

## **Lowest Astronomical Tide as Chart Datum: definition and safety aspects**

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This paper highlights key aspects of the article "Lowest Astronomical Tide in the North Sea derived from a shallow water model, and an assessment of its suggested sense of safety", published in *Marine Geodesy* in its first issue of 2013.<sup>1</sup> For that purpose, it relies on IHO Resolution 3/1919 (as amended), which is partly repeated here:

"2a: ... It is further resolved that the Lowest Astronomical Tide (LAT), or as closely equivalent to this level as is practically acceptable to Hydrographic Offices, be adopted as chart datum where tides have an appreciable effect on the water level. ...

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

Note ii: In non-tidal waters, in order to allow the development of regional solutions, it is recommended that an appropriate long term range of low (...) water definitions of the lower (...) 94-100 percentile be adopted."

Chapter 4 of the article introduces four experiments, of which experiments II and III are relevant here:

II. LAT established relative to the geoid, including time-averaged meteorological conditions;

III. LAT established relative to the geoid, including average monthly variations in MSL. The experiments differ in their interpretation of "average meteorological conditions". Should this averaging be done over such a long time span that all seasonal influences average out (exp. II), or should this be done per month, so that the average seasonal influences are represented (exp. III)? Indeed, the "average meteorological conditions" differ over the various seasons.

**discussion item 1:** How can the definition of LAT be improved in Resolution 3/1919 in such a way that the term "average meteorological conditions" is clearer?

Chapter 5 of the article studies the probabilistic characteristics of LAT. It shows that the actual water level drops below LAT with a frequency depending on the relative range of meteorological effects with respect to the range of the astronomical variations. Such frequencies could be as high as once a week, depending on the season.

**discussion item 2:** It should be prevented that LAT is understood as an absolute minimum level. How can this be achieved, using education, publications, etc.? Would the TWLWG recommend to determine and publish the probability of water levels below Chart Datum, for new realisations of Chart Datum?

Chapter 5 continues by proposing a probabilistic approach of a reference level that is reached once a year, once a decade, or once a full tidal cycle. Such an approach would make the risks of water levels below chart datum explicit, independent of the actual time span chosen. Such a level is clearly contrary to the definition of LAT, but it will be relatively close to it for certain time spans. It depends on the interpretation of "as closely equivalent to [LAT] as is practically acceptable to Hydrographic Offices" if this approach would be in agreement with the Resolution. (Note the use of a plural: "Hydrographic Offices"! ) It is unclear if this means that each Hydrographic Office is allowed to decide for its home waters on its own, or if several Hydrographic Offices need to agree for e.g. an entire tidal basin.

**discussion item 3:** Would a risk based definition of Chart Datum be advantageous for safe navigation at sea? Would a probabilistic definition of Chart Datum with a time span that provides relatively close equivalents be according to the Resolution?

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<sup>1</sup> An overview of this article was presented during Hydro12 (Netherlands, November 2012), the conference paper is available at [www.hydro12.com](http://www.hydro12.com) as part of the Proceedings. Chapter 5 of Slobbe's dissertation is an adapted version of the article, available at [www.ncgeo.nl](http://www.ncgeo.nl) as Publication on Geodesy 82.

One reason that LAT is not used for all sea areas is that the tidal range is not appreciable everywhere. An advantage of a probabilistic approach would be that it is no longer necessary to define a separate Chart Datum for nontidal waters. In fact, Note ii already mandates such an approach for nontidal waters in order to “allow the development of regional solutions”.

**discussion item 4:** Would a risk based approach also be advantageous for sea basins that partly have a considerable tidal range and partly have water level variations dominated by other factors? Could such a probabilistic approach replace the current definition of Chart Datum as LAT entirely, in the long run?