The Abdus Salam
International Centre for Theoretical Physics

United Nations
Educational, Scientific and
Cultural Organization

IAEA
International Atomic Energy Agency

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Workshop on the Physics of Tsunami, Hazard Assessment Methods and Disaster Risk Management (Theories and Practices for Implementing Proactive Countermeasures)

14 - 18 May 2007

Simulation Analyses of Tsunami caused by Chilean and Nihon-Kai Chubu Earthquakes at Nuclear Power Plant Sites in Japan

Kazunari MORI
IAEA/NSNI/ESS

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SIMULATION ANALYSES OF TSUNAMI CAUSED BY CHILEAN AND NIHON-KAI CHUBU EARTHQUAKES AT NUCLEAR POWER PLANT SITES IN JAPAN

14-18 May, 2007

Trieste, Italy

Kazunari Mori, IAEA/NSNI/ESS

Contents of the Presentation

1. IAEA Activities on Tsunami Hazards
2. Test Cases of

   Tsunami Hazard Assessment
3. Outline of Tsunami Simulation Code
4. Examples of Tsunami Simulation

IAEA Activities on Tsunami Hazards

On December 26th 2004, a catastrophic earthquake occurred with epicenter off the Sumatra, Indonesia. The subsequent tsunami caused by the earthquake, devastated the coasts of the Indian Ocean. **IAEA started immediately activities to reassess tsunami hazard.**

IAEA Activities on Tsunami Hazards

1. **"*International Workshop on External Flooding Hazards at Nuclear Power Plant Sites*", Kalpakkam, India, August 2005.**
2. **"*Topical Consultancy on Tsunami Hazards, in Particular, and Coastal Flooding, in General, for Nuclear Facility Sites*", 8-12 May 2006, in Trieste, Italy, IAEA and the International Centre for Theoretical Physics (ICTP).**
3. **EBP with Japan.**
4. **Review and revision of current Safety Guide NS-G-3.5 (to be proposed to NUSSC).**
5. **Co-ordination with UNESCO/ICO in relation to IAEA Emergency Response Centre.**

IAEA Activities on Tsunami Hazards

Experts Meeting - ICTP, Trieste, May 2006:

- **15 Experts, from 6 Member States and 2 IO.**
- **Comments and Recommendations in relation to the Safety Guide. Proposal of future structure:**
  1. General Considerations
  2. Tsunami Generating Sources
  3. Data Collection
  4. Probable Maximum Tsunami
  5. Hazard Assessment
  6. Tsunami Warning System
- **IAEA proposal *"Test Cases of Tsunami Hazard Assessment".***

Test Cases of Tsunami Hazard Assessment

Assessment Methodology

"*Tsunami Assessment Method for Nuclear Power Plants in Japan*":

- **JSCE (Japan Society of Civil Engineers)**
- **February 2002**
- **English version (May 2006).**

Candidate of the Assessment

- **India – Kalpakkan NPP Site**
- **Pakistan – Kanupp NPP Site**
- **Egypt – El-Dabaa NPP Site**

