INTERNATIONAL HYDROGRAPHIC ORGANIZATION

ORGANISATION HYDROGRAPHIQUE INTERNATIONALE

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CIRCULAR LETTER 10/2017
01 February 2017

ADOPTION OF THE PROPOSED REVISION OF IHO RESOLUTION 3/1919 - DATUMS AND BENCH MARKS

References:

A. IHO Circular Letter 27/2016 dated 7 June - *Call for approval of a revision of IHO Resolution 3/1919 - Datums and Bench Marks*
B. IHO Publication M-3 - *IHO Resolutions,* 2nd Edition - 2010, updated to December 2016

Dear Hydrographer,

1. Reference A proposed the adoption of a revision of IHO Resolution 3/1919 - *Datums and Bench Marks* - recommended by the IHO Tides, Water Level and Currents Working Group (TWCWG) and endorsed by the IHO Hydrographic Services and Standards Committee.

2. The Secretariat of the IHO thanks the 48 Member States who replied to Reference A: Argentina, Australia, Bahrain, Bangladesh, Belgium, Brazil, Canada, Chile, Colombia, Croatia, Cuba, Ecuador, Estonia, Finland, France, Georgia, Germany, Greece, Guatemala, Iceland, India, Italy, Japan, Latvia, Mauritius, Monaco, Montenegro, Morocco, Netherlands, New Zealand, Norway, Papua New Guinea, Peru, Portugal, Qatar, Romania, Saudi Arabia, Singapore, Slovenia, South Africa, Spain, Sweden, Tunisia, Turkey, Ukraine, United Kingdom, United States and Uruguay.

3. 44 Member States supported the proposed revision and four Member States objected. 15 Member States offered comments in addition to their vote. Their comments and the consolidated outcome of the considered reviews made by the TWCWG Chair and Vice-Chair and the Secretariat, when appropriate, are provided in Annex A.

4. There were 85 Member States of the IHO with three States suspended when Reference A was issued. Therefore in accordance with the provisions of the Convention on the IHO that were applicable when the consultation was initiated, the majority required for adoption of the revised Resolution is 42. As a result, the proposed revision of IHO Resolution 3/1919 has been adopted, taking into account the adjustments reported in Annex A.

5. The adopted revised version of IHO Resolution 3/1919, is shown in Annex B. It will be made available in an updated version of IHO Publication M-3 - *Resolutions of the International Hydrographic Organization* that will be posted on the IHO website as soon as possible.

On behalf of the Secretary-General
Yours sincerely,

Gilles BESSERO
Director

Annex A: Member States' responses to CL 27/2016 and consolidated comments from the TWCWG Chair and Vice-Chair and the IHO Secretariat.

Annex B: Revised version of IHO Resolution 3/1919 as adopted - *Datums and Bench Marks*.

MEMBER STATES' RESPONSES TO CL 27/2016 AND CONSOLIDATED COMMENTS FROM THE TWCWG CHAIR AND VICE-CHAIR AND THE IHO SECRETARIAT

ARGENTINA (Vote: NO)

With reference to paragraph 8:
A minimum of 19 years is considered insufficient for reckoning the LAT since most of the calculations made for different ports in Argentina have resulted in differences of up to 3.7 cm for several 19-year periods (graphs for 3 locations in Argentina are attached). Even though this is a minor difference, this could lead to Tide Tables showing negative low tide values, which is contrary to LAT definition. The amount of years to be predicted will rely on the number of constituent waves taken into account for the prediction as well as in the range of the site. In our Service a 100-year period of predictions was empirically established to calculate LAT. The results are checked every time that new harmonic constants are available.

With reference to: "* Note: LAT (HAT) is defined as the lowest (highest) tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions. (Note: text moved from paragraph 7)":

The term "average meteorological conditions" should be left out since it is an astronomic tide prediction.

Consolidated comment
19 years is the recommended minimum period corresponding to one full Saros period (Lunar cycle of 18.6 years) that takes into account the better part of the tidal variability. It is true that a period of 100 years would provide better results, subject to the accuracy of the harmonic constants that are used, which is dependent on the duration of the observations. The recommendation is the best compromise taking into account practical constraints and the tidal variability.

