HF Radar WERA for Tsunami Early Warning Systems

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HF Radar WERA
for Tsunami Early Warning Systems /Ocean Coastal Monitoring

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HF Radar WERA for Tsunami Early Warning Systems /Ocean Coastal Monitoring

The HF radar system WERA (WavE RAdar) is an oceanographic radar placed at the coast and providing simultaneous wide area measurements of ocean surface current fields and sea state parameters

The tsunami current velocity is converted into modulating signals and superimposed on measured antenna signals of the WERA radar.

The possible ocean surface current changes due to a tsunami event are evaluated using fast update of the radar backscattered spectra

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HF Radar WERA for Tsunami Early Warning Systems

Field Applications

* Search & Rescue
* Vessel traffic services.
* Research for complex current and wave maps
* Real-time data and sea-state condition for forecasts.
* Fishing Industry
* Environmental Protection and Recovering
* Tourism Industry
* Fully integrated into a national Tsunami Early Warning System.

HF Radar WERA for Tsunami Early Warning Systems

High Resolution, Long Range Remote Ocean Sensing System

WERA Remote Ocean Sensing

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

- Broad frequency range from 5 to 50 MHz to provide ranges from 15 to more than 250 km
- Very low RF-power typically <30 Watts to guarantee no interference with other radio services
- FM-cw principle provides best signal to noise performance and high temporal resolution
- Robust and small antenna system, easy to install
- Flexible, modular system with 4 channels for Direction Finding (current mapping) or 8 to 16 channels for Beam Forming to provide current, wave and wind mapping

HF Radar WERA for Tsunami Early Warning Systems

System Technical Specifications

Pos	Parameter	Description	Condition 1	Condition 2	Condition 3
01	**Broad band system concept**	useable for various applications	**8 MHz**	**16 MHz**	**30 MHz**
		range for ocean currents up to:	250 km	110 km	50 km
		resolution: (depends on frequency allocation)	5 ... 1 km	3 ... 0.5 km	1 .... 0.15 km
02	**Sweep repetition time**	programmable from 2 ... 10 Hz			
03	**Transmit power**	Low, non harmful rf power, 7 W per antenna pole, 28 Watts total			
04	**Antenna construction**	Simple vertical monopoles	**8 MHz**	**16 MHz**	**30 MHz**
	Transmit and receive antenna design is identical	shorter poles will result in slightly reduced range	3 ... 6 m	2 ... 4 m	1.5 ... 3 m
05	**Antenna array**	Rectangular configuration for Tx	18 x 5 m	10 x 3 m	5 x 1.5 m
		Linear receive array, 12 antennas	< 180 m	< 100 m	< 40 m
		Linear receive array, 16 antennas	< 250 m	< 140 m	< 55 m

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System Technical Specifications

06	**Synchronise WERA systems**	simultaneous with WERA-multi method			
07	**Analog data acquisition system**	Narrow band receiver with 16 bit, complex, parallel AD conversion Noise figure: 10 dB Bandwidth: 1.5 kHz			
08	**Digital data acquisition**	near real time processing			
09	**System control**	access to all radar parameters, listen before talk mode, automatic frequency adaptation, rf interference reduction, system self-check and calibration			
10	**Working range** *Can be reduced due to environmental effects*	Depends on frequency	**8 MHz**	**16 MHz**	**30 MHz**
		for currents:	140 .. 250 km	70 ... 110 km	35 ... 60 km
		for wind direction:	110 .. 200 km	55 ... 90 km	30 ... 50 km
		for waves:	65 ... 110 km	30 ... 50 km	15 ... 30 km

