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Multiparameter platforms for coastal monitoring and research

About Aanderaa

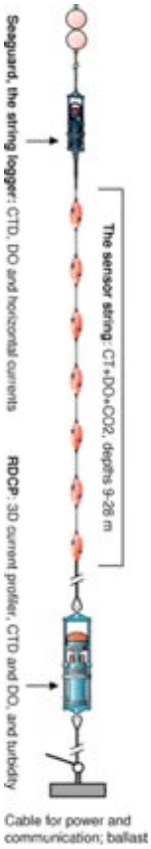
Aanderaa Data Instruments (Bergen, Norway http://www.aanderaa.com) has manufactured reliable, technically advanced, user friendly and robust oceanographic and meteorological sensors, instruments and systems with extremely low power consumption since 1966. Many mechanical current meters (CM) from the early 1970 are still in active use. Parts of these, e.g. pressure cases, top-plates and mooring frames, can be re-used, receiving significant price reduction, when upgrading to a modern state-of-the-art instrument. As of today instruments from Aanderaa are used from top of mountains (+6 km) down to the deepest ocean trenches (-11 km). Aanderaa belongs to Xylem, the name Xylem is derived from classical Greek and is the tissue that transports water in plants. Xylem is a leading global water technology provider with business in more than 150 countries.

The goal of this document is to give examples in which Xylem systems, instruments and sensors are used in coastal applications. The document contains links to more information, on-line data and to short video clips.

Coastal hypoxia and oxygen monitoring

Most aquatic life depends on oxygen. It is alarming finding that the occurrence of hypoxic (low oxygen) conditions is increasing worldwide. This is mainly thought to be a consequence of anthropogenic eutrophication (nutrient input) and climate change.
Aanderaa revolutionized oceanographic oxygen measurements with the introduction of oxygen optodes in 2002. The proven long-term stability (years) and reliability of these sensors have opened new possibilities in coastal monitoring and thousands of Aanderaa optodes are in use. The latest developments of the Aanderaa optodes include the new Aqua optode and forty-point calibrations (4 temp and 10 O_2 concentrations) of the 4330 and 4831 optodes, it results in an absolute accuracy of ±1.5 %.

By scanning this QR code with your cell-phone you will be directed to the pdf version of this document which contains links to more information and on-line data.



Cabled coastal observatory monitoring water quality in real time

In the Koljoefjord an on-line observatory was installed in April 2011 to assess and model the dynamics of a system of fjords on the Swedish west coast (you may read more here). Another function is to serve as a test and development facility for instruments, sensors and antifouling methods. The on-line monitoring module consists of two instruments which are a SeaGuard with a string of maximum 20 sensors and an RDCP (Recording Doppler Current Profiler). During the past years 30-60 sensors from Aanderaa, YSI and other manufacturers have been in operation at this site. Parameters measured at multiple levels include horizontal and vertical currents, temperature, oxygen, salinity, turbidity, pCO_2, wave/tide, chlorophyll, pH, ORP, FDOM and cyanobacteria. For off-line surface water measurements a combination of SeaGuard and YSI EXO2 has been used. You may see a report including data here. The observatory is deployed close to a sampling site of a monthly high quality survey program run by SMHI (Swedish Meteorological and Hydrological Institute). These data serves for quality control and are automatically assimilated into the observatory graphs. Efficient methods have been developed to verify the biofouling status of the sensors using the compact Sontek CastAway profiler. Recovery and deployment is done by drag-lines and takes around 10 minutes each. See video clips here. So far data return rate from individual sensors has been more than 98 %.

Coral reef observatory

At the Conch Reef in Florida (USA) the University of North Carolina is utilizing a SeaGuard with a 170 meter long string (the longest string system delivered from Aanderaa is more than 1 km) for detailed investigations of the respiration of the reef community in general and of giant sponges in particular. Along the string ten 4330 oxygen optodes are distributed in pairs. One mode of operation is to place one optode in the outflow of a giant sponge and the other in the ambient water. The difference in readings give possibilities to track the activity of the sponges with respect to changes in the environment. Each of the smart sensors from Aanderaa also measure high quality temperature. Read more about the project here.

