



Fisheries and Oceans
Canada

Pêches et Océans
Canada



Canadian Hydrographic Service: Chart Datum and the Continuous Vertical Datum (CVD)

October 10, 2025

Canada



Chart Datum

- On most Canadian coastal charts, the surface of lower low water, large tide (also known as LLWLT) has been adopted as chart datum. The term lowest normal tide (also called LNT) has been retained on the charts. This is because it encompasses a variety of other choices for chart datum on some older charts.
- A 2-month water level record at a coastal location may provide sufficient tidal information to determine a reasonably accurate chart datum. However, many years of records may be necessary to provide the information on seasonal and secular fluctuations in mean water level required to determine chart datum on lakes and rivers.
- In non-tidal waters, chart datum is set so that the water level will be above datum approximately 95% of the time. A preferred guideline is that the daily mean water level should **never** fall more than 0.2 m below the chart datum during the navigation season.
- Once Chart Datum has been established in an area, it does not change again until it is updated by CHS.

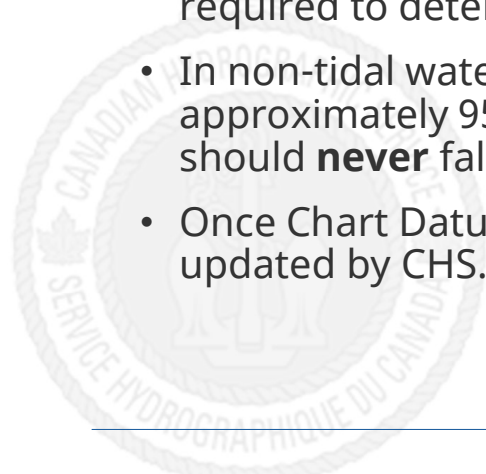




Chart Datum

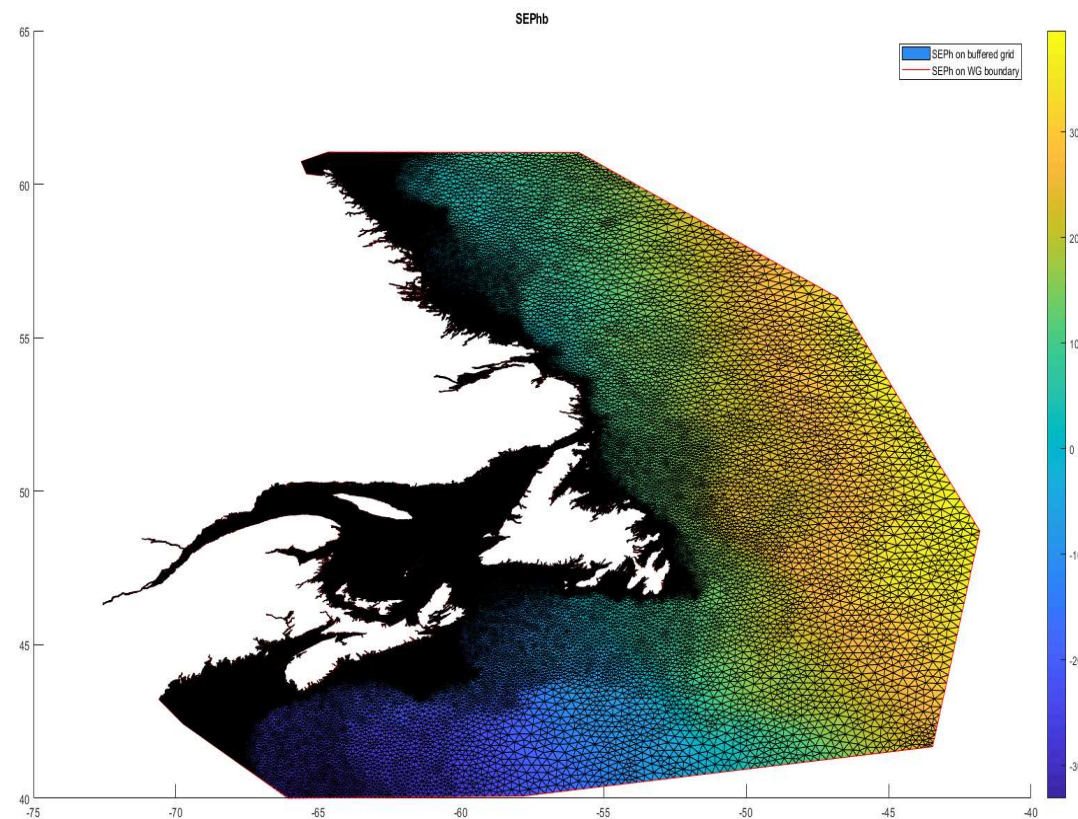
- Chart Datum is represented by benchmarks mounted at stations
- Benchmarks are laser levelled to millimeter accuracy
- Station benchmark elevations are available at tides.gc.ca by clicking the "Tidal and water level stations" link





