether it was still applicable and whether it was a mandatory attribute or there was discretion. Briana Sullivan (CCOM-JHC/UNH) noted that the requirements of the scientific customer and the mariner were different with the data resolution for the mariner very much lower than that required by the scientific community. Maheshwar Gupta (INHO) asked whether HDF5 format could be changed as the INHO used a different format, NOAA-OCS noted that it would remain the format and would not change for the foreseeable future. NOAA-OCS noted that the objective remained the development of a PS for surface navigation for display on an ECDIS, he noted that the scientific community had direct access to the original data.

3.3 Erin Nagel (NOAA-OCS) provided an update presentation on the NOAA S-111 Operational Project and Encoding Dissemination. She provided a demonstration of portrayal. This generated a number of questions and comments, initiating a wide-ranging discussion. Thorkild Aarup (IOC) questioned for what user/customer base were the products aimed.

Briana Sullivan (CCOM-JHC/UNH) provided a presentation on the Coast Pilot/textual information with S-111 data. She highlighted the similarities between S-111 and S-126 and therefore where the opportunities to harmonize might lie. She noted the need for clarity on the symbols and presentation. Chris Jones (UKHO) noted the challenges of providing all the necessary information in meaningful manner, CCOM-JHC/UNH noted the importance of simplification with reduced textural data and providing only what the mariner needs/wants, rather than all the details, which may be of use for other non-operational users. Vice-Chair noted the work being done to streamline the data provision for national weather forecasts

Chikara Tsuchiya (JHOD) provided a presentation on various test datasets created in the S-111 format, he highlighted some of the variations and challenges faced.

Luis Becker (BSH) provided a presentation on a project to develop and generate S-111 and S-104 datasets and to combine water level data with high resolution bathymetry. The first S-111 datasets generated by him were displayed. He highlighted the importance of placing the metadata at the correct hierarchy level. He also questioned how to approach uncertainty, should it be each data point or entire dataset? It was agreed that there should be one value per dataset for uncertainty as trying to attribute to each data point would make the file sizes too large. Additionally, he showed an internal tool for quick visualisation of S-111-HDF5 files and presented a first HDF5 data set for S-104 which was encoded analogous to S-111.

The Chair and Vice-Chair provided a summary of the key issues identified from the S-104 and S-111 discussions; suggested further discussion points were provided and items on which the TWCWG4 needed to make decisions were highlighted. The Chair asked for participants to become involved in various tasks and activities to assist in taking the development of the PS forward. The Chair showed the KRISO S-100 Sea Trial video to highlight the interaction and relationship between the various S-100 PS. BSH indicated all the tools they had developed for their project would be made available freely to the TWCWG, if considered of value. The Chair showed additional video demonstrators showing S-102 usage with other layers. The Chair provided a table with a list of documents to be reviewed by TWCWG. Member States were asked to volunteer for reviewing them and for providing a synopsis of each. MS were invited to inform the Chair, Vice-Chair and IHO Secretary if declaring themselves as volunteer to read one or more of these documents by the end of April 2019. Vice-Chair agreed to monitor progress and circulate reminders approximately one month prior to a deadline. **Action 2 - Chair/Vice-Chair/NOAA/CHS/BSH/Shom/JHOD/RNlN**

4. Product Specification Work Packages

4.1 The results of the discussions for the S-104 breakout session were presented by AHO. It was agreed that Edition 1.0.0 would not be available for publication at the end on 2019, it was agreed that it should be presented to TWCWG5 in 2020 and subsequently to HSSC12 in May/June 2020. The Chair asked for additional members to contribute to development of the S-104 PS and the provision of addition compatible datasets.

S-100 - The group agreed that access to S-100WG registry was necessary with the possibility to display Water level product using S-100 web tool. It was agreed to ask for a login to S100WG to access the registry. It was noted that it was necessary to:

a. develop use case definition and then review **Action 3 - AHO/All**
b. add this scenario to the S-100 tool **Action 4 - AHO**
c. display the water level S-104 new file

It was agreed that guidance from S-100WG on validation method would help the development in the framework of S-100 environment. It was agreed that these issues will be forwarded to S-100WG for comment. **Action 5 - Chair**

To complete the development plan and milestones, it was agreed that NOAA-OCS (Kurt Hess) would provide new HDF5 structure for plotting of S-104, key milestones to be defined
* Definition of use case for S-111 and S-104:

Step1: Send a template of use case definition (Contact + project team) target 30.04.2019

Step 2.1: Volunteers send to the team their definition of one use case they want undertake. Target 20.06.2019
Step 2.2: Review of all the use cases proposed and selection at least 3 use cases. The simpler they are, the better it will be.

It was noted that water level trend computation is possible for a gridded data model, but not for single point data/observation. It was noted that the need to define water level trend for NRT data/observations remained a problem, it was suggested the category number for trend could be filled as "unknown". The size of the file has to be considered to avoid "heavy" files. One file for one single point water level data has been preferred to one file containing several single point data, this choice comes from the use of this data by mariners.

Mandatory attribute (trend discrimination) scope of producers authority, this is a mandatory for AIS. It is also mandatory for real time and optional for gridded mode.

Colour features: Define what colour for what type of data (see p24 S-104). A check is needed to see if it's a prediction then print it in colourX, if it's an observation then colour chosen will be Y. This should refer to the feature's metadata. **Action 6 - NOAA-OCS/AHO**

It was noted that there was a need to remove AIS from the first version of S-104 document. **Action 7 - AHO**

It was suggested to join the effort done on S-104 product specification with the experience gained from development of S-111. AHO, NOAA-OCS, BSH and JHOD volunteered to assist; it was suggested that KHOA could also contribute. **Action 8 - AHO**

For the definition of use cases AHO, NOAA-OCS, BSH and Chair volunteered to assist; it was suggested that KHOA could also contribute. **Action 9 - AHO/NOAA**

4.2 The Chair provided details of her engagement with other IHO subordinate bodies and other external bodies. She asked all to review the draft IMO Maritime Service 15 – Water level information for navigation – and provide comment and feedback within the WG prior to forwarding proposed amendments to the Chair of NIPWG later in the year. **Action 10 - All** The Chair highlighted the proposal for an S-100 strategy implementation plan and the need for wider consideration and feedback. She highlighted the S-98 product interoperability in S-100 navigation system and noted the key issues which need to be addressed and taken forward, she highlighted some of the items in the S-98 Edition 1.0.0. She highlighted the S-100 Data as a Service using the CHS, Teledyne CARIS and PRIMAR elements.

5. Programme Matters

Two breakout sessions on Product Specifications and on Compare Tidal Predictions generated as a result of analysis of a common data set by different analysis software took place during TWCWG4.

5.1 Standard constituent list

UKHO provided a brief background on the development of the Standard Constituent List, the current list, available on the TWCWG page, was displayed. He described the ongoing work to maintain and further develop the list. He noted that the work to update to 7 decimal places has been completed and uploaded to the IHO website. He asked for feedback from the use of the constituents in their new format. **Action 11 - All** It was suggested an alternative format could be uploaded.

5.2 Standard for digital tide tables

Vice-Chair provided a short background on the development of the proposed draft resolution on the Standard for digital Tide Tables. He noted that the final draft text was now completed and available on the TWCWG4 meeting documents. He noted that the draft would be presented to HSSC11 for endorsement and submission to Council 2. He asked all participants to undertake a final review and for any necessary amendments to be highlighted before the end of the meeting. **Action 12 - All** It was confirmed that it covered all formats of digital Tide Tables.

