NEAMTWS
Tsunami Watch Operations
- Communications Perspective -

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Since July - August 2012

France and Turkey both declared their CTWP status as of 1 July 2012, followed by Greece on 28 August 2012.

Due to their operational status, the systems of these CTWPs are under continuous testing.

Candidate Tsunami Watch Providers and from the Member States Subscribers for receiving TWMs

FRANCE / CENALT
Centre d'alerte aux tsunamis

GREECE / NOA – HLNTWC
National Observatory of Athens

TURKEY / KOERI
Kandilli Observatory and Earthquake Research Institute
Standard Operational Procedures

- Earthquake detection
- Message dissemination for tsunamigenic events following a Decision Matrix
- Data analysis: earthquake & sea level
- Message dissemination with update information
- Tsunami detection (or not)
- Message dissemination with alert cancelation or/and declaring the end info
- Continue monitoring of the various networks
Standard Operational Procedures

Initial EQ Parameters (Magnitude, Location)

Is there a tsunami potential?

Yes!

DECISION MATRIX

No!

TSUNAMI MODEL DATABASE (optional)

Tsunami Information Message

Tsunami Advisory Message

Decision matrix for the North-eastern Atlantic

<table>
<thead>
<tr>
<th>Depth (km)</th>
<th>Epicentre location</th>
<th>Earthquake magnitude (Mw)</th>
<th>Tsunami potential</th>
<th>Type of tsunami message</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>Offshore or close to the coast (≤ 40 km inland)</td>
<td>5.5 – 6.5</td>
<td>Weak potential for a destructive local tsunami</td>
<td>Advisory Information Information</td>
</tr>
<tr>
<td>&lt;100</td>
<td>Offshore or close to the coast (≤ 100 km inland)</td>
<td>6.5 – 7.0</td>
<td>Potential for a destructive local tsunami</td>
<td>Advisory Information Information</td>
</tr>
<tr>
<td>&lt;100</td>
<td>Offshore or close to the coast (≤ 100 km inland)</td>
<td>7.0 – 7.5</td>
<td>Potential for a destructive local tsunami</td>
<td>Watch Advisory Information</td>
</tr>
<tr>
<td>&lt;100</td>
<td>Offshore or close to the coast (≤ 100 km inland)</td>
<td>7.5 – 7.9</td>
<td>Potential for a destructive regional tsunami</td>
<td>Watch Watch Advisory</td>
</tr>
<tr>
<td>≥ 100</td>
<td>Offshore or inland (≤ 100 km)</td>
<td>≥ 7.0</td>
<td>Potential for a destructive ocean-wide tsunami</td>
<td>Watch Watch Watch</td>
</tr>
</tbody>
</table>

No message if the earthquake is localised inland beyond 100 km distance; no message if Mw < 6.5 and distance to the coast > 40 km; no message if Mw < 5.5.

Decision matrix for the Mediterranean

<table>
<thead>
<tr>
<th>Depth (km)</th>
<th>Epicentre location</th>
<th>Earthquake magnitude (Mw)</th>
<th>Tsunami potential</th>
<th>Type of tsunami message</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;100</td>
<td>Offshore or close to the coast (≤ 40 km inland)</td>
<td>5.5 – 6.0</td>
<td>Weak potential for a local destructive tsunami</td>
<td>Advisory Information Information</td>
</tr>
<tr>
<td>&lt;100</td>
<td>Offshore or close to the coast (≤ 100 km inland)</td>
<td>6.0 – 6.5</td>
<td>Potential for a destructive local tsunami</td>
<td>Watch Advisory Information</td>
</tr>
<tr>
<td>&lt;100</td>
<td>Offshore or close to the coast (≤ 100 km inland)</td>
<td>6.5 – 7.0</td>
<td>Potential for a destructive regional tsunami</td>
<td>Watch Watch Advisory</td>
</tr>
<tr>
<td>≥ 100</td>
<td>Offshore or inland (≤ 100 km)</td>
<td>≥ 7.0</td>
<td>Potential for a destructive basin-wide tsunami</td>
<td>Watch Watch Watch</td>
</tr>
</tbody>
</table>

No message if the earthquake is localised inland beyond 100 km distance; no message if Mw < 6.5 and distance to the coast > 40 km; no message if Mw < 5.5.
Example of tide-gauges operated by NOA