Continuous Vertical Datum (CVD)

- The Continuous Vertical Datum (CVD) is a continuous tidal datum model
- There are three CVD solutions that together cover all Canadian waters, they are called:
 - CANEAST
 - CANWEST
 - CANNORTH
- All CVD surfaces are, by default, referenced to NAD83(CSRS) and the GRS80 ellipsoid





NAD83 Ellipsoid

- NAD83(CSRS) 2010 epoch currently used for all CVD surfaces
- NAD83(CSRS) realization updated periodically
 - Fixed to the North American tectonic plate
 - Maintained by Natural Resources Canada (NRCan)

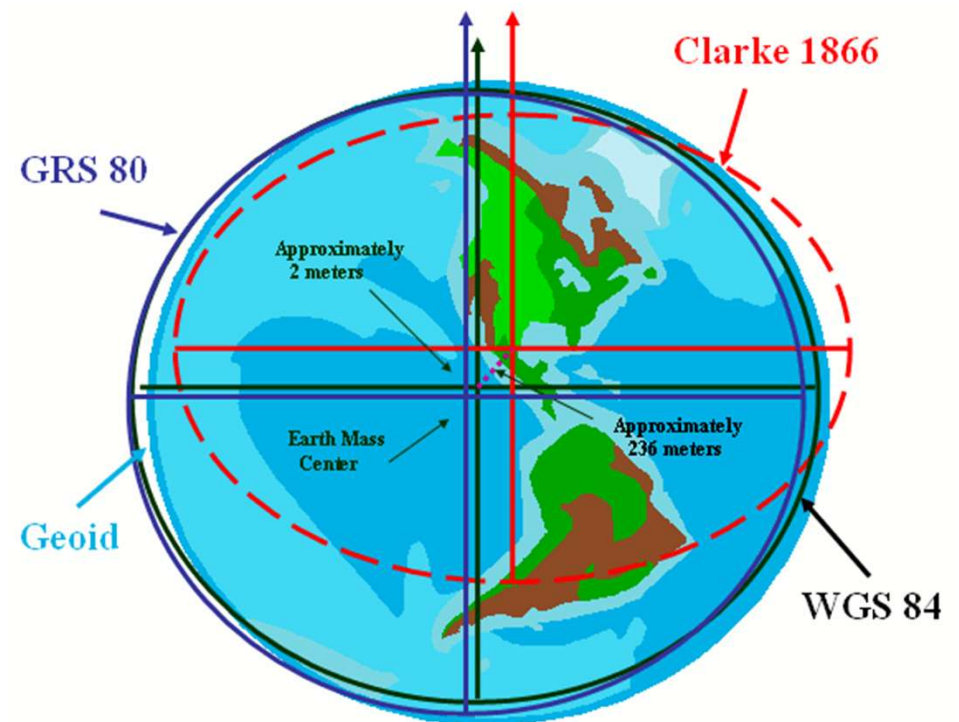
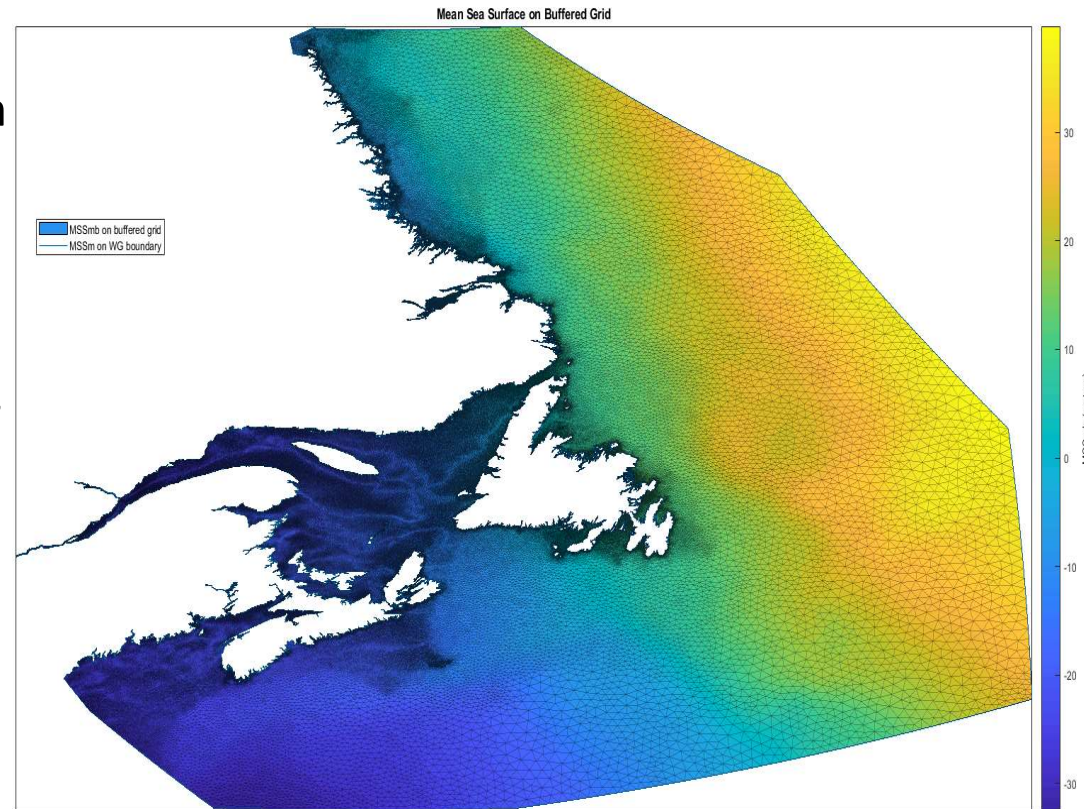