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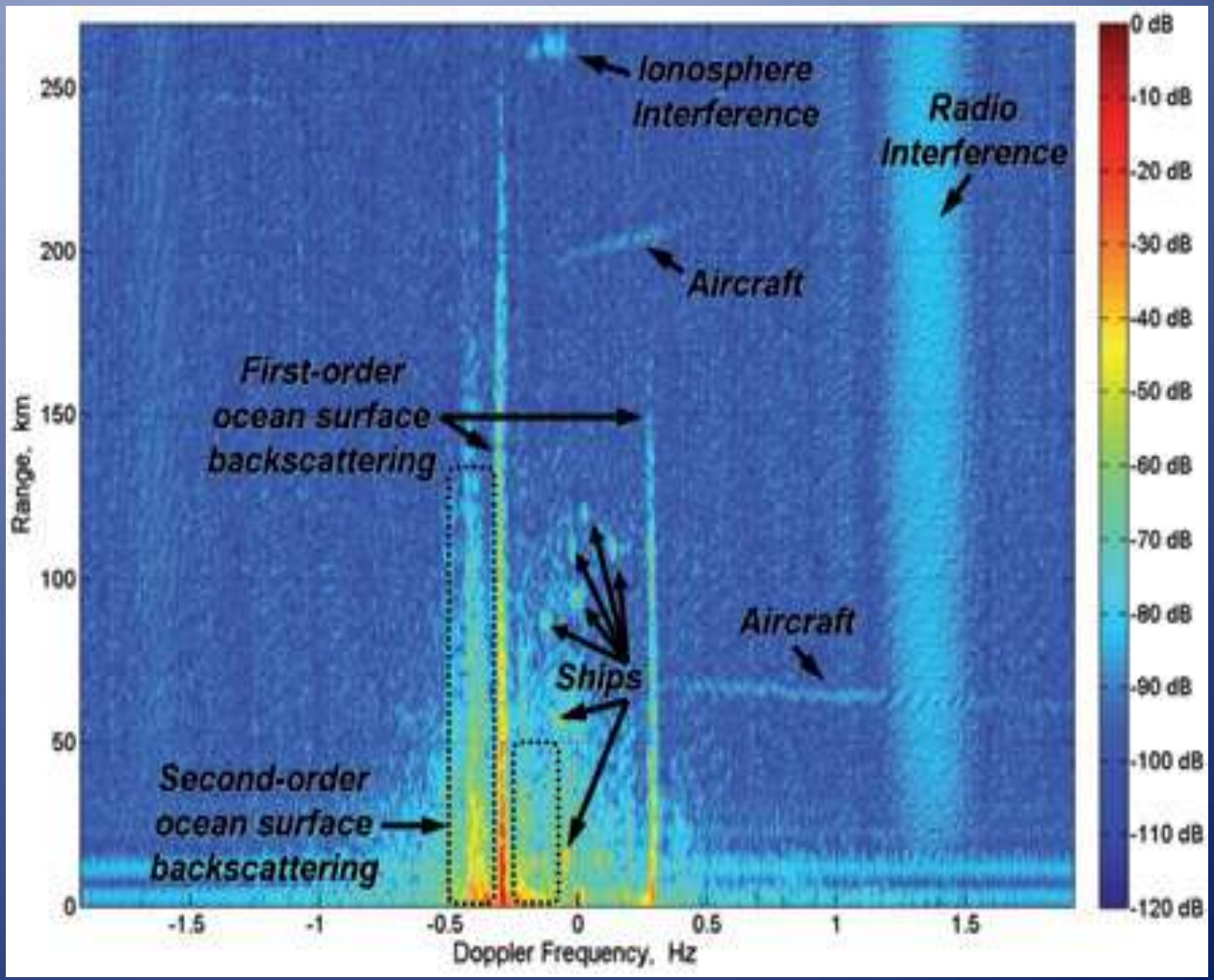
WERA Doppler Power Spectrum

Example of a measured range-Doppler power spectrum with several kinds of interference and target