KORONI – tide gauge station
- Radar sensor
- Data logger & GPS

KITHIRA – tide gauge station
- Radar & Pressure sensors
- GPS

PALEOCHORA – tide gauge station
- Pressure sensor
- Radar sensor
In the framework of cooperation with JRC, both MOD1 & 2 scenario databases have been fully installed and are already in use. The set of scenarios enables NOA-HLNTWC to estimate wave arrival times and wave heights near the coast. The processing and analysis of the scenarios has been implemented using the Tsunami Analysis Tool.
Moreover, *Tsunami Travel Times* software (TTT) by Geoware (kindly provided by NOAA) has also been locally installed and the operator has the possibility to estimate the tsunami arrival time either by using the scenario’s travel time or those calculated by TTT.
End-to-End Chain of Systems-of-Systems

End-to-End Chain starts with data collection and ends with saving lives.
(Figure from Tsunami Warning Reference Guide)
Right...

... information

... time

... place

... people
Message dissemination

WEME42 LTA 41 YGGG # GTS HEADER
TSUNAMI MESSAGE NUMBER [SMN]
NEAM KOERI CANDIDATE TSUNAMI WATCH PROVIDER
ISSUED AT $issuetime$ $issuetime$ $issuetime$

THIS ALERT APPLIES TO ALL COUNTRIES SUBSCRIBED TO THE SERVICES OF KOERI CTWP.

... TSUNAMI INFORMATION ...

THIS ALERT APPLIES TO [countries in the monitoring area where no tsunami is expected sorted in alphabetical order in the following format ...COUNTRY 1... ...COUNTRY 2...]

THIS MESSAGE IS ISSUED AS ADVICE TO GOVERNMENT AGENCIES. ONLY NATIONAL AND LOCAL GOVERNMENT AGENCIES HAVE THE AUTHORITY TO MAKE DECISIONS REGARDING THE OFFICIAL STATE OF ALERT IN THEIR AREA AND ANY ACTIONS TO BE TAKEN IN RESPONSE.

AN EARTHQUAKE HAS OCCURRED WITH THESE PRELIMINARY PARAMETERS
ORIGIN TIME - $orizontime$ $orizontime$
COORDINATES - $lat North$ $long East$
DEPTH - $depth KM$
LOCATION - $locationName$
MAGNITUDE - $magnitude$

EVALUATION OF TSUNAMI INFORMATION
BASED ON HISTORICAL EARTHQUAKE AND TSUNAMI MODELLING THERE IS NO THREAT THAT A TSUNAMI HAS BEEN GENERATED THAT CAN CAUSE DAMAGE OR MAJOR EFFECT IN THE REGION.

END OF TSUNAMI MESSAGE NUMBER [SMN]

E-MAIL
FAX
GTS
SMS
TWR
TWFP and CTWP
A scripting module has been developed in house following Tsunami Analysis Tool messaging output. This module gives to the user the opportunity to send simultaneously all three types of messages, i.e. e-mail, fax and GTS, the last through the Hellenic National Meteorological Service (HNMS) via the dedicated VPN link between HNMS and NOA HL-NTWC operating centers.
Message dissemination

<table>
<thead>
<tr>
<th>Theme</th>
<th>Date</th>
<th>Country</th>
<th>Region</th>
<th>Status</th>
<th>Time (UTC)</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tsunami Advisory</td>
<td>04/07/2012</td>
<td>Greece</td>
<td>Mediterranean</td>
<td>Alert</td>
<td>01:23/07</td>
<td>Tsunami warning...</td>
</tr>
</tbody>
</table>

### Evaluation of Tsunami Advisory

It is not known that a tsunami has generated. This warning is based on the earthquake as the potential to generate a tsunami that can strike coastlines with a wave height less than 0.5m and cause a tsunami not less than 3m. Authorities should take appropriate action to respond to this possibility. This center will monitor sea level data from gauges near the earthquake to determine if a tsunami has generated and estimate the severity of the threat. A tsunami is a series of waves and the first wave may not be the largest. Tsunami wave heights cannot be predicted and can vary significantly along a coast due to local effects. The time from one tsunami wave to the next can be five minutes to an hour, and the threat can continue for many hours as multiple waves approach.

