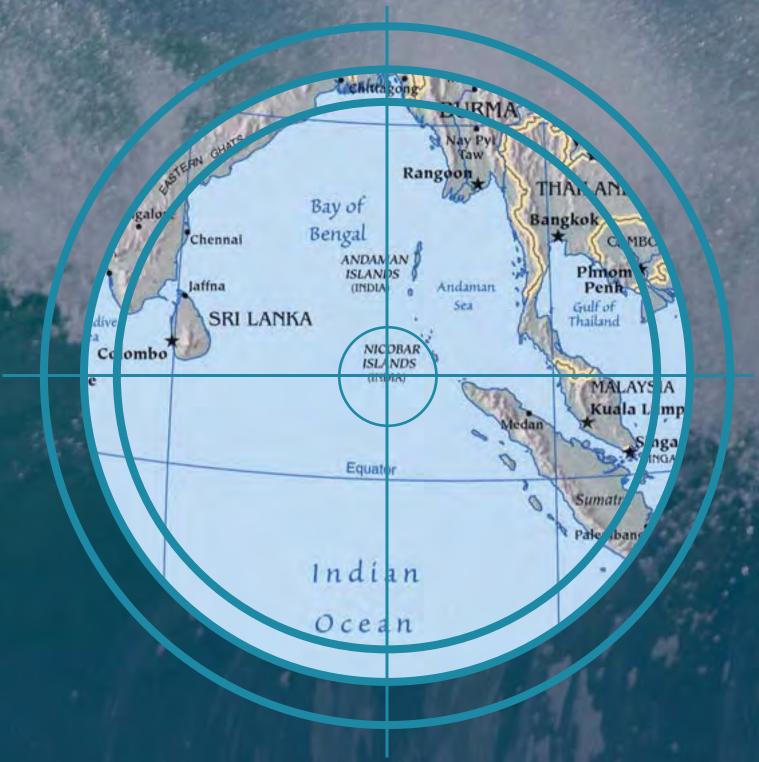
Distant Early
DEWS
Warning System

Abstract Volume

Lessons Learned - From Concept to Demonstrator



DEWS-Midterm-Conference 2009

July 7 - 9, 2009
Helmholtz Centre Potsdam
German Research Centre for Geosciences - GFZ,
Potsdam, Germany

SIXTH FRAMEWORK PROGAMME

www.dews-online.org
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Specific Targeted Research Project
Proposal No: 045453

Programme DEWS Midterm Conference 2009

Tuesday, 7th July 2009				
Time	Session / Presentation	Speaker	Chair	Room
9:30	**Registration**			
10:00	Welcome Speech	Dr. Joachim Wächter Head of Data and Computing Centre GFZ, Germany		Building H (Lecture Hall)
10:20	Conference Opening Session - Welcome to DEWS	José Esteban Lauzan Atos Origin, Spain		” ”
10:45	Greeting address Republic of Indonesia	HE Ambassador S..Eddy Pratomo		” ”
10:55	Greeting address Kingdom of Thailand	HE Ambassador Sorayouth Prompoj (Tbd)		” ”
11:05	Greeting address Democratic-Socialist Republic of Sri Lanka	HE Ambassador Tikiri Bandara Maduwegedera (Tbd)		” ”
11:15	☕ Coffee break			
11:30	Introduction to DEWS	Joachim Wächter GFZ, Germany	José Esteban Lauzan (Atos)	Building H
12:00	**Live Presentation of the DEWS *National Demonstrator* and Discussion**	Edward Mutafungwa TKK, Finland & Training course participants from Indonesia, Thailand, Sri Lanka; Martin Hammitzsch & Matthias Lendholt GFZ, Germany	" "	Building H
13:00	🍽 Lunch break			
14:00	Project presentation **GITEWS** - German Indonesian Tsunami Early Warning System	Jörn Lauterjung GFZ, Germany	Andreas N. Küppers (GFZ)	Building H
14:30	Development of InaTEWS toward Regional Tsunami Watch Provider	Prih Harjadi BMKG, Indonesia	" "	Building H
14:50	Interoprability and Dissemination system of InaTEWS	Fauzi BMKG, Indonesia	" "	Building H
15:10	The Tsunami Early Warning System in the Euro-Mediterranean Region	Stefano Tinti Univ. Bologna, Italy	" "	Building H
15:30	Atlantic and Mediterranean France tsunami warning system	Francois Schindelé CEA/DG, France	" "	Building H
15:50	☕ Coffee break			
16:05	Tsunami Early Warning - overview an experiences	Costas Synolakis	Stefano Tinti (UNIBO)	Building H
16:25	Constitutional, legal and ethical issues	Dieter C. Umbach Univ. of Potsdam, Germany	" "	Building H

16:45	DEWS The Training and Education Strategy	Andreas N. Küppers GFZ, Germany	„ “	Building H
17:05	Scientific and Technical Poster Session		Helmut Dürrast (PSU)	Building H

Wednesday, 8th July 2009

Time	Session / Presentation	Speaker	Chair	Room
9:00	The Tsunami Service Bus, an integration platform for heterogeneous sensor systems	Rainer Häner et al. GFZ, Germany	Joachim Wächter (GFZ)	Building H
9:20	From ORCHESTRA to SANY - An Open Sensor Service Architecture for Early Warning Systems	Desiree Hilbring Fraunhofer, Germany	„ “	Building H
9:40	Tsunami hazard studies in South East Asia	Finn Løvholt Norwegian Geotechnical Institute	„ “	Building H
10:00	High-rate GPS data analysis during the Bengkulu (South Sumatra) earthquake and tsunami 2007	Irwan Meilano ITB, Indonesia	„ “	Building H
10:20	☕ Coffee break			
10:40	Early Warning Experiences in Padang, Sumatra: The Bengkulu earthquake of 12 September 2007	Horst Letz BMKG, Indonesia	Burin Wechbunthung (TMD)	Building H
11:00	Tsunami Modeling Achievements at Alfred-Wegener-Institut	Claudia Wekerle AWI, Germany	„ “	Building H
11:20	National Earthquake Monitoring for Tsunami Early Warning	Sumalee Prachuab & Burin Wechbunthung TMD, Thailand	„ “	Building H
11:40	The Uniqueness of Adjacent Beaches for Tsunami Mitigation Efforts - A Case Study from Phuket, Thailand	Richard Zobel PSU, Thailand	„ “	Building H
12:00	The Chorist Warning System (CHOR-WARN) - Communication to Citizen, in case of an emergency	Wim van Setten SPMM, Netherlands	José Esteban Lauzan (Atos)	Building H
12:20	Professional Mobile Radio: Providing a Dependable Message Delivery Infrastructure for Early Warning Systems	Edward Mutafungwa TKK, Finland	„ “	Building H
12:40	Early Warning Systems as Critical Information Infrastructure: Analysis of Potential Threats and Related Concepts	Edward Mutafungwa TKK, Finland	„ “	Building H
13:00	🍽 Lunch break			
14:00	Lessons Learned from Recent Tsunami Events	Aruna R. Jayarathne DMC, Sri Lanka	Sarath Weera-warnakula (UNIV-M)	Building H
14:20	Geolgical Records of Tsunami in the Southern Coast of Sri Lanka	Nalin Ratnayake Moratuwa Univ., Sri Lanka	„ “	Building H
14:40	Standardized Messages from GITEWS DSS - how they are useful for national and international warning dissemination	Tilmann Steinmetz DLR, Germany	„ “	Building H
15:00	Tsunami Warning and Rescue Services- an overview	Peter Månsson MSB, Sweden	„ “	Building H

15:20	☕ Coffee break			
15:35	***OPEN LECTURE*** Rescue work and coordination with the national authorities in Thailand	Göran Schnell Swedish Fire Protection Association	Peter Månsson (MSB)	Building H
17:00	Conference closing	José Esteban Lauzan ATOS, Spain Joachim Wächter, GFZ, Germany		Building H
Thursday, 9th July 2009				
9:00 - 18:00	**DEWS Project Review** Cupola of the former Astrophysical Institute			A 31

Abstracts & Posters
DEWS Midterm Conference 2009

Setup and Architecture of the DEWS Demonstrator

WORK PACKAGE 1, 2, 3

Implementation, Transfer and Outreach

WORK PACKAGE 4, 5, 6

Abstracts

Poster Abstracts

Introduction to the Distant Early Warning System (DEWS)

Joachim Wächter

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One of the great scientific, technical and social challenges resulting from the Indian Ocean Tsunami event of 2004 is the development of a cross border regional tsunami warning system in order to enable the nations around the Indian Ocean to improve the disaster resilience of their societies. The DEWS project, partly funded under the 6th Framework Programme of the European Union, has the objective to create a new generation of interoperable tsunami early warning systems based on an open sensor platform. This platform integrates sensor systems for the rapid detection of earthquakes, for the monitoring of sea level, ocean floor events, and ground displacements.

Constituting the next generation of interoperable tsunami early warning systems, DEWS will be based on an open sensor platform, integrating sensor systems for

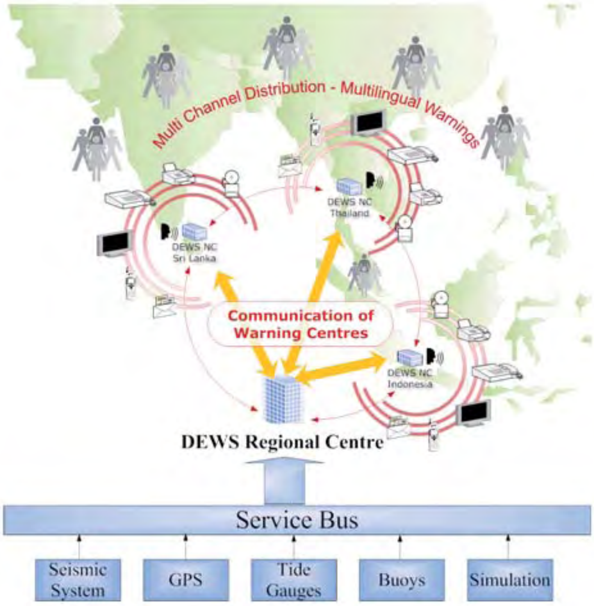
- earthquake - seismic
- sea level - tide gauge, buoys
- ocean floor - pressure sensors
- ground displacement - GPS land stations

monitoring.

Based on improved upstream (sensor) information flow the downstream capacities will be enhanced by sophisticated information logistics and multi-channel warning dissemination. Alongside excellent state-of-the-art sensor instrumentation it is equally important to establish an IT-platform supporting the integration of additional or completely new sensor systems. Standardised interfaces are used to access event and monitoring data of these sensor systems. GITEWS and DEWS are based on the Service Oriented Architecture (SOA), an architectural principle which supports the flexible setup of new process chains by orchestrating IT services, e.g. sensor systems. This in turn opens up the possibility for a new generation of future early warning systems able to protect the population against different types of natural hazards, such as volcano eruptions, floods or land slides.