Tsunami Simulation Code

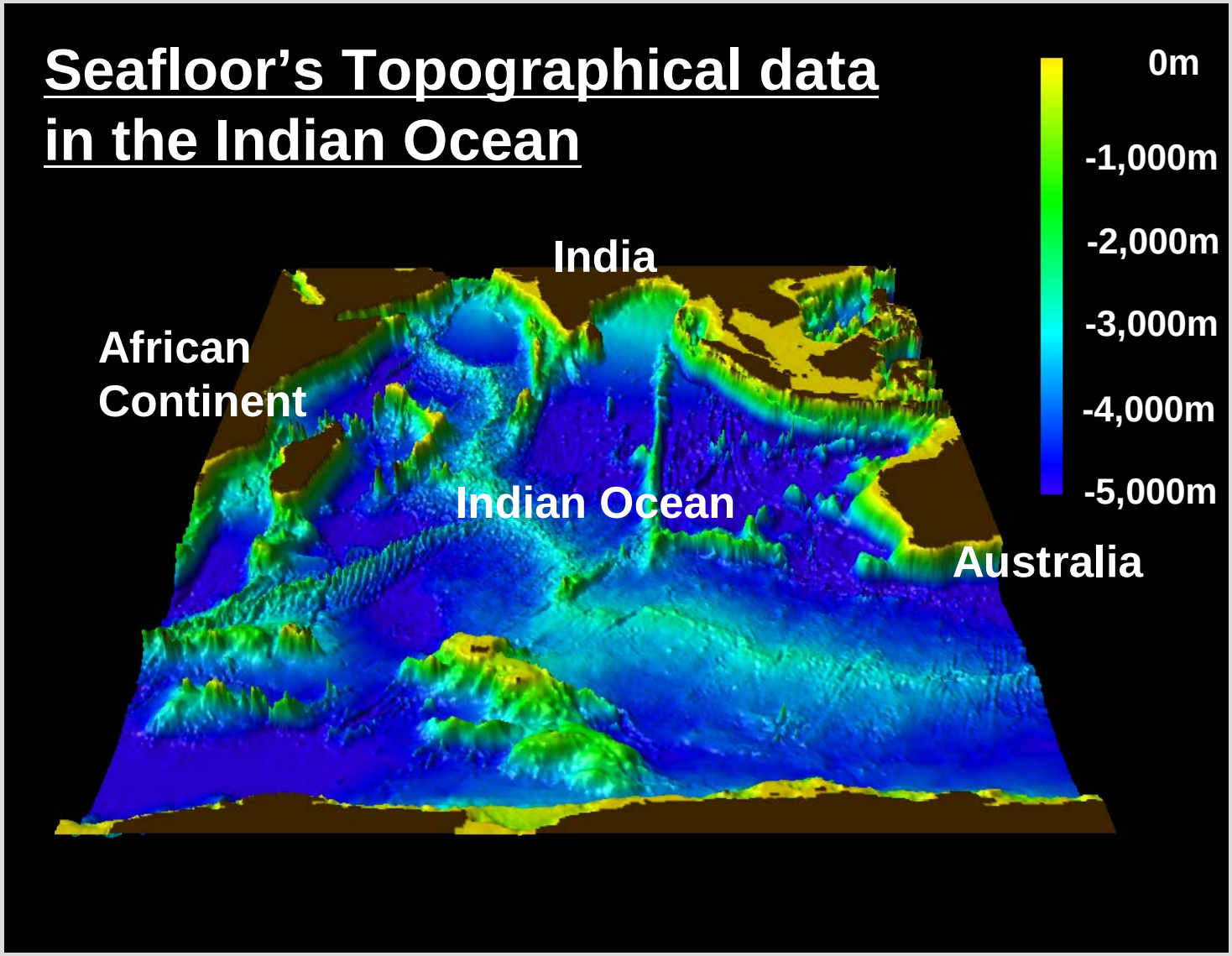
- **Equations and models proposed by Prof. IMAMURA**
- **Use for tsunami generation and propagation analyses**

Outline of Tsunami Simulation Code

	Functions	
	Near-field Tsunami Analysis	**Far-field Tsunami Analysis**
Tsunami Traveling Distance	Less than about 1,000 Km	More than about 1,000 Km
Geometric Coordinates for Modeling	Plane/ Cartesian coordinate	Spherical coordinate
Input	Seafloor's Topographical data	
	Depth of Sea	
	Earthquake Fault Parameters	
Output	Tsunami Heights	
	Tsunami Traveling Time	
	Flooded Areas for Run-up Higher than Ground Level	
Coefficients in Fundamental equations	Seawater Dynamic Viscosity	Coriolis Forces due to the Earth's Rotation
	Seafloor's Frictional Resistance	

