138

WERA Tsunami Probability

Background

The WERA high-frequency coastal radar is capable of measuring ocean currents, wave heights, detecting and tracking tsunamis (all types including atmospheric tsunami expression on the ocean), seiches, storm surges and, potentially, oil slicks. More background maybe found on the following included page on HF radar detection:

High-frequency (HF) radar systems are capable of measuring surface ocean currents with high spatial and temporal resolution. Numerical experiments have demonstrated that HF radar systems can be used as tsunami warning systems for coastal regions with wide continental shelves (Gurgel et al., 2011). Post-event processing of data from the 2011 Tohoku-Oki tsunami shows that HF radar systems are capable of detecting tsunami waves based on radial velocity for the first time (Lipa et al., 2011; Hinata et al., 2011).

New research on HF RADAR systems has indicated their capability to detect tsunami waves on their way to shore in a radius up to 300 km (Grilli et al., 2015). The Tohoku-Oki tsunami in 2011 was detected between 10 and 45 minutes earlier on the HF radar than on coastal tide gauges (Lipa et al., 2011).

As part of this project a new high-frequency Wellen radar (WERA) was installed at the Long Beach Airport, Tofino, British Columbia in March 2015 (Figure 2). This system is currently operating at a transmitting frequency of 13.5 MHz. The Tofino WERA is composed of twelve 3 m RX antennas spaced 10.1 m apart and four 5.1 m TX antennas arranged in a rectangle of 11.1 m by 5.5 m. Once fully operational, this system operates at 33.3 seconds/sample and the output will be integrated over 2 min time intervals.



Three different major methods were used in the past for the detection of tsunamis with HF radar: 1) direct observation of current velocities based on signals from two radar systems combined; 2) analysis of the radial components from a single radar system and 3) frequency shifts in the Doppler spectrum of the radar echo (Murata et al., 2010; Lipa et al., 2011). The distance, and therefore the time before coastal arrival, at which the wave is detected are highly dependent on the bathymetry and extension of the continental shelf in the area (Lipa et al., 2011). These approaches have the limitation of detecting tsunami currents only down to a certain velocity (10-15 cm/s) therefore limiting the use of this technology to near-shore areas with an extended shelf. A new algorithm developed by Grilli et al. (2015) is able to detect tsunami currents as low as 5 cm/s therefore allowing more effective detection. This algorithm takes advantage of the correlations between HF radar signals at two different locations shifted in time proportionally to the propagation time from the tsunami source (Grilli et al., 2015).

During the first testing after deployment the system demonstrated the capacity of detecting wave heights up to 100 km offshore Tofino (Figure 3).