Within DEWS three prototype implementations, a Principal Demonstrator, a National and a Regional Warning Centre, are planned. While the Principal Demonstrator shows the overall feasibility of the method, the National Centre will focus on public warning. It will disseminate warning messages to the different groups of a population adjusted to the specific need of target organisations, e.g. national and local governments, mayors' offices, police and fire brigades, military, search and rescue organisations, broadcasting media and others. The Regional Centre acts as a fallback/standby system in case a National Centre is hindered in the execution of its tasks. Communication paths exist between Regional and National Centres constituting a multilingual environment.

The philosophy and approach of the DEWS project is based on a technical and methodical two-way transfer of knowledge and know-how between partners. The results and experiences will be swiftly transferred to tsunami prone areas in Europe. A long term implementation of a professional education scheme for early warning systems engineering contributes a corner stone in DEWS.



Project presentation GITEWS - German Indonesian Tsunami Early warning System

JÖRN LAUTERJUNG

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The Sumatra earthquake of December 2004 was the second largest earthquake ever recorded by instruments. The earthquake waves travelled around the world.

In Potsdam/Germany, after 12 minutes they were automatically recorded and analysed. At this point in time, the first tsunami waves had not yet reached the coastlines of Northern Sumatra.

There was no possibility to pass the warning on to the population in time.Directly after the disaster the Federal Ministry of Education and Research (BMBF) commissioned the Helmholtz Association of National Research Centres with developing a tsunami early warning system for the Indian Ocean which can later be extended to the Mediterranean and the Atlantic Ocean. The conception integrates terrestrial observation networks of seismology and geodesy with marine measuring processes and satellite observation. Thereby, Germany cooperates with Indonesia, which is the area most heavily threatened by earthquakes in the Indian Ocean because of its proximity to the seismically active Sunda trench. The Joint Declaration of BMBF and RISTEK, the Indonesian research ministry, which was signed on 14 March 2005, is the basis for this cooperation. Besides the early warning system itself, it also contains the provision of capacity building for Indonesian institutions.

The integration of the German-Indonesian activities and the contributions of further countries to an overall system for the Indian Ocean is coordinated by the Intergovernmental Oceanographic Commission (IOC) of UNESCO.The establishment of the German-Indonesian tsunami early warning system aims at the combination of a very rapid and at the same time reliable warning. It has an open design, i.e. it enables an easy integration of compatible external equipment and external data.

This design ensures that observation networks of other countries can be integrated. Rim countries are given the possibility to use the data for their centres in order to issue tsunami warnings in their own countries when required.

The Components
Data and readings from the individual components of the early warning system for the Indian Ocean are to form a chain from the recording of an earthquake to its analysis, its evaluation and finally a warning.

Recording - Earthquake monitoring
A network of broad-band seismometers rapidly localizes the earthquake and determines its strength.At the same time, monitoring of the deformation takes place by means of a high resolution GPS network in order to gather as much information as possible on the earthquake.

Analysis - a tsunami
In order to rule out false alarms, which are unavoidable if only the earthquake itself is considered, a tsunami wave must be oceanographically recorded and its dimension be measured. Ocean floor pressure sensors and specially equipped GPS buoys are used for this task. They are supported by sea level gauges on the coast which, in the case of Indonesia, are installed on the islands off Sumatra and Java. They also provide data for improving ocean models which are the basis for the computation of the wave.

Evaluation - Potential damage
Modelling and simulation of tsunami are to provide detailed information on its arrival as well as on the potential damage and local differences in impact caused by a tsunami. This presupposes an exact knowledge of the ocean floor topography from the deep sea and the shelf area to the coastline but also of populations and infrastructures. The models are pre-calculated and collected in databases wherefrom they can be retrieved in the case of a tsunami event.

Warning
All data is collected in a data centre which carries out the analysis and evaluation. This must be accomplished under national responsibility. Based on incoming data and simulation results, the data centre is also the institution to issue the warnings.

Implementation
The implementation of the technical installation of the sensor networks and data centre is to be concluded after three years by end of 2008. A subsequent twoyear operation phase with German support is planned to follow. The capacity building measures take place over a period of five years. While the early warning system is being established, concept studies on enlargements will be initiated and new technologies will be developed which shall facilitate a future – global – cutting-edge system.

Development of Indonesia Tsunami Early Warning System (InaTEWS) toward Regional Tsunami Watch Provider (RTWP)

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Indonesian Tsunami Early Warning System (InaTEWS) is set up to produce Tsunami Warning in 5 minutes after the earthquake. This scenario is based on the experience of local tsunami where the first tsunami attacks the coast within 20-40 minutes after the earthquake. To reach the goal, it requires 160 Broadband seismic stations, 500 accelerograph stations, 60 tide gauges, 20 DART buoys, and several continues GPS stations for monitoring purposes. The whole InaTEWS system consists of 4 subsystems namely; 1. Monitoring, 2. Processing, 3. Dissemination, and 4.Preparedness. The monitoring system has 3 types of network; 1. Earthquake monitoring, 2. Sea Monitoring, and 3. Earth Deformation.

The earthquake monitoring system is used to forecast whether the earthquake is potentially tsunami or not, and if potentially tsunami, the warning is issued and then tsunami wave is monitored using sea monitoring network. Tectonic deformation and the impact of the earthquake-tsunami can be seen by using Global Positioning Satellite (GPS) and satellite image by comparing the data before and after the earthquake.

The goal to develop InaTEWS is to be able to produce the first tsunami warning in 5 minutes after the earthquake. There is a possibility to have observation of tsunami within 5 minutes after the earthquake. If no observation is available, the first tsunami warning message is estimated from earthquake parameters and tsunami modeling scenario which contains highly uncertainty. To reduce uncertainty is always trade off with time. The effort to reduce uncertainty needs to develop the network of observation as dense as possible. The effort to reduce time consuming before dissemination needs to develop an integrated system called DSS (Decision Support System) for tsunami and mitigation system.

DSS is basically integrated parameters and aggregated of all monitoring earthquake and tsunami system to support operators on duty to prepare timely the tsunami messages and earthquake information. The tsunami message is updated based on the available observation in a way that DSS links and match between the observation and simulation to produce robust information for distance recipients.

Currently, 148 Broadband seismograph stations, 85 accelerographs, 57 tide gauges, 19 DART – OBU-buoy and 19 GPS stations have been installed in well distributed at tsunami and earthquake prone area in Indonesia. All seismic stations are transmitted to BMKG as National Tsunami Warning Center in real time and provided to the countries in Indian Ocean and ASEAN member states to access the data in real time based on IOTWS and TTF of ASEAN (Technical Task Force) recommendation. All Tide gauge stations are transmitted in real time to BAKOSURTANAL who runs the network in daily basis. Some of the stations are already available in near real time to BMKG and all will be available in near real time in BMKG Jakarta for tsunami warning purposes. DART buoy data is also available in near real time in BMKG and will be available in real time in BMKG based on tsunami mode status.

Using the current capabilities, BMKG is able to issue tsunami warning within 5 minutes after the earthquake based on the earthquake parameters criteria or service level 1. The next effort is to complete the system by early 2010, where tsunami warning contains estimation of tsunami arival and tsunami height as well as inundation.

Interoperability and Dissemination system of Indonesian Tsunami Early Warning System (InaTEWS)

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The tsunami warning messages from warning center need to be responded by the local government in timely and correctly manner to save people life from the threat of tsunami wave. Indonesia Tsunami Early Warning System (InaTEWS) has developed the system to provide tsunami warning messages, not only for national needs, but also for member states of Indian Ocean Tsunami Warning and mitigation System (IOTWS). To serve member states in Indian Ocean rim, IOTWS/ICG working group develops an interoperable system to exchange information among National Tsunami Warning Center (NTWC).

Not all NTWC in Indian Ocean serves other. NTWCs that should be able to serve other NTWC are known as RTWP (Regional Tsunami Watch Provider). Indonesia is one of candidates of RTWP; others are Australia, India, Malaysia, Iran and Thailand. It is up to member states to choose, from which RTWP/s to receive warning messages. This paper describes the preparation of dissemination system toward the RTWP to serve member states of IOTWS.

IOTWS/ICG, Working Group 5 Task Team identified that NTWC should issue 3 levels of services for tsunamigenic earthquake. Service level 1 contains tsunamigenic potential, predicted by using earthquake parameters. Service level 2 contains tsunamigenic potential predicted by using tsunami simulation to estimate time of tsunami arrival and the height. Service level 3 contains additional information on the inundation of tsunami to the land side.

IOTWS defines that there is no single center of tsunami warning but consists of many centers to serve NTWCs with all service levels. Six countries; Indonesia, India, Australia, Malaysia, Thailand and Iran commit to develop their center to be able to provide all service levels namely RTWP (Regional Tsunami Watch Provider). Currently, India, Australia and Indonesia have the capability to serve service level 1 and still develop the system for service level 2 and 3.

The recipients in the member states are NTWCs who receives the messages should be able to decode all of these information through several modes of communication.

Since all RTWPs are new players as NTWC, it requires time to set up the system performances. With some restriction, data have been exchanged for a better configuration of monitoring purposes. The preliminary earthquake bulletin, in term of service level 1, has been exchanged by India, Indonesia and Australia. The content and the format of all types of services need to be discussed and agreed in the next working group meeting. PTWC and JMA as Interim Advisory Service will keep shadowing operation and products until NTWC as RTWP system is completed.

NTWC of Indonesia in the group of InaTEWS develops the dissemination system for public through interface institutions. In case of national needs, the interface institutions are local governments (District Disaster Management Agency), National Disaster Management Agency, Police Headquarter, military head quarter, and Department of Home Affair. For international needs, interface institution is the NTWC of the country. NTWC of Indonesia has no direct communication to the public however; there are direct communication link to 11 TV stations and 2 Radio stations under government regulation.

The French Western Mediterranean and North-East Atlantic Tsunami Warning Center

François Schindelé

Commissariat à l’Energie Atomique - CEA/DAM/DIF

The French Western Mediterranean and North-East Atlantic Tsunami Warning Centre will be operated by the Commissariat à l’Energie Atomique (CEA): it is established so that France will have a capability to detect, monitor, verify and warn the civil defence authorities of the occurrence of tsunami in the region and possible threats to Western Mediterranean coast and French coastal locations.

The French Western Mediterranean TWC is a key component in the establishment of the fully functional Tsunami Warning System in the Euro-Mediterranean region. This project, funded by the French Government, is due to be completed end of 2011- early 2012 and includes:

- the establishment of the French Tsunami warning center with 24/7 tsunami monitoring, operation and analysis for France and the Western Mediterranean region

- the upgrade of the seismic monitoring and the extension and upgrade of the sea-level monitoring

- assistance to the Inter-governmental Oceanographic Commission in developing the North-East Atlantic and Medi-terranean Tsunami warning and mitigation system (NEAMTWS).

