HELZEL Messtechnik

WERA Ocean Remote Sensing

Newsletter

August 2011

- **WERA Chile observed Tsunami Signature**
- **Example of Surface Current Map Interpretation**
- **WERA wireless TX synchronization**
- **PortMap Ocean Radar for Ports and Harbours**
- **WERA Operators Seminar 2011**
- **See you on Big Island for Oceans '11**
- **Ocean Remote Sensing Workshop ROS 2011, Italy**

We invite you to meet us in Belgium for:

5 – 8 September 2011
Oostende, Belgium

CoastGIS 2011

Ocean Radar WERA –
A tool for coastal management

Thomas Helzel
September 6, 2011 at 11:30 am

[S1A] GIS Technology Stream

Island of Norderney, Germany www.norderney.de

Leader in reliable high-quality ocean current, wave and wind mapping

10 years WERA of excellence in remote ocean sensing

WERA in Chile observed Tsunami Signature

The research group lead by Prof. Dante Figueroa from the University of Concepcion in Chile, has reported that their WERA radar system was able to capture the signal of the tsunami that struck northeast Japan in March, 2011. This is the first time ever that an ocean radar detected an approaching tsunami.

After the strong earthquake occurred in Japan on March 11, 2011, the generated tsunami travelled across the Pacific Ocean and reached the coast of Chile within 22 hours. Following the earthquake and tsunami news, and due to lack of internet access, Prof. Dante Figueroa drove to the remote WERA ocean radar site and manually switched his WERA system into fastest operation mode, which allows the collection of real-time data every 30 seconds.

