Geophysical Research Abstracts
Vol. 12, EGU2010-9928, 2010
EGU General Assembly 2010

A study on the interactions of the MSL and the movement of amphydromic points and their impact on the mean tidal range in the North Sea

Juergen Jensen and Arne Arns

Research Institute for Water and Environment (fwu), University of Siegen, Paul-Bonatz-Str. 9-11, 57076 Siegen, Germany, phone +49 (271) 740 2172, fax +49 (271) 740 2722, email: juergen.jensen@uni-siegen.de

According to IPCC (2007), the global average sea level rise projections are significant to the end of the century. Even the current time series analyses of the North Sea show, that there have been significant changes in the tidal regime starting from 1955 to 1960. While one can observe an appreciable increase in the mean tidal high water (MHW) from then on, the mean tidal low water (MLW) behaves contrary; as difference between the MHW and the MLW, the mean tidal range (MTR) in the German Bight rises (JENSEN and MUDERSBACH 2007). The reason for this behaviour is not as yet clarified entirely, but there have been many theoretical approaches ascribing the changes in the MTR either to anthropogenic or natural processes. The changes in the MTR can not only be observed in the German Bight, but also along the British east coast. However the MTR along the British coast shows a small decrease being the largest in the area of Aberdeen and reduces in northern and southern direction respectively reverses in the most southern part of England. According to JEVREJEVA et al. (2006) there is a significant change in the sea level of the north-eastern Atlantic starting at the same time as mentioned above, which is characterized by an uncommon increase.

A tidal wave is influenced by the coriolis force which causes a deflection in the currents towards the right side of the direction of the motion in the northern hemisphere. In wide and at the end closed channels – what the North Sea may be considered as – the reflection of the tidal wave away from the boundary results in two waves travelling in the opposite directions. The resulting waves are oscillating around a time dependent position which is called an amphidromic point; in this position, the waves amplitude respectively the tidal range is zero. In the North Sea there are two amphidromic systems and a third incomplete amphidromic system. In the North Sea the average tidal range is between 0 to 8 metres. With an increasing distance from this position, the amplitude of the tidal wave and thereby the MTR rises.

If the reflected wave within the basin is weaker than the in going tidal wave, the resulting centre of rotation in the northern hemisphere is shifted towards the left side of the running in (PUGH 1987). That is what one can also observe in the North Sea. Due to the proportionally more dissipated energy in the shallower shelf of the German Bight in relations to the steeper shelf of the British coast, there is an eastwards displacement of the amphidromic points. In consequence of the above mentioned sea level rise, the relative amount of energy being absorbed in the shallower shelf is considerably larger than in already steeper shelf regions. Additionally, anthropogenic interventions influence the topography along coastlines. As a result, the overall time dependent positions of the amphidromic points in the German Bight could have moved westwards.

On basis of the measured MSL rise, the data of German and British gauges so far are indicating a long term shifting of the amphidromic points and a correlation with changes in the MTR. Recollecting the future MSL rise, the changes in the MTR could intensify and as FÜHRBÖTER and JENSEN (1985) pointed out, have impacts on the morphology, ecology but also the safety in coastal regions and estuaries.