



# The waves are coming

## System control and data acquisition in coastal monitoring

**A special measuring process has been developed for Husum's Department for Rural Environment (ALR - *Amt für ländliche Räume*) to acquire data on the wave run-up at dykes. The process was subjected to thorough laboratory trials prior to it being installed at the dykes. A single, flexible unit was used as the measurement, control and storage device.**

A new procedure had been developed for safety monitoring and measurement of dykes as part of Schleswig-Holstein's 2001 general plan for coastal protection. The safety of the dykes was to be monitored at regular intervals with sea depth, sea condition and wave run-up being amongst the most important measurement parameters, especially during storm surges. To determine such parameters, extensive field measurements were necessary.

### Measurement procedures

Measurement stations are operated by ALR at selected sites along Schleswig-Holstein's west coast to measure sea conditions, tidal flows and wave run-up. The stations are positioned at around 50m apart and have flow meters and pressure sensors positioned at the foot of the dykes. The flow meters function according to the electromagnetic measurement principle with a measurement range of -5 to +5 m/s. The pressure sensors are used for determining sea conditions and sea depth using the piezoresistive measurement principle. Special sea cables were laid for power supply and data transmission.

A new measurement system for wave run-up needed to be developed because no suitable system existed on the market. Aluminium carrier plates were laid on the dyke outer banks, equipped with stainless steel, individually addressed measurement sensors sorted into pairs at distances of around 30cm.

A sensor resistor is connected parallel to the measurement electrodes. The resistor has a dual pole sensor lead which provides the Rx total resistance of a measuring bridge. This enables detection of broken wire and short circuit occurrences. Differing conductivities occur between the measurement sensors depending on the properties of the electrolyte (rain, flotsam, spray, wave run-up). The bridge voltage is cyclically (10Hz) recorded analog to the occurrence of the different conductivities.

Preliminary trials using a wave channel established conductivity limit values for the various mediums (fresh water, sea water etc.). Up to 70 pairs of measurement sensors were installed to cover the whole of the dyke banks.

A virtual calculation channel was allocated to each of the 70 input channels. This channel use limit values and elevation to determine whether a wave run-up occurs.

A further calculation channel establishes the highest measurement sensor detecting a wave run-up. This procedure then makes it possible to determine the wave run-up with great accuracy.

### Recording the storm surge

Because wave run-up onto dykes occurs only during high surge sea levels, measurement and recording is dependent on sea levels and wave depths. The pressure sensors installed at the foot of the dyke provide the data and trigger information required here. Measurement data is then recorded only when it is necessary, avoiding any redundant acquisition of data in "calm conditions".

### Delphin Technology AG

Sülztalstrasse 23 • 51491 Overath / Germany • Phone: 0049 (0) 2207 9645-0 • Fax: 0049 (0) 02207 9645-35  
info@delphin.de • www.delphin.com



Despite this intelligent method of acquiring and recording data, a large amount of data still need to be processed. The measurement device used is equipped with a 1GB, robust, storage capability. This ensures data security and provides the required storage space. In this way an event can be recorded at the required temporal resolution and for the entire duration of the event.

To guarantee data acquisition continues when a power failure occurs (a likely occurrence in the event of a storm surge), the entire data acquisition system is equipped with a battery backup system. The tried and tested devices can also operate autarchic requiring no PC support. The top-hat rail devices, measuring at just 200mm, are installed into compact switch cabinets at each measurement station.

A remote data transfer capability was also necessary because the devices are located at various measurement stations around the island of Pellworm. Two serial ports on the devices enable direct connection to analog, ISDN or GSM modems. Data can then be transmitted directly to the ALR headquarters in Husum during an event, with no on-site manual read out of the devices being necessary.

### **Analysis of an event**

The ProfiSignal Software is available to evaluate the data acquired during an event. An intelligent Dataservice processes the information using a PC. The whole event or each individual wave can be zoomed on the screen within seconds (see figure *Analysis of measurement data*). Measurement data can be evaluated both online and offline. A toolbar and intuitive software aids these functions.

Measurement data requiring additional evaluation can be exported in ASCII or CSV format. This function enabled ALR to continue using their existing evaluation software.