5.3 Compare Tidal Predictions generated as a result of analysis of a common data set by different analysis software

Vice-Chair provided background to the comparison of Tidal Predictions and the fact that it was a fundamental task set by the first IHO Conference to its original working group. He noted the limited number of datasets that had been provided. He noted the desire to create a bank of datasets covering different tidal characteristics for comparison. He highlighted five objects he proposed to achieve with reinvigoration of this task:

- Assemble long term data sets (one year or greater) from different tidal regimes;
- Resource for Member Organization (MO) to assess and improve tidal analysis routines to improve products;
- Compare MO harmonic analysis routines and tidal predictions;
- At TWCWG3 expanded objective to include analysis of sea level trends conducted by MO; and
- Work is defined in WG's ToR

He highlighted the types from which datasets are lacking and the focus of the work. Ruth Farre (Hydro SAN) noted that different organizations used different numbers of constituents and therefore there was a need to provide these with the datasets to allow balance comparisons. UKHO suggested that there was no standard harmonic analysis as different HOs use different numbers of constituents in their own analysis. Vice-Chair asked whether the work should be expanded into tidal currents. It was noted that the tasks was included in the ToRs and was an identified task in the Work Plan. Vice-Chair displayed some of the current datasets, he noted that there was no set format required, although it was suggested that guidance should be developed. Bill Mitchell (BOM) highlighted the Global Extreme Sea Level Analysis (GESLA) site, which gave access to a network of data outputs available for analysis. He identified the tasks which needed to be undertaken:

- Reaffirm the ad hoc small group to take leadership of this action item -
- Current Group consists of USA, UK, Norway, Spain
- Develop Vision and Scope document for future work by 31 Dec 2019 -
- How should WG investigate Sea Level change?
- Develop needs list
- Report at TWCWG5 on work plan and needs list

Vice-Chair requested a volunteer to develop the guidance necessary and the leadership to take the task forward and report to TWCWG5 on the progress and way forward. Cesar de Oliveira Borba (BRA DHN) agreed to provide additional datasets**; s**ubsequently a number of other participants agreed to provide additional datasets reflecting different regimes (NOAA/SHOM/NHS/JHOD). **Action 13 - All** Hydro SAN asked what was the minimum number of years required for the larger time series, it was agreed that this would be defined by the group leading the task. Andrew Matthews (NOC) noted that different formats were often produced from the same gauge. NHS agreed to lead this task and will report at TWCWG5 on a plan for additional analysis. Others were encouraged to assist and provide

their contact details to NHS. UKHO suggested there needed to be agreement on what was the intended output.

The results of the breakout session were presented to the participants by NHS.

She highlighted the work previously done by the TWCWG on this task:

> Some reports on analysis and comparisons of common data sets are available at the TWCWG's page but not all. Gather the reports, analysis and data provided that are currently missing from the website – target 31 May. **Action 14 - All, BOM, Shom**

She then highlighted on what the group should focus for the next year. It was agreed that the group should focus on harmonic analysis on common datasets (1 year or longer), first for heights, but then also on currents. It noted that other topics related to long term analysis might come later.

Continue to collect common data set of 1 year or longer for interesting stations with a variety of tidal phenomena (as already noted in Action 17) with initial target 31 May. For longer time series it could be agreed on a set of long series already available online to be studied. The need to specify the format for common datasets we share on the webpage was not covered by the breakout session.

In order to compare the analysis TWCWG needs to know what methods have been used and what constituents are included:
Gather general information about what methods are used, including choice of constituents. **Action 15 - NHS**. Define/specify what results and output should be supplied with/from the analysis. **Action 16 - UKHO/BOM**.

It was suggested that the HO's should analyse the common dataset available from June onwards and report the results by end of November. **Action 17 - All** Comparison of the results will be provided to TWCWG5. **Action 18 - NHS**

There is a need for a more scientific plan to resolve some of the problems and challenges faced in doing harmonic analyses, such as:.

> Uncertainty of the resulting analysis.
>
> Choosing constituents; there are different approaches in different countries, different selections are used, excluding non-significant constituents based on the results is not done by all.
>
> How to cope with different long term effects such as trends in the analysis?

It was agreed that it was within the scope of the TWCWG to develop guidance or recommendations on harmonic analyse:

Outline topics and challenges that should be resolved or covered. **Action 19 - BOM/NHS**

Generate first draft for recommendations concerning uncertainty. **Action 20 - BOM/NHS**

Why does the TWCWG need to deal with long-term datasets and trends? For instance, there is a need to take into account changes in mean sea level and/or other reference levels at some point.

It was noted the way the TWCWG deals with reference frames, separations models, LAT-surfaces, chart datum will change with time.

5.4 Exchange of Harmonic constants/predictions, feedback on comparison of tidal constituents

This is an ongoing action with no major change and input this year. Results are expected for TWCWG5.

5.5 Establishment and maintenance of VRF for High Resolution Bathymetric Surfaces

Reported and discussed during other agenda items.

5.6 New Organization and status of vertical datum change

This major topic was discussed in several talks. Outcomes are reported in paragraph 3 above. Moreover, the Chair summarized an email from the Chair DQWG requesting feedback on the topic of the size of error considered of importance, as this was important when validating a survey against S-44 standards. IHO highlighted some of the thoughts and proposals discussed at the recent HSPT3 meeting and which are to be proposed to HSSC11 for consideration. The Chair displayed the DQWG document on the shared interest between chart producer and user. AHO highlighted the order of magnitude error difference between vertical and horizontal which can be achieved. TWCWG4, suggested answers to this question:

- Provide to DQWG Chair the TWCWG background on the consideration of geoid and LAT regarding to vertical uncertainty: TWCWGN°1 to N°3 with items on geoid, LAT, CD and surface reference projects (among the documentation, R. Klees et al. 2017 TWCWG3);
- The difference between zero-tide, mean tide and free tide correction in the geoid computation is recognized and the impact of tide correction and the method can be significant on the geoid. Within TWCWG, this point should be regularly discussed in TWCWG framework and remains an ongoing action.
- Suggestion: Promote the topic (vertical uncertainty method dependent) in the vertical reference session of TWCWG meeting.

  Suggested step 1: prepare a synopsis on the existing surfaces of references and compare it to CD (difference and uncertainty when available) **Action 21 - Chair + volunteers?**

5.7 Inventory of Tide gauges used by IHO Member States

The Inventory of Tide gauges used by IHO Member States was highlighted and requested for all to check, at least annually, their national details and provide amendments, corrections and updates to keep the inventory current. Participants were requested, through their appropriate representatives, to highlight the Inventory to RHC meetings so as to expand the contents beyond TWCWG members. **Action 22 - All** IHO agreed to add details of the IOC Manuals and Guides No 14 and link the report on Sea Level Measurements in Hostile Conditions to the top of the inventory list. **Action 23 - IHO**

5.8 Actual Tides On-line Link status

The Actual Tides and Currents on-Line links were highlighted and requests for all to check, at least annually, their national details and provide amendments, corrections and updates to keep the list current. It was recognized as a highly valuable and unique resource, which needed to be expanded beyond the member states represented in the TWCWG; all were encouraged to

contact their national representations for RHC meetings to advertise the list and request additional inputs from all coastal states. **Action 24 - All**

6. IHO Resolutions and Charting Specifications

6.1 IHO presented the IHO resolutions for which the TWCWG had responsibility for maintenance. IOC highlighted that many of the resolutions were focused on paper chart and publications, rather than that the current consideration the data had multiple uses beyond safe of navigation and that the resolutions need to reflect this approach. IOC suggested that the MSL only focus needed to be considered, more consideration on data exchange of high frequency Real Time data should be included, all should be levelled to connect to the land system and consideration should be given to historic data recovery; he suggested that comment should be included that there was significant scientific use of the data beyond the traditional HO safety of navigation use and that this should be noted where appropriate. Hydro SAN agreed to coordinate the review of all the resolutions with a view of providing mature drafts for consideration at TWCWG5. **Action 25 - Hydro SAN** The following agreed to assist in the task: USA (NOAA and NOAA-OCS), Netherlands, Peru, Australia and Germany

6.2 The IHO Charting Specifications were reviewed and it was agreed that no amendments were necessary at present.

7. IOC/GLOSS Programme

Covered in joint session discussions.

