Paper for consideration by HSSC12

Report of the Tides, Water Level and Currents Working Group

Submitted by:	TWCWG
Executive Summary:	Overarching presentation of the tide water level and current IHO-TWCWG activities
Related Documents:	HSSC11/57, HSSC11/58, S-100WG5-03.8, TSM7-517, S-100WGTSM7, S-100 Ed., S-104 v0.0.3, S-111 v1.0.1, TWCWG4-4.5.6, DQWG-1405D, CL 31/2019, NIPWG architectural display of S-100 based products, Terms of Reference and Rules of Procedure : Ref Annex C TWCWG report to HSSC11
Related Projects:	S-104, S-111
Chair:	Gwenaële Jan, (Shom, France)
Vice-Chair:	Peter Stone (NOAA, USA)
Secretary:	David Wyatt, IHO
Expert Contributor: ***Organisations:***	CCOM-UNH, SPAWAR Atlantic, C-Map IOC-GLOSS

Next Meeting

TWCWG5 Stavanger, Norway (2021, April)

TWCWG5 Stavanger, Norway 2020 May has been postponed to 2021 due to COVID-19 global circumstances.

Introduction / Background

The version attached to this document presents the status and raises questions which need further discussions and considerations.

TWCWG list of actions are identified in annexe B. Terms of Reference and Rules of Procedure : Ref Annex C TWCWG report to HSSC11

Work Program / Analysis/Discussion

5.7	**Tides, Water Level and Currents (TWCWG)**				
5.7	Digital Tide and Tidal Current Tables	HSSC 11/57	**HSSC** endorsed the proposed IHO Resolution on Standard for Digital Tide and Tidal Current Tables. **IHO Sec.** to issue an IHO CL seeking the approval of IHO Member States on this proposed Resolution.	**July 2019**	Decision Complete (IHO CL 04/2020 refers)
		HSSC 11/58	**HSSC** encouraged the IHO Member States to consider participating in the tidal data archaeology project led by the TWCWG**.**	**HSS C-12**	IOC-IHO sponsored Workshop on Sea Level Data Archaeology, 10-12 March 2020, Paris

Table 1Source HSSC11 2019

Action 5.7 HSSC11/57 in HSSC11 list of actions: done

Action HSSC11/58: IHO-TWCWG talk was given by TWCWG Chair at Unesco during the data archeology meeting.

- **Capacity building:**

Joint - 4.1 Capacity Building: Add details of IOC resources and material Hydro SAN/IOC . All relevant links to IOC docs within the presentations are completed.

Joint - 4.1: Investigate appropriate acknowledge statement/copyright protection for on-line Tides and Water Levels course material: Feedback still awaited A method to secure the test/evaluation still required as well. A link to the IOC resources page/ documents for download could be added if this is necessary.

Develop and maintain material for CB course on Tides and Tide gauges: English, French, Spanish versions completed. A feedback need to be delivered from Brazil on Portuguese's translations. IHO looking into where on the new website the courses will be displayed.

- **Charting Specifications** highlighted in TWCWG5-6.2. The IHO Circular Letters are of interest: 2/2019 dated 10 January 2019; 25/2019 dated 22 May 2019; 31/2019 dated 26 June 2019; 32/2019 dated 27 June; 40/2019 dated 28 August; 46/2019 dated 25 September 2019; and 4/2020 dated 17 January 2020.
- **Contribution or review** on MS15 : HSSC11/38, S-52 dictionary, TWCWG4-4.5.6, DQWG-1405D
- **Long term time series analyses** :

One of the action items from TWCWG 4 was to analyze the common data sets available online. The common data sets are now part of the new Document Archive at the IHO website, in the folder "Tidal Predictions Data Sets" at the following location: Content/Committee Documents/Hydrographic Standards & ServContent/Committee Documents/Hydrographic Standards & Services (HSSC)/Working Group Documents/TWCWG/Miscellaneous Informationices (HSSC)/Working Group Documents/TWCWG/Miscellaneous Information. The document "cumulative_list_Misc.htm" shows an overview of the datasets with additional information and/or reference to a readme file.

