

International Tsunameter Partnership

(Submitted by Ken Jarrott – Chairperson of the ITP)

Background

The International Tsunameter Partnership was established under the auspices of the IOC Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (IGC/IOTWS). Its purpose is to support the establishment, effectiveness and on-going viability and enhancement of tsunami detection and warning systems using deep ocean monitoring stations (tsunameters).

The ITP's mission closely parallels the DBCP's mission for other ocean observing platforms. Technical and operational synergies between tsunameters and other open ocean observatories will become more important once the priorities of tsunami warning system establishment are addressed.

Developments

A small number of ITP national members and supplier representatives met informally in April 2009, coincident with the IOC ICG/IOTWS meeting in Hyderabad, India. The ITP met formally in Paris in September 2009, immediately prior to the DBCP XXV meeting.

The Paris ITP meeting was well attended. Almost all of the nations operating tsunameter networks were represented. All commercial suppliers and R&D agencies for moored tsunameter products were represented, and one supplier of cabled tsunameter systems. Importantly, the conjunction of the ITP and DBCP meetings enabled DBCP national and supplier representatives to join an ITP meeting for the first time, and for ITP national and supplier representatives to participate in a DBCP meeting for the first time.

On the last 12 months, the collective efforts of ITP member countries and suppliers, has:

- Continued the establishment or augmentation or restoration of tsunameter networks, especially in the Indian Ocean region;
- Developed and trialled, and had adopted by the WMO, a new CREX / BUFR coding template for the GTS exchange of sea level data from tsunameters;
- Fostered exchange of technical and operational experience between operators and suppliers, with a view to recognising best practice, and promoting improvements in products and practices;
- Compiled material on the incidence and cost of vandalism to tsunameters in the Indian Ocean, with intent to develop a global perspective and response.

Issues for Discussion

1. Network Establishment and Availability

During the year, many of the nations operating tsunameter networks continued with efforts to establish tsunami monitoring networks. See map below showing planned tsunameter networks. By September 2009, some 70 tsunameters have been deployed globally, but many are not currently operational.



Figure 1 - Planned Global Tsunameter Networks

The large networks of DART™ buoys in the Pacific Ocean and in the Caribbean Sea and NW Atlantic Ocean have been fully populated for some time. They have transitioned to a product improvement and sustaining phase. By September 2009, around 37 DART™ and DART-derivative stations had been deployed in the Pacific Ocean and adjacent seas by the US and other nations. Around 80% of these stations were reporting data at 25 September 2009.

The various national networks contributing to the Indian Ocean Tsunami Warning and Mitigation System (IOTWS) are less mature, and more heterogeneous. Eight tsunameter types have been deployed in the IOTWS network-of-networks.

The operational availability of IOTWS tsunameter networks has been compromised by a combination of continuing technical product developments, production immaturity and vandalism. The consequence is shown in the map below. Note that the map does not represent current network status – the vandalism markers are a cumulative record over the four years since the first station deployment.