8. Any other business

8.1 None was submitted.

9. TWCWG Work Plan and ToRs

9.1 TWCWG ToRs and RoPs

The ToRs and RoPs for TWCWG were displayed, Annex F. No revisions were deemed necessary.

9.2 TWCWG Work Plan 2020-2021

The IHO displayed the draft work programme for 2020-2021 which had been prepared in advance of the meeting. Amendments were made to reflect discussion and progress during this meeting, Annex G. It was noted that the updated version would be included in the meeting report and that it would submitted to HSSC11 for approval. **Action 28 - Chair/IHO**

10. Venue and dates of the 5th TWCWG Meeting

The Chair asked if any MS would volunteer to host TWCWG5. It was agreed to accept the kind offer of Norway and the IHO was requested to liaise with NHS to make the necessary arrangements and upload them to the website. **Action 29 - IHO/NHS** After further discussion in was agree the week 25-29 May 2020 was the most suitable, taking into account other external events. In addition, Hydro SAN indicated that they were investigating hosting TWCWG6 in South Africa in 2021.

11. Review of Action Items

11.1 A draft list of Action Items from the meeting were reviewed and agreed. All Action Items are marked in this report and are collected together at Annex D. It should be noted that the list of action items does not include tasks that are in the TWCWG Work Plan. An updated list of the Action Items will be maintained on the TWCWG5 web page and all those who have actions to complete should keep the IHO informed of any progress.

12. Draft Report to the HSSC / Draft Agenda for TWCWG5

12.1 It was agreed that the IHO would circulate a draft meeting report to all attendees by 19 April. **Action 30 - IHO.** Participants were requested to provide any comments by 3 May. **Action 31 - All.** It was intended the final meeting report would be published by 17 May. **Action 32 - IHO**

12.2 The IHO, Chair and vice-Chair would prepare the final report to HSSC11 using the format required by HSSC. Representation of TWCWG at the HSSC11 meetings would be discussed between the Chair and the vice-Chair. **Action 33 - IHO, Chair & vice-Chair**

12.3 A draft Agenda was presented to the meeting and is included at Annex H to this report. The draft Agenda may require further amendment following the outcome of HSSC11.

13. Closing remarks

The Chair summarized the TWCWG4 outcomes, highlighting the activities on which participants should focus during the intersessional period before the next meeting, TWCWG4.

On behalf the group, the Chair thanked the Korean Hydrographic and Oceanographic Agency for hosting this meeting, providing excellent support and facilities, without which the meeting would not have achieved the progress it did, and for their warm hospitality. Chair thanked all working group members and GLOSS experts group for their participation and contributions. Also a number of the other identified actions are underway.

The IOC thanked KHOA for making the collocated meetings possible and he thanked the TWCWG for opening its meeting to GLOSS-GE participants, he noted that a considerable number of topics were common to both groups and much benefit had been gained by the exchange of ideas and information. He hoped that there could be a repeat event at some stage in the future.

The meeting closed at 1445 on 10 April 2019

Joint TWCWG4 and GLOSS-GEXVI Sessions

Shilla Stay Haeundae, Busan, Republic of Korea
11 April 2019

(Paragraph numbering is the same as the Agenda Item numbering and does not necessarily reflect the order in which matters were discussed. ISO three letter country codes have been used to identify individual participants)

1 Opening

1.1 IHO and IOC provided brief overview introductions to their organizations.

1.2 The programme for the sessions was agreed.

2 Programme Related Matters

2.1 Chair GLOSS-GE introduced the background and importance of Data Exchange, he highlighted the need for high frequency raw data beyond the core GLOSS gauge network. Vice-Chair TWCWG highlighted the main difference in the activities of the organizations with the IHO being involved in more operational focus to support safety of navigation and protection of the marine environment with scientific activities being of secondary importance. He also noted that much of the IHO data was short time series to support a particular activity.

2.2 Peter Stone (NOAA-OCS) gave a short presentation on the Patterns and Projections of High Tide Flooding along the US Coastline Using Nationally Consistent Impact Thresholds. He provided examples of events and the increasing frequency of occurrences. He described the definition of Minor, Moderate and Major Thresholds and the anticipated impacts which had been developed. He highlighted the products which had been developed to help forecast events and allow necessary actions to limit the impacts. He asked how organizations communicate the information when the datum and reference levels are updated and therefore the raise in levels is altered, even if the frequency of events and impacts remain or increased.

2.3 Hilde Borck (NHS) provided a presentation on communicating long term sea level changes. She displayed the visualization of future sea level website, which provided illustrations of predicted impact of sea level rise on coastal areas. This generated a number of questions and discussion.

3 National Project Presentations

3.1 Chikara Tsuchiya (JHOD) gave a presentation on the ellipsoidal height of chart datum in beach marks for the purpose of rapid recovery of chart datum from future hazards. He described the proposed processes to be undertaken to recover chart datum after an earth quake or tsunami incident. He noted the particular issues and challenges faced by Japan and JHOD and the experience gained from previous events. This generated numerous questions and wide discussion.

3.2 Phillip MacAulay (CHS) provided a presentation on Developing robust Dynamic Electronic Navigational data to support S-111 development.

3.3 Kim Young Taeg (KHOA) gave a presentation on Approach for the Application for S-111 Surface Current predictions, in which he proved brief background details of the related services to the surface currents provided by KHOA.

3.4 Kim Aram (KHOA) gave a presentation on S-104 and tidal observations. She provided background details on KHOA observation network and data availability.

3.5 Peter Stone (NOAA) provided a presentation on the NOAA/CO-OPS cGNSS Implementation within National Water Level Observation Network (NWLON). He provided background details on the number of stations, including those in the GLOSS network.

3.6 Thomas Hammarklint (SMA) gave a presentation covering the Baltic Sea Chart Datum 2000 with a focus on a reference level for nautical charts and sea level information in the Baltic Sea. He highlighted the proposed work and the anticipated timeline for delivery of initial results.

3.7 Oda Roaldsdotter Ravndal (NHS) provided a presentation on a Common reference frame for Norway – ocean topography in a long fjord. She highlighted the challenges faced by the NHS due to resources and the nature of the coastline.

3.8 Ronald Kuilman (RNlN) provided an update presentation on the determining ellipsoidal height of MSL at the coast. He noted that this was a follow-on and an update to the information provided at TWCWG3.

3.9 Jyrki Mononen (TRAFICOM) provided a presentation on ship borne GNSS geoid model validation in the Bay of Bothnia. He described the motivation for the work and then the methodology used. He provided details of the results achieved. This generated numerous questions and a wide ranging discussion.

4 Capacity Building/Development

4.1 Ruth Farre (Hydro SAN) provided a presentation on the IHO Tides and Water Level Workshop training material. She provided details on the background to the development of the course and the stages in the development of the material and trial courses that were undertaken in the SAIHC and SWPHC regions. She noted the changes which had taken place in light of the experiences gained after delivery of the two initial courses. She proved details of the course content and the completion of the translations (French, Spanish and Portuguese). IHO to investigate how to deal with people/organizations downloading the course without IHO Secretariat knowledge – encourage point at link rather than download course to ensure currency, need acknowledgement of source data, need statement prior to download to ensure appropriate request to Secretariat is made. **Action 26 - IHO** IOC highlighted the IOC Capacity Development resources, which are available from the IOC website. He noted that IOC have provided equipment and remote assistance to coastal states. He highlighted the IOC Sea Level display service onto which SIDS can upload data for display, without significant investment in software and contracts. He noted the importance of local ownership and local investment (buy-in) is important for the future sustainability. It was agreed to add this information to the course. **Action 27 - Hydro SAN/IOC**

5 Historical Data Recovery/Data Archaeology

5.1 Vincent Donato (Shom) provided a presentation on data archaeology and data recovery, which has become more significant as a result of the need to monitor changes in Sea Level and climate. He highlighted the importance of analysis of long series datasets to provide valid condition comparisons.