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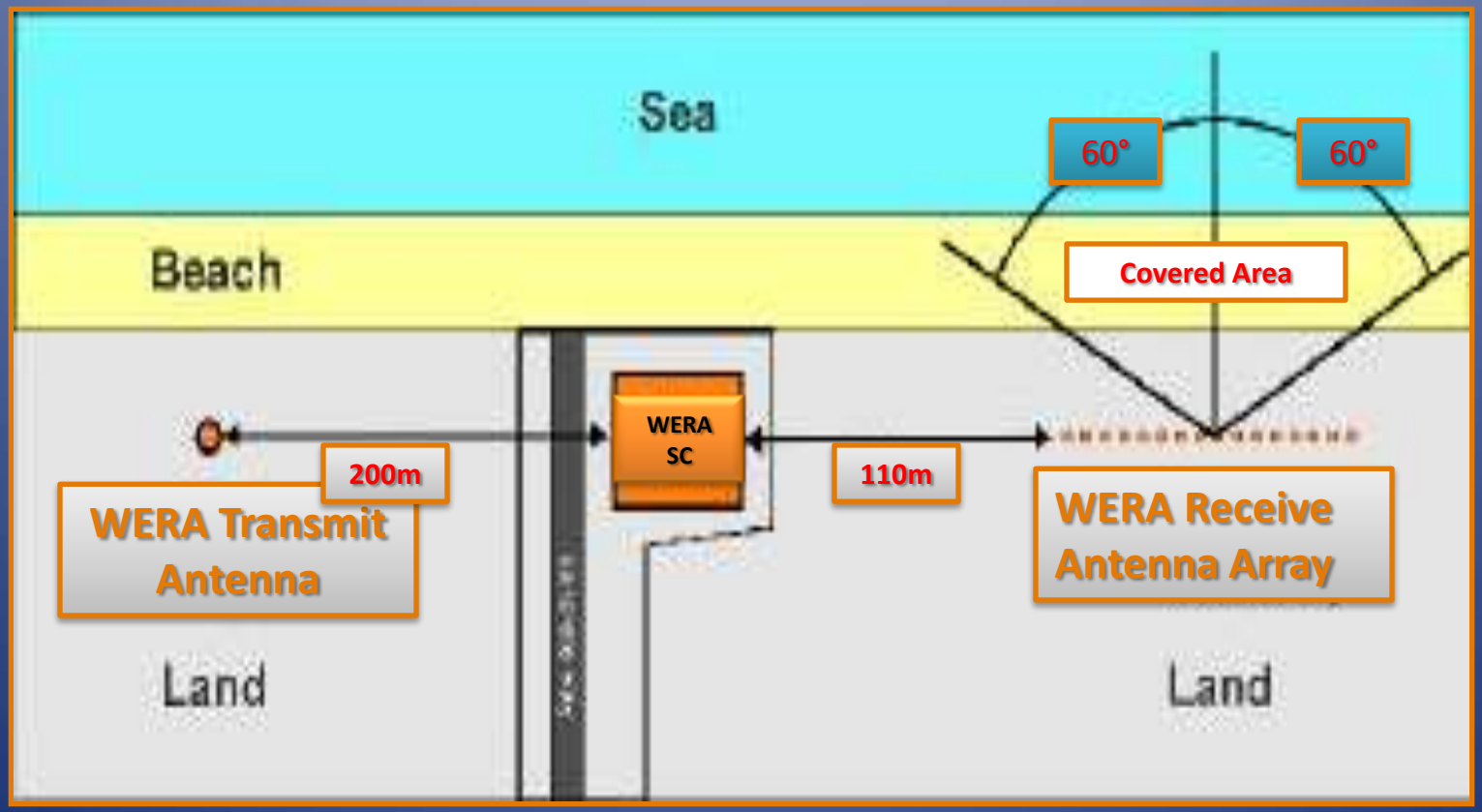
Field System Diagram



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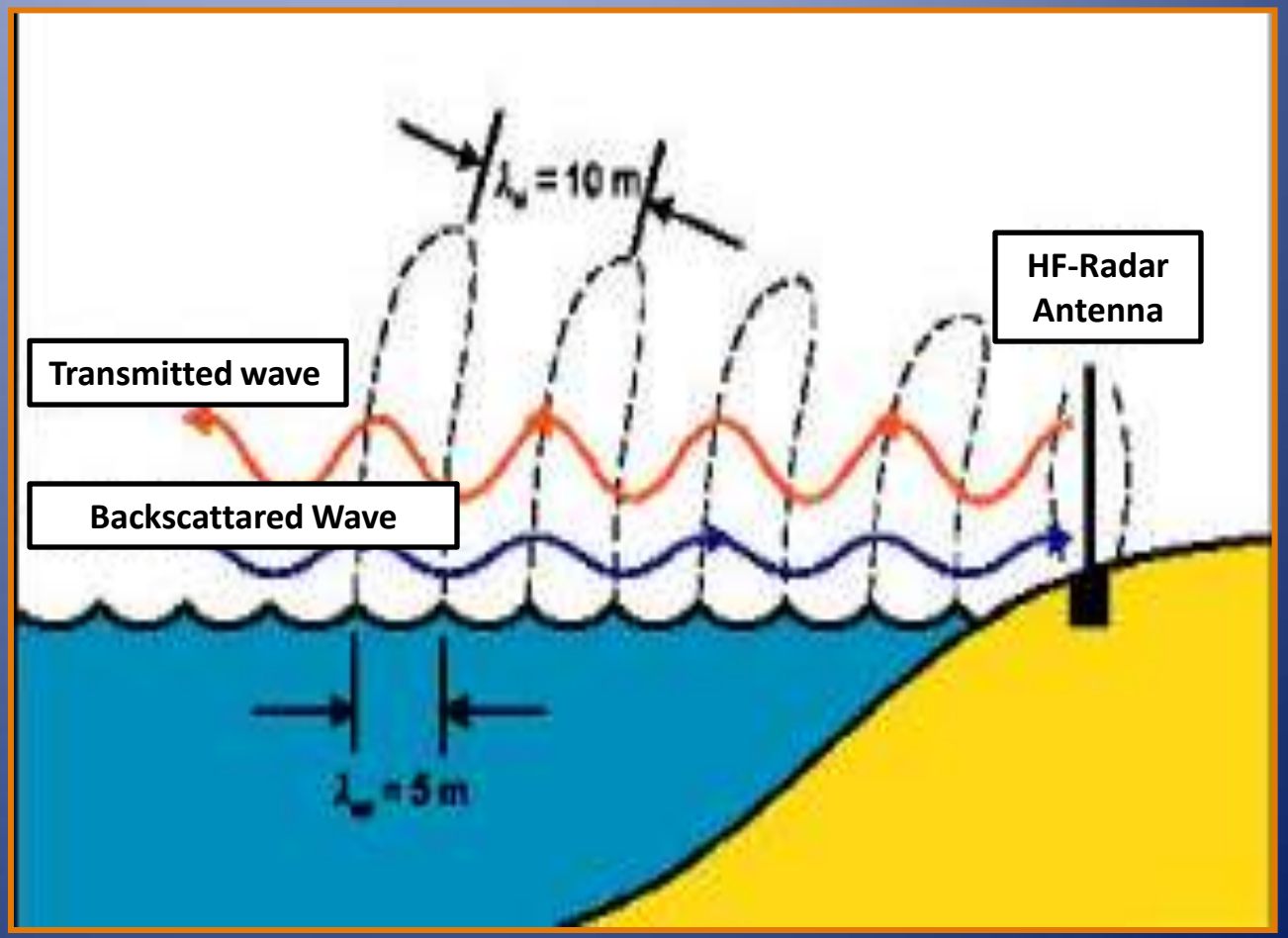
Principal of Operation