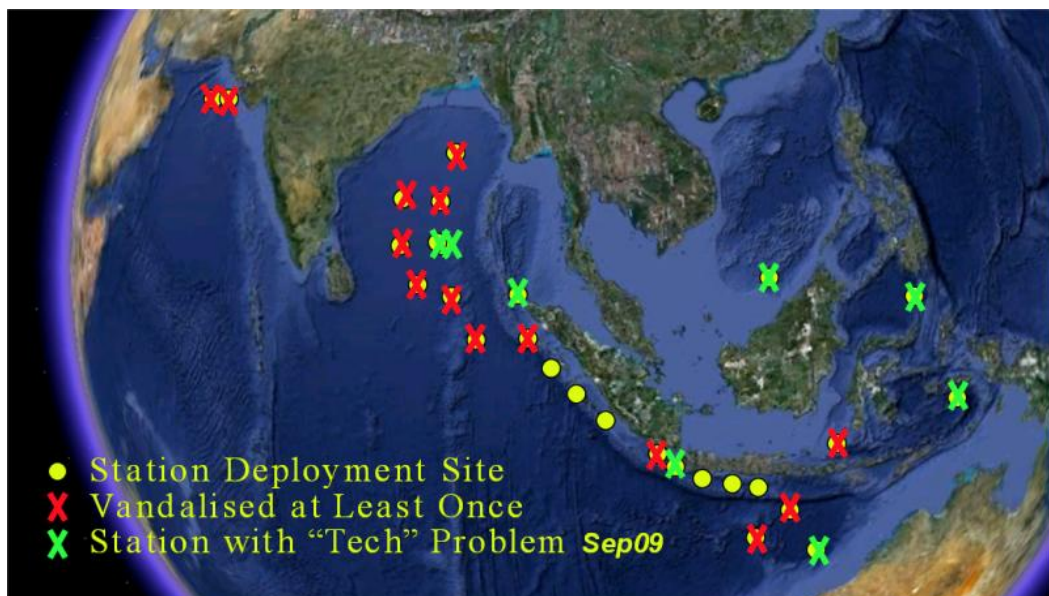


Figure 2 IOTWS Network Impacts of Technical Maturity and Vandalism Since 2005

In the Indian Ocean and adjacent seas, 25 stations had so far been deployed. At end September 2009, only 30% of these stations were reported to be delivering data. Many of the non-reporting stations have been the victim of surface buoy vandalism, and are awaiting re-establishment.

2. Product Developments

During 2009, continuing attention was given to improving product performance and reliability of both the mature and new tsunameter products. These developments include:

- In the DART-derivative products, experience sharing between the US and Australia had helped identify and resolve a number of problems. Evidence was emerging of improved station reliability in the second half of 2009.
- GFZ (Germany) was continuing development of an underwater acoustic link capable of handling high bandwidth seismic and pressure sensor signals, while continuing with the application of GPS-based technology on its surface buoys.
- India is re-developing their surface buoy to operate from battery power alone, to reduce the station's vulnerability to vandalism or theft of solar cells.
- Indonesia has implemented design and hull-form changes to its InaBuoy product.
- Envirtech (Italy) reported significant evolution of its original tsunameter product, including the incorporation of optional seismic and current sensors.
- The small-format Easy-To-Deploy (ETD) DART variant continues to be trialled in the Australian network, and by NOAA's Pacific Marine Environmental Laboratory. SAIC confirmed plans to commercially produce ETD stations under licence from NOAA.

3. Observed Tsunameter Detection Performance and Product Inter-comparisons

Many of the different tsunameter types have now recorded tsunamis or major seismic events. While opportunities for inter-comparison of different tsunameter products have been limited by lack of their physical proximity, or by equipment failures or vandalism events, opportunities are expected to expand over the next year, as some networks densify or incorporate mixed technology solutions. Examples of current and new opportunities include:

- Co-located DART and ETD products in the Australian network are confirming closely matched detection and reporting performance of these products, including for very small tsunamis.
- India is examining the acquisition of a DART-based system to compare performance with its existing solution.
- The restoration of the Thai DART station will re-establish that site as a source of inter-comparison data in the Indian Ocean.
- Data recovery from ocean bottom units with currently inoperative surface buoys will add to the data sets collected so far.
- Indonesia is planning to deploy two trial DART-ETD systems, in partnership with the US and Australia, adjacent to other stations in the Indonesian network.
- China is acquiring both SAIC-supplied STB units and Envirtech tsunameters.

Because of the region's diversity of tsunameter products, the Indian Ocean and adjacent seas remain the global focal point for inter-comparison studies.

4. Data Exchange (Real Time and Non Real Time)

Continuous real-time international data exchange from all operational tsunameter platforms remains the major near term objective of the ITP.

