WERA Ocean Radar in Chile Observed Tsunami Signatures after the Earthquake in Japan on March 11, 2011

The research group lead by Prof. Dante Figueroa from the University of Concepcion in Chile, has just 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 tsunami generated 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 a fastest operation mode, which allows the collection of real-time data every 30 seconds.

The theoretical basis for the detection of an approaching tsunami with ocean radars was first introduced by Dr. D. Barrick in 1979; 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. 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 only be achieved 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.

Fig. 1: 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 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 (see Figure 1).

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, manufactured by Helzel Messtechnik of Germany, 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.

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 Helzel Messtechnik and their scientific partners.

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

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