TOWS-WG IV Meeting
21- 22 March 2011
Paris, France

DRAFT Report

Inter ICG Task Team 1
Sea Level Monitoring for Tsunami
1. Introduction/Background

1.1. Working group on Tsunami and other hazards related to Sea-level Warning and Mitigation Systems (TOWS-WG)

IOC Resolution XXIV-14, based on findings of the ad hoc Working Group, approved a proposal for the establishment of a permanent global Working group on Tsunami and other hazards related to Sea-level Warning and Mitigation Systems (TOWS-WG). It comprises representatives of all relevant IOC subsidiary bodies and those from UN sister agencies, like ISDR and WMO, as well as representatives of relevant stakeholders.

IOC charged its Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) to review the governance and organization of the ICG’s of all Tsunami Warning Systems to ensure common operation explore synergy effects and mainstream in particular the upstream activities, i.e. detection and verification, into existing ocean observing systems.

The IOC XXV Assembly adopted Resolution XXV-13 in 2009, which decided to establish the following Task Teams:

- Inter-ICG Task Team on Sea Level for Tsunami
- Inter-ICG Task Team on Disaster Management and Preparedness
- Inter-ICG Task Team on Tsunami Watch Operations

The establishment of these task teams was to meet the need for and the benefit from enhanced coordination, common requirements, and exchange knowledge and information among the ICGs.

1.2. Inter-ICG Task Team on Sea Level for Tsunami

Terms-of-Reference:

1. Develop requirements for tsunami warning system sea-level data, and all characteristics of the data stream including networks and network design, for the information of relevant implementation groups, such as GLOSS, the ICG working groups and national sea level authorities;

2. Review the provision and availability of sea-level data as they pertain to tsunami warning systems and provide advice, as appropriate, to GLOSS and the ICGs;

3. Provide a focus for sea-level issues amongst ICGs;

Membership:

- Rick Bailey (PTWS/Australia) (Chair)
- Allison Allen (CARIBE-EWS/USA)
- David Farrell (CARIBE-EWS/Barbados)
- Begoña Perez (NEAMTWS/Spain)
- Ronan Créach (NEAMTWS/France)
- Parluhutan Manurang (IOTWS/Indonesia)
- Atma (IOTWS/India)
- Simon Holgate (GLOSS/UK)
- Secretariat – Thorkild Aarup (IOC)

Objectives:

1. Develop **guidelines** on sea level monitoring requirements for operational groups (GLOSS and ITP) to provide ongoing support for tsunami warning systems
2. Identify **principles** and supporting **pillars** to underpinning the Guidelines

Reference Material Utilised:

- ICG Implementation Plans
- ICG WG reports
- ICG/IOTWS RTWP Implementation Plan
- IOC Manual & Guides #3
- OCEANOBS09 Paper “Tsunami Resilient Communities”
- National reports and guides
2. Data Requirements for Tsunami Warnings

The individual requirements, network design and status of implementation of sea level monitoring networks for each ocean basin can be found in the respective ICG Implementation Plans (Refs.…). The represent status of these networks is shown below. (TO BE UPDATED)

Indian Ocean Tsunami Warning & Mitigation System (IOTWS)

Pacific Tsunami Warning & Mitigation System (PTWS)
Caribbean Tsunami Warning & Mitigation System (CARIBE-EWS)

North East Atlantic & Mediterranean Tsunami Warning & Mitigation System (NEAMS-TWS)
Following review of the overall needs for each individual ocean basin and feedback from TOWS-WG Inter-ICG Task Team 3 Tsunami Watch Operations, the following basic requirements were developed for tsunami warnings:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>IOTWS</th>
<th>PTWS</th>
<th>NEAMS-TWS</th>
<th>CARIBE-EWS</th>
<th>GLOSS</th>
<th>ITP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sampling</td>
<td>&lt;1 min</td>
<td>&lt;1 min</td>
<td>&lt;=1 min</td>
<td>&lt;= 1 min</td>
<td>15 secs - 1 min</td>
<td>TBC</td>
</tr>
<tr>
<td>Transmission</td>
<td>5 min (&lt;1hr or 100km)</td>
<td>5 min (&lt;1hr or 100km)</td>
<td>1 min (&lt;1hr or 100km)</td>
<td>&lt;15 mins (l&lt;less if &lt;1hr)</td>
<td>5 – 15 mins</td>
<td>TBC</td>
</tr>
<tr>
<td>Internal Latency</td>
<td>To be specified</td>
<td>To be specified</td>
<td>To be specified</td>
<td>To be specified</td>
<td>To be specified</td>
<td>TBC</td>
</tr>
<tr>
<td>Accuracy</td>
<td>+/- 1 cm</td>
<td>+/- 1 cm</td>
<td>&lt;= 1 cm to enable multipurpose</td>
<td>+/- 1 cm</td>
<td>+/- 1 cm</td>
<td>TBC</td>
</tr>
</tbody>
</table>

