WERA Ocean Radar
Support for Tsunami Early Warning Systems

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Reducing Tsunami Risk in the Western Indian Ocean:
a Regional Conference in Muscat, Oman 2015
Content:

• Introduction of Ocean Radar Technology

• How WERA can help to provide more reliable Tsunami Early Warning?

• Multi-Hazard Management Features

• Conclusions
1.1 Introduction

WERA is a shore based remote sensing system using the over the horizon radar technology to monitor ocean surface currents, waves and wind direction. A vertical polarised electromagnetic wave is coupled to the conductive ocean surface and will follow the curvature of the earth. The rough ocean surface interacts with the radio wave and due to the Bragg Effect back-scattered signals can be detected from ranges of more than 200 km.
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How WERA can help to provide more reliable Tsunami Early Warning?

- The ocean radar measures the significant current pattern, generated by an approaching Tsunami wave.
- The Tsunami wave generates an orbital movement of the water particles which can be detected as current velocity.
An Example from Chile

Detection window of a compact ocean radar, e.g. 4 antenna WERA

Sensitive area of an array type ocean radar, e.g. 8 antenna WERA
How can WERA help to provide more reliable Tsunami Early Warning?

- WERA can detect an approaching tsunami at the continental shelf edge.
How can WERA help to provide more reliable Tsunami Early Warning?
How can WERA help to provide more reliable Tsunami Early Warning?

- WERA can detect an approaching tsunami even in the deep ocean.
- WERA data can confirm a tsunami alarm and increase the reliability of TEWS by reducing the false alarm rate.
- It would be possible to provide a tsunami wave height forecast for specific coastal areas (combination with numerical models).
Rapid Data Acquisition and Analysis

WERA Tsunami Alert Software provides 3 levels of information.

With 180 sec delay:
Automatic alert generation based on comparing “normal” current pattern with the actual situation.

With 150 sec delay:
Radial current velocity maps

With 120 sec delay:
Noise reduced, beam formed and range resolved spectra

120 sec integration time
+ 30 sec processing
+ 30 sec decision making
+ data transfer = 3 min
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There are different user interfaces available to configure and manage the Multi-Hazard Features.
### Application “Current Drift Prediction”

**CurDrift**

Interface for the computation of object drift at sea surface

**Modify the scenario # 371**

<table>
<thead>
<tr>
<th>Name</th>
<th>Work area</th>
<th>Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>demo</td>
<td>Manche_Atlantique</td>
<td>Fishing vessel</td>
</tr>
</tbody>
</table>

**Begin date**

<table>
<thead>
<tr>
<th>Begin date</th>
<th>End date</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011/02/01 00:00</td>
<td>2011/02/01 00:00</td>
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**Begin latitude**

<table>
<thead>
<tr>
<th>Begin longitude</th>
<th>Init Radius (NM)</th>
<th>Draw current fields?</th>
<th>Draw wind fields?</th>
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</thead>
<tbody>
<tr>
<td>48° N 0.000</td>
<td>5° W 0.000</td>
<td>✓</td>
<td>✓</td>
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</tbody>
</table>

**List of scenarios for demo**

<table>
<thead>
<tr>
<th>#</th>
<th>Name</th>
<th>Work area</th>
<th>Object</th>
<th>Begin date</th>
<th>End date</th>
<th>Init latitude</th>
<th>Init longitude</th>
<th>Status</th>
<th>Result Google Earth</th>
<th>Action</th>
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</thead>
<tbody>
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<td>383</td>
<td>bouee_phare_1</td>
<td>Manche_Atlantique</td>
<td>Containers, barrels</td>
<td>2010/11/09 08:27:00</td>
<td>2010/11/14 23:00:00</td>
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<td>005° 19.20' W</td>
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<td></td>
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<tr>
<td>382</td>
<td>chimiquier1</td>
<td>Manche_Atlantique</td>
<td>Oil slick</td>
<td>2010/10/08 03:30:00</td>
<td>2010/10/10 23:00:00</td>
<td>47° 50.40' N</td>
<td>006° 1.63' W</td>
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<tr>
<td>381</td>
<td>demo19</td>
<td>Manche_Atlantique</td>
<td>Coastal Freighted</td>
<td>2010/10/08 09:23:00</td>
<td>2010/10/09 09:23:00</td>
<td>48° 0.00' N</td>
<td>005° 0.00' W</td>
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<td>✓</td>
<td></td>
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<tr>
<td>376</td>
<td>demo18</td>
<td>Manche_Atlantique</td>
<td>Person in water, sitting</td>
<td>2010/09/09 00:00:00</td>
<td>2010/09/10 00:00:00</td>
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<td>005° 0.00' W</td>
<td>0.5</td>
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<td></td>
</tr>
</tbody>
</table>
Current Drift Prediction for **SAR**

Experiment to test the drift prediction based on numerical models or measured surface currents.

- **Blue**: real drifter position
- **Green**: prediction based on hydrodynamic model & wind data
- **Red**: prediction based on real-time WERA data (new independent current data set every 15 min)

Data kindly provided by ACTIMAR S.A. Brest, France

Drift prediction using WERA current data about 40 km off the coast near Brest, France

![Drift prediction diagram](image)
Current Drift Prediction - SAR

Distance Between Real and Predicted Position versus Time

Distance in km

Time in Hours

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Application: Short Term Current Forecasting

The forecasting tool can be used for gap filling purpose as well.

Validation with measured data 4 hours later
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Conclusions

- The shore based radar system **WERA** is a powerful oceanographic instrument giving **reliable information** about large ocean areas.

- The **outstanding temporal resolution** makes **WERA** a perfect component for time critical applications like disaster warning systems and ship tracking.

- Due to the implemented **real-time Quality Control** for each grid cell the data are perfect suited for **assimilation** into hydrodynamic model to improve met-ocean **forecasts**.

- The **WERA Data Management** is a perfect interface for operational applications as well as for scientific users.
Acknowledgement

We thank for providing data from their WERA systems:

SHOM and Actimar in Brest, France

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Klaus-Werner Gurgel, University of Hamburg, Germany
Thank you for your attention!