CONSEQUENCES OF CHANGE FROM MLLWS TO LAT

Converting NL Chart Datum

Following international agreements, the Hydrographic Service of the Royal Netherlands Navy is in the process of changing the Chart Datum in its nautical charts and other products from Mean Lower Low Water Springs (MLLWS) to Lowest Astronomical Tide (LAT). LAT is in general a level 2 to 3 decimetres below the level of MLLWS, so that depths in nautical charts will decrease and tidal height predictions increase commensurately. Transition is expected to take several years.

The Hydrographic Service of the Royal Netherlands Navy (NLHS) conducts hydrographic surveys and publishes nautical charts and other nautical information concerning the Dutch part of the North Sea and adjacent waters, as well as waters surrounding the Netherlandsâ€™ Antilles and Aruba. The vertical datum used as reference level in the nautical charts, Electronic Navigational Chart (ENC) and tide-tables is called Chart Datum.

Varying Datum

Chart Datum is a low-water level that reveals the critical depth for users of the charts: see Figure 1. A Chart Datum situated higher than low water results in charted depths that are occasionally greater than the observed depth, which might lead to a false sense of safety. Not every country uses the same level as Chart Datum. Due to the varying tidal characteristics a large number of implementations of Chart Datum exist, such as Mean Lower Low Water Springs (MLLWS), Mean Lower Low Water (MLLW), Mean Low Water (MLW), Low Water (LW), Lowest Astronomical Tide (LAT) or Mean Low Water Springs (MLWS).

Regulations

The International Hydrographic Organisation (IHO) and International Maritime Organisation (IMO) suggested in the early 1980s that states should consider adopting an astronomical level as Chart Datum. Following IHO Technical Resolution A 2.5 Datums and Benchmarks, in September 1998 the Tidal Working Group of the North Sea Hydrographic Committee (NSHC) proposed adoption of the Lowest Astronomical Tide (LAT) as Chart Datum, as of 1st January 2000. The NSHC Tidal Working Group at a later stage changed this to â€˜at the earliest practicable opportunityâ€™. The transition in The Netherlands from MLLWS to LAT began in the second half of 2006. It will take some years to convert all NLHS products to LAT because nautical charts are not republished every year. Germany (Bundesamt fÃ¼r Seeschifffahrt und Hydrographie (BSH)) embarked upon the transition in 2005, the UK and France have already adopted LAT, and Flemish Hydrography aims to publish a new LAT edition of its charts simultaneously with the publication of the southern charts of the Netherlands Hydrographic Service.

MLLWS and LAT

Until recently all NLHS charts referred to MLLWS: the mean of the measured lowest water level of a month over a period of five years. During average meteorological conditions this MLLWS level is a plane which will seldom result in charted depths greater than those observed. LAT is the lowest water level that can occur as a result of the tidal effects of astronomical bodies and local geographical circumstances. A water level below LAT can only occur due to abnormal meteorological circumstances. This implies that charted depths will generally be less on a LAT chart than on a MLLWS chart of the same area, based on the same data. Of course, this does not have any consequences for observed depth, as more tidal rise has to be added to obtain the predicted depth, see Figure 2. The general difference between MLLWS and LAT is about 2 to 3dm, but can be as great as 5dm at a distance of 60km off the coast of Zeeland, see Figure 3. Also, the Equivalent Low Water (in Dutch abbreviated OLW), used only at locations upstream of Hoek van Holland (the Hook of Holland), has been adjusted to fit the LAT plane.

Computation

The new LAT reference level has been computed in co-operation with the Netherlands Institute for Marine and Coastal Management (RIKZ) of the Dutch directorate-general for Public Works and Water Management (Rijkswaterstaat). The LAT matrix is based on three RIKZ tidal models. Use has been made of the Dutch Continental Shelf Model and two more detailed models for inland water bodies such as the Waddenzee and Westerschelde. Tidal models contain harmonic constants in all grid points, determined using tide-gauge measurements, depth measurements and bottom roughness. RIKZ has computed LAT by determining the lowest predictable water level in nineteen years (the longest tidal period) in each grid point. NLHS has integrated and smoothed the result of the three tidal models. LAT has also been computed for places where water levels are measured by permanent tide-gauges. LAT values have been derived from these measurements by performing harmonic analyses. The differences between the model LAT values and the measured LAT values are in the order of 5cm. The precision of the LAT level is expected to be in the order of 10cm. The model is also in accordance with calculated LAT values at tide-gauges belonging to neighbouring countries, enabling a seamless connection between Netherlands data and bathymetric data of Belgium and Germany.

PCTrans

Instead of a paper North Sea high and low-water reduction chart, such as the â€˜Reductiekaart 1988â€™ showing the MLLWS values, the

digital matrix for LAT has been implemented in multi-functional software program PCTrans. This freeware can be downloaded from the NLHS website (1). Use of this software program allows the user more flexible access to LAT values than that offered by a paper sheet. The user can provide a coordinate, after which the program returns the LAT and MLLWS values. Other, non-tidal, functionalities of the program include datum transformation, direct and indirect geodetic problem calculations and area computations.

Charts

Charts (paper and ENC) are being converted to LAT from North to South. The charts of the northern part of the Netherlands have already been converted, see Figures 4 and 5. The information on the charts will clarify which level is used as Chart Datum. It is possible that the same area on one chart is shown in LAT and on another in MLLWS, a chart that, for instance, has a different scale. In Figure 6 the impact of the transition from MLLWS to LAT on depth figures and contours can be seen. The top half shows the 2006 MLLWS edition of chart 1811.5, the bottom half shows the 2007 LAT edition. The most obvious change is the extension of the drying heights in green, emphasised by the red arrows.

Tide Tables

Two tide tables are published by the NLHS: a paper product, HP33, and a digital product HP33D-NLTides. During the transition period the Chart Datum for the predictions of every single port in the HP33 will be taken into consideration each year. In HP33 edition 2007, MLLWS is used for all ports, as there are none that will be charted on charts referenced to LAT only in 2007. Every page containing tidal height predictions shows how to convert from hourly heights in MLLWS to LAT. In the HP33Dâ€“NLTides edition 2007 the Chart Datum is user-selectable, see Figure 7. NLHS issues the program NLTides as an official equivalent of paper tide-tables in accordance with SOLAS V2.2. This may replace traditional paper tide-tables, provided that appropriate back-up arrangements are available (e.g. print facility or second installed program).

Other Consequences

In nautical charts a maintained depth is often shown in channels and harbours. In the Netherlands maintained depth is stated in a contract between port authorities and a dredging company with respect to Mean Sea Level or Normal Amsterdam Peil (NAP, the Netherlands Land Levelling System). This means the maintained depth figure in the chart will change whilst remaining static in the established contract. Any change in low-water line will influence the maritime limits because it serves as the basis for calculation of these. This low-water line is also called the â€˜normal baselineâ€™. An example of such a limit is the twelve-nautical-mile outer limit of the territorial sea. The differences will be greater near coasts where the seafloor slopes more gradually; for example, north of the Frisian Islands the twelve nautical mile outer limit shifts two miles to the north. The maritime limits are calculated frequently by the NLHS and can be requested via the â€˜Data application formâ€™ (1). Maritime boundaries already established with neighbouring states will not, of course, change.

HAT

As can be seen in Figure 1, there is another vertical datum, namely for the reference of clearance heights. With the transition to LAT the IHO also states that the datum for vertical clearances should preferably be the Highest Astronomical Tide (HAT). Over the coming year the NLHS will also implement HAT in its charts for charted vertical clearance.