### Estimated Initial Tsunami Wave Arrival Times

<table>
<thead>
<tr>
<th>Location</th>
<th>Forecast Point Coordinates</th>
<th>Arrival Time</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Athens - Greece</td>
<td>34.54 23.23</td>
<td>04/07 12:23 UTC</td>
<td>1.0/4.37</td>
</tr>
<tr>
<td>Patras - Greece</td>
<td>34.47 21.56</td>
<td>04/07 12:23 UTC</td>
<td>2.7/6.98</td>
</tr>
<tr>
<td>Dardanos - Turkey</td>
<td>36.38 25.35</td>
<td>04/07 12:23 UTC</td>
<td>1.5/3.64</td>
</tr>
<tr>
<td>Istanbul - Turkey</td>
<td>36.94 29.50</td>
<td>04/07 12:23 UTC</td>
<td>0.5/1.86</td>
</tr>
<tr>
<td>Athens - Greece</td>
<td>34.41 23.08</td>
<td>04/07 12:23 UTC</td>
<td>0.4/1.67</td>
</tr>
</tbody>
</table>

This message is issued as advice to government agencies. Only national and local government agencies have the authority to make decisions regarding the official state of alert in their area and any actions to be taken in response.
IOC coordinated Exercises

NEAMWave12
The Candidate Tsunami Watch Providers (CTWP), National Tsunami Warning Centres (NTWC) and Tsunami Warning Focal Points (TWFP) must keep a high level of readiness so as to be able to act efficiently and effectively to provide watch (CTWP) and warnings (NTWC/TWFP) for the public’s safety during fast-onset and rapidly-evolving natural disasters like the tsunamis.

To maintain this high state of operational readiness, and especially for infrequent events such as tsunamis, tsunami watch/warning centres and emergency agencies must regularly practice their response procedures to ensure that vital communication links work seamlessly, and that agencies and response personnel know the roles that they will need to play during an actual event.
Initial CTEs

Initial CTEs were planned, conducted and evaluated by the a Task Team on Communication Test Test Exercises (TT-CTE) in June and September 2010.

The scope of these exercises was limited to the Tsunami Watch Providers candidates at this time (Greece, France, Portugal and Turkey), in order to make a thorough evaluation on the procedures to broadcast and receive the tsunami messages.
The communication links used were limited to e-mail and fax.

Despite the small-scale and limitations, these two first Communication Test Exercises provided the required capacity building that opened the way to the first Enlarged Communication Test.
The first Enlarged Communication Test Exercise was conducted on 10 August 2011.

Message Provider: KOERI (Turkey)

E-mail, fax and GTS

ECTE1 was realized with the participation of 139 end-users, belonging to 42 agencies in 31 countries.
ECTE-1 Performance
The second NEAMTWS Communication Test Exercise was conducted on 22 August 2012.

Message Provider: **CENALT (France)**

E-mail, fax and GTS

ECTE1 was realized with the Participation 31 countries.
Updates

In the future, the conduct of the CTEs should be expected as the responsibility of CTWPs as a regular activity, where the TT-CTTE should perform an oversight role and should be responsible for the validation only.

\[ \# \text{ of CTWPs} \propto \# \text{ of CTEs} \]

Need to simplify and optimize the evaluation!

CTE Performance Indicators

The performance indicators are grouped into two major sets, one characterizes the universe of the exercise participants and the second one summarizing the technical details of the exercise results. The “CTE Performance Indicators” document is closely linked and cross-referenced to the CTE Manual and will be updated by the TT-CTTE co-chairs after each CTE.
CTE Performance Indicators

Table 4.2 Success of e-mail reception

<table>
<thead>
<tr>
<th>Exer.</th>
<th>Addresses available</th>
<th>Addresses reported</th>
<th>No information</th>
<th>Success</th>
<th>Failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTE1</td>
<td>78</td>
<td>22</td>
<td>28%</td>
<td>56</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>72%</td>
<td>100%</td>
</tr>
<tr>
<td>CTE2</td>
<td>62</td>
<td>48</td>
<td>77%</td>
<td>14</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23%</td>
<td>98%</td>
</tr>
</tbody>
</table>

- Success of e-mail message delivery
- Success of e-mail reception
- Latency of e-mail messages
- Success of fax message delivery
- Delivery time of fax messages
- Fax transmission time
- Latency of fax messages measured from delivery time
- Latency of GTS messages.
- Latency of 1st message to be received by each country
- Type of the 1st message that was received by each country

Indicators on the Participants University
- Registered TWFP and TNC
- Messages distribute
- Evaluation questionnaires received

Indicators on the Exercise Preparation
- Synchronization of PCs
- Synchronization of Fax machines
CTE Manual: Timeline Flowchart

NEAMTWS - CTE
Communication Test Exercise Timeline and Responsibilities

Week -4
First announcement from official IOC channels to all TWFPs/TNCs registered in the NEAMTWS. CTE Manual and CTE Performance Indicators document should also be sent at the first announcement as an attachment and the announcement should clearly indicate from where this Manual could be downloaded.