Image Source: <https://vdatum.noaa.gov/docs/datums.html>



Continuous Vertical Datum (CVD)

- The CVD models Chart Datum (CD), and number of other tidal targets such as Mean Water Level (MWL, or Z0), Lower Low Water Large Tide (LLWLT), Higher High Water Large Tide (HHWLT), Highest Astronomical Tide (HAT), Lowest Astronomical Tide (LAT), etc.
- “Ideal surfaces” are corrected for sea level rise where possible
- Chart Datum (CD) and all other tidal targets are linked to the ellipsoid via Mean Water Level (MWL) surface





Why Use Mean Water Level (MWL)?

- Mean Water Level (MWL) should be relatively flat and smooth
- Global Mean Sea Surface (MSS) data available
- Mean Water Level for a given area can be measured directly, or calculated as the sum of two factors:
 1. Geoid elevation
 2. Dynamic Ocean Topography (DOT)

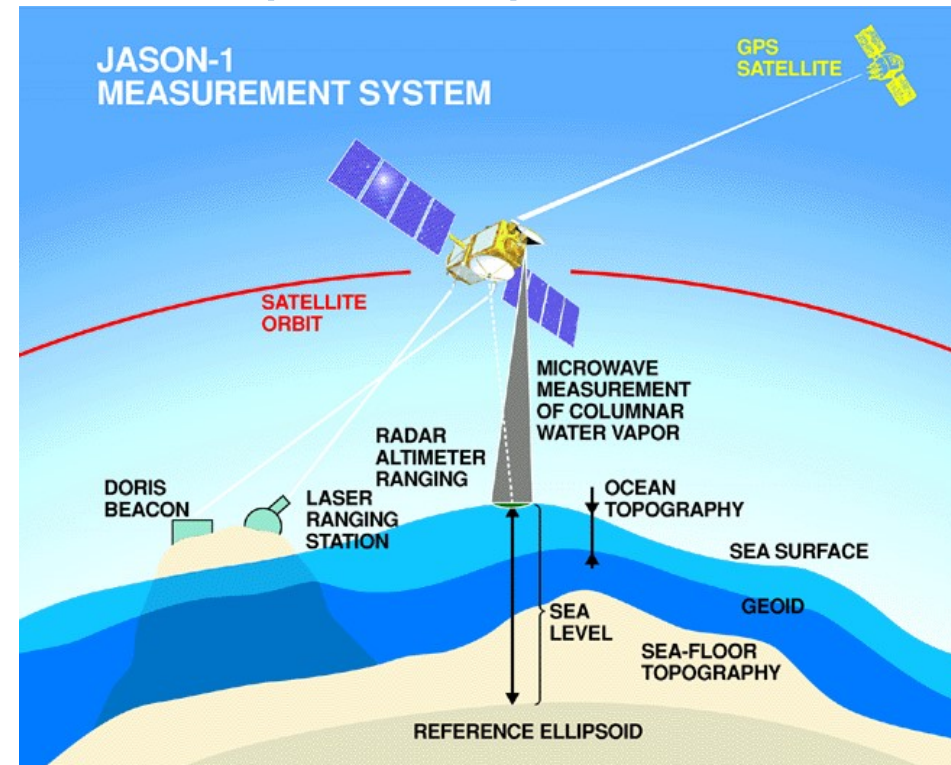


Image Source: <http://sealevel.jpl.nasa.gov/gallery/posters.html>



The Geoid

- A model of global mean sea level that is based on variations in the Earth's gravity through space
- Also referred to as a gravitational equipotential surface
- Currently two geoid models commonly used in Canada
 - CGVD28
 - CGVD2013
- Both geoid models are maintained by NRCan

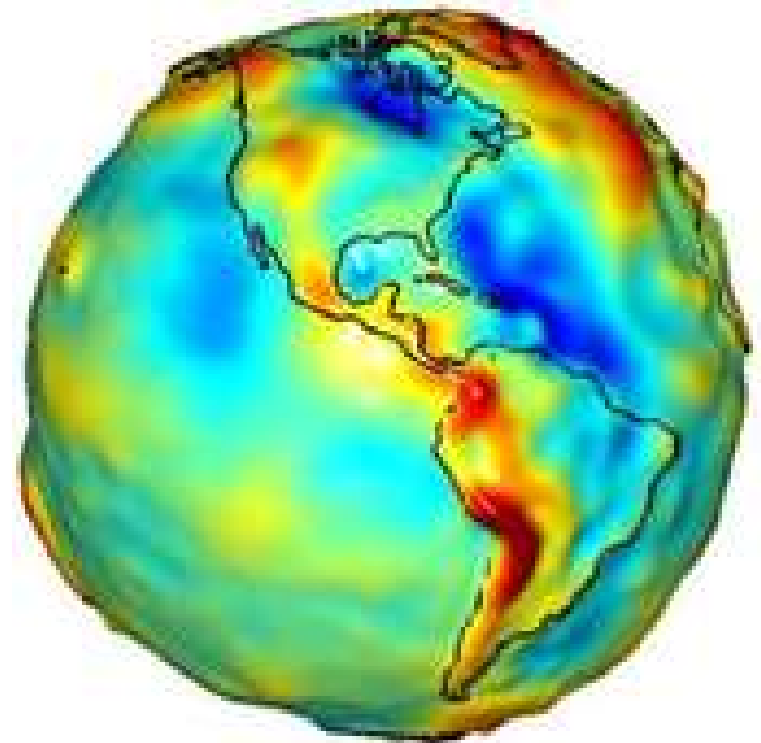


Image Source: <https://www.pxw1.snb.ca/snb7001/e/PDF/presentationANBL-e.pdf>



Dynamic Ocean Topography (DOT)

- Differences in ocean water levels created by oceanographic and meteorological events
 - Ocean currents
 - Gyres
 - Consistent weather patterns (wind)