Lesley Rickards (NOC) gave a presentation on data rescue and GLOSS. She provided background behind the project and the work being undertaken to organize the historic data and how to then recover it into digital format. She highlighted the challenge of recovering records from manuscripts, which lack significant technical details and the work required to undertake the subsequent investigations to obtain the necessary metadata and technical data to make it scientifically of use. She noted the use of social media. She highlighted the results of a questionnaire and some proposals for the next stages. She noted some courses (Maynooth University, Ireland and CSIRO, Australia) where data recovery was part of their programme either for undergraduates or school children. She listed a number of new data rescue projects being undertaken in the next few years. UKHO highlighted the significant quantities of data that should be archived in the described manner, he indicated that UKHO would investigate supporting GLOSS in this project. Chair TWCWG highlighted the interest for guidance on best practises and this meeting was an ideal opportunity to share experiences and ideas on how to develop the project further and whether it was intended to create an international database for this data. IOC indicated that it was important to include this project on the GLOSS website as well highlighting the need to encourage HOs to participate, he asked what the incentive was for HOs to engage; he noted that the review of the IHO resolutions provided an opportunity to include the importance of this activity to the wider scientific community. 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.

6 Consideration for future joint events

Vice-Chair TWCWG highlighted the extensive interaction that had taken place over the period of the meetings. He asked participants to consider if they had found it of benefit and if there was value in repeating the event again. Chair GLOSS-GE highlighted that there was general agreement; however further discussion would take place at the close of the GLOSS-GE meeting.

7 Review of Actions

IHO noted the actions which had resulted from the Capacity Building/Development discussions.

8 Closing remarks

The Chairs and Secretariats thanked KHOA for making the collocated meetings possible and the opportunity of exchange between the two communities on topics of mutual interest and relevance.

The following Annexes are attached:

A. TWCWG4 – List of Participants.
B. TWCWG4 – Agenda
C. TWCWG4 – Joint Session Agenda
D. TWCWG4 – List of Documents
E. TWCWG4 – List of Actions
F. TWCWG4 – Draft IHO resolution for Standard for Digital Tide Tables
G. TWCWG4 – TWCWG ToRs and RoPs
H. TWCWG4 – TWCWG draft Work Programme 2020-2021
I. TWCWG4 – TWCWG5 Draft Agenda

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Names underlined also attending GLOSS-GE meeting

Apologies:

Glen Rowe - New Zealand
Greg Seroka - USA (NOAA-OCS)

Tides, Water Level and Currents Working Group
Busan, Republic of Korea – 8-10 April 2019
Agenda – (TWCWG4)

1. Opening

.1 Opening address – Chair
.2 Address by host nation – KHOA
.3 IHO comments – IHO

2. Administrative Arrangements

.1 Adoption of the Agenda and Apologies – Chair/Secretary
.2 Programme and timetable of the Sessions – Chair/Secretary
.3 Meeting administration, including H&S – Host
.4 Report on Intercessional Activities including HSSC10 – Chair
.5 Matters arising from TWCWG3/Review of Action Items – Secretary

3. Product Specification Presentations

.1 Water Level Information for Surface Navigation (S-104) – AUS
.2 Surface Current Product Specification (S-111) – USA/CAN
.3 S-111 test data – JPN

4. Product Specifications Work Packages

.1 Progress report on current datasets – USA/CAN
.2 Progress report on water level information – AUS
.3 Feedback on results from encoding tests – USA/AUS/DE/FR/JPN/NLD
.4 Application of encoding tool(s) to additional datasets – USA/CAN
.5 Engagement with S-100WG – Chair

5. Programme Matters

.1 Standard Constituent List – GBR
.2 Standard for digital Tide Tables – USA
.3 Compare Tidal Predictions generated as a result of analysis of a common data set by different analysis software – USA
.4 Exchange of Harmonic constants/predictions, feedback on comparison of tidal constituents – GBR/USA
.5 Establishment and Maintenance of VRF for High Resolution Bathymetric Surfaces – GBR/NLD
.6 Inventory of Tide gauges used by IHO Member States – IHO
.7 Actual Tides On-line Link status – IHO

6. IHO Resolutions and Charting Specifications

.1 Review of relevant IHO Resolutions – IHO
.2 Review of relevant IHO Charting Specifications – IHO

7. IOC Programmes

.1 Update on IOC TOWS Programme items and events – CHL

8. Any Other Business

.1 Development of report to S-100WG and HSSC11 – Chair

9. Work Plan and ToRs

.1 TWCWG Work Plan up-dates – IHO
.2 Review TWCWG ToRs and RoPs – IHO

10. Venue and dates of the 5th TWCWG Meeting (TWCWG5) – Chair/Secretary

11. Review of Action Items from TWCWG4 – Secretary

12. Draft Agenda for TWCWG5 – Chair/Secretary

13. Closing remarks – Chair

IHO Tides, Water Level and Currents Working Group and
IOC Global Sea Level Observing System-Group of Experts
Busan, Republic of Korea – 11 April 2019
Agenda – Joint Meeting

1. Opening

.1 Opening address – Chairs
.2 Approve agenda – Secretary

2. Programme Matters

.1 Data exchange – Chair GLOSS-GE/All
.2 The study of long term data sets for the determination of global sea level rise – Jones (GBR)/Borck (NOR)/Stone (USA)/García (ESP)
.3 Feedback on long term sea level variation – Borck (NOR)
.4 Sea level network observing gaps – Chairs/All
.5 Determining ellipsoidal height of MSL at the coast – Kuilman (NLD)

3. National Project presentations

.1 Ellipsoidal height of the chart datum in bench marks for the purpose of rapid recovery of chart datum from future hazards – Tsuchiya (JPN)
.2 Installing GNSS sensors at water level stations and tying ellipsoidal elevations to tidal datums – Stone (USA)
.3 Approach for the Application of S-111 (Surface current prediction) – KOR
.4 S-104 and tidal observations – KOR
.5 Baltic Sea Chart Datum 2000 – a common reference level for nautical charts and sea level information in the Baltic Sea – Hammarklint (SWE)

4. Capacity Building/Development

.1 Tides and Water Levels Workshop training material – Farre (ZAF)/ Jayaswal (AUS)
.2 Opportunities for coordination and cooperation in delivery – Chairs/All

5. Any Other Business

.1 Historical data recovery/data archaeology – Chairs/All

6. Considerations for further joint meetings – Chairs/All

7. Review of Action Items – Secretary

8. Closing remarks – Chairs

TWCWG4 - List of Documents

Document No	Document Title
TWCWG4 Letter 1	Letter of Invitation
TWCWG4 Annex B	TWCWG4 Registration (Word version)
TWCWG4 Annex B	TWCWG4 Registration (pdf version)
TWCWG4 Annex C	Logistic Information
TWCWG4 Annex D	Hotel reservation form
TWCWG4	Joint Session Agenda v4.0
TWCWG4-2.1	Agenda v4.0
TWCWG4-2.2	Programme v6.0
TWCWG4-2.4a	TWCWG Report to HSSC10
TWCWG4-2.4b	Draft outcomes of HSSC10
TWCWG4-2.4c	Actions from HSSC10
TWCWG4-2.5	TWCWG3-List of Actions - 1 April 2019
TWCWG4-4	S-100 Schedule
TWCWG4-4	Summary and Considerations S-100 PS presentations and discussions v1.0
TWCWG4-4.1	S-111 Edition 1.0.1 - Track Change version
TWCWG4-4.2	S-104 Edition 0.0.7 - Track Change version
TWCWG4-4.5.1	MS15 - Water level information for navigation
TWCWG4-4.5.2	NIPWG S100 strategic implementation plan v1.0
TWCWG4-4.5.3	HDWG Chair Letter HD Change Proposal Form v1.0
TWCWG4-4.5.4	HSSC11.05.3C HGDM2 report and related tasks v1.0
TWCWG4-4.5.5	NIPWG 6.08.1 Status report S126 v1.0
TWCWG4-4.5.6	Data Quality a shared interest between chart producer and user v1.0
TWCWG4-4.5.7	Inter-Working Group 2018-2019 report
TWCWG4-6.1	IHO Resolutions
TWCWG4-6.1.1	Digital Tide and Tidal Current Table - Draft IHO Resolution v1.1
TWCWG4-6.2	Review of relevant IHO Charting Specifications
TWCWG4-9.1	TWCWG Work Plan 2020-2021
TWCWG4-9.2	TWCWG ToR
TWCWG4-12	TWCWG5 - Draft Agenda
TWCWG4-INF.1	Datum reference status and provision of modern nautical charts covering Indonesian archipelagic sea lanes
TWCWG4-INF.2	IOC Sea Level Measurements in Hostile Conditions