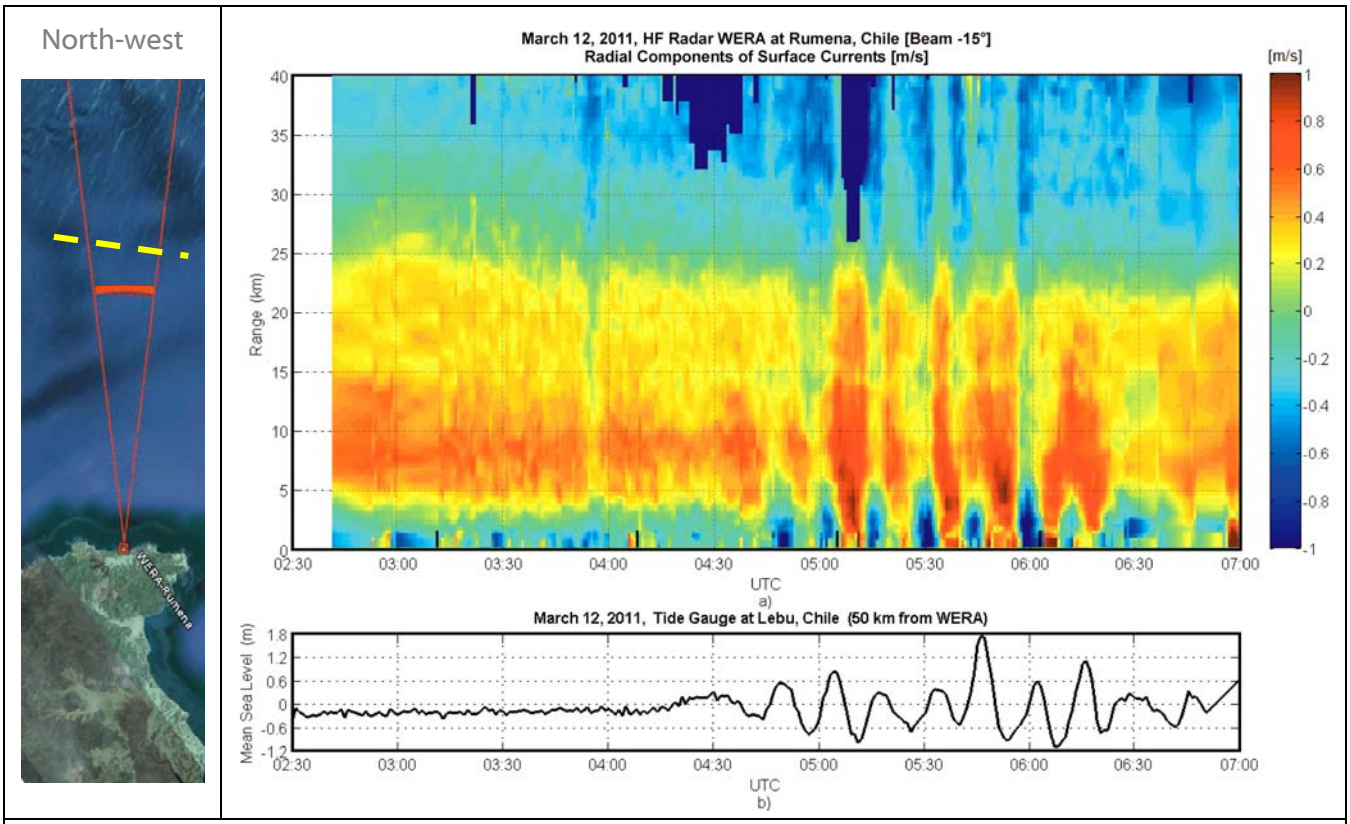


Fig.1: *Left panel:* Used beam (15°) for the plot on the right panel. The direction of the approaching tsunami is marked yellow, the size of the measured pixel is marked red.
Upper panel: Colour coded plot of WERA derived current velocities as function of time (x axis) and range (y axis).
Lower panel: Sea surface elevation measurements from a tide gauge located approximately 50 km away from the WERA site. Note the significant correlation between the WERA derived velocity and sea surface elevation variability due to the tsunami generated by the earthquake in Japan.

The theoretical basis for the detection of an approaching tsunami with ocean radars was first introduced by Dr. D. Barrick in 1979[1]; nevertheless until this event, no real data of tsunami detection existed to confirm the ability of ocean radar systems to detect an approaching tsunami. Following the Sumatra tsunami in 2004, Drs A. Dzvonkovskaya and K.-W. Gurgel (University of Hamburg, Germany) used a numerical model that was able to prove that ocean radar systems could be used as Tsunami Early Warning Systems[2]. The results clearly showed that ocean radar systems can be used as a tsunami warning system, assuming the distance between the coastline and shelf edge is long enough (> 50 km) to allow sufficient time for warning. This can be achieved only with array type antenna systems like WERA which are the only systems able to provide the spatial and temporal resolution required for reliably detecting the fast approaching tsunami wave[2].

The theoretical basis for this approach is that tsunami waves generate a characteristic periodic ocean surface current pattern that can be used as the tsunami "signature". This tsunami signature was detected in the signal recorded by the WERA system in Chile. A comparison of the measured radar signatures with nearby sea level measurements showed a high correlation between the two signals confirming that the WERA system was successful in capturing the tsunami signal (Fig. 1).

Fig. 2: WERA ocean radar system at Rumena, Chile, (near Concepcion). The system shown operates at 22 MHz and consists of a short array of 8 antennas that receive the signal backscattered from the surface of the ocean.

This unique radar measurement of a real tsunami is the proof of concept the ocean radar community has been waiting for. The delay of this discovery and announcement is solely due to fact that the radar site in Chile (see Figure 2) is not equipped with real time telemetry.

In addition, the significance of this finding required the rigorous review of the acquired data and confirmation of the results by three independent scientific groups (University of Concepcion, Chile, University of Hamburg, and Hamburg University of Technology, Germany). The final and detailed results of the analysis will be presented by these groups in upcoming conferences and in the peer reviewed literature.

The used ocean radar system WERA is the most reliable and accurate system. It can be easily operated from land and provides data over a range exceeding 200 km (for low HF frequencies). Within this range a tsunami signature can be detected making WERA a useful component for any national and/or international "Tsunami Early Warning System".