- TSM-7-517: Paper for Consideration by S-100 WG TSM7 Potential Changes to S-100 HDF5 for S-104
- TWCWG4-4/6.1
- Focus on S-104, S-111:

Front-of-bridge , Back-of-bridge "The initially introduced terms "Front-of-bridge/ECDIS" and "Back-of-Bridge " lead to misunderstanding and disharmony between the terms used by IMO and IHO. Therefore, the IMO compliant terms "Route Monitoring" and "Route Planning" replace the terms "Front-of-bridge/ECDIS" and "Back-of-Bridge/ECS". An adequate and harmonised product specification description is essential to assign product specification to "Route Monitoring" and "Route Planning" use correctly." (source: S-100WG)

TWCWG build products specification on a similar basis descripted by S-100WG (key word in S-104 v0.0.7 and S-111 v1.0.1: "route"). Doing so, route planning and monitoring are thought in S-111 and S-104 PS documents. It appears to be coherent with the S-100 definition above. TWCWG will precisely integrate/write the wording of front of bridge for route monitoring and back off bridge for route planning.

Portrayal requirements:

Taking in consideration the S-100 architectural diagram that raised the disharmony between what S-98 (interoperability specifications) and the current position of the HSSC working groups. "The product specifications are separated into those relevant for the Route Planning mode and those relevant for Route Monitoring mode. The mariner may select different S-98 interoperability levels." (S-100WG)

TWCWG, in case of distinct information provided under S-111 and S-101 (for example), a prioritization has to be proposed for navigation and end users. Some suggestions were discussed at TWCWG4 (2019) and are still under consideration.

Harmonization is needed between IHO-WG to progress with efficiency and to avoid PS documentation that will follow different routes.

Data quality indicators:
S-100WG notes will impact section 11 Data Product Delivery (S-111 PS v1.0.1) the guideline for TWCWG is that data quality indicators should only apply to products under the remit of IHO. Other communities might define their own data quality indicators or may adapt the IHO approach. See points defined in S-111 and S-104 PS.
TWCWG will check with S-100WG how this point can be harmonized between S-100WG and TWCWG (2020).

Real-Time data: The state of the art on this point is currently identified in S-111 v1.0.1 PS and S-104 v0.0.3

Reference : Ref Table 7.1 – Types of surface current data, based on the source of the data.

8 Maintenance

8.1 Maintenance and update frequency

Surface currents change rapidly, so more-or-less continual revision or updating of the data is essential. For real-time observations, new values are periodically collected (on the order of once every 5 minutes). For a forecast, the entire field of currents is created one or more times per day. New issues of real-time observations or forecasts are not considered new editions, but new datasets. New editions may occur in predicted time series data. New dataset may distinguished by a unique datetime in the file name.

Tidal atlas or harmonic constant data are updated much less often, typically on an annual basis. Table 8.1 summarizes this information.

Table 8.1 – Typical update/revision intervals and related information for S-111 products produced by a single HO.

Data Types	Interval	Number Of Spatial Locations	Number Of Time Values Per Location
Harmonic Constant Tidal Predictions	1 year	100 to 1,000	8,760 (hourly data)
Model Forecasts	6 hr	100,000 to 1,000,000	1 to 24
Real-time Observations	0.1 hr	1 to 10	1 to 240
HF Radar Observations	0.1 hr	10,000 to 100,000	1 to 24

NOTE: Because of the possibility of hourly release of new datasets, the ECDIS system must check on the availability of new data at a similar frequency.

8.3 Production process

S-111 data sets, including the metadata and the coverages for current speed and direction, are updated by replacement of the entire data product. HOs routinely collect observational data and maintain an analysis and/or forecast capability. When new data become available (often several times per day), the data is reformatted and made available for dissemination.

