Group 1: TECHNICAL ASPECTS OF AN INDIAN OCEAN TSUNAMI WARNING SYSTEMS

1. **INTRODUCTION AND BACKGROUND**
2. **The technological basis**
   - **2.1. Measurements and Telecommunication** — **ToR 1, 4ii**
   - **2.2 Analysis, processing and hazard/risk assessment** — **ToR 2**
   - **2.3 Warning dissemination and hazard assessment** — **ToR 3**
3. **ELEMENTS OF THE DESIGN OF THE INDIAN OCEAN TSUNAMI WARNING AND MITIGATION SYSTEM**
   - **3.1. General strategy**
   - **3.2. Measurement Design** — **ToR 1 (cont), 4i, iii**
   - **3.3 Analysis and processing centres** — **ToR 2 (cont), 4i**
   - **3.4 WARNING SYSTEM ELEMENTS** — **ToR 3 (cont)**
   - **3.5 DATABASE AND DISTRIBUTION CAPABILITIES**
4. **The Strategy for Building a System** — **ToR 4iv**
5. **New technologies and needed R&D**

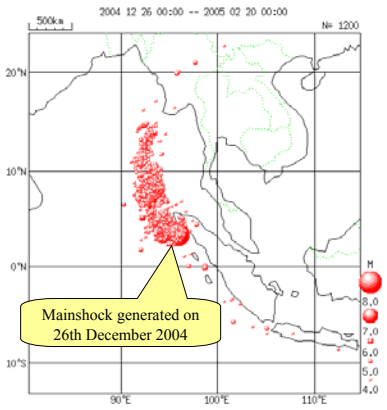
Assumptions

a) Have national commitments (Group 2) that together provide the technical and scientific basis of an IOTWS.
b) Group 2: governance, organisational.
c) Multi-hazard framework, but tasks 1, 2 and 4 primarily related to tsunami warnings.
d) IOTWS: integrated measurement, analysis, and warnings networks at various levels.
e) Technological basis: proven and reliable technologies
   - but consider promising/emerging technologies and R&D.
     - [Task not completed]
f) Existing, interim, and “final” capabilities.

What technology? Seismic

Distribution map of epicenters

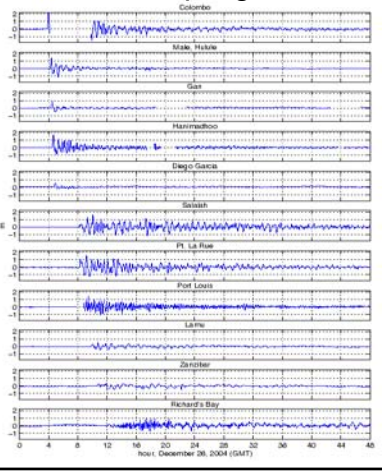
(20th February 2005)

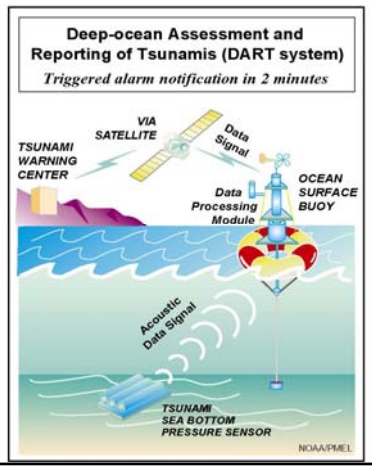


- Technology exists
- Telecomms in real-time main weakness

What technology? Ocean

- Tide gauges, deep moorings, cables, …
- Telecomms: GTS, etc.
  - sampling for tsunami

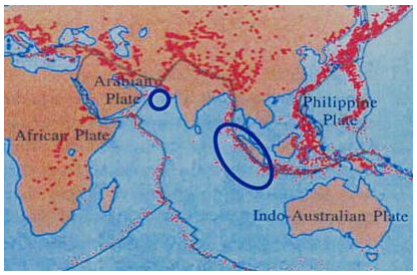




What new technology?