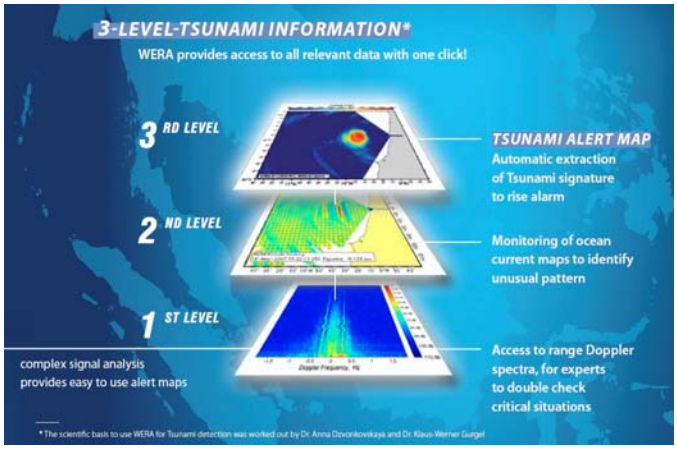


Fig. 3: The WERA tsunami detection software package. It consists of three levels of analysis that can be integrated into any Tsunami Early Warning System. Its application requires a 50 km minimum distance between the coastline and the continental shelf edge.

Helzel Messtechnik provides a WERA tsunami detection software package with automated analysis on three different levels as displayed in Figure 3. The adaptation to location specific conditions requires scientific expertise that can be provided by us and our scientific partners.

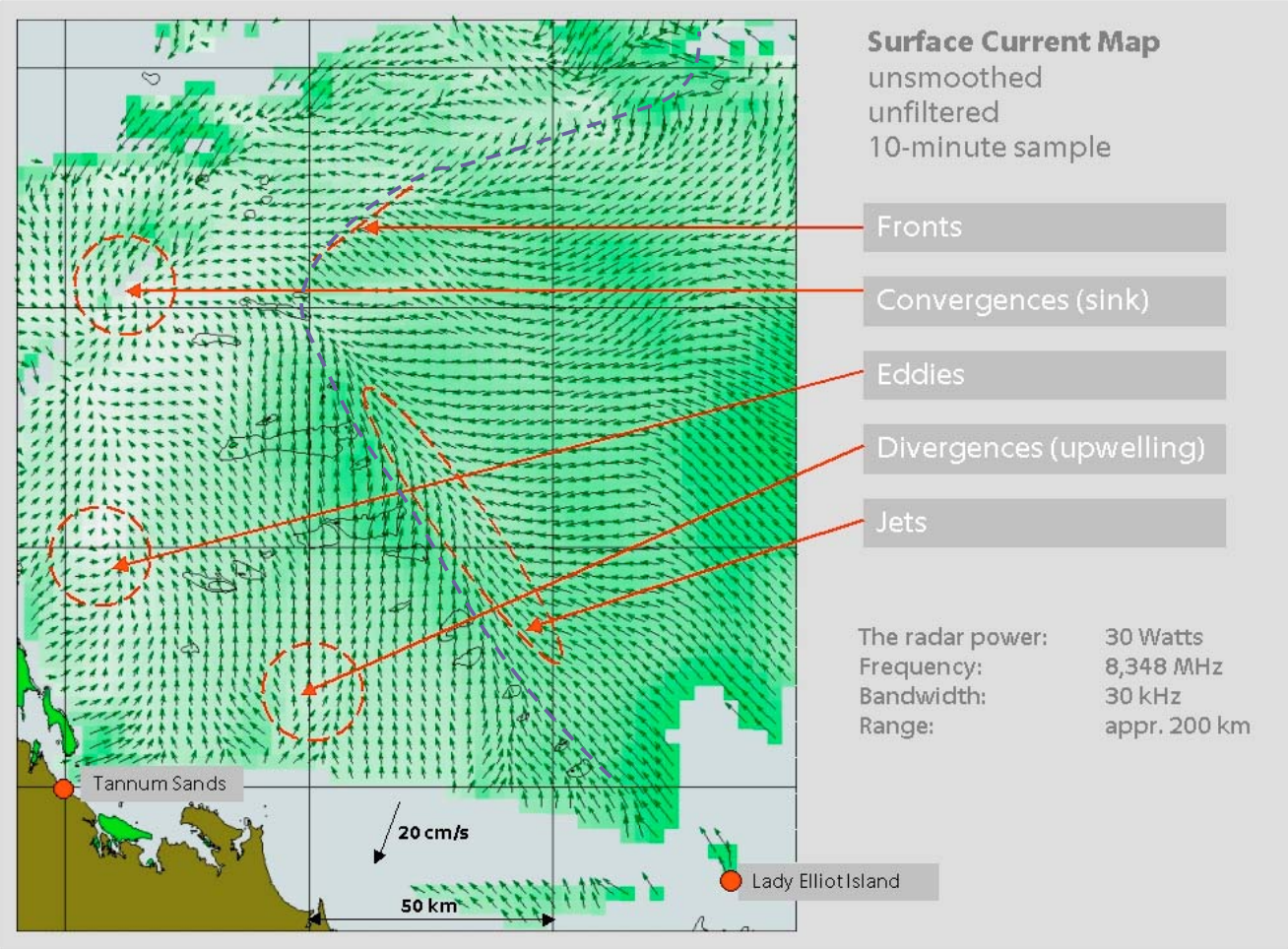
More detailed information on tsunami research using WERA HF radars can be found online at www.helzel.com