Meteorological conditions such as storm surge phenomena or anti-cyclonic pressure affect the water level observations from which reference tidal levels are computed. It is therefore important to ensure that the methods used to compute the reference tidal levels remove any meteorological bias and in that sense, the LAT should reflect "average meteorological conditions".

CANADA (Vote: YES)

Paragraphs 3 and 4. CA accepts these resolutions but notes that not all CA tide stations have pre-existing geodetic linkages and CA will continue to build these linkages on an opportunity basis.

Paragraph 5. CA suggests the word "Highest" be substituted by the word "High".

Paragraph 8. CA accepts Paragraph 8 under the understanding that the words "LAT" and "HAT" refer either specifically to LAT and HAT, or to the individual HO's similar datums, as provided for in paragraphs 6 and 7. CA also stipulates the understanding that the prescribed use of a minimum of one year's data can only be applied to calculations where data sets of this length exist.

Paragraph 9. CA accepts paragraph 9 under the understanding that the qualifying text in brackets, "(such as lowest water (LW) as a reference level for depth and HW for vertical clearances)" is non-binding and meant as a recommendation only. CA considers that paragraph 9 may be applied to all situations that fall outside areas covered by paragraphs 5 through 8, and that paragraph 10 is intended to provide HO's with the option to adopt a geodetic or MSL reference in certain commonly administered bodies of water with limited or negligible tidal range

Consolidated comment
The CA comments on paragraphs 8 and 9 reflect the intention of the Resolution.

Changing "Highest" to "High" in paragraph 5 is not considered appropriate in relation with the provisions of paragraph 7.

CHILE (Vote: YES)

Before paragraph 5 of the Spanish version there is the following text: "En las zonas de marea del ~~los~~ océano~~s y las zonas geográficas conectadas a los océanos~~" which in the end would be: "En las zonas de marea del océano". In our opinion, in Spanish we cannot understand this and that is why we propose that it reads: "En las zonas oceánicas influenciadas por marea".

Before paragraph 9 of the Spanish version there is the following text: "En aguas mixtas (donde la variabilidad del nivel del mar se debe a los mecanismos debidos a las mareas y a los mecanismos de forzamiento regional específicos) y en aguas interiores."
"Inland waters" has been translated as "aguas interiores", which is a mistake. It must be "aguas internas", in order not to mix it up with the definition given by UNCLOS.
The text should be: "En aguas mixtas (donde la variabilidad del nivel del mar se debe a los mecanismos debidos a las mareas y a los mecanismos de forzamiento regional específicos) y en aguas internas".

Before item 10 of the Spanish version there is the following text: "En las zonas geográficas ~~con una conexión limitada a los océanos y~~ donde ~~una~~ la amplitud de marea es insignificante y en zonas sin mareas ~~(<30 cm)~~" which in the end would be: "En las zonas geográficas donde la amplitud de marea es insignificante y en zonas sin mareas".
In our opinion it is not appropriate for a resolution not to be distinctive and to use the term "insignificante", which can have a very wide interpretation. Definitely, we prefer that it is mentioned, either leaving "menor de 30 cm", or with another value. We do not see any problem in having "menor de 30 cm", but we think that leaving this open is inconvenient.
For the title our proposal would be: "En las zonas geográficas sin mareas o donde la amplitud de marea es menor de 30 cm".

Consolidated comment
The issue of setting a minimum range was discussed at length by the TWCWG and it was agreed that a range smaller than 0.30m means that tides are not significant in the water level height. After due consideration, the TWCWG decided to propose the term "negligible" to qualify this small variation in level. This wording would allow local and regional determination of what tidal amplitude and water level is estimated to be significant or not, depending on local conditions and requirements. After further considering Chile's comment, the final text is adjusted to read: "In geographical areas where the tidal range is negligible (for example less than 0.30 m) and in non-tidal areas".

The Spanish version of the adopted revised text takes into account the comments which are specific to the Spanish version of the proposed revision. To avoid any confusion with the term "internal waters" used in the English version of UNCLOS, the term "continental waters" is used in the revised Spanish and French versions as equivalent to "inland waters".

COLOMBIA (Vote: NO)
IHO CL No. 17/2014 was clear, excepted for item 8, which is in contradiction with item 6. In this latter CL, item 10 is in contradiction with items 6 and 7. The depths must refer to the lowest level determined by each country. Ideally it should be the LAT.