IOC Secretariat

Week -1
Second announcement sent by the Message Provider via e-mail. Evaluation Questionnaire to Message Receiver (Annex III.B) should also be distributed as a word file to the Message Receivers during this second announcement.

Message Provider

IOC Secretariat

Exercise Day
Prior to the second announcement, the IOC Secretariat will send the most up-to-date list of TWFP / TNC contact information in the format specified in Section 2 of the CTE Manual to the Message Provider, copied to the Task team chair/co-chairs.

Message Provider

Message Receiver

The NEAMTWS CTE begins by the broadcast of a Tsunami Test Message by the Message Provider.

Message Provider

The participant NTWC/TWFP receives this message. Operator that receives the message takes note of the time when the message was received by the local equipment (TS1), and the time when the message was read and understood by the operator (TS2).

Message Receiver

Message Provider and Message Receiver

Evaluation Questionnaires should be filled.
CTE Manual: Timeline Flowchart

**NEAMTWS - CTE**
Communication Test Exercise Timeline and Responsibilities

- **Week +1**: Evaluation Questionnaires should be sent to the Message Provider via designated e-mail address.
  - Message Receiver
- **Week +5**: Message Provider prepares the Exercise Report and sends it to TT-CTTE co-chairs.
  - Message Provider
- **Week +7**: TT-CTTE co-chairs provide their comments to the Message Provider.
  - TT-CTTE co-chairs
- **Week +9**: If necessary, the Message Provider will update/modify the CTE report accordingly and send it back to the TT-CTTE.
  - Message Provider
- **Week +11**: TT-CTTE co-chairs approve the CTE report and send it to IOC Secretariat.
  - TT-CTTE co-chairs
- **Week +16**: IOC Secretariat approves and disseminates the CTE report to Members States.
  - IOC Secretariat
- **Week +16 onwards**: Member States are invited to provide their comments to IOC Secretariat to be forwarded to TT-CTTE co-chairs to elaborate a revised version of the report when necessary.
  - IOC Secretariat
CTE Manual Update: Checklist

<table>
<thead>
<tr>
<th>Time-line</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week referred to Exercise Day</td>
<td></td>
</tr>
<tr>
<td>-4</td>
<td>The CTE period begins by issuing a first announcement from official IOC channels to all TWFPs and TNCs registered in the NEAMTWS, at least 4 weeks in advance of the planned exercise date. This CTE Manual and CTE Performance Indicators Document should also be sent at the first announcement as an attachment and the announcement should clearly indicate from where this Manual could be downloaded.</td>
</tr>
<tr>
<td>between -4 and -1</td>
<td>During the following 3 weeks period TWFPs from Member States (MS) will have the time to correct and or update all the contact information. Updates are collected by the IOC Secretariat.</td>
</tr>
<tr>
<td>between -4 and -1</td>
<td>During the following 3 weeks period the Message Provider defines the contacts that will be used to broadcast the Tsunami Test Message. This information is collected by the IOC Secretariat.</td>
</tr>
<tr>
<td>-1 and 1/2 days</td>
<td>Prior the CTE second announcement, the IOC Secretariat will send the most up-to-date list of TWFP / TNC contact information in the agreed format (provided in the CTE Manual) to the Message Provider, copied to the Task team chair(s)-chair(s).</td>
</tr>
<tr>
<td>-1</td>
<td>The CTE is preceded, one week before, by a second announcement sent by the Message Provider via e-mail in order to ensure that the anti-spy and firewall software operating in the Message Receivers networks do not block the Communication Test Exercise Message. Evaluation Questionnaire to Message Receiver (Annex III.B) should also be distributed as a word file to the Message Receivers during this second announcement.</td>
</tr>
<tr>
<td>before 0</td>
<td>ASCII character set should be used in the message templates used in all communication technologies. All times in the evaluation questionnaires should be reported in HH/MM:SS UTC format.</td>
</tr>
<tr>
<td>before 0</td>
<td>All communication technology systems should be synchronized.</td>
</tr>
<tr>
<td>before 0</td>
<td>The number of e-mail message recipients would be restricted to 2 e-mail addresses per agency and 4 e-mail addresses per member state.</td>
</tr>
<tr>
<td>before 0</td>
<td>The number of fax message recipients would be restricted to 2 per member state, thus 1 per agency if two agencies are designated. If a single agency has been designated, both primary and alternate fax numbers would be utilized.</td>
</tr>
<tr>
<td>before 0</td>
<td>At least an 8-channel fax server for should be used for the fax message dissemination.</td>
</tr>
<tr>
<td>before 0</td>
<td>The Message Provider should set up the fax server in such a way so that each recipient fax number will be subject to at least three attempts to send the fax message, where in each attempt the fax recipient will be notified.</td>
</tr>
<tr>
<td>before 0</td>
<td>Message Recipients are recommended to develop codes to automatically detect fax messages and send them as internal email.</td>
</tr>
<tr>
<td>before 0</td>
<td>Message Recipients are recommended to develop codes to automatically detect GTS messages and send them as internal email.</td>
</tr>
</tbody>
</table>