[1] D. E. Barrick, 1979. "A coastal radar system for tsunami warning", *Remote Sensing of the Environment* Vol. 8, 353-358]

[2] K.-W. Gurgel, A. Dzvonkovskaya, T. Pohlmann, T. Schlick, E. Gill, 2011. "Simulation and detection of tsunami signatures in ocean surface currents measured by HF radar", Ocean Dynamics, Earth and Environmental Science, Springer, DOI 10.1007/s10236-011-0420-9

Example of Surface Current Map Interpretation

Detailed structure in complex surface current features is one of the strengths of the WERA phased array system. The unsmoothed 10-minute grab of data on the Great Barrier Reef illustrates this. It is a surface current map from the IMOS-ACORN radar stations at Tannum Sands and Lady Elliot Island, Great Barrier Reef, Australia.



Data courtesy of the Australian Coastal Ocean Radar Network (ACORN) which is part of the Australian Integrated Marine Observing System (IMOS) imos.org.au

The Tannum Sands station is on the mainland in the south-west corner of the map, and a shallow shelf extends out to the grey line which marks the sudden drop from about 40-50 m to over 200 m depth. The black lines show the reefs and islands of the southern Great Barrier Reef (GBR). Surface currents in the deep water to the east are generally dominated by winds and geostrophic systems. The flow dynamics on the eastern side of the map are affected by the western edge of the east Australian current which flows southwards outside the reef. Currents on the shelf, in the GBR lagoon are driven predominantly by winds and tides.

The fine structure shown in maps like these is valuable for research and for the management of the Great Barrier Reef World Heritage Area. It also valuable for maritime accidents, mitigation and pollution monitoring. In April 2010 the ocean data provided by the WERA system was used to support the management of the incident and eventual salvage of the coal carrier "Shen Neng 1" which ran aground on Davies Shoal, within the Great Barrier Reef Marine Park.

WERA wireless Tx synchronization

A new WERA option allows to operate a WERA transmitter without any cable connected to the receiver unit. This increases the flexibility to find suited site locations. With this new WERA Tx-SAT unit it is possible to install the transmit antenna independently from the main WERA system in a distance of up to 1 % of the radar range and still use the standard mono-static software.