9 Portrayal

9.1 Introduction

This section describes means of displaying surface current vectors to support navigation, route planning and route monitoring. Two types of data are discussed in depth. They are:

point data, which would apply to historical data, astronomical predictions, and real-time data at a small number of locations; and

sets of multiple points, which would apply to analyses, coastal radar observations, and model-based hindcasts and forecasts. For multiple point data, the current vector portrayal characteristics used for single-point data can be adapted to displaying data at individual points.

For example, a point portrayal may be provided to display currents at significant locations such as turning points or where real-time observations are available. A multiple-point portrayal may be provided for voyage planning where a mariner's selection of routes may be influenced by an overview of the currents. Note that not each portrayal category (single point and multiple point) may be available for all types of currents data (historical observations, real-time observations, astronomical predictions, and forecast total currents).

All recommended sizes are given assuming a minimum size ECDIS display of 270 by 270 mm.

9.2 Display of current at a single point

Portrayal of current using single point data should be used for instances where the data source is a current meter (for example a historical or real-time current measuring device) at a single geographic location.

9.2.1 Arrow shape

The generalized arrow shape must be created using the input dimensions shown (Figure 9.1) and scaled according to the current speed and the display area. This shape is unique and so does not conflict with existing arrow and arrow-like shapes previously approved for use in ECDIS (Figure 9.2).

9.4 Temporal rules

The metadata variables related to time are the *dateTimeOfFirstRecord, dateTimeOfLastRecord, timeRecordInterval*, and *numberOfTimes*. The time selected for display (that is past, present, or future) of the surface currents by the display system will typically not correspond exactly to the timestamp of the input data. For a correct display, the ECDIS will have to select the correct data.

For data with only a single record (where the timestamp of the earliest value equals that of the latest value) such as real-time data, the surface current values are displayed only if the display time is later than the timestamp and the absolute time difference between the display time and the data timestamp is less than a discrimination interval (for example 5 minutes). For a single record, the variable *timeRecordInterval* (see clause 12.3) can be used to set the discrimination interval.

For data with multiple times, if the selected display time is later than the first timestamp and earlier than the last timestamp, then the closest but immediately preceding values in the data are displayed. However, if the selected display time is earlier than the first timestamp then the data is not displayed. If the selected time is later than the last timestamp, then surface current values at that time are displayed only if the absolute time difference between the display time and the data timestamp is less than a discrimination interval (for example the value of the variable *timeRecordInterval*).

We try to gather information also in § 12.2.16 S100_DataDiscoveryMetadata. Information here pertains to the data product, and repeats some of the variables in the Product Metadata (clause 12.3).

The paper and presentation (S-100WG5/4.17) are recently received will be discussed by TWCWG in order to integrate the elements that will be factors of harmonization between the distinct products specification.

https://iho.int/uploads/user/Services%20and%20Standards/S-100WG/S-100WG5/S100WG5_2020_4.17_EN_RealtimeData.pdf

https://iho.int/uploads/user/Services%20and%20Standards/S-100WG/S-100WG5/S-100WG5_2020_04.17-Pres_EN_Realtime_Data.pdf

"**Route Monitoring" product specification** (src: extract from S-100 WG)+ column : TWCWG related topics and elements provided

From S-100WG		TWCWG related topics and elements provided
S-101	Fundamental basis for route monitoring and route planning mode. Will a future version of S-101 cover the S-103 scope and make S-103 superfluous?	S-104 analysis, suggestion: Transparency must be adjusted according to ECDIS standard (S-57, S-101), see S-111 section 9.3 for guidance
S-102	The depth information can deteriorate/improve the S-101 information. That could have effects on spatial operations such as the determination of the "Safety contour line".	
S-104	The water level information can deteriorate/improve the S-101 information. The current edition provides only information on predicted data and no real-time data.	Real-time data is present in S-104, S-111 documentation : REF S-104 documentation PS v0.0.3 : ***S-104 elements/ analysis** (below the table)
S-111	Surface current information overlay the S-101 information.	"Route Planning and monitoring