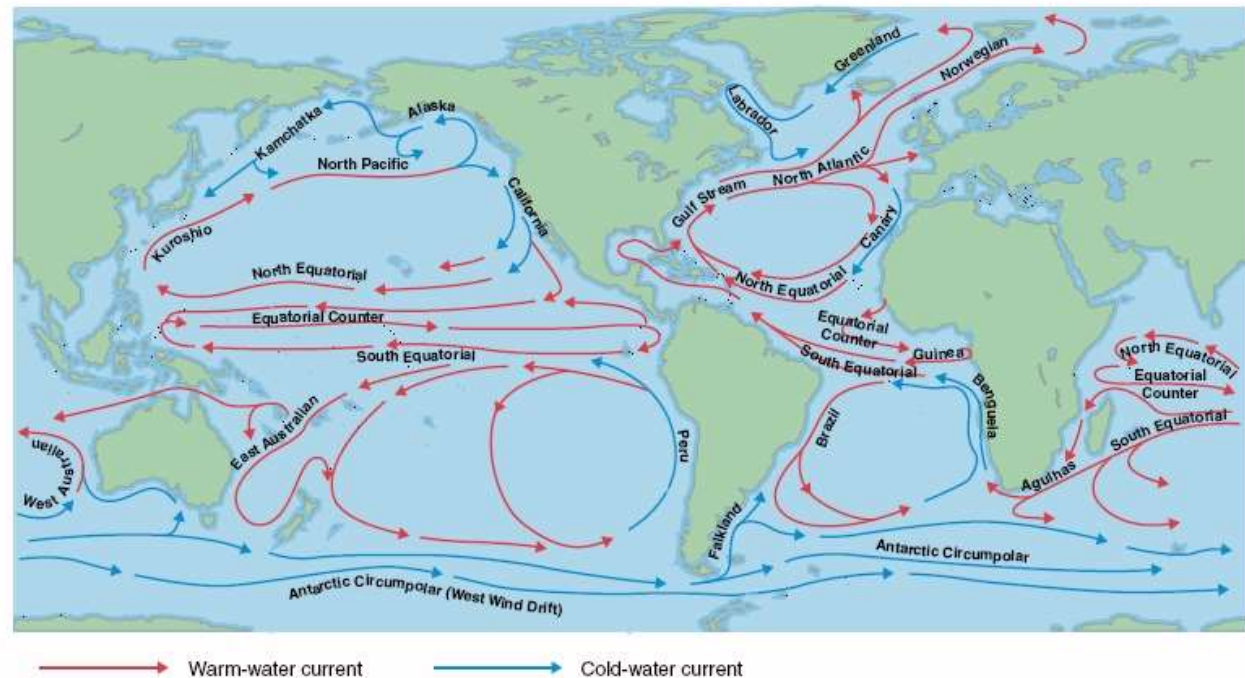


Image Source: <https://cimss.ssec.wisc.edu/sage/index.html>



Dynamic Ocean Topography (DOT)

- Global Dynamic Ocean Topography calculated by subtracting geoid elevations from satellite Mean Sea Surface (MSS) product
- Can also be calculated at tidal stations by subtracting the geoid from Mean Water Level (MWL)

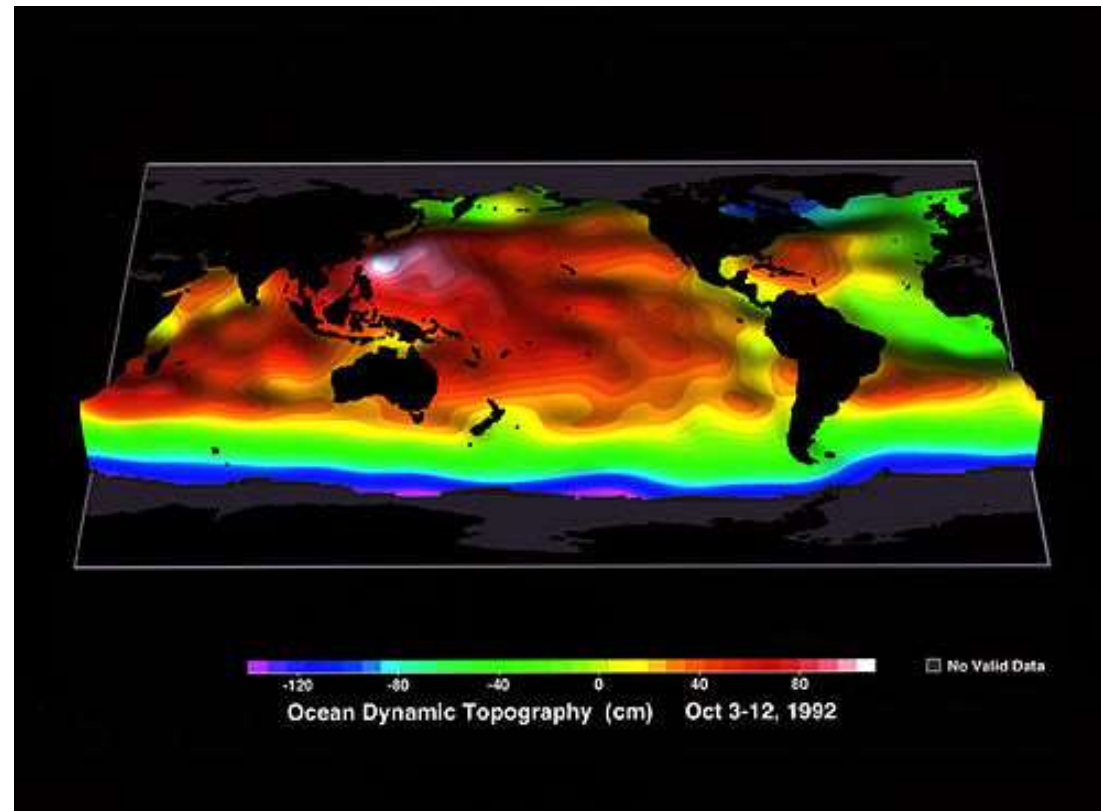


Image Source: <http://sealevel.jpl.nasa.gov/gallery/science.html>



Making the Surface

- Mean Water Level is linked to the ellipsoid using satellite altimetry data offshore and tidal station data inshore where GNSS data is available
- GNSS data collected for 24h and processed using NRCan Precise Point Positioning (PPP) service
- Tidal modelling process fills in the gaps