Principle of operation (Bragg Effect) The Bragg Effect describes the amplification effect of a back-scattered electromagnetic wave having twice the wavelength as the ocean wave, e.g. for a 30 MHz radar signal with Lambda 10m is the corresponding ocean wave 5 m to fulfil the Bragg condition.



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Field System - Coastal

TX Antenna Array

RX Antenna Array

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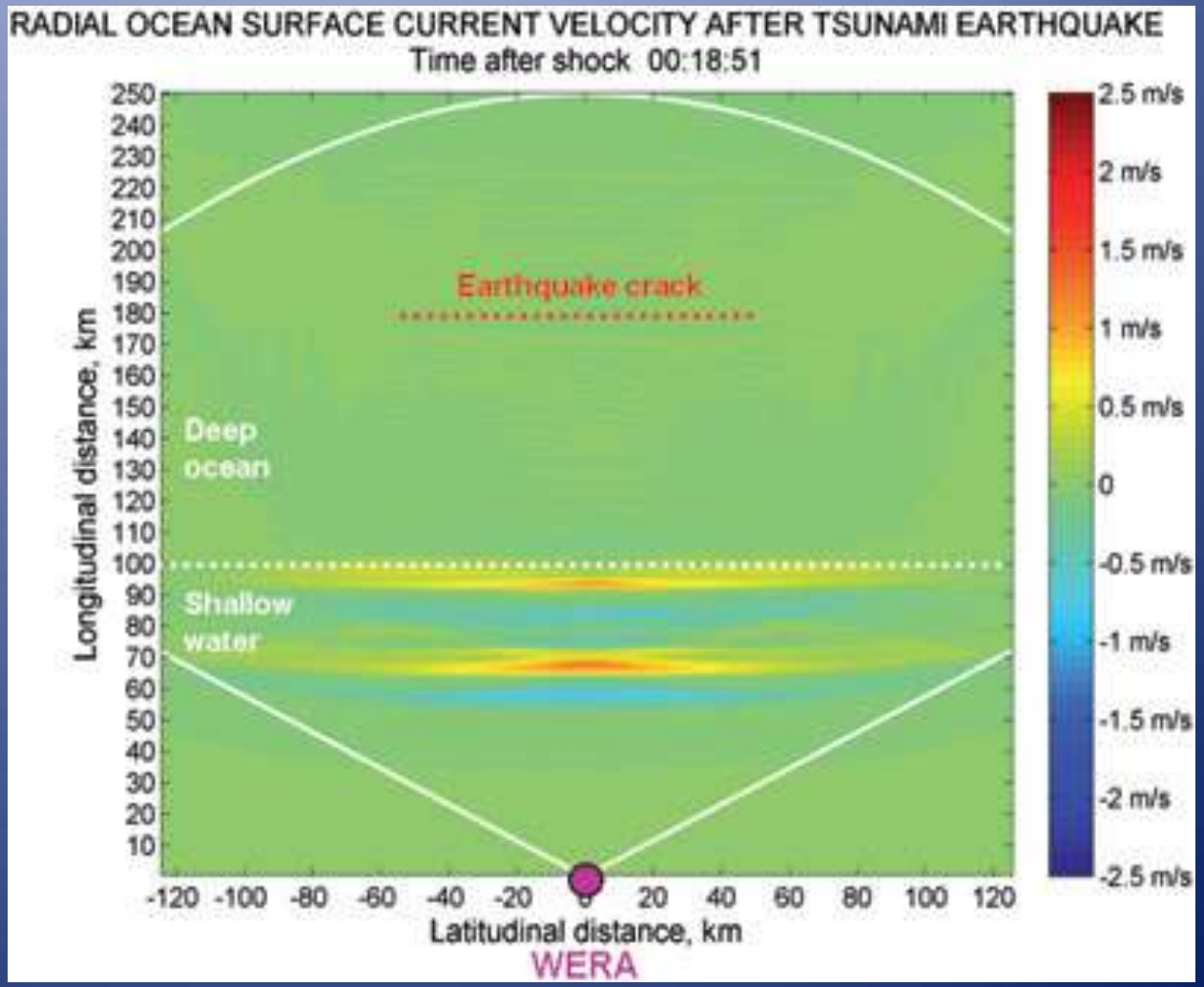
Generated Tsunami Alert Map