*S-104 elements / analysis:

"S-104 is the Water Level Information for Surface Navigation Product Specification, produced by the IHO.
The development of electronic navigation with high resolution bathymetric data, and the drive to increase safety of navigation are now demanding time-sensitive data. IHO has identified the requirement for a product specification for dynamic tidal and water level data.
Tidal height information has traditionally been provided as high/low predictions however with increasing drafts and technology, there has been a move to hourly predictions with major ports providing real-time height information to their pilots and web-sites.
There is now a requirement to supply tidal and water level data as a single point time-series and as a surface time series to manage critical depths and provide tidal windows."

S-104 – section 2 Specification Scopes
"This product specification outlines the types of water level products from the national Hydrographic Office (HO) or authorised producer, to the end user. The data may be Historical observation, Real-time observation, Astronomical prediction, analysis or hybrid method, hindcast or forecast models. Requirements for data and metadata are provided. This document does not include product delivery mechanisms. The three data products are:
a) Single point product– provision of water level information for a single point in the traditional graphic display mariners are familiar with from hard copy publications and digital tide tables.

b) Gridded data product– provision of water level information for a defined region as a surface. Allowing any grid point to be queried as per a traditional single point.

c) Gridded Hydroid product – this product will provided the mariner the separation surface between the Ellipsoid and chart datum for a defined region.

Scope ID: Global "

*** Route Planning and monitoring:**

Section 9 Portrayal in S-111 v1.0.1 PS:

9.1 Introduction

This section describes means of displaying surface current vectors to support navigation, route planning and route monitoring. Two types of data are discussed in depth. They are:

point data, which would apply to historical data, astronomical predictions, and real-time data at a small number of locations; and

sets of multiple points, which would apply to analyses, coastal radar observations, and model-based hindcasts and forecasts. For multiple point data, the current vector portrayal characteristics used for single-point data can be adapted to displaying data at individual points.

For example, a point portrayal may be provided to display currents at significant locations such as turning points or where real-time observations are available. A multiple-point portrayal may be provided for voyage planning where a mariner's selection of routes may be influenced by an overview of the currents. Note that not each portrayal category (single point and multiple point) may be available for all types of currents data (historical observations, real-time observations, astronomical predictions, and forecast total currents).

All recommended sizes are given assuming a minimum size ECDIS display of 270 by 270 mm.

Points addressed in S-104 and S-111 in relation to sub surface navigation

TWCWG decided to treat surface navigation first but reserved place in metadata product specification for information that is required for subsurface navigation (ex: vertical coordinate but not only). This point is of importance. For TWCWG today, priority is given to surface PS. Subsurface input recommendations from other IHO WGs would easy the process starting the conception of this specific part of PS (S-103, S-100).

S-111, S-104 use cases definition process started**.**

Justification and Impacts

"A clear desciption of the archirectural infrastructure of S-100 based product specifications under the remit of IHO is essential for the stearing of the product specifications development." (source : S-100WG)

S-100 will share with TWCWG its tools. TWCWG plan to use it for test applied to water level and current application.

Recommendations

A consensus on the data model is essential - from that S-100WG can then build the feature catalogue and start putting out some test data using S-100 processes.