Non-GNSS Stations & Other Tidal Datums

- Stations with no GNSS data are not directly linked to the ellipsoid
- Tidal datums at these stations “hang” off the Mean Water Level (MWL) surface to estimate their link to the ellipsoid
- This process is also used to calculate datums other than MWL at all stations.

Heights - Relative to chart datum

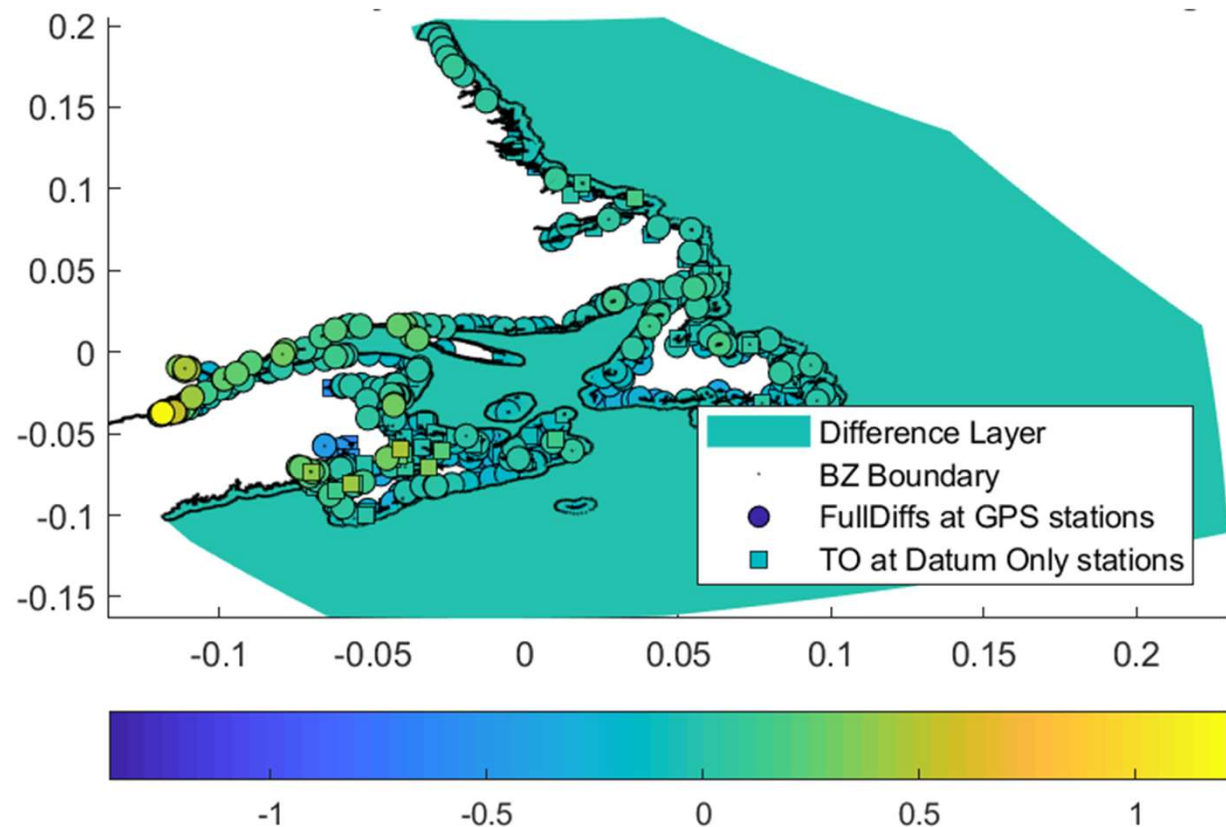
ID 	Height(m) 	Date 
Highest Recorded Water Level 	2.95	1976-03-17
Highest Astronomical Tide 	2.21	N/A
Higher High Water Large Tide 	2.17	N/A
Mean Higher High Water (Higher High Water Mean Tide) 	1.83	N/A
Mean High Water (High Water Mean Tide) 	1.77	N/A
Mean Water Level 	1.10	N/A
Mean Low Water (Low Water Mean Tide) 	0.46	N/A
Mean Lower Low Water (Lower Low Water Mean Tide) 	0.36	N/A
Lower Low Water Large Tide 	-0.01	N/A
Lowest Astronomical Tide 	-0.05	N/A
Lowest Recorded Water Level 	-0.32	2007-03-21