2-10 second interval of currents, waves and surface wind observation.



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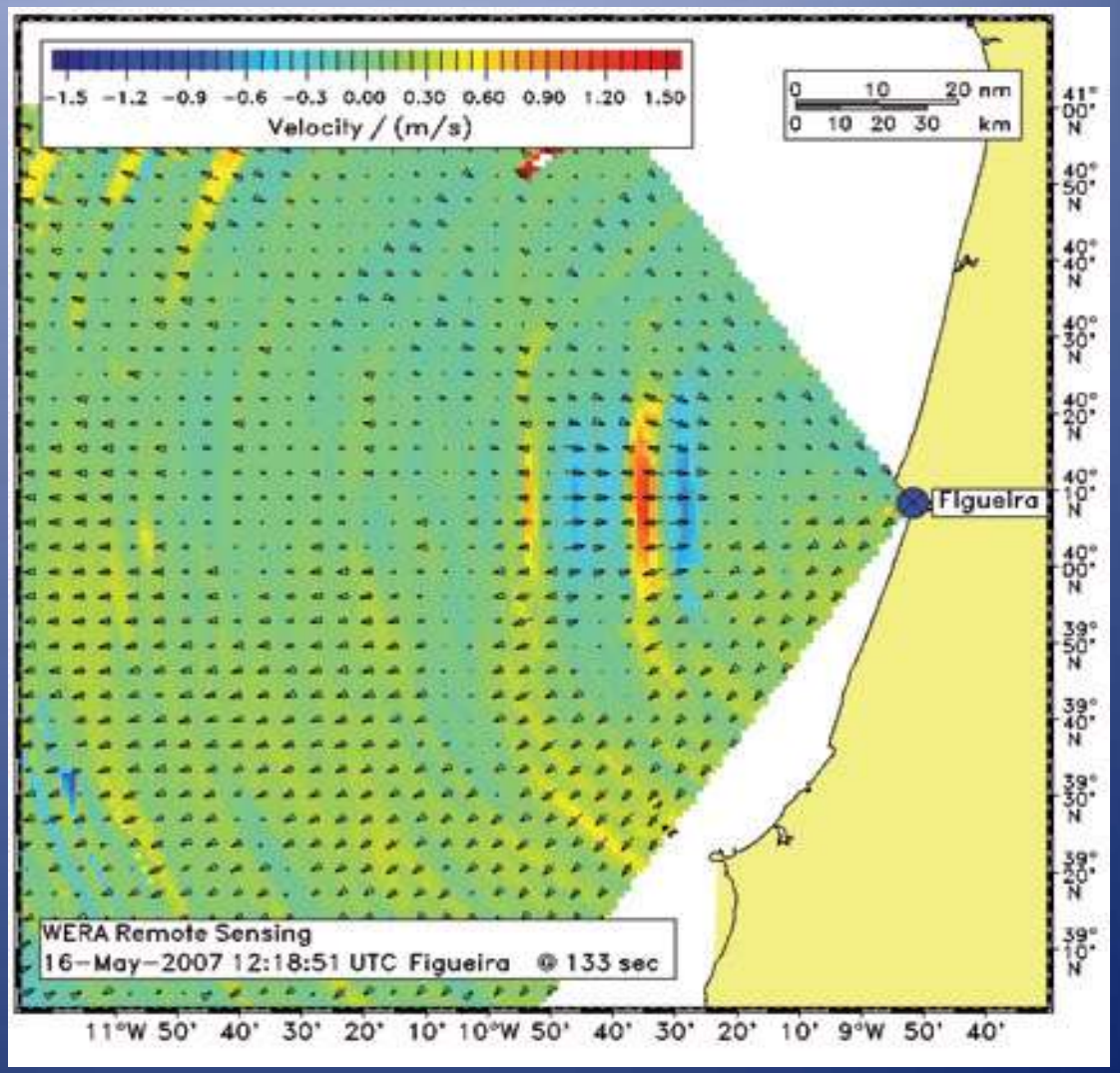
WERA HF Radar Spectra