Ethical and legal aspects in the early warning process

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Day-to-day experience with the different stages of the early warning process from basic research over development, technical design, marketing, testing and application exhibits problems and shortcomings which cannot be attributed to the underlying science or technology. Although the hitherto available early warning systems for natural disaster reduction have made significant progress in the recent years in several fields of technical development and societal implementation, it must be concluded from practical experience with „real world conflicts“ encountered that for long-term oriented and sustainable concepts of early warning the development and installation of firm overall ethical standards and rules on a global scale, as well as their application and monitoring are becoming indispensable. As a consequence, an extensive means of ethical training for institutions and individuals involved in the divergent fields of the process itself must be seen as an important factor on the way. This constitutes an evolving necessity of bringing the discourse on an appropriate level, by far exceeding the limits of the existing guidelines and common principles in use, which are right away available but necessarily had to be based on „best practice“ approaches as a general rule – a substantial step ahead in comparison with the over-all setup of early warning at the time of the Potsdam Conference.

It is felt that the introduction of the term responsibility (Imperative of Responsibility) in the sense of the philosopher Hans Jonas (Jonas 1984) in this discourse clearly adds a strong future orientation and offers a chance to establish a set of consistent base-lines for progress, spanning over the different sectors, from science to legislation, from technology to politics, and from the media to the public sector, to name some more prominent relationships. Having been applied in pure science and technology first, it is shown that the reflection on the imperative of responsibility in this sense offers a useful means of disclosing practical solutions for some of the most critical is-sues of early warning, like definitions of general terms. For instance: What do we have to call a hazard? What is a disaster? What is the quality of a warning? Who de-fines the standards and who is in charge of monitoring them? How much commerce can be seen as acceptable in the respective sectors involved? And, as the most important: what about the truth and communicating it?

These questions lead to different aspects in the given framework which are mostly neglected or simply not identified, namely the legal-political criteria which govern all or at least most of the technical points. Policy making – and this can hardly be over-emphasized – means nothing without an ethical background and its expression in laws: Lawmaking is all. It starts with constitutional law and the very basic question, to what extent the single state is responsible for appropriate institution-building and capacity-building in our given context. Does the welfare of the nation also mean a duty to protect the citizens against disasters? The theme continues with non-constitutional law as international public law. There are consequences, if the disaster is crossing boundaries and it is in many cases not clear, who is in command and what kinds of responsibilities arise in one state for the neighbouring state. Especially in cases where inter-state matters are involved, a solid framework is required in order to let solidarity come into effect. And: to what extent should internal administrative laws like health laws, police and public order laws etc. provide a legal basis for disaster warn-ing and management? Up to now all this has merely been seen as a field for natural sciences and technology, guided by common principles and some kind of spontaneous pragmatism. Ongoing processes and flaws or failures of the recent past taught us that this is not enough. It might be advisable to discuss the legal principles before politics set the pace.

Literature:

Jonas, Hans (1984): The Imperative of Responsibility. In Search of an Ethics for the Technological Age. XII+255p, Chicago & London: The University of Chicago Press.

The European Convention (2003): Draft Treaty establishing a Constitution for Europe. VII+241p. Luxemburg. Internet Version, 769.482 B http://european-convention.eu.int/docs/Treaty/cv00850.en03.pdf

DEWS – the Training and Education Strategy

Andreas Nikolaus Küppers

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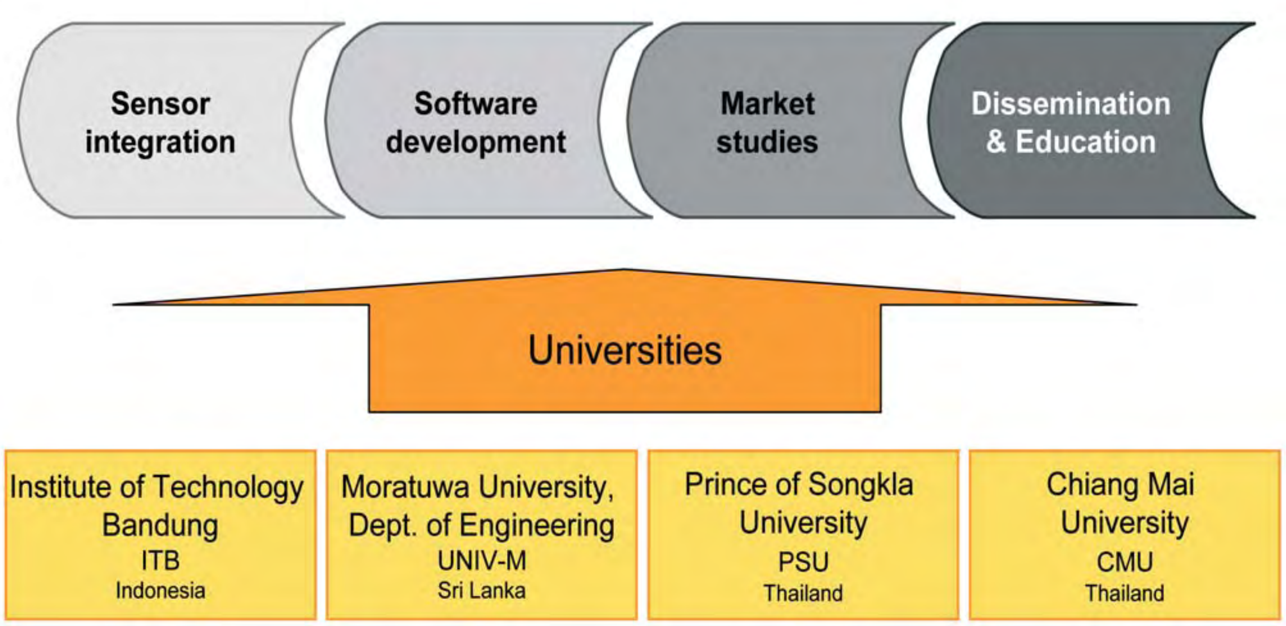
Early Warning for tsunami events is seen as a highly cross cutting task, starting with the understanding of geological processes far out in the oceans and ending in the middle of administrative, medical and financial activities in the heart of the inflicted societies. It is self-evident that at this stage of technical and governance progress, the introduction of a new profession – the early warning engineer – is imminent. The DEWS undertaking with its intersectoral and interdisciplinary partnership is offering a vast field of opportunities towards the curricular generation of knowledgable and responsible professionals, covering the complete warning chain.

The DEWS venture constitutes an enormous bundle of chances for the researchers to enhance the technical systems for early warning as well as their perception about the underlying process in a large number of knowledge areas. In order to attain a long term perspective it is found useful to start with a concept of implementation together with a number of famous universities and research institutions in the Indian Ocean region and in Europe. This group of institutions later should include partners in New Zealand and Japan, among others.



The Tsunami Service Bus, an integration platform for heterogeneous sensor systems

Rainer Häner[1], Ulrich Kriegel[2], Jochen Wächter[1], Jens Fleischer[1] and Stephan Herrnkind[1]

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2 Department of Secure Business IT Infrastructures, Fraunhofer ISST, Berlin, Germany

The Sensor Integration Platform was developed to access sensor measurements and events as well as to task and control sensor system components in a uniform manner. Its core consists of the so called Tsunami Service Bus (TSB), built on top of a service and messaging backbone. The TSB realizes functional integration compliant to a service-oriented architecture pattern: Functionality is implemented in form of dedicated components communicating via a service infrastructure. These components provide their functionality in form of services via standardized and published interfaces which can be used to access data maintained in - and functionality provided by dedicated components. Functional integration replaces the tight coupling at data level by a dependency on loosely coupled services. If the interfaces of the service providing components remain unchanged, components can be maintained and evolved independently on each other and service functionality as a whole can be reused. The TSB provides four services that are realized in conformance to the Sensor Web Enablement (SWE*), a standard specified by the Open Geospatial Consortium (OGC):

- A Sensor Observation Service (SOS) to retrieve sensor measurements (e.g. time series).
- A Notification Service (TSB_NS) to provide any notifications (e.g. sensor system state changes).
- A Sensor Alert Service (TSB_SAS) to deliver sensor alerts (e.g. earthquake events).
- A Sensor Planning Service (SPS) to task special sensor features (e.g. filtering).

Beyond services SWE specifies data encoding both to access sensor measurements and to describe the sensor itself in a comprehensive way:

- Observations & Measurements (O&M)

- Sensor Model Language (SensorML)

Because SWE-services define operations like “describeSensor” to access meta-information, data of new sensors could be provided dynamically without any change of service interfaces allowing the realization of dynamically configurable early warning systems.

* SWE is an initiative of the Open Geospatial Consortium, Inc. ® (OGC) [5]. It‘s an acronym for Sensor Web Enablement and defines standard interfaces to access sensor data via Web Services.

For further information see

http://www.gitews.de

The Meteorological and Geophysical Agency of Indonesia (BMG), see http://www.bmg.go.id

The National Coordinating Agency for Surveys and Mapping (BAKOSURTANAL), see http://www.bakosurtanal.go.id

The Agency for the Assessment & Application of Technology (BPPT), see http://www.bppt.go.id

Open Geospatial Consortium, Inc.® (OGC), see http://www.opengeospatial.org

The open source application server JBoss, see http://www.jboss.org

Java Enterprise Edition, see http://java.sun.com/javaee

KBSt - Federal Government Co-ordination and Advisory Agency, see http://www.kbst.bund.de

Business Process Execution Language, see http://www.oasis-open.org/committees/wsbpel

From ORCHESTRA to SANY - An Open Sensor Service Architecture for Early Warning Systems

T. Usländer[1], D. Hilbring[1], K. Watson[1]

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The paper describes an architectural approach for the integration of sensors into open geospatial service platforms that are compliant with international standards. The conceptual foundation for the Sensor Service Architecture (Usländer (ed.), 2009), recently published by the SANY project (Schimak et al, 2008), has been the OGC Sensor Web Enablement Architecture (SWE) (Simonis (ed,), 2008) and the Reference Model of the ORCHESTRA Architecture (Usländer (ed.), 2007).

The RM-OA provides a platform-neutral specification of a geospatial service-oriented architecture that responds to the requirements of environmental risk management applications. It comprises generic architecture services and information models based on and extending existing OGC specifications.

The SensorSA extends the RM-OA with respect to scope and architectural style. It focuses on the access, the management, the processing of information and event notifications provided by sensors and sensor networks. Furthermore, it supports multiple architectural styles: classical remote invocation, event-driven processing and resource-orientation.

The SensorSA foresees mechanisms to generate events and distribute them as notifications to interested consumers. This enables spontaneous distribution of information about changing configurations in underlying sensor networks, e.g. the dynamic addition or removal of sensor devices, which is a prerequisite for the support of the ‚plug-and-measure“ type of operation. Furthermore, the SensorSA foresees the combination of so-called RESTful Web services (following the resource-oriented architectural style) with OGC services (following the remote invocation architectural style). This enables the design of user-oriented Sensor Web applications based upon the concepts of resources and their representation in multiple forms such as reports, map layers (e.g. to be visualised in OGC Web Map Service clients, Google Earth or Google Maps) and diagrams.