Outline of the Tsunami Simulation Code

Input Data Example of the Code



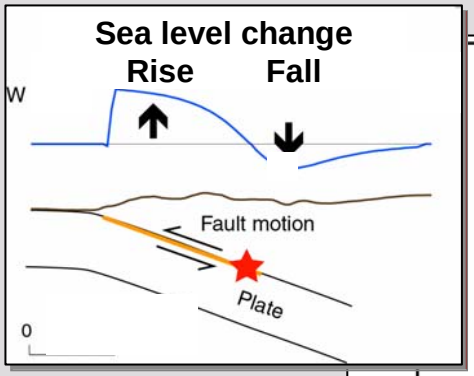
Example of Tsunami Simulation by the Code

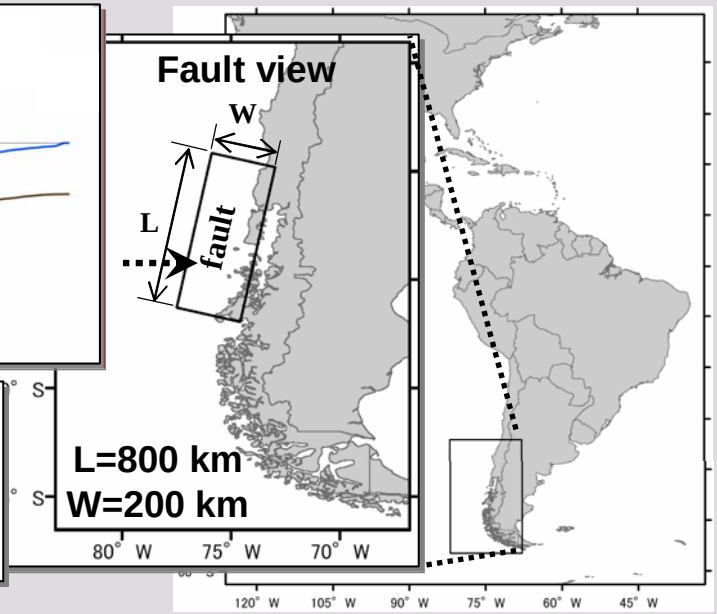
Two tsunami simulations are shown by the video:

(1) the 1960 Chilean Earthquake Tsunami selected as far-field tsunami.

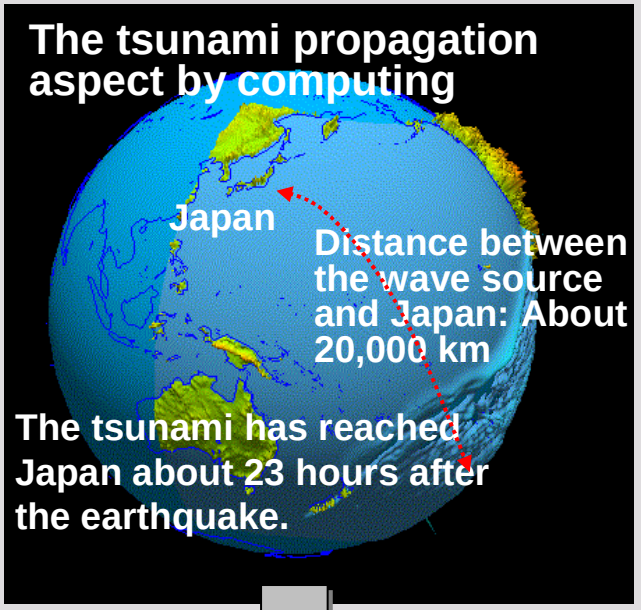
(2) the 1983 Nihon-kai Chubu Earthquake Tsunami selected as near-field tsunami.