Radial ocean surface current velocity map based on the measured HF radar spectra with the simulated tsunami currents



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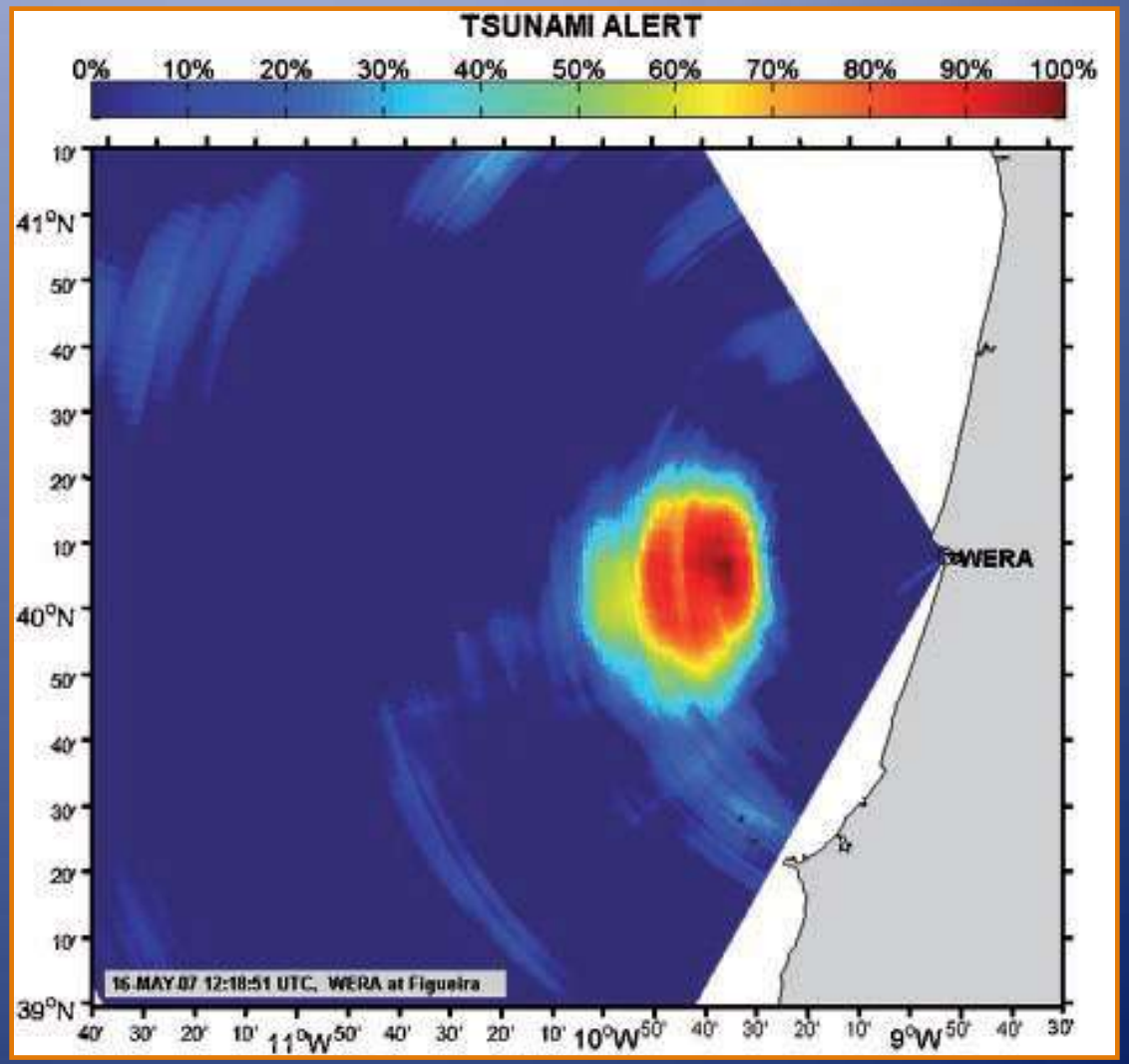
HF Radar WERA for Tsunami Early Warning Systems

Generated Tsunami Alert Map

Tsunami alert map generated from the WERA Modulated Vector.



