



## Measuring the Sea State and Waves by Radar Gauges

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For a couple of years, radar gauges have been used in coastal waters. Their main advantage lies in the easy way of installation, the information gained in high frequency, their reliability, and the low costs. The classical way to measure the water level is with a float within a stilling well, what means that the enclosed water level is smoothed, and waves and the sea state cannot be registered. Radar gauges work in a different way: they do not need a stilling well, because they measure the sea surface of a particular area in high frequency. Thus, the smoothing of the radar signals has to be achieved by mathematical methods. Mathematically speaking, this is a low-pass filter like a moving average or exponential smoothing. All these methods are well known and are described in good textbooks. As mentioned before, radar gauges measure the sea level of a particular area in high-frequency. With these high-frequency data we are able to gain more information, such as waves and the sea state. Both waves and the sea state are important parameters for nearly all kinds of coastal-engineering works. Therefore, the knowledge of these is an essential core information. To estimate the spectral intensity in the proper sense, a radar sensor with a very short sampling interval and low noise level is required. As every sensor has its own characteristics, a field test was carried out to find the right sensor for the particular purpose, and it was found that the noise level of the chosen sensor was rather high. Waves with amplitudes below 20 cm could not be properly detected. In this context, the question arises whether we have to measure all small waves at all. Since radar gauges allow to measure waves directly, the local authority asked the German Federal Institute of Hydrology (BfG) to design, plan, and install a radar gauge to assess the waves at the lighthouse 'Alte Weser' in the estuary of the River Weser. The lighthouse 'Alte Weser' is also an official tide gauge. The water-level data collected by the official tide gauge and those of the radar sensor proved to be identical in height and curvature. There are only very small dif-

ferences, which are in the range of accuracy of the German gauge regulations. As stressed above, the data collected by the radar gauge give us the information about the height and the period of the measured waves. The first installation was completed at the end of October 2007, but soon a severe storm hit the equipment so badly that the whole instrumentation had to be rescued. At the moment there are serious plans to re-install a radar sensor on a research platform offshore to get detailed information about the ongoing physical processes and to compare the results with other wave-measuring devices.