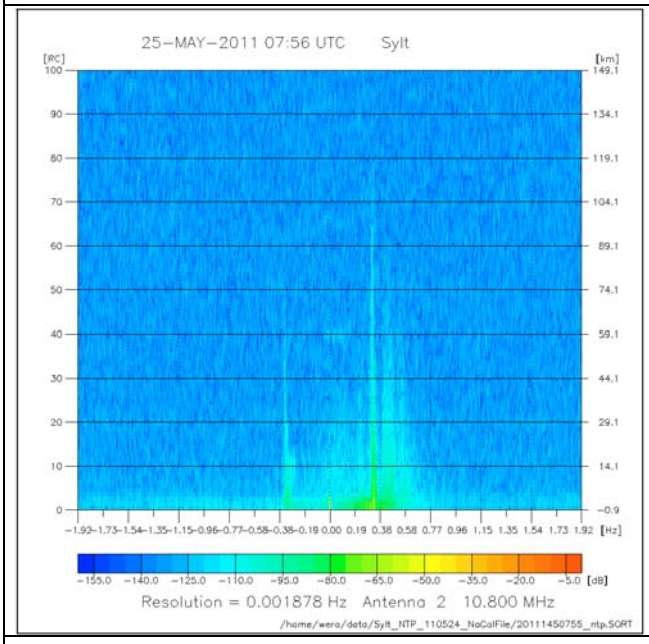
The motivation to use a Tx-SAT unit is to simplify the siting for Rx and Tx antenna arrays, e. g. the Tx can be installed on roof of a building and the Rx array on the beach in some 100 m distance.

During a one-week experiment a team of Helzel Messtechnik and the University of Toulon tested the capability of the new WERA system configurations. The experimental platform was the WERA system installed on the island of Sylt, Germany, operated by the Helmholtz Zentrum Geesthacht.

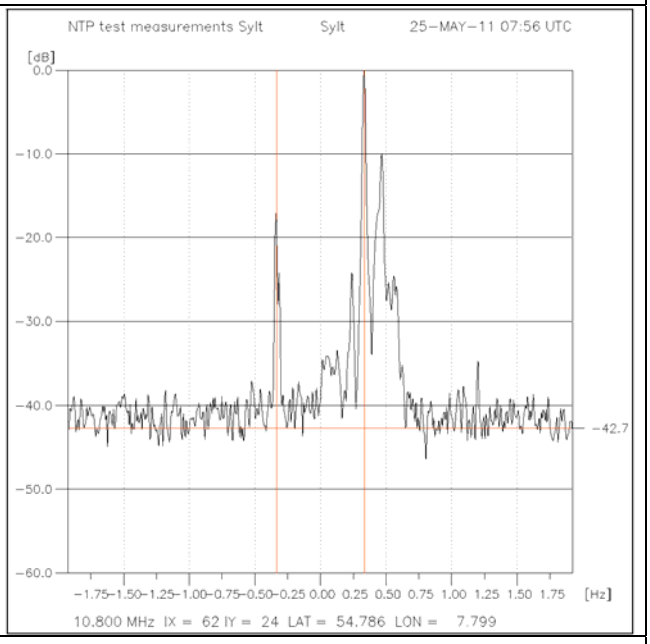
The measurement results show that the wireless synchronization of transmitter and receiver do not degrade the quality of the measured signals. The tests were carried out with integration times of up to 9 minutes, which can be used for wave measurements as well.

The Tx-SAT unit can be programmed by means of a PC or laptop via LAN or W-LAN. This interface allows to keep permanent remote control of the Tx-SAT unit. The Tx-SAT unit is housed in a water proof box and available with an output to drive a WERA power amplifier or with integrated 20 W power amplifier. The power consumption is 40 Watts without power amplifier or 90 Watts with PA.