In CL No. 44/2014:

- Canada suggested considering a definition [of navigationally safe datums] for all navigable water between ocean and the inland waters. Please advise what was done with this suggestion.
- The Netherlands suggested changing the wordings "is resolved" by "is recommended". Was this recommendation taken into account?
- Peru: the situation is similar to that of Colombia. At sea, the Hydrographic Office uses the MLWS, MHWS and is calculating the LAT and HAT. On the land, the national institute IGAC uses the MSL. Colombia agrees that nautical publications should reflect these differences.
- Spain suggested changing the word "traducción" by "referenciación". Was this suggestion taken into account?

Conclusion: The drafting of the IHO Resolution No. 3/1919 is better described in CL 17/2014, except for paragraph 8. We recommend including the observations made in CL 44/2014.

Consolidated comment
The responses to IHO CL 17/2014 which were provided in IHO CL 44/2014 were further considered by the working group with additional inputs from Canada and others. The text proposed in IHO CL 27/2016 reflects the outcome. Paragraph 10 deals with areas where the tide is negligible. In such areas where the tidal forces do not drive the water level dynamics, the mean sea level (MSL) is the recommended reference level. There is no contradiction with paragraphs 6 and 7 that deal with tidal areas.
Note that the suggestion made by the Netherlands reported in CL 44/2014 referred to IHO Resolution 27/1919.

CUBA (Vote: YES)

Cuba approves the proposal of this circular letter.

About point 4. We agree. But for Cuba when we finish the modernization of our National Geodetic Network we will be able to implement an International Terrestrial Reference System (ITRS).

About point 8. We agree. In Cuba the LAT and HAT are determined by the harmonic constants of the tide stations and every 19 years they are upgraded, except for those towns where temporary stations were established in the 1970s and reiterated measurements are not available. For that we should establish 9 new tide stations.

ECUADOR (Vote: YES)

Paragraph 5 (for the Spanish review). We suggest to remove "más Alta", leaving only "dátum de Pleamar (HW)".

Paragraph 11. In the note it is suggested to add the word "oceanography" in: "average meteorological and oceanographic conditions" by virtue of variations originated by events El Niño/La Niña.

Consolidated comment
Changing "dátum de Pleamar más Alta" (Highest Water datum) to "dátum de Pleamar" (High Water datum) in paragraph 5 is not considered appropriate in relation with the provisions of paragraph 7.

It is considered that the meteorological conditions referred to in the note to paragraph 11 include the impact of the interaction between the atmosphere and the ocean causing events such as El Niño/La Niña.

FINLAND (Vote: YES)

Finland approves the proposed version of IHO Resolution 3/1919 as amended, but proposes the following clarifying editorial change:
Paragraph 9, last sentence: Change "…from a minimum of one year's observations" to "…from a minimum of one year's observations **or one year's navigation season/open waters observations"**.
Reasoning: There are areas where especially inland waters are regularly ice covered part of the year and thus closed from traffic, e.g. in Finland. During the ice covered season the water level deviates from the open waters season and when taking these observations into account it leads to impractical LW or HW for the areas where traffic exists only in open water season. Thus only observations from open water season or navigation season are to be taken into account.

Consolidated comment
It is considered that highlighting issues with water covered by ice will raise more comments and questions than the current version of the Resolution. The final text is adjusted to read "from a minimum of one year observations of free water level" in order to take the proposal into account.

NEW ZEALAND (Vote: YES)

New Zealand has reviewed the proposed revision and makes the following comments:

- in clause 11 "or as a suitable percentile" should read "or a suitable percentile";
- otherwise the wording looks good, definitions use consistent phrases and section headings etc. have been simplified.

Consolidated comment
Clause 11 is adjusted as suggested in the final text.

PERU (Vote: YES)

In item 5 (ocean tidal areas), it is mentioned that the heights on shore, including elevations of lights, should be referred to a Highest Water (HW) Datum.

Currently, in Peru, at the national level, we use the mean sea level as the topographic reference level for all the continental and island areas.

PORTUGAL (Vote: YES)

Between points 4 and 5, instead of "In ocean tidal areas" we suggest "In oceanic tidal areas".

Consolidated comment
The final text is adjusted as suggested.