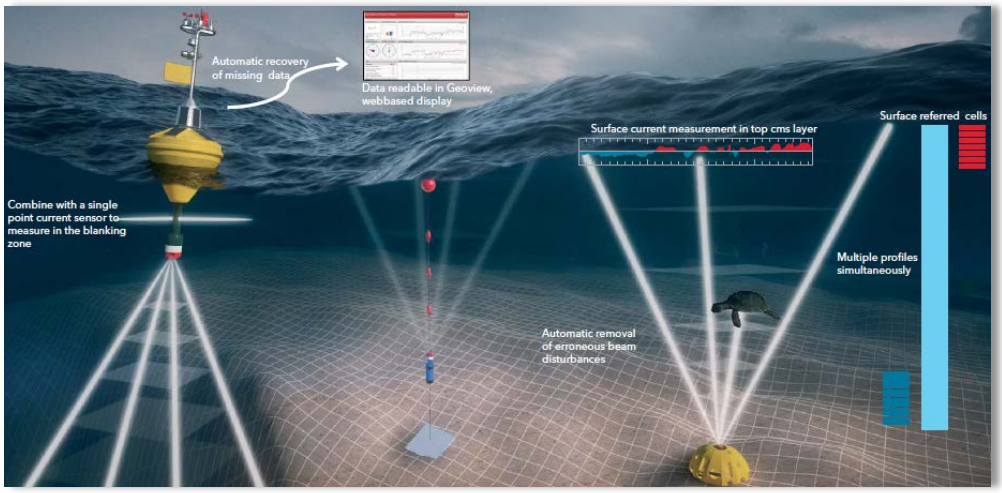
Another coral reef related project is the NOAA run "CREWS" (Coral Reef Early Warning System) project. The regions' unique reefs have been impacted by rising sea temperature and pollution. Monitoring and modelling of environmental conditions in the Caribbean will help to track the health of the reef. Information from similar systems as on the picture to the right is sent hourly via GOES or cellular. Data is then constantly evaluated to determine short term and long term impact with special attention given to coral bleaching.

Sediment-water exchange

In coastal waters sediments contribute greatly to the water quality by storing or recycling different compounds. The use of in-situ incubation chambers mounted on bottom landers to estimate sediment-water exchange of oxygen, total carbonate, nutrients, metals, toxic compounds etc. has been common practice for over three decades. The Gothenburg University (Sweden) landers have served in several hundred deployments. These are equipped with automatic syringe water sampling systems and sensors and instruments from Aanderaa. Oxygen, conductivity, turbidity and pCO_2 sensors are measuring inside the incubation chambers. For data logging and for monitoring background conditions outside the incubation chambers SeaGuard and the newly developed coastal current meter RCM Blue (se picture), are used. For a video clip from coastal lander work please click here.

SeaGuardII DCP: innovation in Doppler Current Profiling and observatory technology

SeaGuardII DCP is the newest acoustic profiler from Aanderaa joining the SeaGuard/Smartguard family. It features innovative new development of the acoustic profiling capacity and exceptional abilities to collect high quality current information on moving and tilting moorings/buoys.
It is available as a 600 kHz frequency instrument with broadband and user selectable narrowband modes making it a flexible profiler for ocean, coastal, harbors and fish farming applications.
SeaGuardII DCP has expanded the capacity to serve as an observatory by hosting multiple sensors (e.g. analogue and serial sensors and long sensor strings). In addition two acoustic profiling sensors can be plug-and–play connected to the same instrument making it possible to profile upwards and downwards simultaneously, reaching the double range with the same moored instrument. The battery capacity has also been doubled compared to the RDCP.