Quasi-mono-static setup, but separate transmit and receive modules



Range-Doppler-plot antenna #2



Spectrum grid cell 62, 24 – 30 km in front of RX

WERA
Ocean Remote Sensing

PortMap Ocean Radar

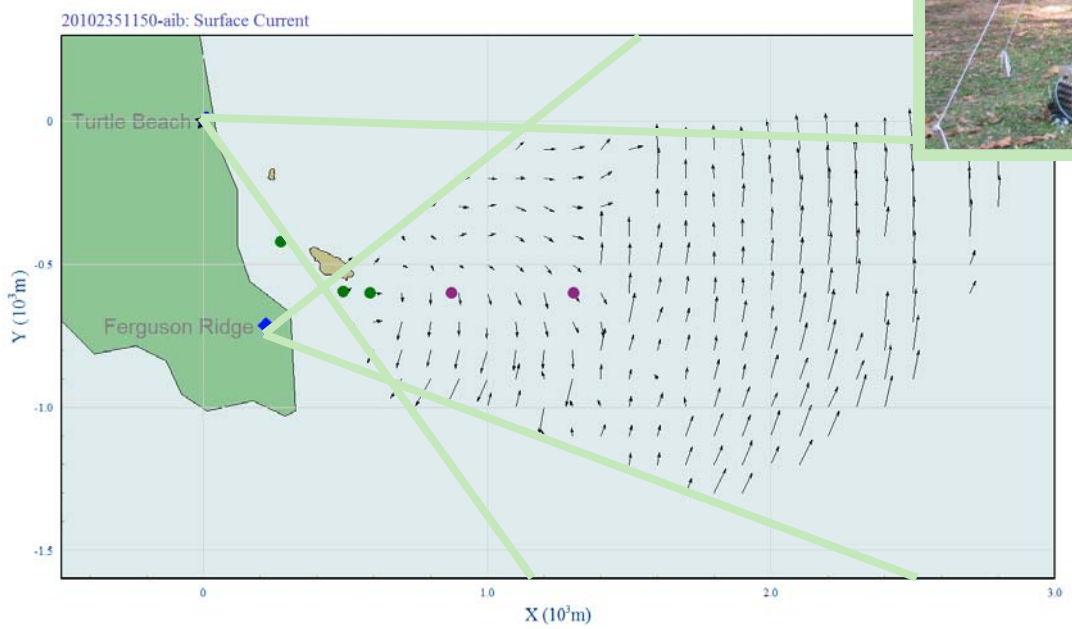
A portable high resolution surface current mapping system for ports and harbours

The PortMap ocean radar produces maps of surface currents at high resolution in space and time, and is designed for use in Ports and Harbours and anywhere where small scale jets and eddies affect maritime operations, coastal engineering and marine park management.

The use of high VHF frequencies (50 – 180 MHz) means that operational bandwidths are wider than those available in the HF band. Tests at 151.2 MHz with a 1.5 MHz bandwidth confirm that the range resolution of 100 m can be achieved.

The system uses a continuous chirp modulation system perfected by Helzel Messtechnik GmbH in Germany. With transmit power less than 1 Watt and test conditions at 151.2 MHz, an operating range of 3 km is confirmed.

Two stations are required for mapping surface current vectors. The stations are separated by approximately 1/3 of the maximum operating range. Significant wave heights are produced by each station separately using the line width of first-order Bragg echoes.



PortMap
Remote Ocean Sensing
Pty Ltd

Significant structure in the surface flow can be seen here with wind-driven currents near to the shore from a northerly wind, and an ebb tidal flow further off-shore. The site is at the Australian Institute of Marine Science near Townsville in North Queensland, Australia. This is a 10-minute grab of data with no smoothing, outlier eradication or interpolation; these are high quality raw measurements.

For additional information, please e-mail PortMap@gotalk.net.au

WERA
Ocean Remote Sensing

It's time for another WERA Operators Seminar !

We would like to invite you to join us for our next WERA Operators Seminar in Kaltenkirchen, Germany:

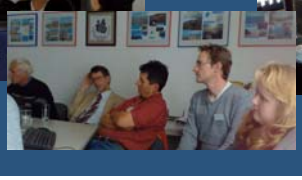
September 26 – 30, 2011

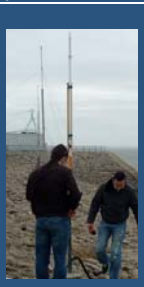
This one-week intensive seminar is an excellent opportunity for potential users or for operators who already work with the WERA system and data on a daily basis to get to know all they need to experience about our Ocean Remote Sensing Technology.

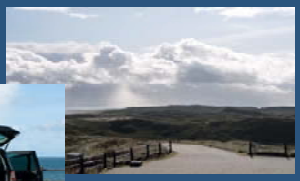
Understanding the physics and technology behind WERA, an overview on the system hard- and software structure, basics for site planning will be explained to enable users or consultants to carry out future site planning, introduction to the software tool box and tools for quality assurance will be points on our agenda.

