HSSC4-03C rev2

4rd IHO-HSSC Meeting
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Report to HSSC-4 by the Correspondence Group on Definition and Length of Coastline

***Submitted by*:**	France
Executive Summary:	This paper reports on progress made by the CG on Definition and Length of Coastline. The CG proposes an IHO technical method on calculating the length of coastline for comparison purposes.
Related Documents:	HSSC2-03D *Report to HSSC-2 on the Correspondence Group on Definition and Length of Coastline* HSSC3-03C *Report to HSSC-3 on the Correspondence Group on Definition and Length of Coastline* CL90/2008 *French Study Group on the Standardisation of the Length of Coastlines*
Related Projects:	None
Annexes:	1. Final draft IHO method on calculating the length of coastline for comparison purposes. 2. Example list of lengths of coastlines for comparison purposes. 3. Example list of different calculations for the length of coastline not based on the recommended method.

1 Introduction / Background

Following a request from the European Commission, the 20th CHRIS Meeting (November 2008) encouraged the creation of a Correspondence Group (CG) aimed at harmonizing the way Member States define and measure the length of their national coastlines.

France volunteered to coordinate such a CG to study the feasibility of such standardization and members were invited to join the group.

The HSSC at its 2nd meeting in October 2010 invited the CG on the Definition and Length of Coastline to complete its work by HSSC-3.

The CG had a meeting on 30-31 march 2011 in Brest, France, with the participation of Germany, Finland, Spain, Cyprus, USA, Slovenia and France.

A first draft method was proposed to HSSC3 in 2011. This new version clarifies the aspects related to determinations between Usage Band ENC.

2 Main conclusions and proposals

2.1 Users' need and purposes for length of coastline

The CG found that there are no clear legal or other obligations to define how length of coastline is determined, but identified that obviously it is possible to define the length for various different purposes, such as, for administrative and comparison purposes (allocating fishing quotas, referencing aquaculture production statistics, coastal zone management, defining "hydrographic interest", etc.), environmental protection (for example, evaluating response capacity requirements) and various scientific purposes.

It was found that there are often several lengths available for the calculated or estimated length of coastlines, but only few metadata is associated with these values. There are many worldwide digital source data sets available. There exist several GIS softwares available to make the calculations.

The CG recognized that the coastline is by nature a fractal object; so it is not possible to provide an unambiguous length. The length may be calculated in as much detail as is desired and the length may therefore grow to infinity. There is never one simple solution (see Annex 3).

However, the CG noted that there are often requirements to be able to compare the length of coastlines between States for certain administrative purposes. Thus a standardised method for calculating these lengths is required.

2.2 General requirements

The CG noted that in order to develop a harmonised approach there are many issues that must be clarified before the length of a coastline can be calculated for a given purpose. Among these are:

- Requirements on the level of detail
- Sources to be used
- Scale of the sources
- Method to be used
- Generalisation
- What to be included (islands, inland waters, artificial structures…)
- How far do we measure river mouths
- Dynamical aspects and evolution of coastline

The CG identified some general requirements, specifications and guidance for those who may need to calculate the length of a coastline:

- Have a common definition of what is used in calculations
- Sufficient metadata should be associated with the calculated length. These include at least information on the methods used, source data, purpose of the calculation, what is included in the calculation, specifications used, expected use of the results
- The calculated results should be repeatable

- The results should be auditable

2.3 Coastline Length calculation for comparison purposes based on ENCs

The CG has developed a draft specification on a harmonised approach to define the length of a coastline for comparison purposes, based on official, standardised and available data: Electronic Navigational Charts (ENC).

The ENC coverage at Navigation Purpose code 1 (Overview), which is almost complete, is recommended as the basis for the calculation. Where this coverage is not available or suited for comparison purposes, Navigation Purpose code 2 or largest existing scales should be used.

The proposed specification (see Annex 1) identifies the sources to be used for the calculation, what elements should be included and the metadata to be associated with the results. Annex 2 provides examples of calculated lengths together with relevant metadata.

The CG noted the following benefits of using ENC as the basis for the calculations:

- ENCs are officially produced under the authority of national hydrographic offices (HOs).
- The coverage of small scale ENCs is effectively complete.
- The ENC product specification does not allow overlaps in the same navigation purpose code – hence a single unambiguous source of data should normally be available.
- It is possible to identify the producer State from the ENC data for each coastline segment.
- Data is already in a consistent structure and in a uniform format and associated with a unique geodetic datum.
- There are tools to extract coastlines from unencrypted ENC data sets.
- Calculations based on small scales minimises the “fractal” aspect of the coastline and makes comparison between countries more consistent.

2.4 Calculation and publication

In order to support Member States who need to calculate the length of their coastline, the CG proposes that the IHB publishes the current method in the hydrographic review with a list of coastline lengths to illustrate it.