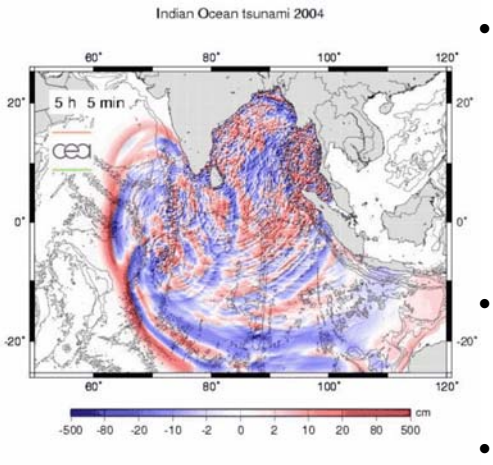
- GPS
- Remote sensing
- Cables with pressure sensors
- …

Methodologies for hazard assessment



- Risk management framework
  - Most probable sources
  - Hazard, vulnerability database
  - Hazard risk maps

Methodologies for hazard assessment



- Simulation and analysis (pre)
  - Several modelling systems available
  - Scenarios, databases
  - Ad hoc Working Group
- Processing/analysis geophysical data
  - Availability, Real-time
- Forecasts (long-term)

Warning Delivery

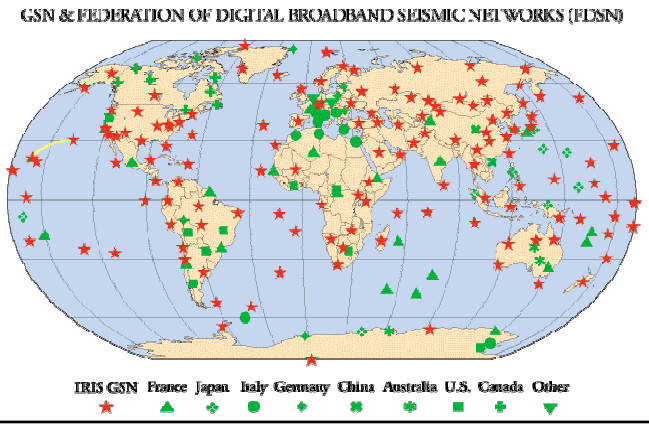
- **Authority to Authority**
  - **International/Regional Centres ↔ National Centre**
  - **Within Nation - from national to local authority**
  - **Take advantage of existing and evolving systems**
    - **WMO GTS**
    - **Future WMO Information System (FWIS)**
    - **International SafetyNET System/IMO/IHO/WMO**
    - **Leased lines, satellite communications, VPN internet, direct broadcasts**
  - **Redundancy is a prime concern**
- **Authority to Public**
  - **Make best use of existing dissemination and communications infrastructure**
  - **Collect best practices**
  - **Inventory existing standards and protocols**
  - **Identify requirements on delivering emergency and distress messages and information to end users**
  - **Communicate such requirements to standards development organizations**

The Design

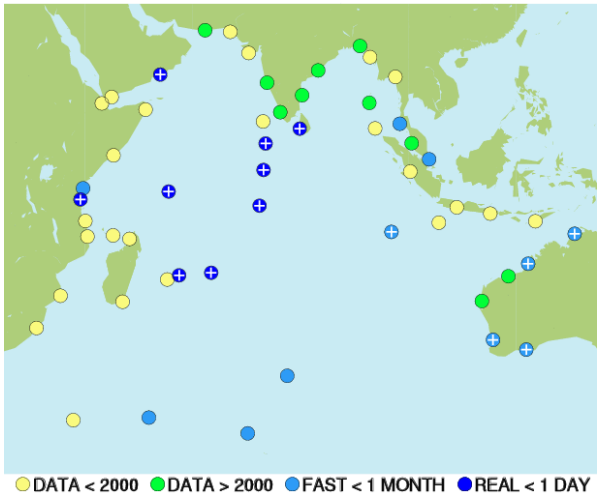
- Lack specificity for some commitments
  - ►Detailed design not possible here
- Focus on principles, general strategy
  - ►Immediate distribution of raw data in real-time founding principle for technical design
  - ►Build on existing, within multi-hazard framework
  - ►Standards
  - ►Integrated; co-operation; from local to basin
  - ►…

Network: Seismic

- Enhanced, upgrade IO network
- Real-time
- Real-time high gain GPS network
- Need study to identify at-risk areas