One day is reserved for a field trip to one of the WERA sites at the North Sea coast to carry out practical training.

For additional details on our seminar, please visit http://www.helzel.com/de/13917-WERA-Operators-Seminar

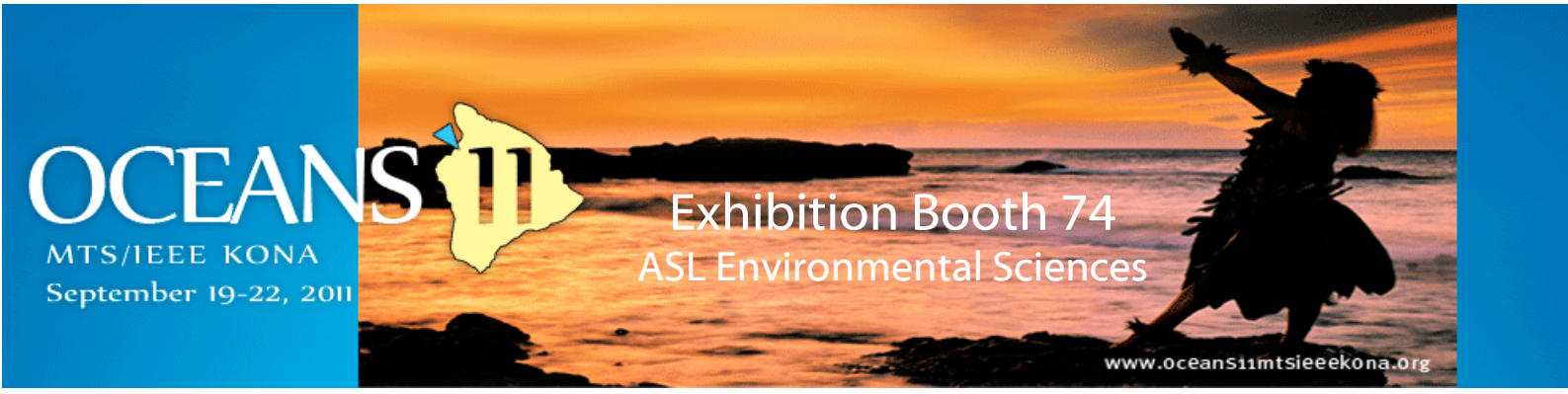







See you on Big Island for Oceans '11

When minutes matter – Local (Near Field) Tsunami Detection, Assessment and Warning Guidance
Monday (September 19) – Room: Kona 5
8:30 – 12:30 am



WERA
Ocean Remote Sensing

International Remote Ocean Sensing Workshop ROS 2011

It is a special pleasure for us to announce the continuation of the successful International Remote Ocean Sensing Workshop ROS.

The HF Radar ocean applications community has been participating in a number of conferences and workshops over the last decades that have provided a unique opportunity for the researchers to present their work to the scientific community.

Three years ago the Remote Ocean Sensing (ROS) workshop was launched in Germany. ROS 2011 is the third in this series and will be hosted by the NATO Undersea Research Center in La Spezia, Italy.

In contrast to the previous workshops ROS 2011 will be dedicated solely to HF-radar remote sensing of the ocean and its applications.

ROS 2011 will focus on retrieval of information such as surface currents, waves, and winds as well as ship detection.

Furthermore, ROS 2011 will address the utilization of the retrieved information in other applications e.g. environmental modeling.

We want the workshop to be a forum for researchers and users to come together and discuss results, needs, issues as well as possible future applications and collaborations.

We would like to encourage you to join us for this workshop and pass the information on to colleagues who are interested to get to know this state-of-the-art in ocean remote sensing with HF radars.

As the number of participants is limited and a personal invitation from NURC required, please contact us prior registration.

For details, please visit the official workshop website at http://geos2.nurc.nato.int/ROS/

Helzel Messtechnik GmbH • Carl-Benz-Strasse 9 • 24568 Kaltenkirchen • Germany • Tel. + 49 (0)4191 - 95 20 - 0

www.helzel.com