The paper provides an overview of the generic SensorSA service types used to support, the design of decision support and early warning systems. Particular focus is put upon the integration of models and multi-step fusion algorithms. The OQC SWE approach allows the modeller to see a sensor as a procedure that provides observation results as an „estimate of the value of some property of the feature of interest“ from any source of information. As a consequence, SensorSA models the output of fusion and modelling services, cadastres, sensor data archives, event and alert histories, and service status information as „sensors“. Their observations may then be accessed through the interfaces of the OGC Sensor Observation Service in a uniform manner.

The paper concludes with the description of an earthquake early warning system for transport lines. This early warning system produces an alert map during an ongoing earthquake, followed by a damage map immediately after the strong-motion phase that visualises potential damage to the railway infrastructure (Hilbring et al, 2009).

Literature

HILBRING, D, TITZSCHKAU, T. & BUCHMANN, A. (2009): Earthquake Early Warning System for Transport Lines. In: Science Report, German research programme „Geotechnologien“.

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Tsunami hazard studies in South East Asia

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The 2004 Indian Ocean Tsunami has led to an increased awareness of tsunamis on a global level, and in particular in the South East Asian region. Emphasis has been on awareness as well as establishing warning system, and to a less degree on tsunami hazard and risk mapping. Notwithstanding, there is a need for quantifying the hazard and risk on a regional basis as an instrument for decision makers on national and regional scales.

In this presentation we discuss potential tsunamis in South East Asia and regional hazard mapping, with emphasis on the Philippines and eastern Indonesia. The hazard analysis presented here is conducted for a range of projects, which objectives are reviewed.

First, historical tsunamis and seismicity and the associated tsunami potentials is discussed briefly. A number of tsunami scenario simulations are conducted, examples of the seismic analysis leading to the scenarios briefly reviewed. Initial wave heights for the tsunami scenarios are computed using a standard analytical dislocation model, combined with a smoothing of the sea surface discontinuities above the fault line.The wave propagation is modelled using the dispersive wave model GloBouss. Because of the large geographical extent of the study area, the method for quantifying the tsunami hazard has been scenario based, focusing on overall trends rather than details. For a regional assessment of the shoreline run-up heights of each scenario, amplification factors computed for plane waves are utilised. Moreover, possibilities in coupling the propagation model to a run-up model for local run-up evaluations are exemplified.

The scenarios are based on a thorough investigation of past tsunami events throughout the recorded history, as well as the regional seismicity. Most of the scenarios are designed to closely resemble so called ‘credible worst case scenarios’, i.e. with magnitude equal to or slightly higher than the largest recorded earthquake within a given study region. The study regions include (i) Bali/Flores Sea region, (ii) The Banda Sea, (iii) Northern Sulawesi, (iv) Irian Jaya, (v) South western Mindanao, and (vi) The Manila Trench and western Luzon Island. Results are presented for a selection of the above mentioned study regions. Finally, regional / merged hazard maps for the whole region are presented.

High-rate GPS data analysis during the Bengkulu (South Sumatra) earthquake and tsunami 2007

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The Global Positioning System (GPS) is well-established tool for static investigation of volcano eruption and earthquake reccurence. Typically three dimensional positions are estimated after 24-hour spans of data collected every 30 seconds. However information can be seen during 24 hours time interval, by using high-rate GPS analyisis. This information is very usefull for investigating crustal dislacement during earthquake rupture and tsunami.

We processed all data with Bernese 5.0 (Hugentobler et al., 2001).The elevation cut of angle used in the analyses was set to 100. For each station troposphere zenith path delay was estimated for a time interval 2 hrs introducing the condition that the troposphere delay changes only linear with time for each interval. Antenna phase center variations were taken into consideration using consistent, absolute models of both receiver and satellite antenna phase center (Schmid and Rothacher, 2003). All relevant geodynamic reductions were applied in order to enable a careful determination of crustal deformation. The troposphere delay of the observation at different elevation angles is mapped to the zenith using Niell's mapping function.

In order to get better solution each baseline is processed three times. First the L1 (1575.42 MHz) and L2 (1227.6 MHz) solution saving the coordinate results to get good a priori coordinates for next step. The wide-lane (L5) ambiguities resolution fixing all coordinates are resolved and stored in the observation header file. A limiting factor is that the number of unknown in the normal equation may become very large. To reduce the number of parameters we pre-eliminate the pseudo-kinematic coordinates epochwise. After fixing the ambiguities using the ionosphere-free linear combination of the L1 and L2 phase measurements we introduce the integer ambiguity values in a subsequent solution.

Detection and removal of outlier was performed strictly if the algorithm failed to resolve the ambiguity. Outliers result from a complex combination of GPS data quality problems, multipath and other related site-specific errors, atmospheric refraction and the incorrect phase ambiguity resolution. Large spikes in the data, with residual 1 to 10 meters occurs as satellites just rise above the elevation cutoff, or lost of lock for more than 5 minutes, so the ambiguity has to re-estimated.

We analyze SuGAR (Sumatran GPS Array) data during the earthquke by using kinematic technique of BERNESE 5.0 software. Two earthquakes were hit the southern part of Sumatra on September 12,2007 near the capital of Bengkulu Province, Sumatra, Indonesia. The first earthquake Mw 8.4 on 11:10:26 UTC is located approximately 130 km Southwest from Bengkulu City. The second earthquake Mw 7.9 occurred approximately 210 km North-West from the city on 23:49:04 UTC. The rupture initiated at the southeastern edge of a patch of the subduction interface that had been shown to be strongly locked from geodetic and paleogeodetic interseismic measurements. Two days after the mainshock, aftershocks continued northwest of the original magnitude 8.4 earthquake which indicates the rupture propagated unilaterally to the north as a sequence of Mw 6 and Mw 7 earthquakes.

The maximum coseismic displacement from GPS result was 1.2m southwestward and 0.1 m subsidence at South-Pagai Island. More than 0.6 m displacement toward southwest and and 0.06 msubsidence at Mukomuko. While in Bengkulu city horizontal displacement were detected more than 0.7 cm. We also detect 0.36 m and 0.04 m horizontal displacements associated with the Mw7.9 and Mw7.1 earthquake respectively.

Early Warning Experiences in Padang, Sumatra: The Bengkulu Earthquake of 12 September 2007

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On September 12 and 13, 2007, a series of large earthquakes originating from the Sunda Trench off the West coast of Sumatra struck Padang, the capital of West Sumatra Province. The first earthquake, at 18:10:23 (WIB, Western Indonesian Time), was recorded at a magnitude of M 7.9 (BMKG). Shortly after the ground shaking (4 min 41 sec) a tsunami warning was issued by BMKG Jakarta, the National Meteorological, Climatological and Geophysical Agency, via SMS and other channels and received by decision makers in Padang. As stated by several sources, key informant interviews were conducted with representatives of different government and non-government institutions in Padang, the information varied largely. In conclusion, it seems that the mayor actually did call for evacuation. The precise wording of the evacuation message, however, could not be clarified. The mayor of Padang announced guidance for evacuation to Padang citizens around 15 minutes after the earthquake via FM radio in response to the tsunami warning.

Around one and a half months later, from 29 October to 2 November 2007, GTZ IS-GITEWS in cooperation with the Padang Working Group conducted an explorative survey in Padang in order to shed some light on the experiences with the first earthquake and the subsequent tsunami warning. The survey used a standardized questionnaire to conduct interviews with 200 randomly selected citizens of Padang City who live in the “red zone” (elevation zone: 0-5 m in accordance to the First Generation Elevation Zone and Evacuation Map of Padang City) and/or were within that area at the time of the first earthquake.

The survey does not claim to provide representative results for all Padang City but is considered explorative. It aims to approach the question of tsunami preparedness by providing answers to the following key aspects:

Respondents’ actions after the earthquake had ended

- What percentage of respondents evacuated?
- How long after the first earthquake did those who evacuated actually start to do so?
- What did those respondents do who did not evacuate?

Information about tsunami potential

- What percentage of respondents received the information about a potential tsunami? What were their source and channel of information? How long after the earthquake did they receive the information and how did they perceive its content?

The two crucial issues for tsunami early warning are timely dissemination of comprehensible information about a potential threat (i.e. warning and guidance) and appropriate reaction by communities at risk. The survey recorded both: it documented a sequence of actions after the earthquake for each respondent and recorded source and channel of information on tsunami potential as well as timing of reception and perceived content. One section summarizes the respondents’ actions performed after the earthquake had ended in two groups of those who performed some kind of evacuation action and those who did not, irrespective of what triggered these actions. The other section examines the information respondents received regarding a potential tsunami threat and relates it to the respondents’ actions.

Tsunami Modeling Achievements at Alfred Wegener Institute

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INTRODUCTION

Alfred Wegener Institute (AWI) has the leading role within GITEWS for tsunami simulations. The tsunami wave propagation and inundation model TsunAWI [1] has been developed by the mathematical modeling group of AWI and is based on nonlinear shallow water theory.

TSUNAMI MODELING

Tsunami simulation consists of three basic steps. First, a source will be created. This can be achieved either by applying Okada's method or any other suitable initial condition. In our simulations, we employ a method developed by A. Babeyko (GFZ), utilizing a number of micro patches. As input parameters one needs information about the moment magnitude of the earthquake and the epicenter; and for Okada's method additionally the amount of slip, depth of the hypocenter and fault values such as strike, rake and dip angle.

Second, the wave propagation in the ocean is computed.

Third, inundation processes will be included. Therefore, a moving boundary technique is utilized which uses linear extrapolation through the coastline into the dry region.

As a result, one obtains arrival times of the tsunami wave, sea surface heights as well as inundation maps.

A spatial discretization of the shallow water equations using the finite element method was carried out. For approximating elevation and velocity variables, linear conforming shape functions and linear non-conforming shape functions respectively were used. Time discretization is performed by the leap-frog scheme.

The finite element method allows a flexible discretization of the computational domain. The model is based on an unstructured grid with a coarse resolution in the deep ocean and a higher resolution up to 100m in coastal areas. As a refinement criterion for generating the mesh we use the CFL-criterion. Different meshes representing the whole Indian Ocean or parts of it are available. Unstructured meshes allow for an accurate representation of complex domains, especially approximation of the coastline will be very exact in contrast to structured meshes.

TsunAWI has been validated by benchmark experiments as well as by comparing model results to tide gauge data, satellite altimetry and field measurements of flow depth of the tsunami generated by the Sumatra-Andaman earth- quake on 26 December 2004.

MULTISENSOR APPROACH

Tsunami scenarios computed by TsunAWI are stored in the Tsunami Scenario Repository. In order to give a reliable prediction in case of a tsunami in very short time, the most probable scenario will be selected and serves as a forecast. Traditional approaches rely on seismic data such as epicenter, depth and magnitude. If a certain threshold is reached, a warning will be issued. This method works well in the far field, but leads to wrong predictions and false warnings in case of near field tsunami forecasts, especially in Indonesia where there are extremely short forecast times.

