WERA Ocean Radar supporting decision making at National Tsunami Warning Centres

In general the ocean radar detects the **ocean surface current signature** which is generated by an approaching **Tsunami or Meteo-Tsunami** when traveling over the **continental shelf**.

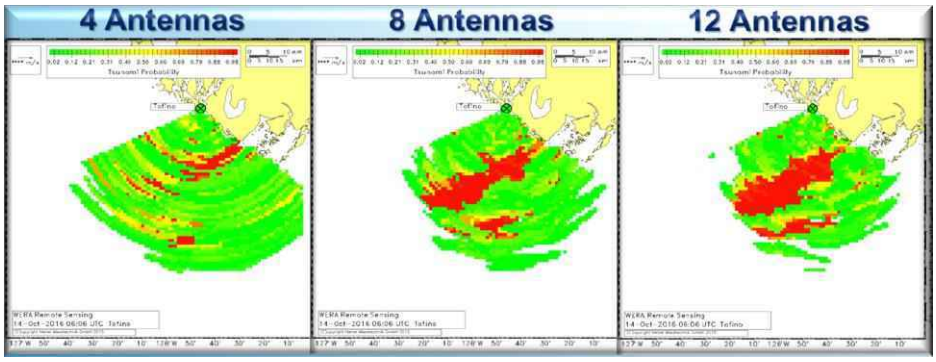
The selection of a location suited for the installation of WERA for Tsunami detection needs to be carefully investigated and the system configuration needs to be optimised for this sensitive application. The following points need to be taken into account:

- Distance to continental shelf edge, required to select optimal HF radar frequency
- Find potential area to install the antenna arrays at the coast near to the water or at the edge of a cliff
- Provide robust power supply with back-up options (strong UPS) for the case of power failure
- Provide redundant data connection line, in Tsunami warning situations at least a slow connection is required
- Ensure to get professional operational service (preventive maintenance) to guarantee a reliable operation

The receive antenna system:

The number of used receive antennas defines the sensitivity of the Tsunami detection.

The figures on the right show the Probability maps of the same small Meteo-Tsunami detected at the Canadian coast at Tofino in October 2016.



Small active or passive antennas are available for the receive (Rx) array.

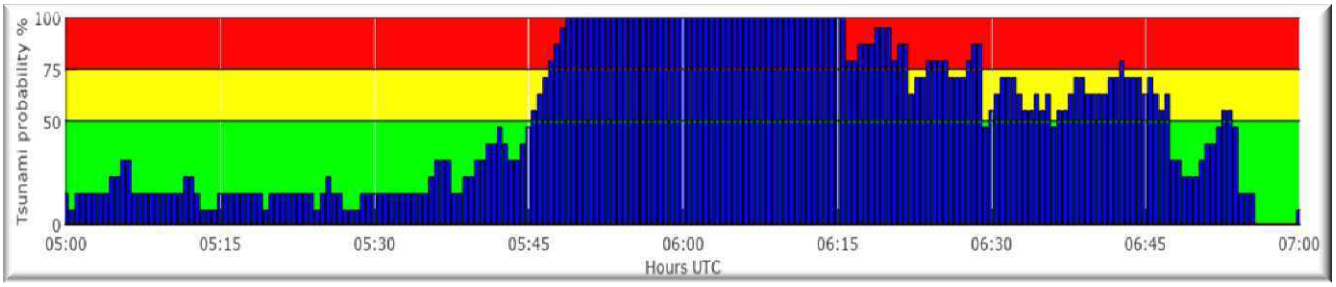
For the transmit (Tx) antenna system passive antennas should be used.