Network: sea level



- Additional gauges
- Upgrade for tsunami, r/t
- Need study to identify at-risk areas

Network: other

- Network of deep ocean sensors (e.g., DART, cable-based systems)
  - complement tide gauge network
  - Data collection and distribution standards
- Real-time telecommunication of data and reliability
- Coastal bathymetry, sea floor configuration and land mapping
  - Immediacy for national coastal regions
- Monitoring and maintenance

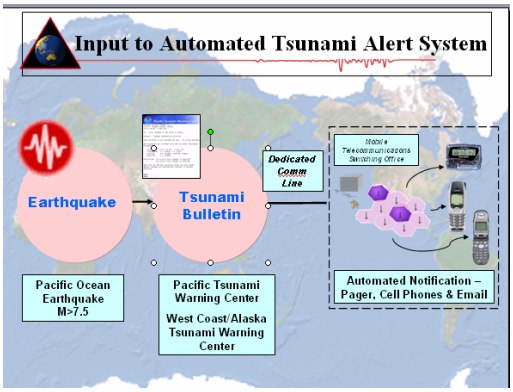
Telecommunication

- WMO GTS should be updated and fully operational within the 6 months time frame in the Indian Ocean.
  - Jakarta meeting held by WMO on March 14-18, 2005
- Expansion of the already-in-use satellite facilities.
- Ensure that the space-system use for data collection and dissemination is fully coordinated and utilized in the region.
- Other means including IP-based system and use of mobile network should be expanded.
  - ITU willing to respond

3.3 Analysis and processing centres

- **Hazard and risk modeling**
  - Develop maps of extreme / maximum run-up and impact;
  - Develop maps of probabilities of different run-ups and impacts;
  - Focus initially on earthquake and volcanic source in the subduction zones in the east Indian Ocean;
  - Focus initially on identifying regions of higher hazard (headlands, bays, etc.), which can be done without detailed bathymetry or topography data; and
  - Develop over time to capture impact as well as uncertainty and variability in hazard and risk to communities.
- **Tsunami analysis and simulation**
  - a base, regional scale model as a matter of priority;
    - Is limited by lack of detailed bathymetric data and tsunami source information (earthquake, landslide, volcano);
  - a detailed model, incorporating near-shore run-up and inundation
    - Needs to be interfaced with the base model at the regional and national level;
    - Requires better bathymetry (<200 m depth) and topography data to be acquired at the local level;
    - Requires training, expert assistance and guidelines to implement at national or local centers; and
- **Recommend for immediate action**: working group to decide in the short-term which models to use and to build the model library and training tools.
- **Analysis and processing of geophysical data**
  - Detection - need **continuous real-time analysis** of seismic and sea level data that:
  - Warning system
  - Warning criteria and standards need to be established recognizing:
  - Dissemination

Warning system



- Urgent need for interim system
  - See Group 2 also
- Must have regional grouping/coordination to respond to regional/teletsunamis
- Within multi-hazard framework

Overall system and linkages

- **National capabilities provide the foundation of the system:**
  - **Operation of national measurement networks**
  - **Contributions to regional networks, as appropriate**
  - **Operational 24/7 centres**
  - **Early warning arrangements**
  - **…**
  - **Local tsunami warning capabilities**
- **Sub-regional coordination, system**
  - **Mutual assistance in IOC parlance**
  - **Providing data capabilities and information needs for a sub-region**
  - **Issuing warnings to specified and agreed national contact points**
  - **Shared and aggregated pool of expertise, for all elements of the warning system;**
  - **Shared responsibility for CB&T needs**
  - **…**
- **"basin" level.**
  - **Interaction**
  - **Interoperability**
  - **Advocating participation and shared ownership**
  - **Ensuring agreements for need exchange of data and information**
  - **Cooperation**
- **Global cooperation and interoperability**

Conclusions

- Thank all contributors
- Good case for forming *ad hoc* WGs/Task Teams now to further
  - Complete initial observing network design
  - To examine modelling issues and hazard assessment
  - …
- Technology transfer strategy must be further developed
- Regional cooperation fundamental
- Sustained commitment essential for a durable and reliable system