SOUTH AFRICA (Vote: NO)

Paragraph 5 to read: "It is resolved that heights on shore, including elevations of lights, should be referred to the Highest Water (HW) datum or a different datum as established by national policy. The datum used should be clearly stated on all charts."

Heights on shore on all South African navigational products are referred to MSL.

Consolidated comment
It is understood that local or regional circumstances may justify deviations but the objective of the Resolution is to define and recommend the best practice and to promote the implementation of common standards and methods.

SPAIN (Vote: NO)

This Hydrographic Institute does not agree with item 5 of the proposal to refer to the shore heights and to the elevations of lights to a highest water (HW) datum.

The regulations in force in Spain establish as a reference for the heights the mean sea level records in Alicante for the Peninsula and the local tidal references for each of the islands. This Institute has no authorization to amend such Regulations, that is why, in case this proposal is adopted, we could not meet item 5.

Consolidated comment
It is understood that local or regional circumstances may justify deviations, but the objective of the Resolution is to define and recommend the best practice and to promote the implementation of common standards and methods.

UNITED KINDGOM (Vote: YES)

UK recognizes the importance of this Resolution and congratulates the concerted efforts by MS attending the recent TWCWG (and formerly TWLWG) in achieving a consensus on the wording and definitions within it.

UNITED STATES (Vote: YES)

NGA/SFNI recommends approval of the revision to the IHO Resolution 3/1919 - Datums and Benchmarks.
NGA/SFNI notes:
a) Clarification of statements relative to the World Geodetic System 1984 (WGS 84} is strongly requested;
b) Implications of approval by the United States Government exist to implement the revision which should be considered by the final approving authority.

Observations/Comments:

Clarification of statements relative to the World Geodetic System 1984

a) WGS 84 is not a realization of ITRF. It is a Terrestrial Reference Frame which stands alone; we maintain a close coincidence with the ITRF for reasons of interoperability with international DoD/IC partners.
Proposed wording:
> "It is further resolved that such observations should relate to a geocentric reference system (GRS), preferably the International Terrestrial Reference System (ITRS), the World Geodetic System 1984 (WGS 84), or other geodetic reference systems coincident with ITRS."

b) There should be a space between "WGS" and "84"; i.e., "WGS 84", not "WGS84".

Implications of approval by the United States Government

a) Treaty: The United States officially utilizes Mean Lower Low Water (MLLW) as the chart datum per Convention on the Territorial Sea and the Contiguous Zone. This convention was adopted by the United Nations conference at Geneva 1958, establishing the sovereignty of the state beyond its land territory and internal waters "the normal baseline for measuring the breadth of the territorial sea is the low water line". The low water line according to U.S. policy is equivalent to the intersection of the tidal datum mean low water (MLW) with the coast (U .S. Department of State Dispatch, 1995). However, the Department of State's term "mean low water" refers to the NOS term Mean Lower Low Water. Impacts to this legal convention should be considered by the approving authority.

b) Legal Cadastre: The United States officially utilizes Mean High Water (MHW) for determination of shoreline, which establishes legal (cadastral) relationships of ownership between US States and the US Federal Government, as well as the cadastre for property ownership in shoreline regions. Adoption of the proposed revision to the IHO Resolution 3/1919 implicitly means a cascade of legal changes related to Federal and State cadastre.

   The difference between Low Astronomical Tide (LAT) and MLLW is typically on the order of 2~5 decimetres. The implications of this difference to land cadastre, shorelines, and attendant legal boundaries of the United States should be considered by the approving authority, particularly with respect to the attendant financial aspects.

c) Paragraph 3 of the Proposed Resolution states that: "chart datums ... shall always be connected with the general land survey datum". This means that all tide gauges in the United States, contiguous territories, and protectorates will need to be surveyed to establish the required connection. The financial implications should be considered by the approving authority.

d) Relationship to the Geocentric Reference System: Paragraph 4 states that ellipsoidal height determinations of the vertical marks "... should relate to a geocentric reference system".
Practical implementation of this relationship will require precise geodetic measurement of both elevation (GPS) and gravity at every tide gauge location. The financial implications should be considered by the approving authority.

e) Paragraph 10 states "... that depths, and all other navigational information should be referred to Mean Sea Level (MSL) ..."; however, MSL has no real global meaning as defined by the Resolution as MSL is local to each tide gauge. For DoD operations this could be significant and will require the capability to determine the relationship between the geoid model, the MSL, and orthometric height.