The tsunami modeling group of AWI developed a new approach [2] using multiple indicators such as epicenter location, magnitude of the earthquake, depth, GPS dislocation vectors, gauge arrival times and wave height at gauges simultaneously. For comparing multiple sensor data with scenario data from the repository, generalized distant measures have been derived.

CONCLUSION

The tsunami simulation software TsunAWI gives accurate estimates of arrival times as well as inundation results. The multi-sensor approach allows a fast and reliable near-field tsunami early warning.

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National Earthquake Monitoring for Tsunami Early Warning

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After the great Sumatra Earthquake on December 26, 2004, all suffered countries from Tsunami have paid more attention to upgrade their own national seismic monitoring system in order to serve more efficiency for tsunami early warning. Consequently Thai Meteorological Department set up new seismic monitoring network which can be divided into 2 phases during 2004-2009. The first phase is now ready in operation with 15 stations for weak motion and strong motion monitoring. In addition 6 individual accelerograph stations were installed in the western and central part to monitor strong ground motion nearby active fault and to study site amplification. Broadband sensors Trillium 40 and Trillium 120 were installed in first phase, when earthquake occurred, data will continuously send using internet communication via IP star (satellite link) to Thai Meteorological Department:TMD in Bangkok. At present it takes few minutes to analyze automatically to determine location, magnitude, occurring time of earthquakes outside country especially epicenter at Andaman sea, Sumatra and neighboring countries by using 2 popular software called Earlybird and Seiscomp3. This system is able to exchange data internationally via naq server, liss server and seedlink server. More than 30 stations from different countries in the Indian Ocean and from global networks (Malaysia, Indonesia, Philippines, Australia, Taiwan, Japan, Africa, IRIS, USGS, Geofon) are retrieved continuously in near real time through internet. The automatic result of position and several analyzed magnitudes (Ml, Mwp, Mb, Ms, Mw) are quite reliable and convenient to help decision of tsunami warning and canceling message.

Second phase of earthquake monitoring upgrading is in the process of installing which will be completed in 2009. The system will integrate all stations in first phase, then totally the whole national seismic network of Thailand will consist of 40 seismic stations, 26 accelerograph stations, 4 GPS stations and 9 tide gauge stations (4 in Andaman sea, 5 in Gulf of Thailand). Similar to the first phase, most of stations will send data via IP Star, satellite internet link and 5 fixed IP of VSAT link. After major earthquake or local earthquake occurred, several messages and announcement will instantly disseminate to agencies concerned, mass media (TV, radio stations), people at risk area via SMS, fax, siren towers and Seismological Bureau web site.

New national seismic monitoring network of Thailand will raise capability of earthquake mitigation and tsunami warning in the region.

Moreover, during 2008-2009, earthquake and tsunami database together with information of buildings in risk area will be compiled in GIS and will apply to assess the damage causing by scenario earthquake. HAZUS software from FEMA will be utilized as a first step to support short term and long term plan for better management of natural disaster in Thailand.

The Uniqueness of Adjacent Beaches for Tsunami Mitigation Efforts - A Case Study from Phuket, Thailand

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In the aftermath of the 26 December 2004 Indian Ocean Tsunami, it was observed, that the waves had different impact at three different beaches in Phuket, Thailand, the „Pearl of the Andaman“ The best known and most popular is Patong Beach, where many tourists and local people died or were injured. It is a wide curve beach, with a shallow sea, suitable for safe swimming, because it is only gently shelving. The smaller Kamala beach, north of Patong, is similar in this respect. Both suffered severely from the tsunami. However, Surin Beach shelves steeply in a series of steps, from a shelving beach, reached from a small car park and restaurant, itself about a meter above the sand. Relatively little damage was done here.

These details show that each beach is unique and must be considered separately, even at relatively short geographical distances, like in Phuket. This uniqueness has direct implications for run-up modelling and simulation, for tsunami mitigation efforts and consequently for insurance purposes; especially for Phuket, and for Phang Nga further north, where many hotels and resorts are located close to the beaches. Similar situation can be found in countries around the Indian Ocean.

Current work, reported here, concerns evaluation of some specific beaches in Phuket in respect of the size, shape, orientation and shelving, gradients and features of surface and local seabed. Of particular interest are the horns of these beaches and of the very different consequences for each of the selected beaches in respect of the December 2004 tsunami.

The principle beaches concerned are Patong Beach, Kamala Beach, and Surin Beach. These beaches were all affected in different ways, especially in respect of the seriousness of the consequences for people and property. Nai Yang Beach, close to the airport was also considered, along with Rawai beach on the Eastern side of the island, which received the reflected wave from Krabi.

Observations from local Thai people have provided useful information. Recently, sand samples have been taken from these beaches to ascertain their characteristics of density, roughness and particle size and distribution for modelling purposes. Observations of slope and shelving of beaches and of the horns of ends of the beaches have been made to ascertain their susceptibility to approaching tsunami.

Bousinesq and RANS approaches and their relevance to the proposed studies are considered, using a larger number of parallel PCs for simulation studies. Of particular interest are cfd model considerations for various aspects of pickup, carriage, and deposit of sand at high Reynolds numbers and the effects of such sand transport on consequences for beach damage and inundation. The basis of the equations and approximations will be initially obtained from previous work and sources. In respect of this, use of existing estuarine approaches of silt carriage and deposit are being evaluated.

We propose the use of existing simulation results at high Reynolds numbers for initial validation, and are also considering the use of local flume and wave basin facilities for experimental model validation, although it is recognised that scaling may not be appropriate at such high Reynolds numbers.

Consideration of the use of these models and simulations in respect to DEWS warnings and mitigation efforts of likely effects on specific beaches on the West Coast of Thailand are the principle aims of this work.

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The Chorist Warning System (CHOR-WARN)Communication to Citizen, in case of an emergency

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CHORIST is a 3-year project (June 2006 - 2009), funded by the European Commission, which addresses Environmental Risk Management in relation to natural hazards and industrial accidents.

The CHORIST Warning System is an integrated and scalable communication tool allowing authorities to deliver early warning messages to the maximum number of citizens in a given area in the minimum of time.

The CHOR-WARN system essentially facilitates the design of warning messages and the selection of the area where to broadcast them. Warning messages are then automatically broadcast in parallel to the citizens through several communication channels.

Main features

The creation of the content of the warning messages is based on ready made templates which can be overridden if needed. The dispatcher can also quickly select the geographical area to be targeted through a user friendly interface. The system adapts the warning messages to the citizen’s heterogeneity and to the available channels.

These warning messages are then automatically sent to the targeted population within minutes. Multiple technologies can be deployed to reach more people regardless of their whereabouts (at home -possibly sleeping-, at work, at a public venue, on the move...). Besides proper messages delivery to the citizens, the CHOR-WARN system provides an acknowledgement service, allowing authorities to know whether, where and when warning messages were actually broadcast.

Advantages and innovations

The CHOR-WARN system includes the following advantages compared to other existing emergency warning systems: The CHOR-WARN system can be used at different levels (Local / Regional / National), depending on the scale of the disaster.: In case of a major accident, governments and Crisis Response Centres are capable to distribute the warning messages, possibly in large areas involving several countries.

In case of a minor incident, local police or fire brigades can select, edit and distribute the warning messages to citizens in their own area of jurisdiction.

Several areas can be selected; for each area, several warning messages can be defined; each message is then associated to a date/time of broadcast.

Warning messages templates are provided, but override is possible.

Messages can be written in several languages; citizens will only see the message in the language they prefer. The area where to send the messages can be drawn on a map with just a few mouse clicks.

Parallel broadcast of messages through multiple networks allows to reach more people and to solve failure issues.

Standard protocols ease the extension with similar channels or new type channels.

The CHORIST project also proposes the CHOR-SIT system which provides authorities with a real-time picture of the situation related to ongoing natural hazards.

The CHOR-WARN system can be coupled with the CHOR-SIT system for a better design of the messages‘ content and a better targeting of the broadcast area.

Professional Mobile Radio: Providing a Dependable Message Delivery Infrastructure for Early Warning Systems

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The main objective of any early warning system is to rapidly disseminate warning messages to specific users groups in response to an imminent hazard event. The dissemination has to be executed in a manner that ensures that the message delivery is timely, the message content is accurate, understandable, and usable [GLANTZ (2003), WMO (2007)]. Therefore, all available broadcast (television, radio) and telecommunication infrastructure must be used to increase the likelihood of the warning message reaching all persons under risk and organisations expected to respond to a hazard scenario.

Public Land Mobile Networks (PLMN) are considered one of the most important telecommunications infrastructures for delivery of messages from early warning systems. Wireless networks (both fixed and mobile) provide connectivity to end users without the need for fixed communication cables or wires, thus enabling many users to be rapidly connected without the high costs and disruptions associated with cable deployment. Furthermore, the added mobility feature enables users to be reachable wherever there is network coverage and stay connected even when moving at high speeds (e.g., in a car). These advantages have led to very high levels of adoption of the mobile services in most countries. Therefore, PLMNs meet the needs of early warning systems for a message delivery infrastructure with sufficiently wide coverage and large user base.

In recent times privatisation and deregulation measures widely adopted within the telecommunications sector, resulting in, increased competition; higher efficiency; cutting-edge innovations; affordable services for users (thus increasing service penetration to hitherto unconnected citizens), and significant revenues for telecommunication service providers. As a result privately-owned telecommunication service providers are being relied upon to provide services, not just for the general public and the private sector customers, but also for government agencies and authorities. These services include both traditional (commercial) services and emergency services, such as, the early warning services addressed in this paper.

However, time-critical and life-saving early warning systems cannot rely solely on widely shared PLMN infrastructure (typically planned with stringent cost optimization objectives), as they could be corrupted by security breaches or be totally unavailable (e.g., congested) during critical situations. Similar concerns are raised when using PLMNs for other emergency services or any other functions critical to national safety and security. Therefore, there is an increasing preference by government agencies, public authorities, emergency response organizations and critical infrastructure operators to build and/or operate dedicated Professional Mobile Radio (PMR) networks that are designed to guarantee robust security and high service availability at all times [KETTERLING (2004)].

The European Telecommunications Standardization Institute (ETSI) specified an open and harmonized digital PMR standard (EN300-392 series) known as TErrestial Trunked RAdio (TETRA), which is now arguably the most widely used PMR standard. The TETRA standard incorporates features of mobile telephony, mobile data and mobile radio systems, and is widely viewed as a replacement for the fragmented analog PMR systems that have been used previously by different authorities.

To that end, TETRA PMR networks are ideally positioned as a crucial telecommunications infrastructure for delivery of early warnings to first responders. In other words, the current quest for effective early warning systems further highlights the need for adoption of PMR networks (such as, TETRA) that are dedicated for use by first responders. This paper seeks to underline this point by providing an overview of TETRA systems, user terminals, services and applications, which make it useful for early warning purposes. These benefits are further highlighted by a comparative analysis conventional PLMN networks. The arguments are illustratively backed up by some relevant case studies from existing TETRA networks and general architectural diagrams for a TETRA-supported early warning system.