The CG did not find it appropriate to include the lengths of States’ coastlines in the current form of C-55 (as suggested in Annex A to CL 90/2008) as it does not include such theme, nor to upload the results of calculations on its web site as they are not official.

3 Proposals to HSSC4

The HSSC-4 is invited to:

a) Note this report.
b) Publish the method in the hydrographic review.

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Annex 1

Final draft IHO technical method on calculating the length of coastline for comparison purposes

Recognizing that:

- There are requirements to compare the length of a coastline between States;
- There is a consequent requirement for the harmonization of the calculation of the length of a coastline of a State;
- The length of a coastline is fractal by nature; and
- The determination of the length of a coastline based on published ENC data can provide a more consistent source of fundamental data than hydrographic survey data

The IHO resolves that:

1. The length of a coastline for the purpose of comparison between States could be calculated according to the following guidance and specifications.

2. This specification describes a harmonized approach to determining the length of a coastline. It may only be relevant for comparison purposes and should not to be regarded as definitive nor suitable for all purposes.

3. For the purposes of this method, the coastline is defined as the High Water Line as represented by the Coastline, Shoreline Construction and Causeway classes of the applicable Electronic Navigation Charts (ENC).

4. The length of the coastline between two points is the sum of the lengths of the three Coastline, Shoreline Construction and Causeway classes between those points.

5. The relevant lengths obtained from Navigation Purpose code 1 (overview) ENC cells should be used for the calculation.

6. If Navigation Purpose code X ENC cells have not been published or are not suited for comparison purposes, data from Navigation Purpose code X+1 ENC cells (largest scales) should be used.

7. In cases where data from Navigation Purpose code X ENC cells is supplemented by data from Navigation Purpose code X+1 ENC cells, the latter is counted from the vertex closest to the last vertex of the code X ENC corresponding curve.

8. River mouths should be included in the calculation to the point where they become a line feature in the ENC band which is used for calculation. Objects which are upstream of a line object should not be included in the calculation of coastline (for example: in the case of inland water linked to the sea by a canal).

9. The end of each State coastline will be at the agreed or declared border line.

10. Refer to the example in Appendix 1 for further clarification.

11. The result of the calculation of the length of coastline should include the following:

    - Country name
    - Two-letter Country code (ISO S-62)
    - Length
    - Unit of measure
    - Any comments

12. The following metadata should be included with the result of the calculation.

Note: elements marked ***** are repeatable.

- Point of contact of the organisation responsible for the calculation (such as the postal address or web addresses of the HO)
- Method of calculation (Hydrographic review reference, for instance)
- Date of calculation (YYYY/mm/dd)
- Identifier of the ENC cell(s) used for the calculation *****
- Edition date of the ENC(s) *****

- Producer code of the ENC(s) (IHO S-62) *****
- Scale of the line segment(s) used *****
- Object Classes included in the calculation *****

Appendix 1_ An Example of using Navigation Purpose codes 1 and 2 ENC cells

Below is an illustrated example on how Navigation Purpose codes 1 and 2 ENC cells should be handled so that the latter supplement the former.

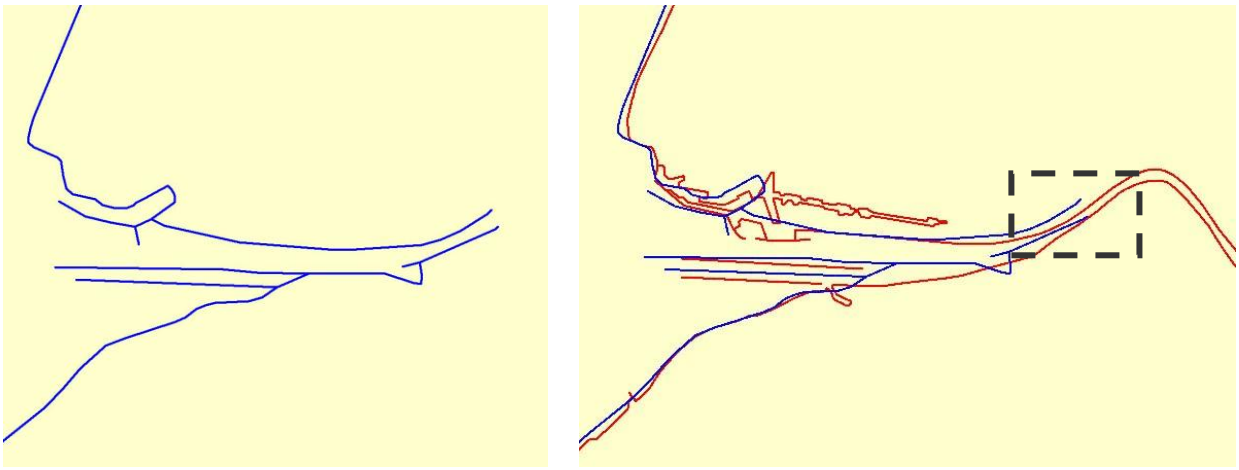

Fig.1 : Navigation Purpose code 1 ENC (blue), classes *Coastline, Shoreline construction* and *Causeway*
The line presents a discontinuity that can be supplemented by Navigation Purpose code 2 ENC data (red). The next figure displays the cropped area (dashed box).

