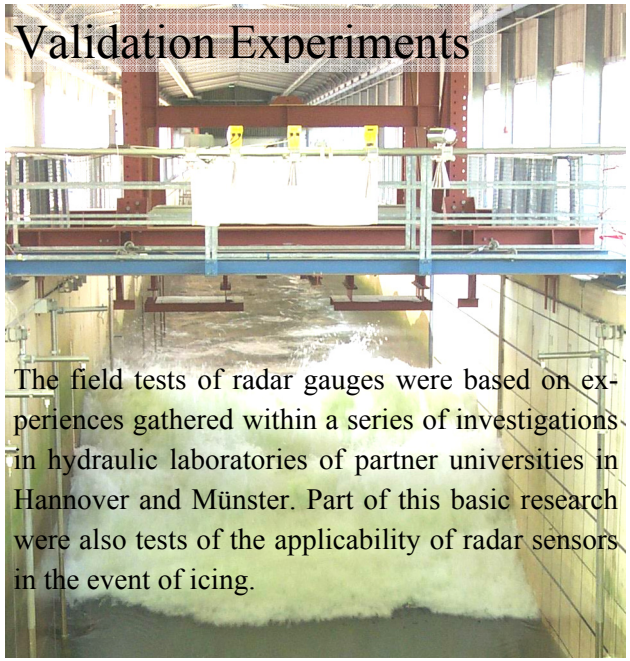
An example of time-series of water level and wave height recorded at the lighthouse “Alte Weser” during the storm surge on 1 November 2006 is given overleaf. During this event the waves were rising up to eight metres. The water-level recordings of both – radar sensor and official floating gauge – did not show significant deviations.

Validation Experiments



The field tests of radar gauges were based on experiences gathered within a series of investigations in hydraulic laboratories of partner universities in Hannover and Münster. Part of this basic research were also tests of the applicability of radar sensors in the event of icing.

Outlook

Radar technology will play an important role in the future measuring concept of the German Federal Waterways and Shipping Administration. This includes gauging stations at inland and in coastal waterways.

Further research is undertaken to optimize the applicability of radar sensors in case of ice cover. The vision is an integrated sensor to measure water level, wave conditions, and ice thickness.

Further Information

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Contact

Bundesanstalt für Gewässerkunde
(German Federal Institute of Hydrology)
Department M1:
Hydrometry and Hydrological Survey
Am Mainzer Tor 1
56068 Koblenz
Germany
www.bafg.de

Dr. habil. Ulrich Barjenbruch
phone +49-261-1306-5406
e-mail barjenbruch@bafg.de

bfg Bundesanstalt für Gewässerkunde

Monitoring of Water Level and Sea State with Standard Liquid Level Radar Sensors

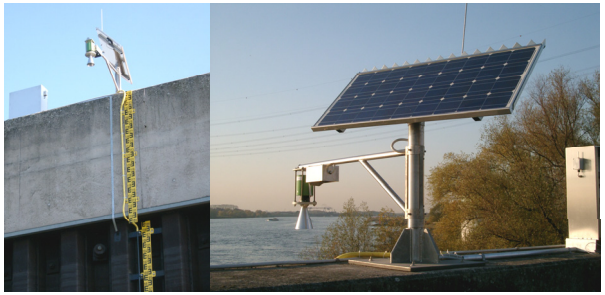
Radar wave gauge of the BfG near the island Borkum

Motivation

Traditional methods of water-level gauging, mainly using a floater in a stilling well, require costly investments and need permanent maintenance. Commercial liquid-level radar sensors provide an inexpensive alternative to the conventional measuring technique and are simultaneously suitable for sea-state monitoring in coastal waters. Their main advantages lie in the easy installation, their reliability, and the low costs of installation and maintenance.

Radar Water-level Gauges

Therefore a growing amount of operational water-level gauges are becoming equipped with radar sensors. For example, a solar powered system was installed at a quay wall in the harbour Duisburg.



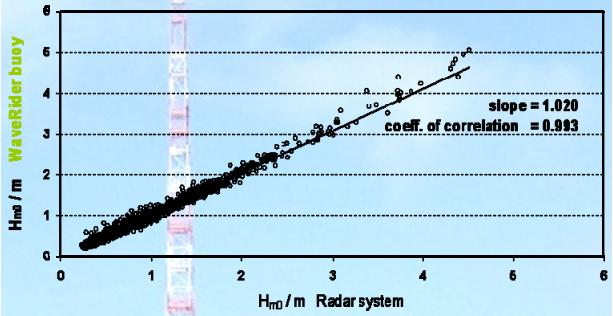
Gauging unit with radar at Duisburg, Rhine

Radar Wave-gauges

Devices for operational wave-height measurements with low-cost and low-maintenance radar sensors were developed by the German Federal Institute of Hydrology (BfG). Such devices were mounted e.g. at the lighthouse “Alte Weser” in the River Weser estuary and in the lagoon of Venice (Italy), in conjunction with the MOSE flood defence system.

Wave-gauging with radar sensor at lighthouse “Alte Weser”

Comparison with Established Techniques



Comparison of a Waverider buoy and the radar wave-gauge

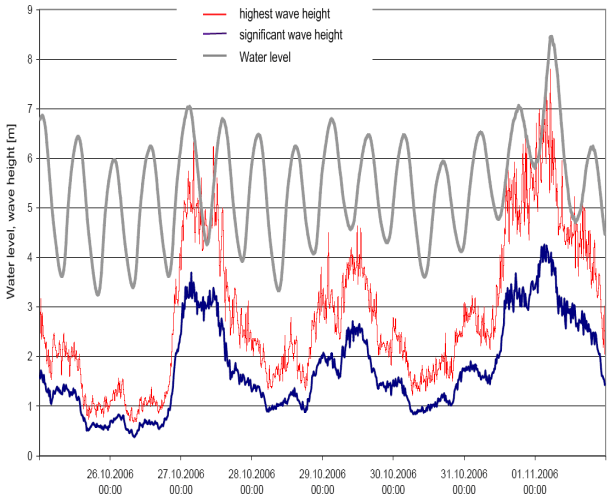
The accuracy of the radar sensor was checked against a Waverider buoy within a field test at the research platform FINO-I located in the North Sea.

The given scatterplot above shows the significant wave heights measured by the radar sensor vs. the ones measured by the Waverider buoy over a period of several months. The results of both systems are in very good agreement.

Radar-wave gauge of the BfG in the lagoon of Venice

Applicability during Storms

While measurements with the classical wave-following buoys imply a certain risk of loss during heavy storm surges, the application of remote-sensing radar wave-gauges mitigates this problem.



Evaluation of the sea-state data during a storm surge: water level (grey curve), significant wave height (blue curve), highest wave (red curve)