Achieving consistent, cross-platform international data exchange via the GTS has so far been impeded by a number of factors. These have included the lack of a suitable coding standard, the instability of data streams from new tsunameter platforms due to technical problems or vandalism, and difficulties in GTS data transmission. GTS transmission has especially been a problem where the tsunameter operating agency is not within a meteorological office, and has no direct GTS access or experience.

During the year, standards for tsunameter data transfer in BUFR/CREX code via the GTS were finalised and were trialled by Australia and the USA. The coding standard was subsequently adopted by the WMO's Commission for Basic Systems (CBS).

Only DART-derivative tsunameters are currently reporting continuous real-time data internationally. Data from these stations are accessible via the National Data Buoy Centre web site <http://www.ndbc.noaa.gov>, and via the GTS. US-operated stations transmit data on the GTS using a legacy NOAA/PMEL format. All Australian stations now distribute data on the GTS in the new coding standard. Data exchange trials using this new standard are planned for all IOTWS tsunameter products by end of the first Quarter of 2010.

While real time exchange of tsunameter data has some way to go, high resolution event data sets are being exchanged with the tsunami modelling community to improve forecasting science. During the ITP meeting in Paris, representatives of network operating agencies committed to exchange high resolution sets from all observed tsunami or seismic events. That information is being provided to NOAA's PMEL, for consolidation.

5. Metadata

Work on metadata standards, repositories and access mechanisms has not progressed on a communal basis, but national custodians, especially the National Data Buoy Center, have made progress at a local scale.

6. Vandalism

In the Indian Ocean in particular, deliberate theft or damage, or unintentional damage arising from fishing operations has had a great cost. It is currently contributing to significant impairment of the IOTWS tsunameter networks. Over 60% of the deployed tsunameter sites in the Indian Ocean have suffered one or more vandalism events, with over 25 events recorded over the last three years. As a result, around half of the deployed network is currently not operational. Some of those stations will return to service once buoy modifications are completed to reduce their exposure to vandalism.

A number of strategies, ranging from community education, technical anti-vandalism measures, and enforcement by local authorities have been applied by various countries with some effect.

When combined with the long-standing experiences of vandalism in the TAO/TRITON, PIRATA and RAMA moored buoy arrays, the ITP communities' experience affirms vandalism as a major threat to the utility and sustainability of global ocean observing and hazard warning systems. Counteracting vandalism requires appropriate product design, and concerted strategies at local, national and international levels. The ITP will in conjunction with the DBCP, contribute to a global assessment of the scope and impact of vandalism, and formulate strategies to reduce its incidence and consequence.

Plans for 2010

1. Trial of new BUFR / CREX data exchange protocol to be extended to all tsunameter types. Initial trials in QTR 1 2010 to involve data format conversion. Subsequently, extend trial to real time GTS transmission from multiple non-DART platforms.
2. A *Report on Vandalism*, covering the incidence, impact, cost and prospective national or international action responses will be jointly developed with the DBCP, combining the experience of all moored buoy networks.
3. A discussion paper on *Sustaining Tsunameter Networks* will be developed by mid 2010
4. Performance analysis of newly deployed stations and new product types to be pursued progressively as new stations come on line in the Indian Ocean region.
5. Progressive compilation of *Best Practice Guidelines* pertaining to technological and operational aspects of tsunameter networks.
6. Formulation of requirements for international data and metadata repositories and data access mechanisms.

Main Issues for Discussion

Closer integration with the DBCP and prospective restructuring of working groups in the ITP's current "parent" entity, the ICG/IOTWS, will require consideration of many factors. These include revised ITP Terms of Reference, working relationships, communications and governance arrangements.

The current geographical focus of the ITP towards the Indian Ocean has been natural. This focus will remain important for some time as the IOTWS matures, but may shift as new tsunameter operators emerge in other regions. Care needs to be taken to ensure that any new framework continues to engage the key members of the IOTWS community, while extending the ITP's contribution to other regions.