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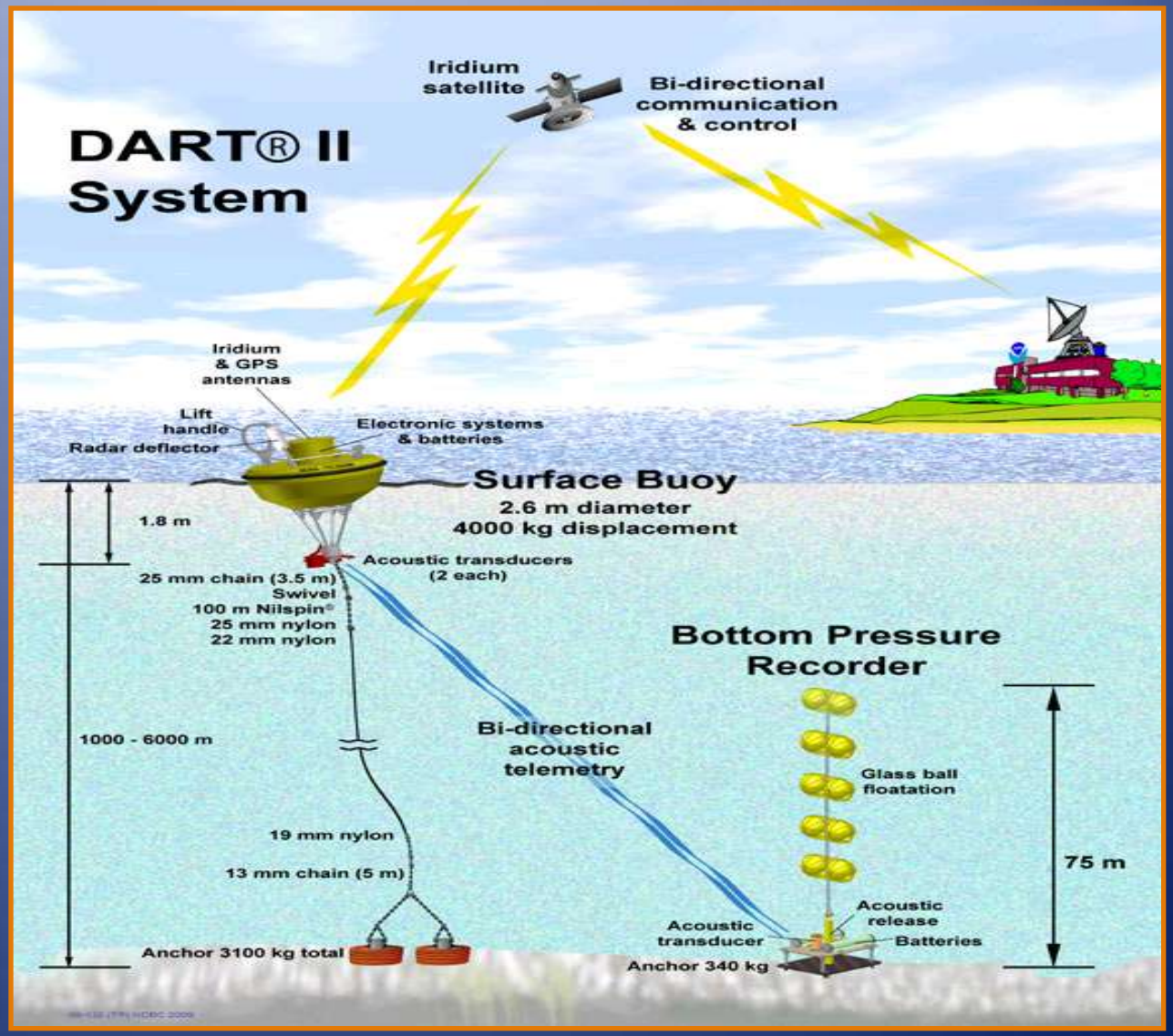
WERA Alternative to Tsunami Buoy