Showing 1 to 11 of 11 entries |



The “Warp”

- Since Chart Datum (CD) is not continuously updated, it can diverge from Lower Low Water Large Tide (LLWLT) over time.
- The difference between the LLWLT surface and Chart Datum is what we call the “warp” since we warp the modelled LLWLT surface to respect chart datum where it has been established.
- Be sure to differentiate between the CD and LLWLT in your work.

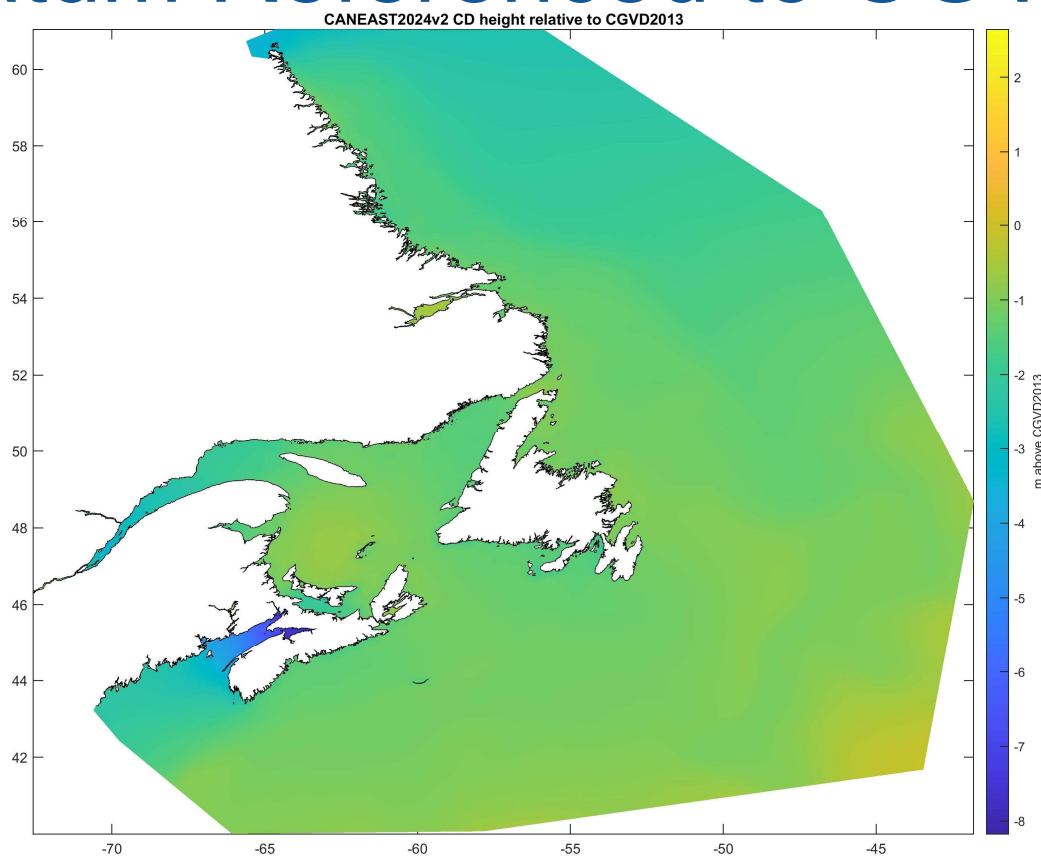




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Chart Datum Referenced to CGVD2013



7 Day and Hourly Tides

Predictions

Observations

Forecasts

Heights

Datum

Benchmarks

Bulk Data Export

7 day and hourly prediction tide tables provide predicted times and heights of the high and low waters.

More info

Print

Annual predictions

Caution:

The information available on this Web site may vary slightly from the information in the official documents published annually by the Department of Fisheries and Oceans and entitled Canadian Tide and Current Tables. In case of discrepancy, the information contained in the official publications will prevail.