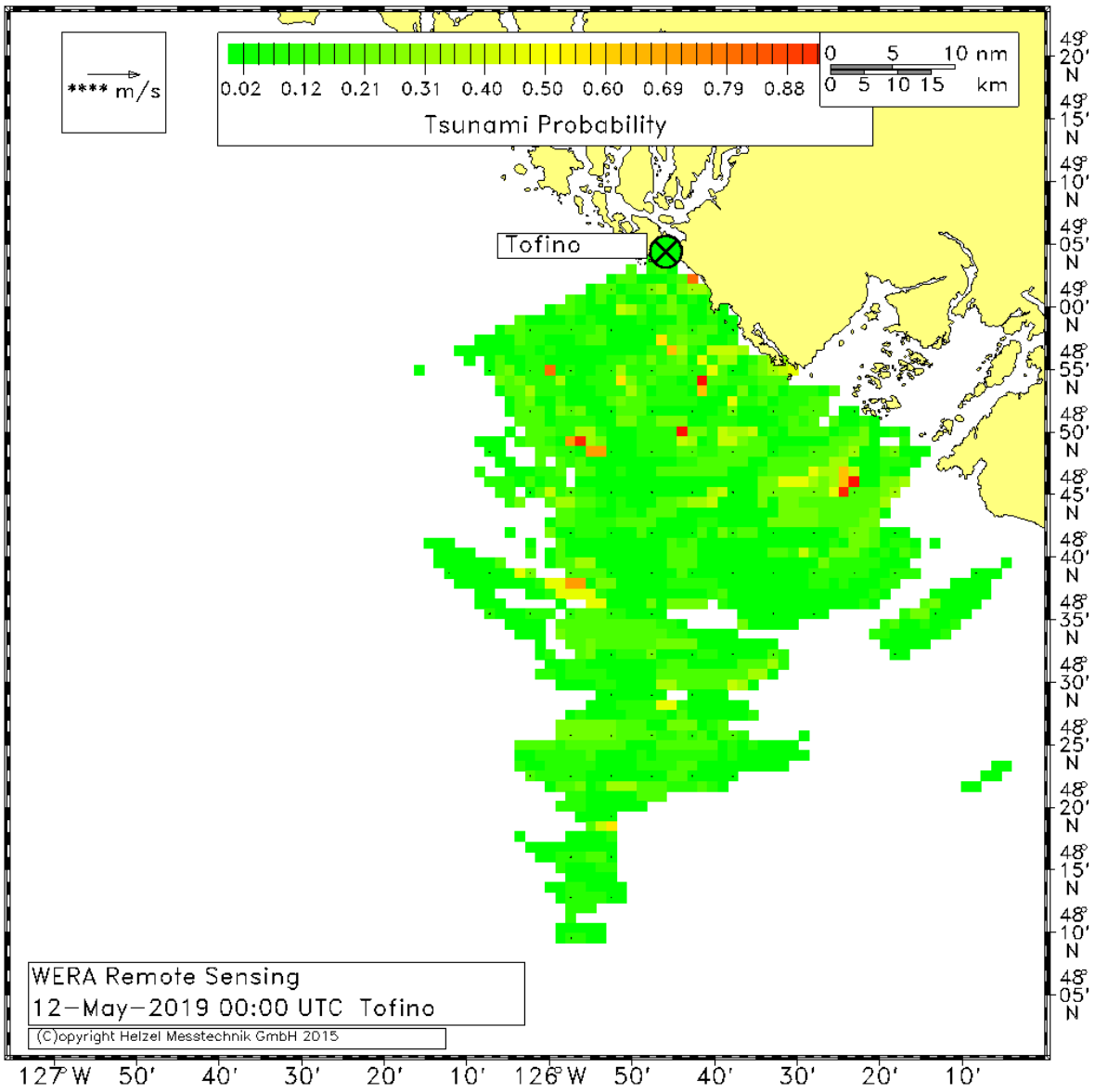
Data are currently being received and stored for this system. New algorithms for automatic detection of tsunamis are currently being developed for the WERA and will be integrated into the tsunami detection system of this project.

Two main streams of research are currently being followed for the WERA system in Tofino. One of them follows the algorithm implementation by Anna Dzvonkovskaya, while the other one explores the algorithm developed by Stephan Grilli.

A preliminary study for the Tofino site by Grilli et al. can be accessed in the next link: Grillietal_2016-TPC-1048_ISOPE16.pdf This article was presented at the ISOPE conference in Rhodes at the end of June 2016. A new article with more detail information has been recently submitted to Pure and Applied Geophysics.

More articles for background will soon be added to this page.

The WERA Tsunami Probability data product is a map of tsunami detection probability, produced by WERA's onboard algorithms developed by the manufacturer (specifically, Anna Dzvonkovskaya). These data products follow ONC's file naming convention with the file-mode field '-TsunamiProbability'. See the example below:



Oceans 3.0 API filter: `dataProductCode=WERATP`

Revision History

1. 20190601: Initial WERA data products released

Data Product Options

No options at this time.

Formats

GIF

All WERA image data products are generated by the WERA software. These products are archived as GIF files with only one frame in each file. Data Search and API data product requests will collate multiple files together into animated GIF files, with one GIF file produced per UTC day.

Oceans 3.0 API filter: `extension=gif`

Discussion

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