TWCWG4-Presentations	Presentations.zip
TWCWG4-Joint Session Presentations	Joint Session Presentations.zip
TWCWG4	Introduction to KHOA

LIST OF ACTIONS – Updated 9 May 2019

No	Agenda Item	Subject	Status/Date	Comments	Action
	Continuous				
-	-	Standard Constituent List	On going	Add additional data and upload to website for further comment.	All
-	-	Study of long term data sets	On going	Circulate to TWCWG national reports on studies into sea level rise and trends	All
-	-	Compare tidal and current predictions	On-going	Provide additional datasets for analysis, with constituents used, to IHO for uploading to web page	All
-	-	Compare tidal and current predictions	On-going	Provide reports of analysis NOR and IHO for wider discussion and comments	All
-	-	Inventory of tide gauges	On going	Contact national representative attending RHC meetings to raise awareness of inventory and encourage input and updating of information	All
-	-	Inventory of tide gauges	On going	Regularly check entries and provide up-dates and amendments to IHO as necessary	All
-	-	Actual Tides On-line Link	On going	Check and provide up-dates and amendments to the information provided to ensure content is current and all links work	All
-	-	Capacity Building	On going	Through their appropriate representatives, highlight to RHC meetings the course availability and the intended target audiences	All
-	-	Any other business	On going	Investigate what historical data is held and to consider preserving it as digital data for future use	All
	TWCWG3				
-	9.1	Capacity Building	~~TWCWG4~~ TWCWG5	Provide guidance on how written assessment documents should be managed	IHO
	TWCWG4				
1	3.1	S-104	TWCWG5	Provide datasets in S-104 compatible format for testing	All
2	3.3	S-111 Test Datasets	TWCWG5	Monitor progress and circulate reminders for S-100 PS tasks	Chair/Vice-Chair/NOAA/ CHS/BSH/Shom/ JHOD/RNlN

3	4.1	S-104/S-111	28 Jun	Develop test case definition and then review	AHO/All (volunteers required - see report)
4	4.1	S-104/S-111	TWCWG5	Add test case definition to the S-100 tool	AHO
5	4.1	S-104/S-111	TWCWG5	Guidance from S-100WG on validation method was required; issues to be forwarded to S-100WG for comment	Chair
6	4.1	S-104/S-111	TWCWG5	Define how the type of data in a time series is linked to the colour in the metadata	NOAA-OCS/AHO
7	4.1	S-104/S-111	TWCWG5	Remove AIS from the first version of S-104 document	AHO
8	4.1	S-104/S-111	TWCWG5	Assist on S-104 product specification development using the experience gained from development of S-111	AHO
9	4.1	S-104/S-111	28 Jun	Definition of use cases	AHO/NOAA (volunteers required - see report)
10	4.5	Engagement with S-100WG	NIPWG7	Provide comment and feedback on draft MS15 for submission to NIPWG	All
11	5.1	Standard Constituent List	TWCWG5	Provide feedback and comment on use of new format values	All
~~12~~	~~5.2~~	~~Standard for digital Tide Tables~~	~~19 Apr~~ Complete	~~Undertake final review and provide any comments on proposed draft IHO resolution~~	~~All~~
13	5.3	Compare Tidal Predictions	31 May	Provide dataset of interest	All
14	5.3	Compare Tidal Predictions	31 May	Gather the reports, analysis and data provided that are currently missing from the website	All/Shom/BOM
15	5.3	Compare Tidal Predictions	28 Jun	Gather information about what methods people use today	NHS
16	5.3	Compare Tidal Predictions	31 May	Define/specify what results and output should be supplied with/from the analysis	UKHO/BOM
17	5.3	Compare Tidal Predictions	29 Nov	Analysing the common dataset available from June onwards and report the results by end of November	All
18	5.3	Compare Tidal Predictions	TWCWG5	Comparison of the results provided	NHS

19	5.3	Compare Tidal Predictions	TWCWG5	Outline topics and challenges that should be resolved or covered in the guidelines	BOM/NHS
20	5.3	Compare Tidal Predictions	TWCWG5	Generate first draft for recommendations concerning uncertainty	BOM/NHS
21	5.6	Status of vertical datum change	TWCWG5	Prepare a synopsis on the existing surfaces of references and compare it to CD	Chair (volunteers required - see report)
22	5.7	Inventory of Tide gauges and Current meters	On-going	to highlight the Inventory to RHC meetings so as to expand the contents beyond TWCWG members	All
~~23~~	~~5.7~~	~~Inventory of Tide gauges~~	~~3 May~~ Complete	~~Add link to IOC Manuals and Guides No 14 and link to report on Sea Level Measurements in Hostile Conditions~~	~~IHO~~
24	5.8	Actual Tides On-line Links	On-going	Check contents and links in Inventory of Tide gauges and Actual Tides On-line Links and provide updates and amendments	All
25	6.1	IHO Resolutions	TWCWG5	Conducted review of all relevant resolutions, generate drafts as identified	Hydro SAN/All
26	Joint 4.1	Capacity Building	31 May	Investigate appropriate acknowledge statement/copyright protection for on-line Tides and Water Levels course material	IHO
27	Joint 4.1	Capacity Building	TWCWG5	Add details of IOC resources and material	Hydro SAN/IOC
28	9.2	Work Plan	HSSC11	Included revised version of Work Plan 2020-2021 in report to HSSC11	Chair/IHO
29	10	TWCWG5	25 Oct	Circulate an initial letter of invitation and post on the website.	NHS/IHO
~~30~~	~~11~~	~~TWCWG4 Draft Report~~	~~19 Apr~~ Complete	~~Draft to be circulated for comment~~	~~IHO~~
~~31~~	~~11~~	~~TWCWG4 Draft Report~~	~~3 May~~ Complete	~~All to provide comments on draft report~~	~~All~~
~~32~~	~~11~~	~~TWCWG4 Final Report~~	~~17 May~~ Complete	~~Publish final report~~	~~IHO~~
~~33~~	~~12~~	~~Report to HSSC11~~	~~19 Apr~~ Complete	~~Final report for submission~~	~~Chair/vice-Chair/IHO~~

TITLE	Reference	Last amendment (CL or IHC)	1st Edition Reference
Digital Tide and Tidal Current Tables.	XX/2019 as amended	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.