Simulation of The 1960 Chilean Earthquake Tsunami



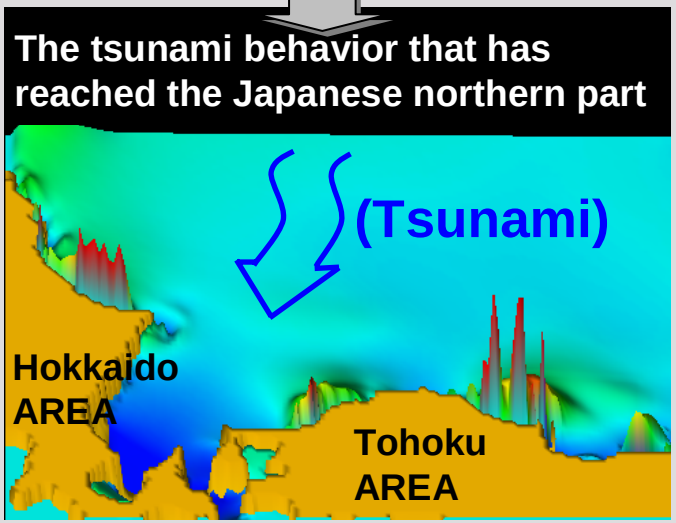


Tsunami source
Set as the sea water surface changed by the seafloor deformation due to the fault motion

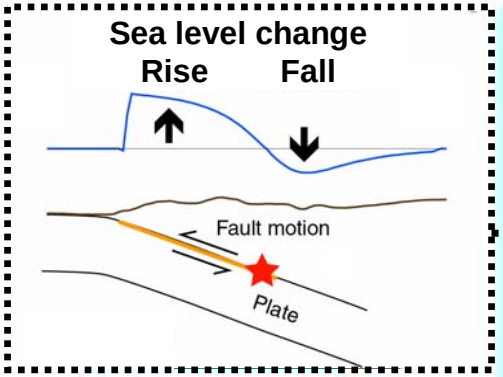


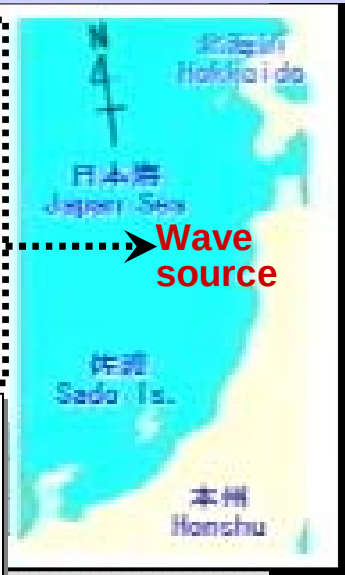
Comparison of simulated and observed highest tsunami waves

Location in Japan	Highest tsunami wave (cm)	
	Simulated	Observed
Hachinohe	530	582
Miyako	199	170



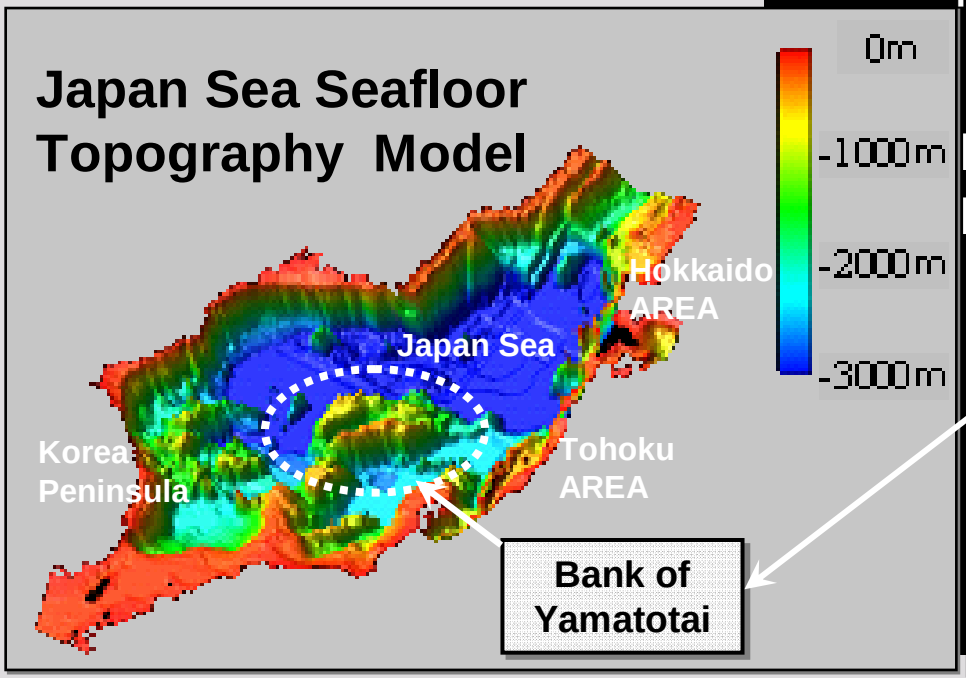
Simulation of The 1983 Nihon-kai Chubu Earthquake Tsunami