0 The Message Provider broadcasts the Tsunami Test Message

0 In addition to T50, T51F (time stamp of e-mail message) should be reported by the Message Provider.

0 In addition to T50, T51F (time stamp of fax message) should be reported by the Message Provider and ASCII character set should be used in the fax message templates.

0 In addition to T50, T51G (time stamp of GTS message) should be reported and ASCII character set should be used in the GTS message templates.

0 In coordination with the WMO-National Representatives, detailed GTS logs should be acquired both by the Message Provider and Message Recipient, where applicable.

0 Operator that receives the message takes note of the time when the message was received by the local equipment (T51), and the time when the message was read and understood by the operator (T52).

0 Evaluation Questionnaires should be filled on the day of CTE.

1 Evaluation Questionnaires should be sent to the Message Provider via designated e-mail address.
3\textsuperscript{rd} Communication Test Exercise is conducted by NOA in October 2013, with the participation of 31 counties and 40 agencies.

4\textsuperscript{th} Communication Test Exercise is conducted by IPMA on 30 June October 2014...
System-to-System Communication Example: TRIDEC

One major initiative leading towards the further improvement of the Tsunami Warning System was IPMA and KOERI’s participation in the FP-7 Project TRIDEC focusing on new technologies for real-time intelligent earth information management in collaborative, complex, critical decision processes involving large volume of data including sensor systems, geo-information repositories, simulation- and data-fusion-tools to be used in Tsunami Early Warning Systems.

KOERI and IPMA’s contribution to TRIDEC is mainly in the areas of end-user requirements, scenario definition and natural crisis management.

The key objective in TRIDEC is establishing a Decision Support System which can critically deliver timely information to decision makers during environmental crisis such as tsunamis or during the drilling process of an exploration well.
TRIDEC Natural Crises Management
Command and Control User Interface

- Monitoring Perspective
- Forecasting Perspective
- Message Composition Perspective
- Dissemination Perspective

ITS 2013
TRIDEC Natural Crises Management
Command and Control User Interface

Monitoring Perspective  Forecasting Perspective  Message Composition Perspective  Dissemination Perspective
TRIDEC Natural Crises Management
Message Composition Perspective
TRIDEC Natural Crises Management
Dissemination Perspective
Use of TRIDEC in NEAMWave12

EC – 7th Framework Programme
TRIDEC
Collaborative, Complex and Critical Decision-Support in Evolving Crises

TRIDEC is an Integrated Project focusing on new approaches and technologies for intelligent geo-information management in collaborative, complex and critical decision processes in earth management.

TRIDEC was used by IPMA as the Main System during the NEAMWave12. At KOERI, TRIDEC was exploited on top of the Operational System making use of additional functionalities such as Crowd-mapping Platform Ushahidi (crisis-mapping platform), Wide Area Centre-to-Centre Communication (WAC), Eyewitness Reports via Android App Geohazard.
TRIDEC @ NEAMWave12
thank you ...