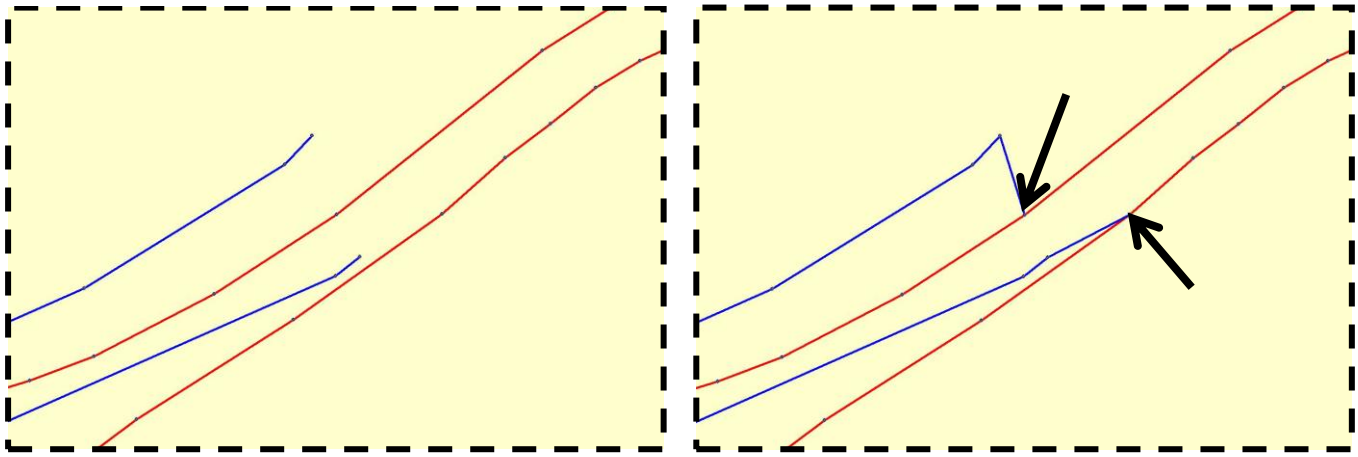

Fig.2. Crop on the discontinuity.
Navigation Purpose code 1 data is supplemented by Navigation Purpose code 2 data from the vertex closest to the last vertex of the code 1 ENC curve (arrows).

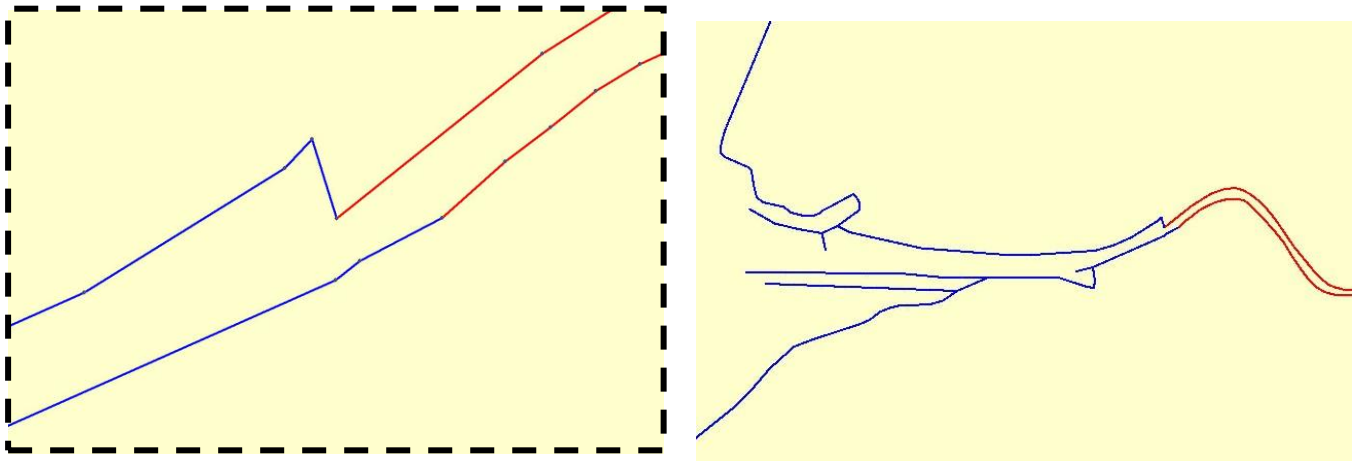

Fig.3. Calculation can now be based on the composite coastline.

