Development of continuous dynamic vertical reference for maritime and offshore engineering by applying machine learning strategies

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With the advent of changes in our climate, calls for the need for spatially accurate solutions in various maritime and offshore industry applications. A key component that has been under-utilized is determination of the realistic sea level data and ensuring that is widely available to potential users. The realistic sea level estimates are achieved by means of Dynamic Topography in the absolute sense, i.e. referring to the marine geoid (i.e equipotential surface of the Earth). As a result this study presents the description of a proposed methodology, whereby realistic sea level estimates are achieved by synergy of different marine data sources that are analysed with mathematical, statistical and machine learning strategies.

The methodology hence consists of using mathematical, statistics and machine learning strategies (e.g. neural networks and inter-technique solutions) with and a synergy of data (e.g. marine geoid, tide gauges, hydrodynamic models, satellite altimetry etc.) to improve sea level determination and forecasts in the absolute sense. The results allow that: (i) oceanographic patterns and processes (currents, eddies, etc.) can now be investigated with better confidence and accuracy using dynamic dynamic topography based reference datum, and (ii) realistic Under Keel Clearance can be computed by using the marine geoid referred spatio-temporal dynamic topography estimates and sea bottom depths. The developed theory is tested and improved in a study area (Baltic Sea), that contains a long time span of many different data sources and where the high intensity of shipping and maritime activities requires accurate dynamic topography forecast.