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Early Warning Systems as Critical Information Infrastructure: Analysis of Potential Threats and Related Concepts

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The increased frequency of occurrence of natural and man-made hazards has underscored the need for early warning systems capable of rapidly and reliably disseminating suitably targeted warning messages in response to an imminent hazard event [GLANTZ (2003), WMO (2007)]. The message dissemination process is typically initiated and executed out by a combination of human operators, Information Technology (IT) systems and existing communication resources that constitute an end-to-end early warning system. The constituent components of an early warning system would be designed to interact in a predictable, harmonised and effective matter, to enable messages to be rapidly composed and disseminated in time to save lives and property at risk.

To that end, early warning systems could be considered to be critical information infrastructure (CII). A CII has been defined to be IT and communications systems that are critical infrastructures for themselves or for the operation of other critical infrastructure [EC (2005)]. The actual designation of what constitutes critical infrastructure varies from country to country [ABELE-WIGERT (2006)], but it generally includes both the people and public or private assets that would be saved if early warning systems function as specified.

As with other CII, early warning systems continuously operate under a specter threats (human/non-human, deliberate/non-deliberate, etc.) that could potentially disrupt their normal operation or cause them to function in a way that deviates from their original purpose. For instance, ill-intentioned individuals could compromise the system into sending hoax warnings causing unnecessary panic and long-term loss of confidence in the legitimate early warning service. Or then, significant outage or faults in parts of the early warning system or interconnected message dissemination infrastructure could result in failure to disseminate messages during crucial moments of imminent hazard events.

Therefore, the concept of critical information infrastructure protection (CIIP) that has recently gaining significant attention [DUNN (2003)] is also highly relevant for early warning systems. CIIP constitutes the programs and activities of various stakeholders (operators, users, authorities, etc.) which aim to keep the performance of CII (such as, an early warning system) above a defined minimum level of service in case of failures, attacks or accidents [EC (2005)]. Moreover, CIIP aims to minimize recovery time and any potential damage to a CII.

The implementation of an effective CIIP strategy requires a comprehensive analysis of potential threats and related concepts of security, vulnerability and attack for a CII. This paper analyzes the potential threats to an early warning system. This analysis includes the classification of threat consequences, the nature of the threats and the accentuation of threats due to system (intra)interdependency. The objective is to contribute to the discourse on early warning systems within the CIIP framework and hopefully bring attention to hitherto unanalyzed aspects of early warning systems.

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Geological Records of Tsunami in the Southern Coast of Sri Lanka

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Studies based on 2004 Boxing Day Indian Ocean tsunami deposits of Sri Lanka, could contribute to interpret tsunami deposits elsewhere in the world geological record in much better way. Tsunamis leave behind layers of sediments that can be used to understand the waves which deposited them. By examining texture and the structure of the Tsunami deposits, we may be able to evaluate the wave height and flow velocity of the wave. Tsunami sediments may also contain markers which illustrate different sources (deep sea, terrestrial, estuarine, etc.) of sediments. Such records are important evidences to understand regions which may be at risk from a Tsunami.

In the present work, we have studied Tsunami sediment thickness, run-up, heights, inundation distance, and topographic profiles for 8 transects along the Tsunami affected south western coastal zones. Samples were collected (by open pit sampling) for laboratory analysis for grain size distribution, sedimentary structures, microfossils, mineralogy, and chemistry. Box cores were taken at several sites to study the stratigraphic details of the sediments. Sedimentary characteristics of the Tsunami deposits and underlying materials were logged and photographed. Erosion and flow-direction indicators were also documented. Residents were interviewed to obtain local conditions before and after the recent Tsunami.

Results show, that the 2004 Tsunami waves were capable of eroding the coastal region, up to 100 m inland. For example at Patanangla (South East of Sri Lanka) effect of erosion extends up to 75m inland and at a nearby location (Mahaseelawewa) it extends up to 100m. At Patanangala thickness of Tsunami sediments at 75m distance inland is 20 cm. The thickness decreases gradually inland. One cm thickness was found at 750 m distance, inland. Tsunami deposits show recognizable layering due to different Tsunami waves, incoming and out going waves and seiches. There were many laminations which could contribute to sedimentations occurred due to seiches between second and third waves. Parameters of 3 layering indicates three main Tsunami waves affected the Mahaseelawa area and the second wave has been identified as the biggest wave due to occurrence of thick coarse and poorly sorted sediments. Even the numerical modeling using the ComMit model also supports the same. Textural and structural data of sediments indicate that the third wave came after a considerable time lag. In between the second and third waves, there were many laminations which may have occurred because of seiches common during Tsunamis. In addition, results show that the mangrove forests have considerably decreased the wave energy (e.g. Yakghagala area in Western coat of Sri Lanka).

In the Sri Lankan history there is a record of major sea inundation in the coastal areas around the city of Colombo during the period of King Kelanithissa (approximately 2100 -2300 yrs B.P; resulted setting afloat his daughter, Princess Vihara Mahadevi into the sea to appease the gods). Extensive investigations of sediment cores collected from Lunawa, Dikwella, Karagan Lagoon (Hambanthota), Kirinda (altogether over 20 cores) do not show presence of paleotsunami sediments belongs to the period of 2100 -2300 yrs B.P. Thus, the particular event could be a local storm surge rather than a Tsunami.

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Standardisation of tsunami warning message generation in Indonesia: Approach and implementation

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The work presented here is embedded in the German-Indonesian Tsunami Early Warning System (GITEWS) project. GITEWS is funded by the German Federal Ministry of Education and Research (BMBF) to develop a Tsunami Early Warning System for the Indian Ocean in close cooperation with Indonesia. The system integrates terrestrial observation networks of seismology and geodesy with marine measuring sensors, satellite technologies and pre-calculated simulation scenarios.

The GITEWS sensor systems integrate the respective sensor information and process them to aggregated sensor observations in real-time. The processed information from all these sensor systems is transmitted to the GITEWS Decision Support System (DSS) for further processing, analysis and decision support.

Among the main tasks of the GITEWS DSS is the generation of situation awareness (the common operational picture), the generation of decision proposals (if, when and how to warn) and –once the decision to warn has been made– the support of the warning product generation and dissemination process.

The DSS is able to generate situation awareness and individual decision proposals on a very detailed level, considering so called warning segments as homogeneous parts of the coastline to which warnings can be addressed.

The requirements regarding product generation and dissemination include:

- The generation of warning segment specific messages, focussing on the situation in the respective warning segment, and

- The generation of so-called aggregated messages that combine information for many, if not all, warning segments.

In addition,

- as different dissemination channels need to be adressed, the messages mentioned above need be formated according to the needs of the specific dissemination channels, usually resulting in versions like “long”, “short”, “text-only”.

Furthermore,

- in order to adress national and international target groups, multi-lingual versions of the above mentioned messages need to be provided.

The recipients of these messages need to be able to decode all this information, and the chosen format of the DSS products must allow for regionalized and target group specific dissemination.

The paper describes how the GITEWS DSS makes use of the Common Alerting Protocol (CAP) standard in order to adress the above mentioned requirements.

Among the dissemination systems registered with the GITEWS DSS in Jakarta is the 2wcom FM-RDS-based message dissemination system which implements the DSS CAP dissemination interface.

The paper presents the CAP-based warning product dissemination process between the DSS and the 2wcom FM-RDS system, refers to other standard based message dissemination options and gives an outlook on future extensions of the DSS dissemination interface.

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MSB´s areas of work/expertise and how this could be connected to and used by the partners within the DEWS Project

PETER MÅNSSON

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Peter Månsson works as an international project manager at the Swedish Civil Contingencies Agency (MSB, formerly SRSA) and is the contact point for the inclusion of the DEWS-project within the MSB. The MSB was enacted on the 1st of January 2009 and is a new authority responsible for all work related to public safety, emergency management, and civil defence in Sweden. The MSB replaces the Swedish Rescue Services Agency (SRSA), the Swedish Emergency Management Agency (SEMA), and the Swedish National Board of Psychological Defence.

Peter makes a presentation about the MSB´s areas of work/expertise and how this could be connected to and used by the partners within the DEWS-project. He will also display some of the information tools that recently have been developed in order to ensure efficient command and enhance the cooperation between organisations dealing with public order, security and health in Sweden.

Rescue Work and Coodrination with the National Authorities in Thailand

GÖRAN SCHNELL

The Swedish Fire Protection Association, SFPA, SE-11587 Stockholm, Sweden, goran.schnell@svbf.se

Göran Schnell has worked 35 years in the Municipal Civil Protection, served two years in Kosovo and equal time in the NATO headquarters in Brussels. There he worked with international disaster management coordination. Since 2003 Göran is the CEO of the Swedish Fire Protection Association.

Göran Schnell tells us about his personal experiences as the leader of the Swedish Rescue Services Agency in southern Thailand after the tsunami disaster on December 26, 2004. The story contains facts about the tsunami and its impacts, the cooperation between different actors during the occasionally chaotic rescue work, handling of deceased, the repatriation of survivors, heavy processes such as identification work, meetings with families of victims, official ceremonies and visits as well the robust Thai society. Mr. Schnell also underlines how important it was to be sensitive to those affected. Being present and showing compassion is essential in crisis management.

Scientific and Technical Poster Session

Leveraging Femtocells for Dissemination of Early Warning Messages

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The main objective of any early warning system is to rapidly disseminate warning messages to specific individuals, communities or organizations in response to an imminent or oncoming hazard event (e.g. hurricane, coastal flooding, forest fire, nuclear fallout, etc.). The warning dissemination has to be executed in a manner that ensures that the message delivery is timely; the message content is accurate; understandable, and usable [GLANTZ (2003), WMO (2007)]. Therefore, all available broadcast (television, radio) and telecommunication infrastructure must be used to increase the likelihood of the warning message reaching all persons under risk and organizations expected to respond to a hazard scenario.

In recent times privatization and deregulation measures widely adopted within the telecommunications sector, resulting in, increased competition; higher efficiency; cutting-edge innovations; affordable services for users (thus increasing service penetration to hitherto unconnected citizens), and significant revenues for telecommunication service providers. As a result privately-owned telecommunication service providers are being relied upon to provide services, not just for the general public and the private sector customers, but also for government agencies and authorities. These services include both traditional (commercial) services and emergency services, such as, the early warning services addressed in this paper.

Public Land Mobile Networks (PLMN) are now considered one of the most important telecommunications infrastructures for delivery of messages originating from early warning systems. The high level of penetration of mobile handsets, subscriber mobility and the widespread adoption of mobile messaging services (in particular, the Short Message Service or SMS) make the PLMN attractive for mass dissemination of messages to targeted recipients.