← *Tx array*

Active Rx antennas →

Decision making:

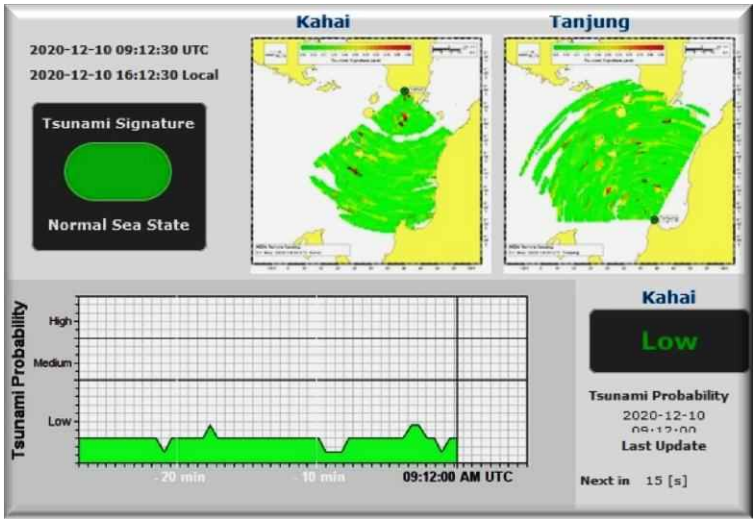
- The Tsunami Probability is calculated on-site in near-real time and an alert will be sent to the warning centre
- At the warning centre the data from the HF radars, probability time series and maps are used to support the decision making



Time series of Tsunami Probability, at Tofino October 2016. The wave reached the shore at 6:20 am.

Carl-Benz-Strasse 9 ❍ 24568 Kaltenkirchen ❍ Germany ❍ Tel.: +49-4191-9520-0 ❍ Fax: -40 ❍ e-mail: WERA@helzel.com

- **WERA** can detect an approaching **Tsunami up to 200 km off-shore**
- The **detection range** can be adapted to the local **site specific requirements**
- **Tsunami Probability** in near-real time as map and as time series
- **Robust and Reliable system**, with small antennas installed on shore
- **Very high data availability**
- Useful for **multiple applications**, providing met-ocean data



Pos	Detection range	*The detection range should reach out to the continental shelf edge at day and night time*				
01	*Depends on frequency*	***9.3 MHz***	***13 MHz***	***16 MHz***	***24 MHz***	***26 MHz***
	for Tsunami detection at **night** time:	200 km	120 km	95 km	60 km	55 km
	for Tsunami detection at **day** time:	140 km	80 km	65 km	40 km	35 km
	for wave height:	70 km	45 km	40 km	18 km	15 km
	for ocean currents:	150 km	100 km	80 km	50 km	40 km
	for wave spectra:	60 km	30 km	25 km	12 km	10 km

02	**Range resolution**	*Resolution depends on allocated bandwidth, finer resolution results in faster responds*				
	Typical values	6 km / 25 kHz	3 km / 50 kHz	1.5 km / 100 kHz	1.0 km / 150 kHz	600 m / 250 kHz

03	**Azimuthal Integration**	*Resolution depends on number of antennas, finer resolution results in faster responds*			
	Rx antennas	*16*	*12*	*8*	*4*
	at 20 km distance	2.4 km	3.1 km	4.5 km	9.4 km
	at 40 km distance	4.9 km	6.3 km	9.1 km	18.8 km
	at 80 km distance	9.8 km	12.6 km	18.1 km	37.7 km*
	at 160 km distance	19.5 km	25.1	36.3 km*	75.4 km*

* not recommended

04	**Detection sensitivity**	*Sensitivity depends on operational frequency*				
	Operating Frequency	*9.3 MHz*	*13 MHz*	*16 MHz*	*24 MHz*	*26 MHz*
	Current signature	0.13 m/s	0.09 m/s	0.08 m/s	0.05 m/s	0.05 m/s

All other parameters are similar to the corresponding WERA long range or medium range systems.

Carl-Benz-Strasse 9 ❍ 24568 Kaltenkirchen ❍ Germany ❍ Tel.: +49-4191-9520-0 ❍ Fax: -40 ❍ e-mail: WERA@helzel.com