2025-06-04 (Wed)

Time ADT

Height (m)

Height (ft)

03:22

1.500

4.9

10:07

0.536

1.8

16:04

1.640

5.4

22:56

0.593

1.9

2025-06-05 (Thu)

Time ADT

Height (m)

Height (ft)

04:30

1.459

4.8

10:54

0.588

1.9

17:00

1.644

5.4

23:44

0.546

1.8

2025-06-06 (Fri)

Time ADT

Height (m)

Height (ft)

05:35

1.458

4.8

11:41

0.626

2.1

17:49

1.663

5.5

2025-06-07 (Sat)

Time ADT

Height (m)

Height (ft)

00:31

0.490

1.6

06:29

1.480

4.9

12:30

0.651

2.1

18:31

1.689

5.5

2025-06-08 (Sun)

Time ADT

Height (m)

Height (ft)

01:16

0.427

1.4

07:14

1.512

5.0

13:17

0.663

2.2

19:10

1.717

5.6

2025-06-09 (Mon)

Time ADT

Height (m)

Height (ft)

01:58

0.364

1.2

07:56

1.546

5.1

14:02

0.666

2.2

19:47

1.743

5.7

2025-06-10 (Tue)

Time ADT

Height (m)

Height (ft)

02:37

0.312

1.0

08:37

1.580

5.2

14:42

0.667

2.2

20:25

1.764

5.8

Hourly Predictions (m)

Event Date

00

01

02

03

04

05

06

07

08

09

10

11

12

13

14

15

16

17

18

19

20

21

22

23

2025-06-04

1.2

1.4

1.5

1.5

1.4

1.2

1

0.8

0.6

0.5

0.6

0.8

1.1

1.4

1.6

1.6

1.6

1.5

1.3

1

0.8

0.7

0.6

2025-06-05

0.7

0.9

1.1

1.3

1.4

1.4

1.2

1

0.8

0.6

0.6

0.7

0.9

1.1

1.4

1.6

1.6

1.4

1.2

0.9

0.7

0.6

2025-06-06

0.6

0.7

0.9

1.1

1.3

1.4

1.4

1.2

1

0.8

0.7

0.6

0.7

0.9

1.2

1.5

1.6

1.7

1.6

1.4

1.1

0.8

0.6

2025-06-07

0.5

0.6

0.6

0.9

1.1

1.3

1.5

1.3

1.1

0.9

0.8

0.7

0.8

1

1.3

1.5

1.7

1.5

1.3

1.1

0.7

2025-06-08

0.5

0.4

0.5

0.6

0.9

1.2

1.4

1.5

1.5

1.3

1.1

0.9

0.7

0.7

0.8

1.1

1.4

1.6

1.7

1.7

1.5

1.2

0.9

2025-06-09

0.6

0.4

0.4

0.4

0.7

1

1.3

1.5

1.5

1.3

1.1

0.9

0.7

0.7

0.7

0.9

1.2

1.5

1.7

1.7

1.6

1.4

1.1

2025-06-10

0.8

0.5

0.3

0.3

0.5

0.8

1.1

1.4

1.6

1.6

1.4

1.2

1

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0.7

0.8

1

1.3

1.6

1.7

1.7

1.6

1.3

2025-06-11

1



CVD Surfaces

- CVD Surfaces and other CHS products can be requested by filling out the Intellectual Property Application Form online

<https://charts.gc.ca/charts-cartes/ip-application/index-eng.asp>

- Some CVD surfaces available “soon” through the NONNA data portal

<https://open.canada.ca/data/en/dataset/d3881c4c-650d-4070-bf9b-1e00aabf0a1d>

* These products are being requested for:

- ☐ Non-navigational use
☐ Navigational use

Previous Licences

Please enter any reference numbers for existing or expired licences with CHS (e.g., yyyy-mmdd-1260-X)

Applicant information

* First name

* Last name

* Email address

If applying as a business, training organization, government employee, or for university science research, enter the business or organization's information below.

* Address

* City

* Province/state

* Country

* Postal code

Telephone

Web site

* You are

- ☐ A Fisheries and Oceans employee seeking one-time use of a product or data
☐ A member of a federal, provincial or international government department or agency
☐ A business wishing to use our data for internal business purposes but not for navigation
☐ Intending to commercialize our products or data
☐ Conducting government or university science research (including university students)
☐ Seeking to use CHS IP in a magazine, movie, novelty item, wall display, etc.



The Future

- Following NRCan's lead
- “The US National Geodetic Survey (NGS) will replace the North American Vertical Datum of 1988 (NAVD 88) with a geoid-based height reference system called the North American-Pacific Geopotential Datum of 2022 (NAPGD2022). This future US datum has the same definition as CGVD2013 and at the time of release will enable a unified continental height system.”