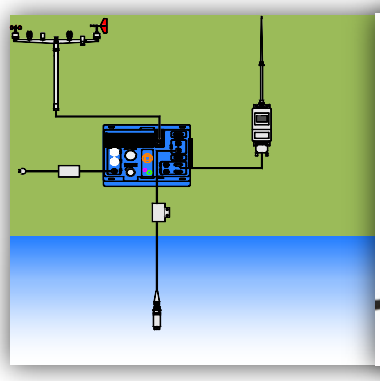


SmartGuard: the “brain” in numerous coastal monitoring projects

SmartGuard is an ultra-flexible data logger and communication hub for Meteorological and Hydrological sensors. In contrast to the SeaGuard and RDCP-600, which are underwater multisensor platforms, SmartGuard is intended for land and buoy installations. It has low power consumption and the capacity to handle more than 50 Aanderaa and/or third party sensors using different signal standards. Data is stored/backed-up on an SD card. For on-line communication it incorporates USB, LAN/internet and serial capacity supported by Aanderaa real time communication and data presentation software.

SmartGuard: radio wave/tide gauge

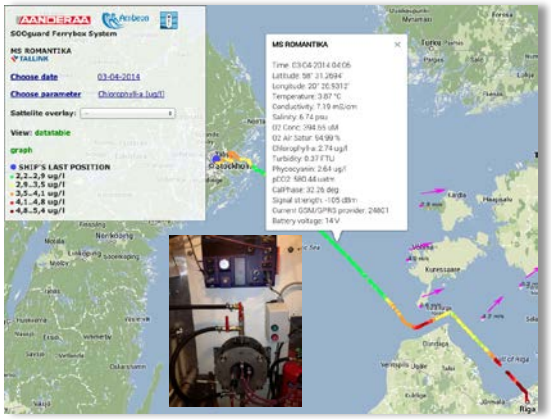
For decades Aanderaa water level and wave/tide recorders are used around the world. The latest development is pressure and Water level/Wave/Tide sensors with 0.01 % FS accuracy and a high resolution long term stable vented, compensated for changes in atmospheric pressure with a tube, wave/tide or tide sensor. Connected to a SmartGuard that is on-line over a direct internet connection or via VHF, UHF, GSM, GOES or Iridium modem will give on-line data to support e.g. navigation, forecast flooding and for dam operations.



SmartGuard on buoys

The Mexican National Commission for Use and Protection of Biodiversity (CONABIO) needed a real time system capable of measuring meteorological, oceanographic and water quality parameters in the proximity of a protected ecosystems. The core of the system is based on the SmartGuard integrated in a buoy module which allow collection and on-line presentation through GOES satellite modem of Meteorological (wind speed and direction, solar radiation, net radiation, atmospheric pressure, temperature and humidity) and hydrological parameters (current speed and direction, oxygen, temperature, turbidity, conductivity/salinity and chlorophyll). To view a presentation on this project click here.

Compact Multiparameter Ferry Box/Ballast Water Monitoring System SOOGuard now with on-line data presentation and cloud solution:



SOOGuard is an exceptionally compact SmartGuard based modular flow-through system primarily intended for surface water measurements from ships/boats/moving platforms. After field evaluations and further development we now offer complete turnkey solutions including: on-line system (cell phone/iridium) with data stored locally and in a cloud solution and color-coded presentation in Google Maps. Typical standard parameters in a one module system include: Position, Flow rate, Temperature, Salinity, O_2, pCO_2, ChlA, Turbidity, Phycoerythrin/Phycocyanin, FDOM/Hydrocarbons and Hull temperature. The system can be expanded with sensor for meteorological measurements. Sensors are easily accessible making operation and maintenance of the system fast and easy by non-experts.