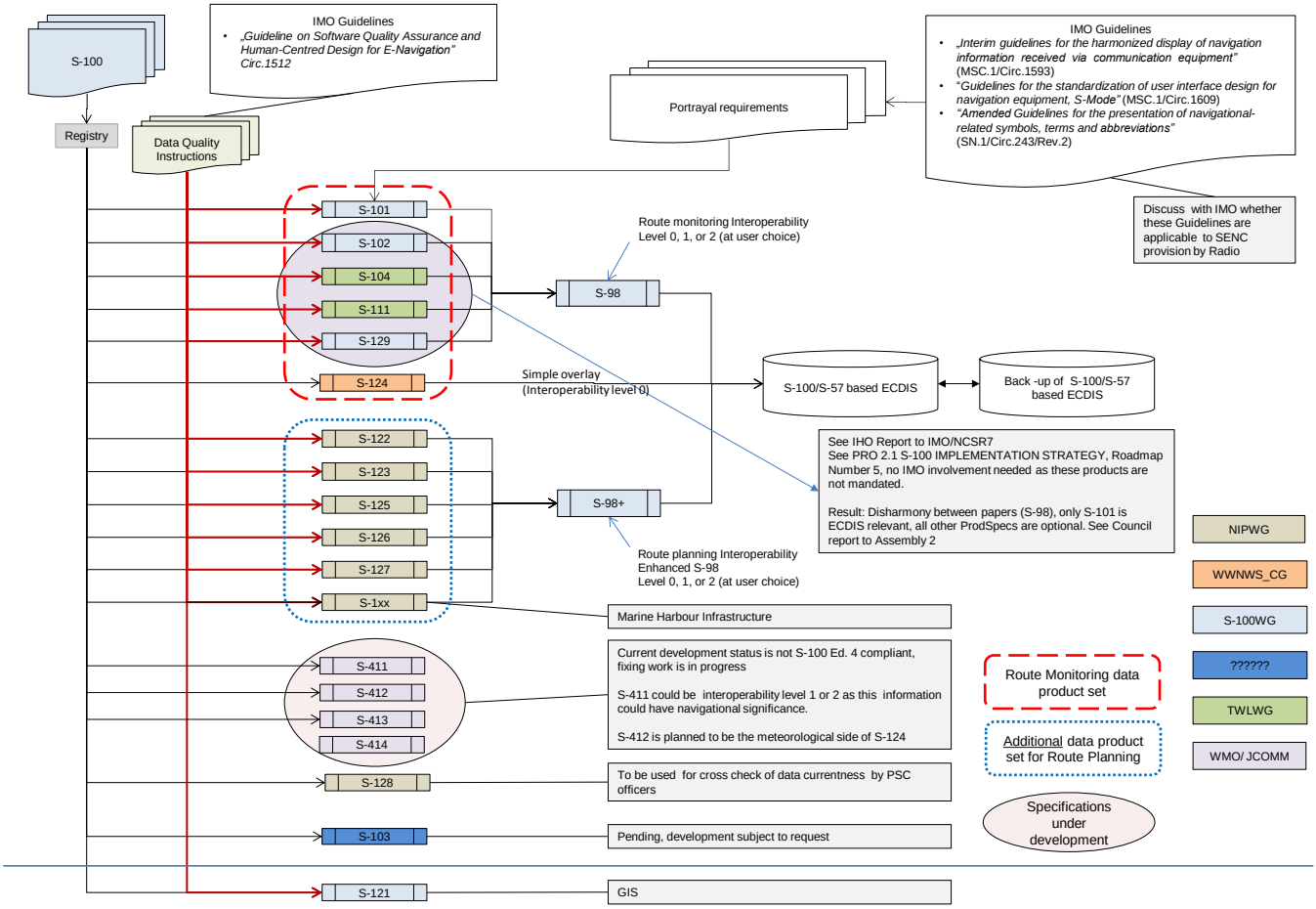
Action required of HSSC12

The HSSC12 is invited to:

a. note this paper,

b. discuss the presentation and act appropriately.

Annex A: From S-100WG



As of 24 February 2020

TWCWG WORK PLAN 2019-20

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		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* + 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)

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
25-28 Mar 2014	Wollongong, Australia	TWLWG-6
3-5 Jun 2014	Québec City, Canada	SCWG-2
21-24 April 2015	Silver Spring, Maryland, USA	TWLWG-7
13-15 May 2015	Tokyo, Japan	SCWG-3
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

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