Sub-surface and Offshore Environment



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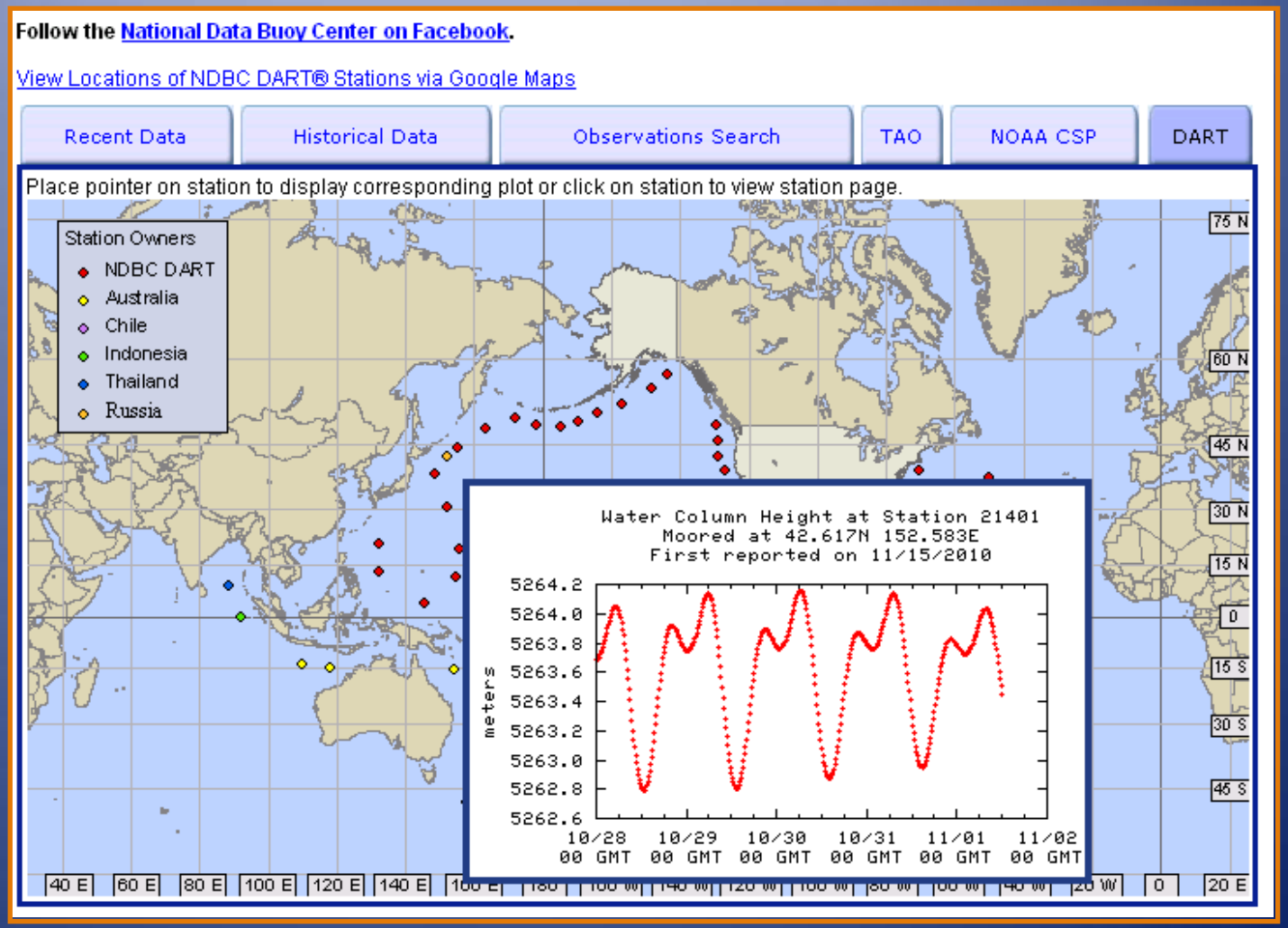
WERA Alternative to Tsunami Buoy

Tidal and Water level Harmonic Principal



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HF Radar WERA for Tsunami Early Warning Systems

WERA : Alternative to Tsunami Buoy

Tsunami Buoy

1. Offshore Environment
   - Mob / Demob
2. Sub-surface Equipment
   - Multiple Components Base
3. High Cost Maintenance -
   -Preventive & Corrective
4. Lost and Vandalism
   - High Risk
5. Communication
   - Inconsistent

WERA

1. Onshore Environment
   - One-off Mob / Demob
2. Land-base Equipment
   - Single Component Base
3. Free Maintenance -
   - Preventive & Corrective
4. Lost and Vandalism
   - Low Risk (Guarded /Fencing)
5. Communication
   - Consistent & Reliable

and ++++

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Thank You

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