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Tide Gauges and the Mean Sea Level

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Knowledge of the height and shape of the surface of the seas is essential for many practical and scientific purposes. The sea surface is influenced by different factors, including the Earth's gravity field, the astronomical tides, meteorological conditions, hydrological effects, but also anthropogenic impacts. Thus, the form and the height of the sea surface may also serve as indicators of a wide range of processes. The traditional method of monitoring the sea level is the land-based tide gauge in coastal waters. These gauges on the coast are subject to additional influences such as river estuaries, ice conditions, or the operation of river barrages. Recently, research stations have been established in the open sea to operate gauges there. Examples are the Marnet stations in the Baltic Sea and the FINO station north off the island of Borkum. In areas of tectonic motion, natural gas delivery, glacial isostatic adjustments or mining, changes in sea level are influenced by vertical and land movements. The research project IKÜS (from German: Integriertes Küstenüberwachungssystem - integrated coastal monitoring system) of the German Coastal Engineering Research Council (KFKI) is dedicated to the combination of the measurements of different height sensors into unified set of data of altitudes and their changes in the German Bight during a reference period. The coupling of these results with water-level data allows to distinguish between land-movement signals and long-term sea-level variations. The sea water level is also influenced by numerous environmental factors such as the astronomical tides, variations in the temperature and salinity of the water or currents. The relations and interactions between hydrological, meteorological, and anthropogenic influences are the subject of scientific research. By averaging the tidal mean water over a longer period of time it is possible to average-out meteorological influences and other high-frequency motions of the water surface. Internationally, the tidal mean water is also called "mean seal level" (MSL) and depends on the location of the gauge station. The entirety of the MSL describes the "mean sea surface topography" which is also the difference between the level of the sea surface and the geoid.