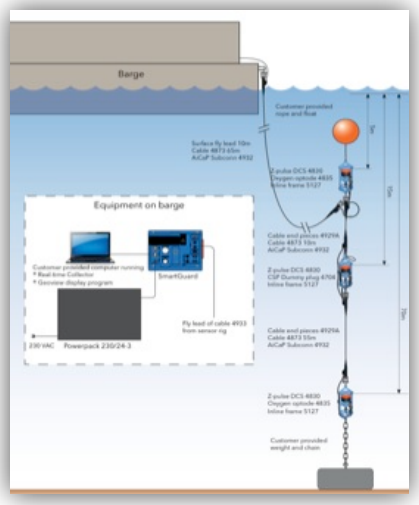
SmartGuard in aquaculture applications

Aanderaa equipment is widely used in aquaculture applications. Before installation of a fish farm a site survey is often carried out to judge if the suggested area is suitable for an installation. For this work typically acoustic profilers and SeaGuard instruments are used. The main parameters studied are circulation, oxygen conditions, salinity and temperature.

During production many fish farms use information from on-line joy-stick controlled underwater video cameras equipped with Aanderaa oxygen-temperature sensors. By moving the camera inside cages the operator can visually inspect the fish and its behavior. If oxygen levels drop below a certain level or if temperature is not suitable the feeding is decreased/stopped because the fish will not grow.

Outside cages systems like the one on the drawing serves the purpose to monitor background conditions that are of special importance if there is risk of contamination, e.g. spreading of viruses, and to select suitable periods for medical treatment of the fish in the cages, e.g. delousing of salmon.

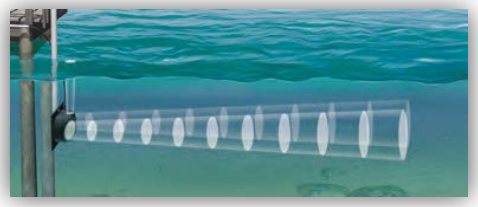
The system on the picture is an example of an operational system where currents are measured at three different levels (5m, 15m and 70m depth) together with oxygen, conductivity and pressure. Data is collected by a SmartGuard on the barge and transmitted and visualized using our GeoView real time display software.



The new Aqua Quality System (AQS) was developed together with the company Data Quality (http://www.dq.fo/). AQS is a complete and flexible environmental monitoring system with real time data quality control and a built-in report generator. The AQS is based on using high quality sensors from Aanderaa and gives the fish farmer access to reliable data in a web based display program both with real time and historical data.

Navigational safety and pollution tracking

During the past 30 years Aanderaa has delivered hundreds of systems for port and harbour installations ranging from simple docking, water level and weather monitoring systems to multi-station networks along the coastline. Vessel Traffic Service (VTS) integrators often prefer the Aanderaa marine transport solutions because we can deliver complete turn-key systems with all hydrological and meteorological sensors needed. For video clip please click here.
Safeport was a joint EU-research project between Polish and Norwegian partners with the overall goal to improve the safety during approach, entering and berthing of large ships. The end product of Safeport is a ship adapted visualization software, presented on the ferry bridge, that gives recommendations on the safest harbour approach taking into account prevailing hydro-meteorological conditions. Main system components include a dynamic model assimilating real time hydro-meteorological data from Aanderaa systems. In Safeport NIVA also developed a site adaptable model for on-line tracking and breakdown of e.g. oil spill. (Click here for Aanderaa's oil & gas brochure).



Recently we have expanded our measuring possibilities in several projects by integrating side looking Doppler current meters from our sister company Sontek. These will update the Harbour Master in real time about current conditions with up to 120m horizontal range in addition to water level, by use of a vertical beam and an inbuilt pressure sensor.

Sediment transport and dredging

In 2009, Aanderaa was awarded a contract by the German Waterway and Shipping Administration to modernize their on-line network of hydrological monitoring stations (read more here). The upgrade comprised 7 data buoys, 10 river pile stations along the estuary of the river Elbe as well as the delivery of 180 SeaGuard instruments. Acquisition of hydrological standard parameters along the River Elbe fulfils the waterway authorities duties in terms of administration and provision of safety navigation.
High dredging activities in the area makes it vital to predict the transport of sediments into the shipping channels. In this regard, it is very important to rely on exact measurements. Measured data includes water flow, temperature, pressure, salinity, oxygen and turbidity. In order to get accurate and reliable turbidity data, Aanderaa performs 12-point calibrations of these sensors.