Annex 2.

Example of a list of lengths of coastlines for comparison purposes

General description: *[for the users of the calculation results]*

The calculated comparison lengths are based on ENCs published by the National Hydrographic Offices of xxxxx.
Navigation Purpose codes 1 (Overview) and 2 (General) within scale ranges 1:XXX – 1:YYY have been used.
Coastlines, islands, causeways and artificial shoreline features (list) have not been included.
Inland waters have not been included.
River mouths up to single line feature objects have been included.
The lengths are intended to be used only for comparison purposes.
The calculation has been completed by XXX on YYYY/mm/dd using the published ENC data available on that date.

See example on the next page

Example of a list of lengths of coastlines for comparison purposes

Note: This list is not official. It was carried out as a test of the proposed system.

					Metadata						
Country name	*Code*	***Lenght***	*UoM*	*Comments*	*Point of Contact for calculation*	*Method of calculation*	*Date of calculation*	*ENCs Ids*	*ENCs Edition Date*	*Producer Code*	*Scale of line segments*
France	FR	**5 077**	Km	Mainland France and Corsica island. Geodetic lenght, calculated using Global Mapper Software v12.01	www.shom.fr	IHO method, Hydrographic review #XX	2012/06/18	FR166230	2007/11/10	FR	1500000
								IT100340	2004/10/04	IT	1500000
								GB100160	2012/05/31	GB	1500000
								FR200010	2010/07/31	FR	700000
								GB202675	2011/04/13	GB	350000
Italy	IT	**6 387**	Km	**Unofficial**. Calculation made by France for comparison	N/A	IHO method, Hydrographic review #XX	N/A	IT100340	2004/10/04	IT	1500000

Monaco	MC	**4**	Km	**Unofficial**. Calculation made by France for comparison	N/A	IHO method, Hydrographic review #XX	N/A	IT100340	2004/10/04	IT	150000
Slovenia	SI	**35**	Km	**Unofficial**. Calculation made by France for comparison	N/A	IHO method, Hydrographic review #XX	N/A	IT100340	2004/10/04	IT	150000
Algeria	DZ	**1 318**	Km	**Unofficial**. Calculation made by France for comparison	N/A	IHO method, Hydrographic review #XX	N/A	IT100340	2004/10/04	IT	150000
Tunisia	TN	**1 599**	Km	**Unofficial**. Calculation made by France for comparison	N/A	IHO method, Hydrographic review #XX	N/A	IT100340	2004/10/04	IT	150000
Bosnia and Herzegovinia	BA	**18**	Km	**Unofficial**. Calculation made by France for comparison	N/A	IHO method, Hydrographic review #XX	N/A	IT100340	2004/10/04	IT	150000
Montenegro	ME	**196**	Km	**Unofficial**. Calculation made by France for comparison	N/A	IHO method, Hydrographic review #XX	N/A	IT100340	2004/10/04	IT	150000
Croatia	HR	**3 779**	Km	**Unofficial**. Calculation made by France for comparison	N/A	IHO method, Hydrographic review #XX	N/A	IT100340	2004/10/04	IT	150000
United Kingdom	GB	**24 690**	Km	**Unofficial**. Calculation made by France for comparison	www.ukho.gov.uk	IHO method, Hydrographic review #XX	2012/07/06	GB100160	2012/05/31	GB	150000

	GB201121	2011/11/03	GB	350000
	GB2A2182	2012/06/07	GB	350000

Annex 3

Examples of different calculations for the length of coastline not based on the IHO technical method

This example is based on a quick web search. It illustrates the wide variation in the quoted lengths of the coastline of Finland **-** from 1,100 km to 314,000 km, thus illustrating the need for a common metric.

Length [km]	What is included	Metadata	Source
1100	Only sea border line.	No metadata available	Unspecified document
1250		No metadata available	CIA World Fact book: Worldwide list of lengths of coastlines
2774	Shoreline only.	Based on 1:4.5M. No other metadata available	Unspecified document
4600		No metadata available	Unspecified document
6299	Coastal shorelines.	No metadata available	Finnish Environmental Centre
31119		No metadata available	NGA World Vector Shoreline
39125		Basic topographic map 1:10.000. No other metadata available	Unspecified document
46198	Coastal shorelines including shorelines of islands and of lakes on islands.	No metadata available	Finnish Environmental Centre
314604	Coastal shorelines and shorelines of lakes including shorelines of islands and of lakes on islands.	No metadata available	Finnish Environmental Centre