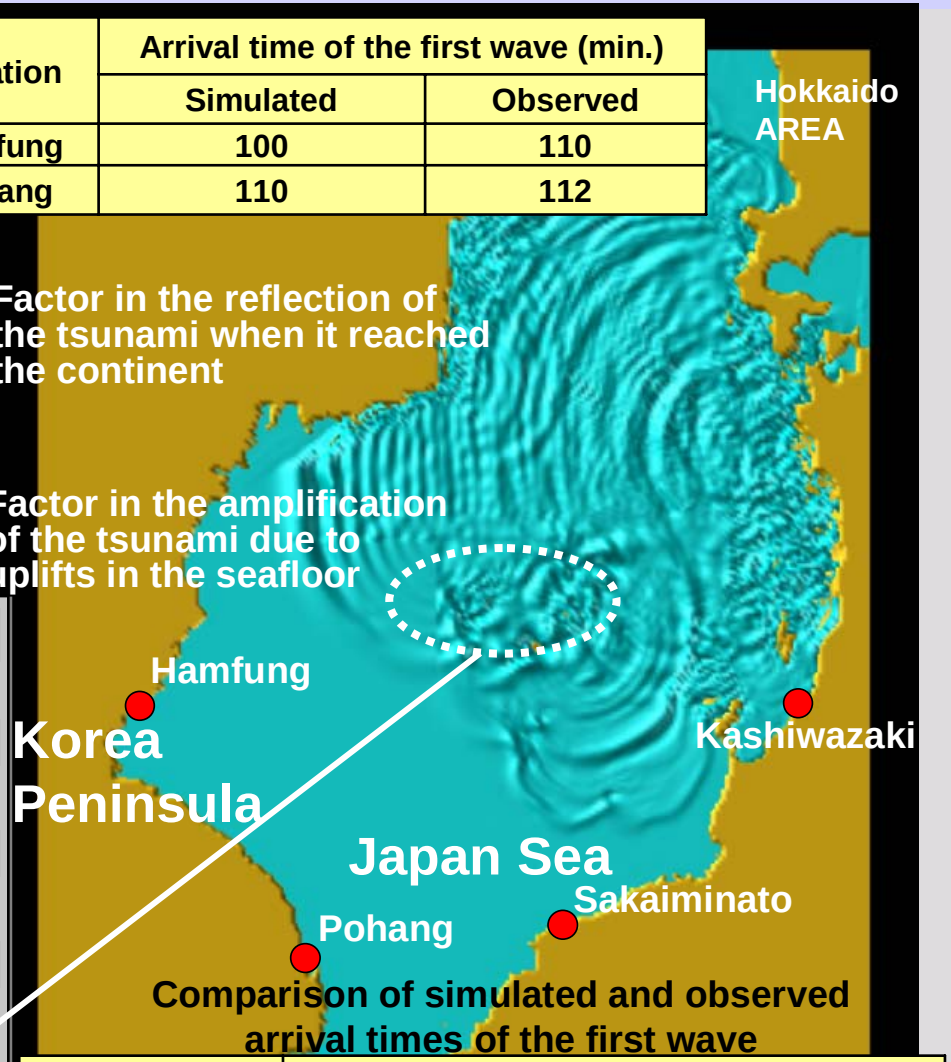




Tsunami source
Set as the sea water surface changed by the seafloor deformation due to the fault motion

Location	Arrival time of the first wave (min.)	
	Simulated	Observed
Hamfung	100	110
Pohang	110	112





Comparison of simulated and observed arrival times of the first wave

Location	Arrival time of the first wave (min.)	
	Simulated	Observed
Kashiwazaki	60	60
Sakaiminato	105	110