However, conventional (macrocellular) PLMN are engineered to support busy hour traffic loads, rather than simultaneous messaging to a large user base, as required for early warning. As a result, warning messages delivered using mobile messaging services, such as SMS, may be excessively delayed or dropped altogether due to inadvertent network congestion or deliberate denial-of-service attacks [MENG (2007)]. Moreover, cost-constraints applied to network planning may lead to imperfect coverage, particularly in indoor environments. The methods employed to improve indoor coverage include the use of repeaters, distributed antenna systems, microcellular base stations (BSs), and the more recent femtocellular network concept [CHANDRASEKHAR (2008)].

Femtocells are characterized by simple, low cost, low transmission power and plug-and-play femto or home BSs, which are deployed indoors similar to WiFi access points. Another attractive feature of femtocells is the utilization of IP backhaul through a local broadband connection (e.g., digital subscriber lines, passive optical networks, cable modems etc.). This reduces the likelihood of congestion by avoiding possible traffic bottlenecks in macrocellular networks. Moreover, the offloading traffic from macrocellular networks to local broadband connections allows redirection of macrocell BS resources towards delivery of early warning or emergency call services to users in the area under risk but without femtocellular network coverage.

This paper presents the most significant and positive aspects of using femtocells as platform for dissemination of early warning messages. These benefits are emphasized further by pointing out the limitations in existing approaches. The possible implementation challenges for warning message delivery via femtocells are also highlighted.

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2004 Boxing Day Tsunami - Sri Lanka`s worst natural disaster

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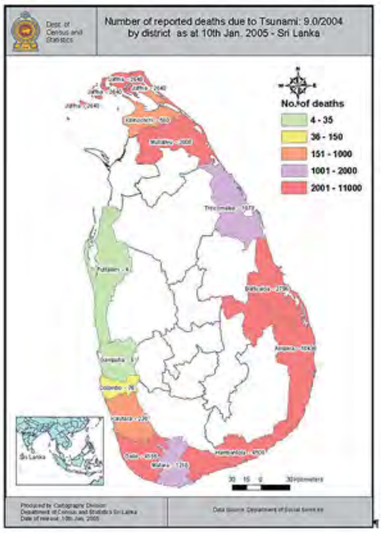
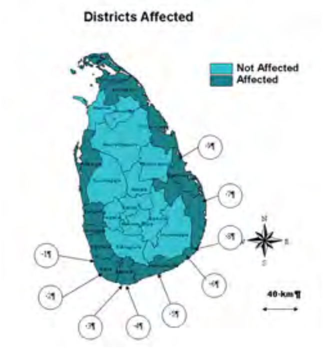
The “Boxing Day Tsunami 2004” was the worst natural disaster recorded in the Sri Lankan history. Sri Lanka is geographically located in a geologically stable zone of the earth’s crust. So disaster of this nature was never expected.

Except the North–Western coastal zone all other coastal zones ware badly effected. Nearly 40000pepole lost their lives and nearly 300000 peoples were homeless and badly effected.

With a tsunami lead time of over 2 hours from Northern Sumatra to Eastern coast of Sri Lanka and at least 30 minutes from Eastern coast of Sri Lanka to the Western part, why we could not save majority of our people’s life? A proper sensor platform together with a well co-ordinated Disaster Early Warning System is essential to solve these problems.





GRASS Development with Eclipse/CDT in the Distant Early Warning System (DEWS) Project

Dr. Peter Löwe

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The Distant Early Warning System (DEWS) Project is a Strategic Targeted Research Project of European Commission (EC). It provides a standard-based reference model (RM) for integrated tsunami early warning systems focussing on information logistics and dissemination aspects of the delivery of messages to end user groups.

The RM will be implemented based on proven FOSS GIS technologies such as uDig and PostGIS. It is a step toward a new generation of interoperable tsunami monitoring systems integrating reliable tsunami detection and effective warning dissemination.

The strategic decision for FOSS GIS tools enables flexible and widespread use among all participating nations, yet especially includes developing nations with limited resources. Also, the openness of the approach ensures flexibility, adaptability and its future-proofing: Since the occurrence of the next major tsunami is unknown, the longevity of the monitoring and warning systems is crucial.

DEWS provides upstream functions based on a multi sensor platform and on the downstream-side target group-oriented compilation of warning messages and multi channel dissemination.

It is based on the sensor integration platform of GITEWS (German Indonesian Tsunami Early Warning System) with development focus on warning centre and dissemination functionality.

Most of the initial geodata infrastructure integration was based on GRASS GIS. This poster showcases a new development for platform independent customisation of GRASS GIS by relying on an integrated development environment (IDE). For this, the GRASS source code repository is accessed via the Eclipse IDE combined with the C Development Tool (CDT) plugin. For a distrubuted group of developers working on different hardware and operating systems this approach brings short term benefits enabling collaborative development, code refactoring mechanisms and the embedding of the traditional build chain in ant-code. This extends beyond the conventional text-editor based development which is still widely used.

On a strategic level, this approach also significantly lowers the learning curve for new programmers joining the developement community by allowing fast and effective navigation of the codebase (of about 500 individual GIS modules). This helps to optimize the overall development capacity and productivity, being critical resources in R&D projects.

The Tsunami Service Bus, an integration platform for heterogeneous sensor systems

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The Sensor Integration Platform was developed to access sensor measurements and events as well as to task and control sensor system components in a uniform manner. Its core consists of the so called Tsunami Service Bus (TSB), built on top of a service and messaging backbone. The TSB realizes functional integration compliant to a service-oriented architecture pattern: Functionality is implemented in form of dedicated components communicating via a service infrastructure. These components provide their functionality in form of services via standardized and published interfaces which can be used to access data maintained in - and functionality provided by dedicated components. Functional integration replaces the tight coupling at data level by a dependency on loosely coupled services. If the interfaces of the service providing components remain unchanged, components can be maintained and evolved independently on each other and service functionality as a whole can be reused. The TSB provides four services that are realized in conformance to the Sensor Web Enablement (SWE*), a standard specified by the Open Geospatial Consortium (OGC):

- A Sensor Observation Service (SOS) to retrieve sensor measurements (e.g. time series).
- A Notification Service (TSB_NS) to provide any notifications (e.g. sensor system state changes).
- A Sensor Alert Service (TSB_SAS) to deliver sensor alerts (e.g. earthquake events).
- A Sensor Planning Service (SPS) to task special sensor features (e.g. filtering).

Beyond services SWE specifies data encoding both to access sensor measurements and to describe the sensor itself in a comprehensive way:

- Observations & Measurements (O&M)

- Sensor Model Language (SensorML)

Because SWE-services define operations like “describeSensor” to access meta-information, data of new sensors could be provided dynamically without any change of service interfaces allowing the realization of dynamically configurable early warning systems.

* SWE is an initiative of the Open Geospatial Consortium, Inc. ® (OGC) [5]. It‘s an acronym for Sensor Web Enablement and defines standard interfaces to access sensor data via Web Services.

For further information see

http://www.gitews.de

The Meteorological and Geophysical Agency of Indonesia (BMG), see http://www.bmg.go.id

The National Coordinating Agency for Surveys and Mapping (BAKOSURTANAL), see http://www.bakosurtanal.go.id

The Agency for the Assessment & Application of Technology (BPPT), see http://www.bppt.go.id

Open Geospatial Consortium, Inc.® (OGC), see http://www.opengeospatial.org

The open source application server JBoss, see http://www.jboss.org

Java Enterprise Edition, see http://java.sun.com/javaee

KBSt - Federal Government Co-ordination and Advisory Agency, see http://www.kbst.bund.de

Business Process Execution Language, see http://www.oasis-open.org/committees/wsbpel

PACT – a bottom pressure based, compact deep-ocean tsunameter with acoustic surface coupling

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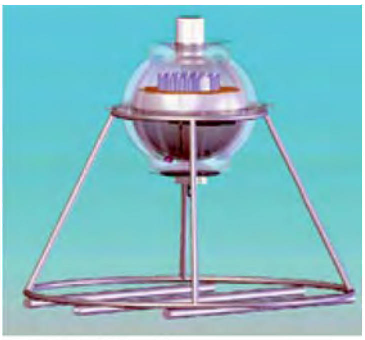
The German-Indonesian Tsunami Early Warning System (GITEWS) is currently established to minimize the risks of disastrous events such as the December 26, 2004 Indian Ocean tsunami. To maximize alerting periods, to avoid false alarms and to accurately predict tsunami wave heights, real-time observations of ocean bottom pressure are required from the deep ocean. To this end, the PACT system (Pressure Acoustic Coupled Tsunameter) was developed. PACT's bottom unit combines a highly-sensitive pressure sensor, a data processing unit for automatic tsunami detection, and an acoustic modem in a single, robust housing. The data are transferred via a bidirectional acoustic link to PACT's surface unit, which is mounted to a surface buoy (not part of the PACT system), allowing also remote activation of the tsunami mode in case a wave is expected from e.g. seismic data. The PACT system has successfully passed extensive laboratory and at-sea tests. The first deployments off Indonesia as part of GITEWS are scheduled for April 2009.

AWI Alfred-Wegener-Institut für Polar- und Meeresforschung



Tsunami Detector

Natural Hazard Preparedness

KRIENGKRAI KHOVADHANA

National Disaster Warning Center, Thailand

FLOOD

Hazards

- Rapid flooding of stream, valleys, and other flood-prone areas. Sometime flood water is mixed with mud and debris.

Hint to remember

- When flooding move to elevated place and cut of electric power to prevent danger from electricity.

Preparedness actions

- Fine out whether you live in a potential flood zone
- Be aware of potentially unsafe area below dams and reservoirs.
- Do not build your home in flood-prone area
- Elevate main breaker and fuse box above the anticipated flood level to avoid short circuit.
- Prepare sand sacks for building dam.
- Remove debris from your property.
- Do not use a vehicle and swim in turbulent stream.
- Have a working radio on hand for listening to news and instruction

Action plan

- Listen news from radio or television.
- Evacuate to elevated and safe place.
- Turn off main switches and do not touch electrical equipment if wet.
- Stay away from electric line that falls on the ground.
- Do not stack sandbags against outside of house; this will add move pressure to the wall which may result in exterior wall collapse.
- Do not drink tap water and flood water because it in contaminated.
- Move valuable properties to upper floors.

Survival Kits

Prepared survival kits for using in your home
or for evacuation as follows:

- Non perishable food for 3 day supply / person
- Drinking water at least 2 liter / person
- Flashlight, candle and matches
- Essential medicines
- Pet food
- Fuel for stoves or charcoal
- Mosquito net, blanket, pillow, clothes and toothbrush
- Special items for infants
- Money
- Portable radio with batterie and battery supply
- Identification cards and driver license
- Telephone numbers for police stations and fire stations, etc.
- Books, games and favorite toys for children

National Disaster Warning Center of Thailand
Call Center 1860 (24 hr.)
www.ndwc.or.th

Natural Hazards Preparedness

National Disaster Warning
Center of Thailand

Call Center 1860

EARTHQUAKE

Hazards

- Severe ground surface movement occuring without early warning.