USA - NOAA Example

Scanned Tide Table

80

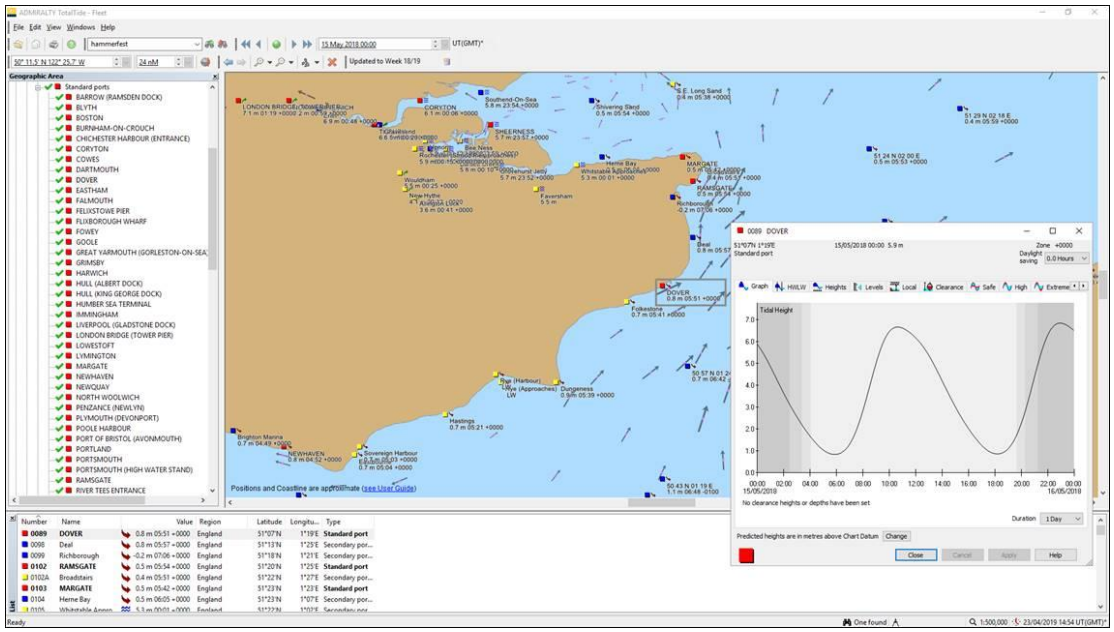
Albany, New York, 2015

Times and Heights of High and Low Waters

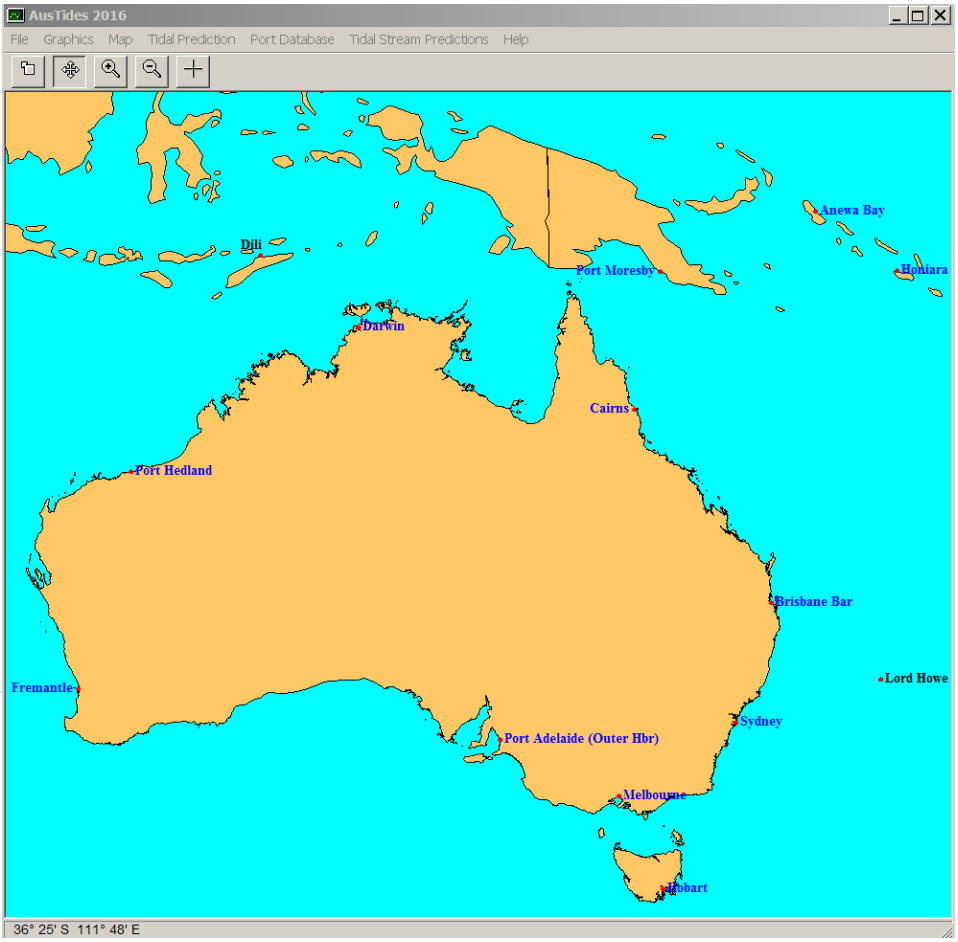
January								February								March							
	Time	Height		Time	Height			Time	Height		Time	Height				Time	Height		Time	Height			
	h m	ft	cm	h m	ft	cm		h m	ft	cm	h m	ft	cm			h m	ft	cm	h m	ft	cm		
1 Th	0048	5.1	155	16 F	0026	4.2	128	1 Su	0214	5.2	158	16 M	0144	4.8	146	1 Su	0102	5.4	165	16 M	0023	5.1	155
	0741	−0.3	−9		0705	0.4	12		0859	−0.1	−3		0856	0.3	9		0743	0.5	15		0715	0.9	27
	1317	5.5	168		1241	5.0	152		1435	5.4	165		1353	5.6	171		1324	5.5	168		1230	5.7	174
	2026	−0.4	−12		2006	0.4	12		2145	−0.3	−9		2127	0.1	3		2029	0.1	3		2006	0.7	21
2 F	0142	5.1	155	17 Sa	0121	4.3	131	2 M	0302	5.2	158	17 Tu	0234	5.0	152	2 M	0153	5.5	168	17 Tu	0120	5.4	165
	0833	−0.3	−9		0803	0.3	9		0946	−0.1	−3		0933	0.1	3		0834	0.4	12		0817	0.6	18
	1407	5.5	168		1331	5.2	158		1519	5.4	165		1445	5.7	174		1413	5.6	171		1333	5.9	180
	2120	−0.4	−12		2101	0.2	6		2230	−0.3	−9		2217	−0.1	−3		2117	0.1	3		2059	0.5	15
3 Sa	0233	5.1	155	18 Su	0211	4.4	134	3 Tu	0348	5.2	158	18 W	0322	5.3	162	3 Tu	0241	5.6	171	18 W	0212	5.7	174
	0922	−0.3	−9		0858	0.1	3		1030	0.0	0		1027	−0.2	−6		0922	0.4	12		0915	0.3	9
	1454	5.6	171		1417	5.4	165		1600	5.4	165		1535	5.9	180		1457	5.6	171		1428	6.0	183
	2210	−0.5	−15		2153	0.0	0		2313	−0.2	−6		2306	−0.2	−6		2201	0.1	3		2150	0.3	9
4 Su	0321	5.1	155	19 M	0257	4.6	140	4 W	0431	5.1	155	19 Th	0409	5.4	165	4 W	0325	5.7	174	19 Th	0300	6.0	183
	1009	−0.2	−6		0952	−0.1	−3		1112	0.1	3		1119	−0.3	−9		1006	0.4	12		1009	0.1	3
	1538	5.5	168		1503	5.6	171		1640	5.3	162		1626	5.9	180		1538	5.6	171		1519	6.2	189
	2256	−0.4	−12		2243	−0.2	−6		2352	−0.1	−3		2353	−0.3	−9		2241	0.1	3		2239	0.1	3
5 M	0408	5.0	152	20 Tu	0343	4.8	146	5 Th	0513	5.1	155	20 F	0458	5.6	171	5 Th	0406	5.7	174	20 F	0347	6.2	189
	1054	−0.1	−3		1044	−0.2	−6		1152	0.2	6		1211	−0.4	−12		1049	0.4	12		1102	−0.1	−3
	1621	5.4	165		1549	5.7	174		1718	5.2	158		1719	5.9	180		1617	5.5	168		1610	6.2	189
	2341	−0.3	−9		2331	−0.4	−12										2319	0.3	9		2326	0.1	3
6 Tu	0454	4.9	149	21 W	0430	4.9	149	6 F	0029	0.0	0	21 Sa	0040	−0.3	−9	6 F	0444	5.6	171	21 Sa	0435	6.3	192
	1136	0.1	3		1136	−0.4	−12		0553	5.0	152		0549	5.6	171		1130	0.4	12		1154	−0.1	−3
	1702	5.3	162		1639	5.7	174		1231	0.3	9		1303	−0.3	−9		1654	5.4	165		1702	6.1	186
									1754	5.1	155		1815	5.8	177		2354	0.4	12				
7 W	0022	−0.2	−6	22 Th	0018	−0.5	−15	7 Sa	0104	0.2	6	22 Su	0128	−0.2	−6	7 Sa	0520	5.6	171	22 Su	0013	0.2	6
	0540	4.8	146		0520	5.0	152		0632	5.0	152		0642	5.6	171		1209	0.5	15		0523	6.3	192
	1216	0.2	6		1227	−0.4	−12		1310	0.5	15		1356	−0.2	−6		1728	5.3	162		1245	0.0	0
	1742	5.1	155		1733	5.7	174		1826	5.0	152		1913	5.6	171						1756	6.0	183
8 Th	0103	0.0	0	23 F	0106	−0.5	−15	8 Su	0137	0.3	9	23 M	0216	−0.1	−3	8 Su	0027	0.5	15	23 M	0100	0.3	9
	0625	4.7	143		0612	5.1	155		0706	5.0	152		0739	5.6	171		0550	5.6	171		0615	6.2	189
	1255	0.4	12		1320	−0.4	−12		1350	0.6	18		1452	−0.1	−3		1249	0.6	18		1337	0.1	3
	1822	5.0	152		1830	5.6	171		1851	4.9	149		2012	5.5	168		1757	5.2	158		1853	5.8	177
9 F	0141	0.1	3	24 Sa	0154	−0.5	−15	9 M	0208	0.4	12	24 Tu	0307	0.1	3	9 M	0058	0.6	18	24 Tu	0148	0.5	15
	0710	4.6	140		0708	5.2	158		0730	5.0	152		0837	5.6	171		0607	5.7	174		0710	6.1	186
	1334	0.5	15		1414	−0.4	−12		1434	0.7	21		1549	0.1	3		1330	0.7	21		1431	0.3	9
	1901	4.9	149		1931	5.5	168		1924	4.8	146		2111	5.4	165		1821	5.2	158		1951	5.7	174
10 Sa	0219	0.2	6	25 Su	0244	−0.4	−12	10 Tu	0240	0.5	15	25 W	0400	0.2	6	10 Tu	0129	0.7	21	25 W	0238	0.7	21
	0755	4.6	140		0806	5.2	158		0752	5.1	155		0935	5.5	168		0627	5.8	177		0807	5.9	180
	1416	0.6	18		1511	−0.3	−9		1526	0.8	24		1647	0.2	6		1414	0.8	24		1526	0.5	15
	1940	4.8	146		2032	5.4	165		2009	4.6	140		2210	5.3	162		1855	5.1	155		2049	5.6	171
11 Su	0256	0.3	9	26 M	0336	−0.3	−9	11 W	0320	0.5	15	26 Th	0455	0.4	12	11 W	0202	0.8	24	26 Th	0331	0.9	27
	0839	4.6	140		0904	5.3	162		0832	5.2	158		1034	5.4	165		0704	5.8	177		0906	5.8	177
	1503	0.7	21		1610	−0.2	−6		1627	0.9	27		1746	0.3	9		1504	1.0	30		1622	0.6	18
	2021	4.6	140		2132	5.2	158		2109	4.5	137		2309	5.2	158		1942	5.0	152		2147	5.5	168
12 M	0334	0.4	12	27 Tu	0429	−0.3	−9	12 Th	0413	0.7	21	27 F	0552	0.5	15	12 Th	0245	0.9	27	27 F	0426	1.0	30
	0922	4.7	143		1002	5.3	162		0923	5.2	158		1133	5.4	165		0751	5.8	177		1005	5.6	171
	1559	0.8	24		1710	−0.1	−3		1733	0.9	27		1843	0.3	9		1602	1.1	34		1718	0.7	21
	2115	4.4	134		2231	5.1	155		2234	4.4	134						2041	4.9	149		2245	5.5	168
13 Tu	0416	0.4	12	28 W	0524	−0.2	−6	13 F	0520	0.7	21	28 Sa	0007	5.3	162	13 F	0341	1.0	30				
	1006	4.7	143		1101	5.3	162		1028	5.2	158		0648	0.5	15		0844	5.8	177				
	1701	0.8	24		1810	−0.1	−3		1837	0.8	24		1231	5.4	165		1705	1.1	34				
	2220	4.3	131		2330	5.0	152		2348	4.4	134		1938	0.2	6		2201	4.9	149				
14 W	0507	0.5	15	29 Th	0620	−0.1	−3	14 Sa	0631	0.7	21					14 Sa	0453	1.1	34				
	1055	4.8	146		1159	5.3	162		1149	5.2	158						0947	5.6	171				
	1806	0.8	24		1908	−0.1	−3		1938	0.6	18						1808	1.1	34				
	2325	4.2	128														2318	4.9	149				
15 Th	0605	0.5	15	30 F	0028	5.0	152	15 Su	0050	4.5	137					15 Su	0607	1.1	34				
	1148	4.9	149		0715	−0.1	−3		0736	0.5	15						1110	5.6	171				
	1908	0.7	21		1255	5.3	162		1256	5.4	165						1909	0.9	27				
					2004	−0.2	−6		2034	0.4	12												
				31 Sa	0123	5.1	155													30 M	0037	5.7	174
					0808	−0.1	−3														0714	1.1	34
					1347	5.4	165														1256	5.6	171
					2057	−0.3	−9														1957	0.6	18
																				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