Consolidated comment
Paragraph 4 is adjusted in the final text to reflect the proposal with respect to WGS 84.
With regard to the comment on paragraph 10, it is noted that the Resolution does not infer that MSL is local to a tide gauge. MSL is a reference surface to which each tidal station and observation contributes.

URUGUAY (Vote: YES)

Uruguay welcomes the efforts made by TWLWG to progress with the production of such reviews, understanding that the changes proposed provide a clarification and an updating of the Resolution about Datums and Benchmarks in force.

Approved revised IHO Resolution 3/1919 on Datums and Bench Marks

TITLE	Reference	Last amendment (CL or IHC)	1st Edition Reference
DATUMS AND BENCH MARKS	**3/1919 as amended**	**CL 10/2017**	**A2.5**

1 It is resolved that the datum of tide/water level observations and predictions for mariners shall be the same as chart datum (datum for sounding reduction).

2 It is resolved that chart datum and other tidal/water level datums used should be clearly stated on charts and all other navigational products.

3 It is resolved that chart datums (datums for sounding reduction), the datums of tide/water level prediction and other tidal/water level datums shall always be connected with the general land survey datum, and, in addition, with a prominent and permanent fixed mark in the neighbourhood of the tide gauge, station, observatory etc.

4 It is resolved that ellipsoidal height determinations of the vertical reference marks used for tidal/water level observations should be made, in order to support the production of seamless data sets; i.e. to allow the translation between data sets with differing vertical datums. It is further resolved that such observations should relate to a geocentric reference system, preferably the International Terrestrial Reference System (ITRS), the World Geodetic System 1984 (WGS 84), or other geodetic reference systems coincident with ITRS.

In oceanic tidal areas

5 It is resolved that heights on shore, including elevations of lights, should be referred to a Highest Water (HW) datum.

6 It is resolved that the Lowest Astronomical Tide (LAT*), or a datum as closely equivalent to this level as is practical and acceptable to Hydrographic Offices, be adopted as chart datum. Alternatively, another, similar datum may be used if low water levels in a specific area frequently deviate from LAT, or a different datum has been established by national policy.

7 It is resolved that Highest Astronomical Tide (HAT*), or a datum as closely equivalent to this level as is practical and acceptable to Hydrographic Offices, be adopted as the datum for vertical clearances. Alternatively, another, similar datum may be used if high water levels in a specific area frequently deviate from HAT, or a different datum has been established by national policy.

8 It is recommended that LAT and HAT be calculated either over a minimum period of 19 years using harmonic constants derived from a minimum of one year's observations or by other proven methods known to give reliable results. Tide levels should, if possible, reflect the estimated uncertainty values obtained during the determination of these levels.
In mixed waters (where water level variability is due to both tidal and regionally specific forcing mechanisms) and inland waters

9 It is resolved that depths, and all other navigational information should be referred to an appropriate level that is practical and acceptable to Hydrographic Offices (such as lowest water (LW) as a reference level for depths and HW for vertical clearances). The selection of which one of the alternatives to be used is a difficult issue which can only be determined locally and which will be largely dependent on seasonal hydrological conditions. LW and HW are defined preferably as the mean of lowest/highest water levels, or as a suitable percentile of lowest/highest water levels, observed over a long time period from a minimum of one year's observations of free water level.
In geographical areas where the tidal range is negligible (for example less than 0.30m) and in non-tidal areas

10 It is resolved that depths, and all other navigational information should be referred to Mean Sea Level (MSL) or other level as closely equivalent to this as is practical and acceptable to Hydrographic Offices.

Note: The adopted level may be a well-defined geodetic datum as used for heights in land survey applications or an observed local Mean Sea Level (MSL) based on long series of water level observations.

11 In order to support other non-navigational applications and also to indicate the characteristics in the area, it is recommended to adopt the mean of yearly lowest/highest water levels, or a suitable percentile of lowest/highest water levels, observed over a long time period from a minimum of one year's observations.

** Note: LAT (HAT) is defined as the lowest (highest) tide level which can be predicted to occur under average meteorological conditions and under any combination of astronomical conditions.*