Core Data Requirements
- Sampling = <1 min
- Internal latency = <2 mins?
- Accuracy = 10 cm ( +/- 1 cm for multipurpose)
- Transmission
  - < 15 min TTT = < 1 min (local tsunami)
  - < 1hr TTT or 100km = <5 mins
  - > 1 hr or 100km = <15 mins

### 3. Network Design
- Regionally specific, recognising the different sources and warning time imperatives.
- Optimal design methodologies to minimise tsunami verification time, maximise warning time and resource utilisation
- Redundancies built in (warning imperative).
- Document practices, station characteristics, etc. (Meta data)

### 4. Sea Level Station Siting
- General (GLOSS Tech#4)
  - Stability (bedrock….)
- Metadata – enable user to identify value of site/gauge for tsunami warning
- Tsunami Specific (See Annex I)
  - Exposure
  - Orientation (including side of island…)
  - Configuration (historic event analysis, etc….)
5. Instrumentation

- Open discussion about adequate and robust infrastructure
- Follow GLOSS manual (chapter 3) description of the different technologies
- Redundancy of power supply (batteries, solar panels). Stations should be able to run for a minimum of 48hrs without external power.
- The sea level station shall function independently of other equipment that may be installed in the vicinity (i.e. meteorological or other oceanographic equipment).
- The proposed station should have sufficient built in redundancy to function under conditions that can be expected in the region. Without being prescriptive it is expected that a typical station configuration will consist of a primary tide gauge, one or two under water pressure sensors (secondary tide gauges), data logger, DCP geostationary satellite transmitter, modem, battery backup, solar panel, cables, mountings.
- Redundant data transmission channels (e.g. Internet or alternative (i.e. via Inmarsat BGAN or similar), as well as via dial-in modem access) should be implemented where possible. The redundant transmission can either be connected directly to the DCP/Data logger for the primary water level sensors, or it can be a separate transmission unit connected to a second water level sensor. DCP timing should be continuously controlled via GPS or Internet, especially important for satellite transmission
- Measurement time should be GMT with at least +/- 1 min accuracy, and if possible GPS controlled
- Sensors must be periodically calibrated in accordance with the accuracy required

6. Data Exchange and Archival/Formats

- Member States are encouraged to exchange their sea level data with the tsunami watch centres
- Sea level stations that are part of the tsunami warning system should exchange their data through the GTS
- For each sensor at the station site, data samples shall be transmitted in CREX format (see Annex II), where relevant via the public geostationary meteorological satellites (for example, METEOSAT) or directly on to the GTS from a web server
- Data can be put in the GTS either by a DCP transmitter from the tide gauge or selected centres can push the data on to the GTS (eg. IOC Sea Level Facility, Bureau of Meteorology, NOAA, etc). The latter may increase data latency
• GLOSS to organize long-term archive arrangement of high-frequency non-quality controlled sea level data, not excluding the role of national and regional archive centres
• Metadata should be included when archiving the data

7. Real-Time Monitoring Requirements
• Automatic alerting of events (implementation of tsunami detection algorithms) for coastal and deep ocean sensors
• 24/7 support is required for real-time sea level monitoring systems and visualization tools

8. Quality Assurance
• No quality control in real-time is required, to avoid flagging or filtering of real events
• Only qualified personnel should receive and interpret sea level signals for tsunami watch/warning
• For data archiving existing well proved standard quality control procedures should be applied for flagging spikes, filling gaps, datum changes, etc, provided no real events are flagged as wrong values
• QC-controlled data should be archived for research applications

9. Performance Monitoring
• Network performance: a data base of network status, including existing and planned stations, should be maintained quarterly
• Station performance: latency, continuity and accuracy of reported data should be monitored continuously for each station:
  • Automatic notification of performance problems should be sent for manual inspection of the data
  • KPI (Key Performance Indicators):
    • Sampling
    • Reporting
    • Frequency
    • Average delay for the last 24 hours
    • Observations percentage for the last 24 hours and for the last 7 days (minimum 95%)
    • Continuity (stations repaired within two weeks)
    • Percentage of bad data (less than 1%)

10. Case Studies

11. References
ANNEX I: Siting Sea Level Stations for Tsunami Monitoring

ANNEX II: WMO CREX Code for Sea Level Data Exchange