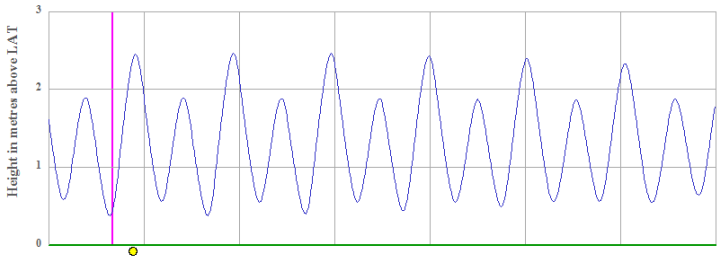
Australian Example



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)

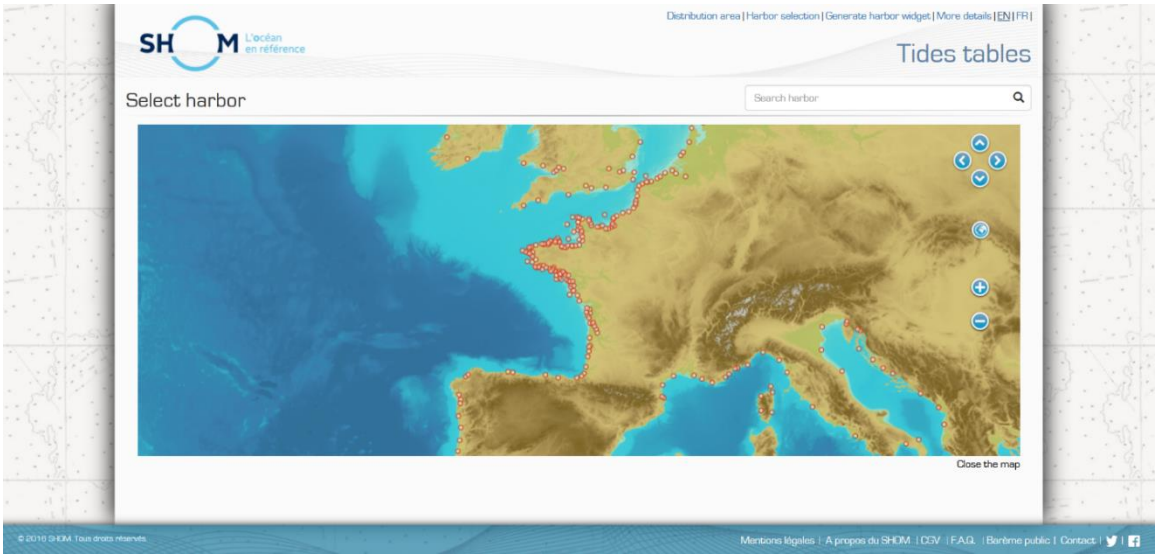


Figure 1: https://maree.shom.fr (2018-02)