Hint to remember

- After a major earthquake, many after shocks usually occur afterward which may cause ground crake, landslide and collapse of buildings.

Preparedness actions

- Inspect settlement area whether it is located in earthquake prone area
- Brace cripple walls that rest on the house foundation and support floor and exterior walls
- Anchor bookcases and furniture to prevent them from falling drown
- Anchor overhead lighting fixtures
- Use flexible connection on gas lines to prevent ruptures
- Move bed away from windows and walls.
- Keep flashlight, footwear and radio near your bed

Action plan

- Move away from buildings to open ground
- In a crowded place, do not rush to the doorway because you may injure from stepping over.
- If you can not go out of the building, kneel under table or stand close to strong pole
- Cover your head until earthquake stop
- If you are in a high – rise building, stay on the same floor, and do not use elevators.
- Be prepared for alarm and sprinkler systems to activate
- In case you are driving a car, stop it immediately in open space, do not stop vehicle under bridges, overpasses, overhead power lines and remain in the vehicle.

TSUNAMI

Hazards

- Series of destructive ocean waves that can severely dal areas and may occur with limited or no early warning.

Hint to remember

- Tsunami is not a single wave but it is series of waves and **the next wave may be larger than the first one.**
- When sea level recede or raise rapidly, it is anticipated that tsunami may occur.
- Tsunami usually occurs after major earthquake in deep ocean.
- Livings in Coastal areas are susceptible to tsunami.

Preparedness actions

- Find out whether your home is located in the tsunami inundation zone.
- Know height of road at sea level and distance from road to shoreline
- Be familiar with tsunami warning signs
- Provide evacuation plans
- Chose a safe place in elevated area
- Have an evacuation and disaster kit ready
- Stay away from beach or coastal area when tsunami is warned
- Have a battery operated radio for receiving of information and news.

Action plan

- Incase you hear an official tsunami warning or observe signs of a tsunami, leave suddenly from shoreline and move boats to deep sea
- Lisien to radio or TV for the latest emergency information
- Stay away from coastal areas and go to higher ground for safer places.
- Help children, elder and handicap people in evacuation.
- Return home only after authorities announce it is safe to do so

STORM

Hazards

- Strong winds, heavy rain, flash flood, damaging surf, and cost inundation.

Hint to remember

- When announce watching situation strong winds are approaching in 36 hr.
- When announce warning situation strong winds are approaching in 24 hr.
- When there is storm, there will be heavy rain and flash flood.
- The eye of the storm is a relative calm center. A phenomenon of immediate calm after the storm means you are right in the eye of the storm. When it passed, another strong wind is approaching again.

Preparedness actions

- Listen to radio and TV for instruction.
- Stay in shelter in elevated land and do not go to sea
- Assemble your survival kit and disaster supplies kit
- Remove branches and tall tree that may fall on your home
- Install storm shutters or precut wood for windows
- Stock extra food, drinking water and batteries
- Fill your car's gas tank for evacuation
- When warning is announced, do not reluctant, evacuates suddenly
- Keep in hand important telephone numbers and a map for emergency communication.

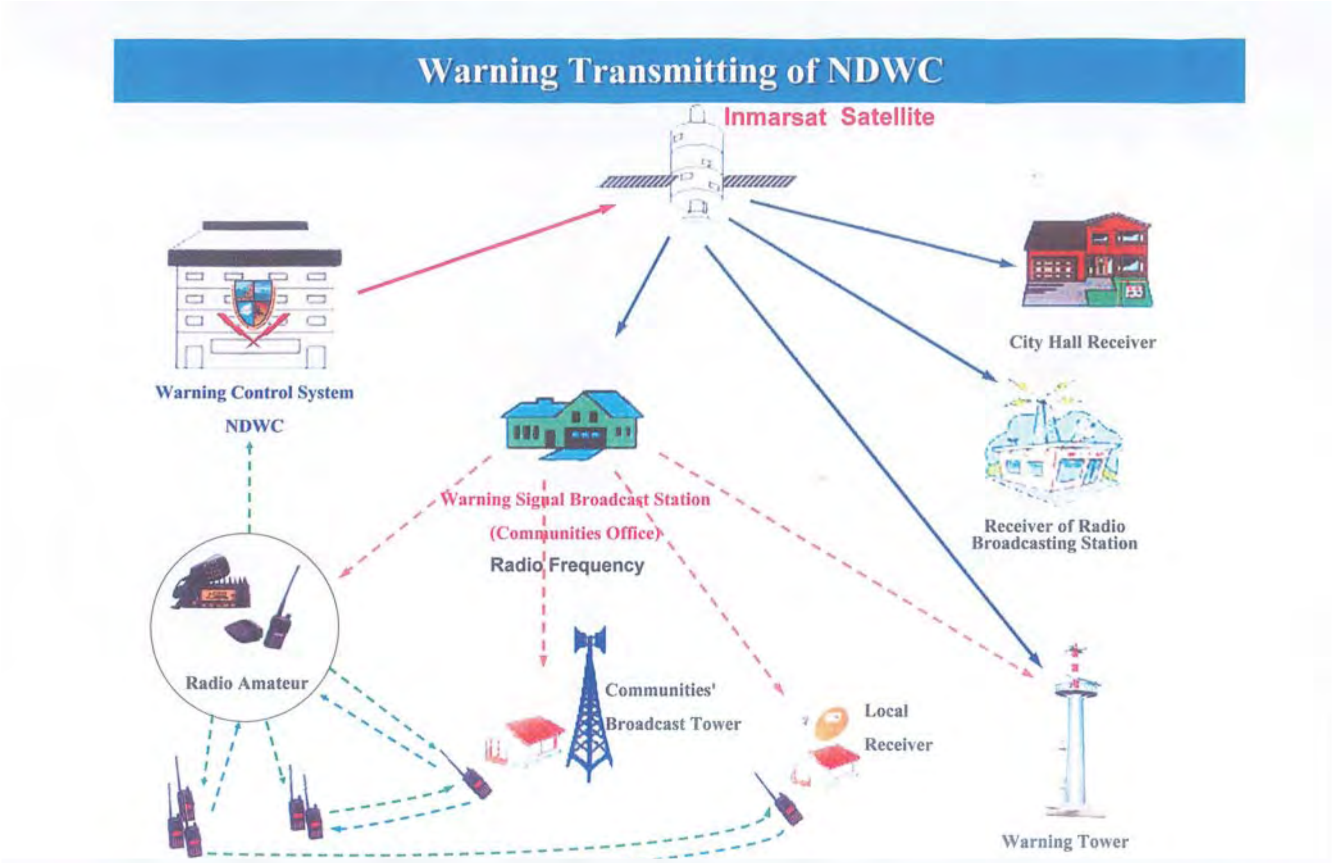
Action plan

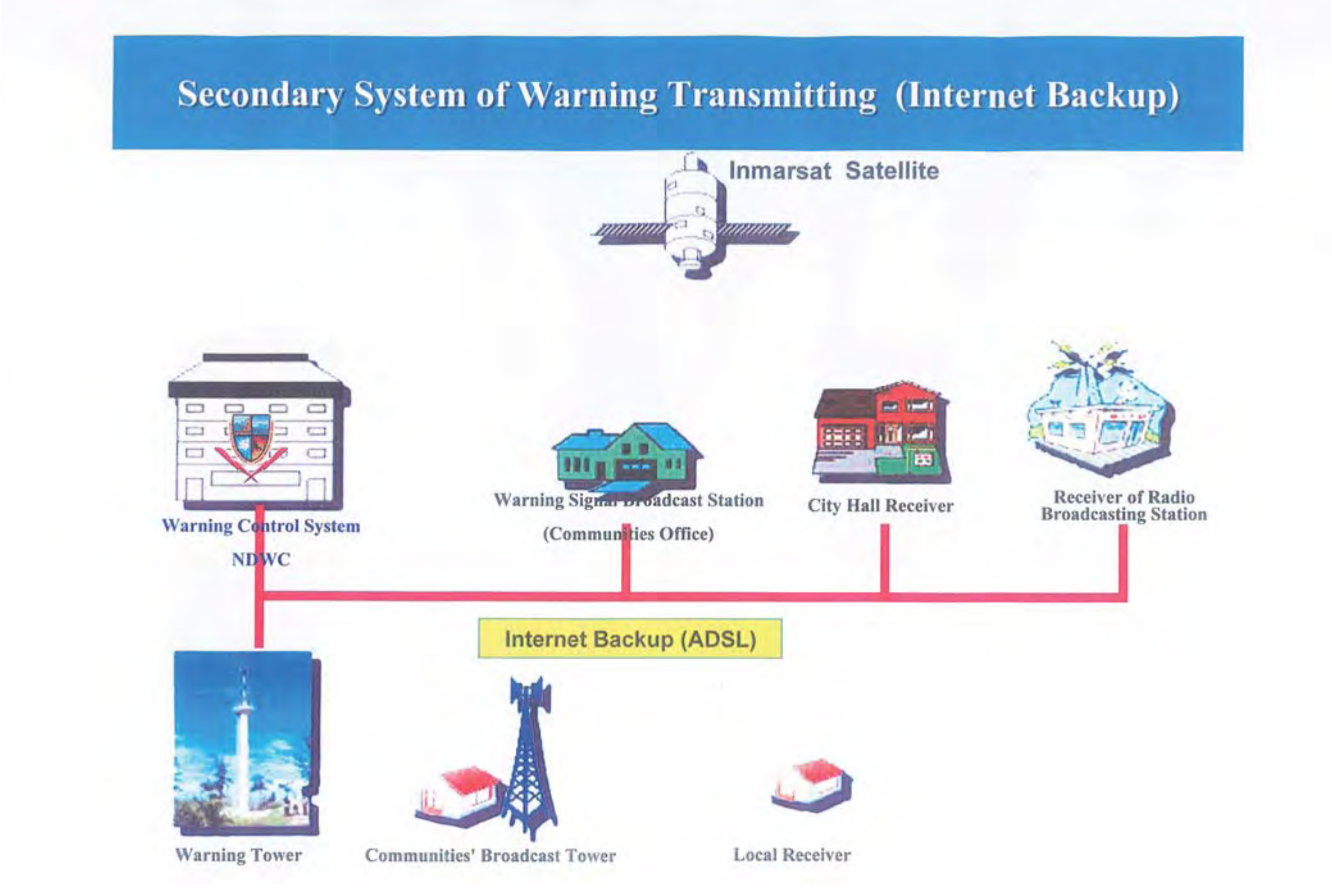
- During a warning, evacuate to sturdy buildings or public shelters.
- When sirens sound, evacuate and before leave your home covers windows with boards or tape.
- Leave areas that may flood to elevated land
- During strong winds, stay in sturdy building
- Be aware of the calm eye of the storm is deceptive; do not hurry from safe place until disaster termination is announced

Warning Transmitting of NDWC/Secondary Warning Transmitting

Kriengkrai Khovadhana

National Disaster Warning Center, Thailand





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