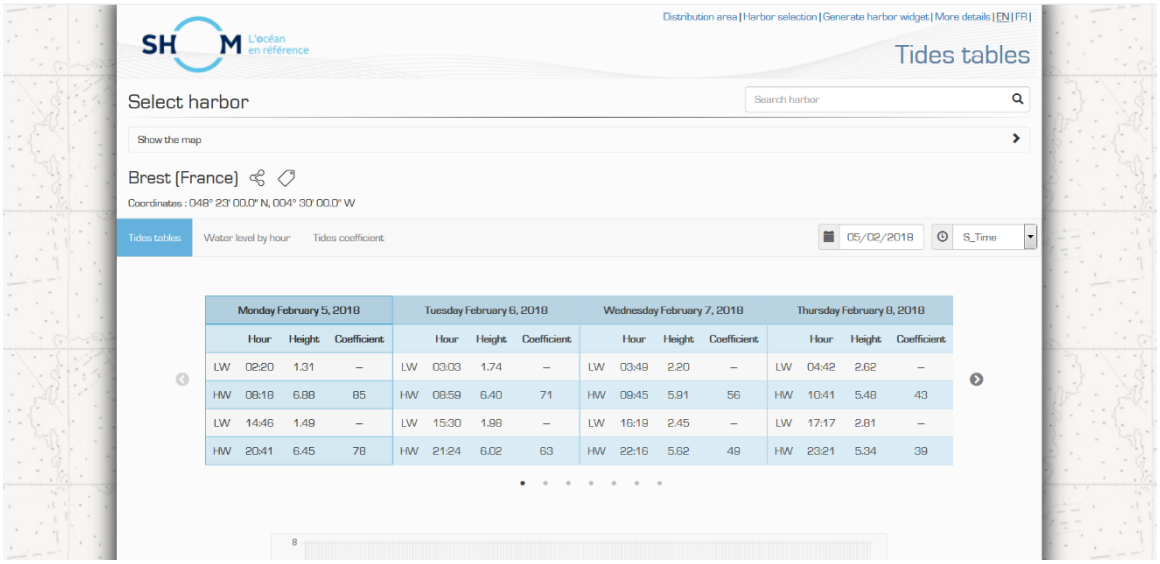


Figure 2: https://maree.shom.fr (2018-02)

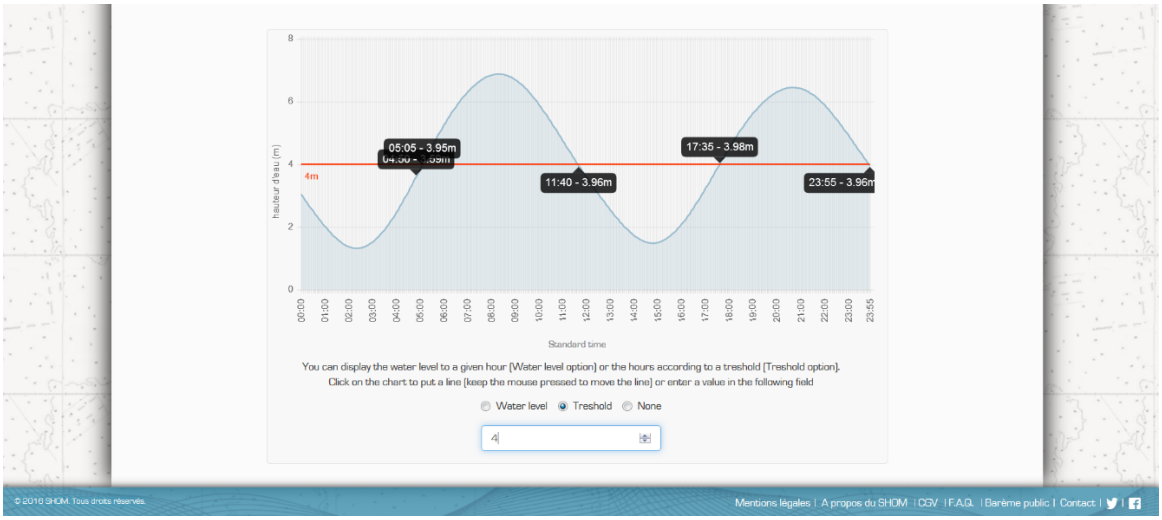


Figure 3: https://maree.shom.fr (2018-02)

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

a) 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.

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

c) 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.

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	See report TWCWG4: List of involved and active members: Kurt Hess* 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)
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 See TWCWG4 report list of MS involved		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
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.
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	

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
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
Stavanger, Norway – 25-28 May 2020
Draft Agenda – (TWCWG5)

1. Opening

.1 Opening address – Chair
.2 Address by host nation – NHS
.3 IHO comments – IHO

2. Administrative Arrangements

.1 Adoption of the Agenda and Apologies – Chair/Secretary
.2 Programme and timetable of the Sessions – Chair/Secretary
.3 Meeting administration, including H&S – NHS
.4 Report on Intercessional Activities including HSSC10 – Chair
.5 Matters arising from TWCWG3/Review of Action Items – Secretary

3. Programme Matters

.1 Standard Constituent List – GBR
.2 Standard for digital Tide Tables – USA
.3 The study of long term data sets for the determination of global sea level rise. – NOR/USA
.4 Compare Tidal Predictions generated as a result of analysis of a common data set by different analysis software – USA/NOR
.5 Feedback on long term sea level variation – NOR
.6 Exchange of Harmonic constants/predictions, feedback on comparison of tidal constituents – GBR/USA
.7 Establishment and Maintenance of VRF for High Resolution Bathymetric Surfaces – GBR & NLD
.8 Determining ellipsoidal height of MSL at the coast – NLD
.9 Inventory of Tide gauges used by IHO Member States – IHO
.10 Actual Tides On-line Link status – IHO

4. Product Specification Presentations

.1 Water Level Information for Surface Navigation (S-104) – AUS
.2 Surface Current Product Specification (S-111) – USA

5. Product Specifications Work Packages

.1 Progress report on current datasets – USA
.2 Feedback on results from encoding tests – USA
.3 Application of encoding tool(s) to additional datasets – USA
.4 Encoding datasets in HDF5 S-111 format – USA
.5 Engagement with S-100WG and other relevant subordinate bodies – FRA

6. IHO Resolutions and Charting Specifications

.1 Review of relevant IHO Resolutions – ZAF
.2 Review of relevant IHO Charting Specifications – IHO

7. IOC Programmes

.1 Update on IOC GLOSS Programme items and events – USA
.2 Update on IOC TOWS Programme items and events – CHL

8. Capacity Building

.1 Tides and Water Levels Workshop training material – ZAF/AUS

9. Any Other Business

.1 Development of report to HSSC12 – Chair
.2 Historical data recovery/data archaeology – Chair
.3

10. Work Plan and ToRs

.1 TWCWG Work Plan up-dates – IHO
.2 Review TWCWG ToRs and RoPs – IHO

11. Venue and dates of the 6th TWCWG Meeting (TWCWG6) – Chair/Secretary

12. Election of Chair and vice-Chair (in accordance with ToRs article 3c) for next triennium – Secretary

13. Review of Action Items from TWCWG5 – Secretary

14. Draft Agenda for TWCWG6 – Chair/Secretary

15. Closing remarks – Chair