Developing Tsunami Damage Estimation and Mitigation Technologies

Tsunami Research Group

(Group 2)

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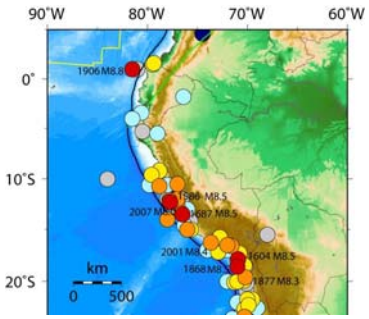
Research Plan

Tsunami Source based on worst case scenarios

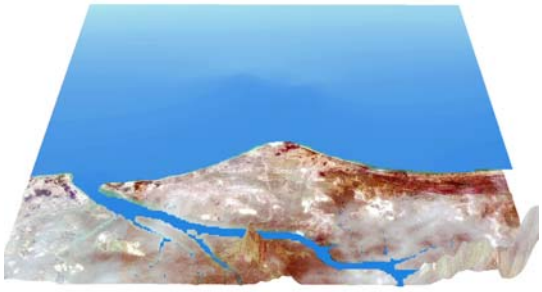


Tsunami Model validation through the representation of historical events（2001 Camana and 2007 Pisco）

Developing Tsunami simulation model in Peru

Damage assessment

Mapping of tsunami impact



2004 Indian Ocean tsunami

Contents of discussion

- What we are going to do in 2010
  - Japan side
    - Seismic and tsunami source model of 2001 Camana and 2007 Pisco (Dr. Yagi, Dr. Fujii)
    - Tsunami modeling to identify what the worst-case scenario is (Dr. Koshimura, Dr. Yanagisawa)
    - Collecting field survey data of 2001 Camana event
    - Tsunami damage assessment (Dr. Koshimura, Dr. Shoji, Dr. Yanagisawa)
  - Peru side
    - Tsunami numerical simulation and field survey (Mr. Jiménez).
    - Investigation of present status on tsunami research and practice in Peru from Pisco and Camana (Prof. Ocola)
    - Investigation of tsunami issue in Peru (San Marcos Univ. Prof. Ocola, DHN , Mr. Jiménez).
    - Seismicity (IGP) and GPS information (IGP, SIRGAS project/IGN,)

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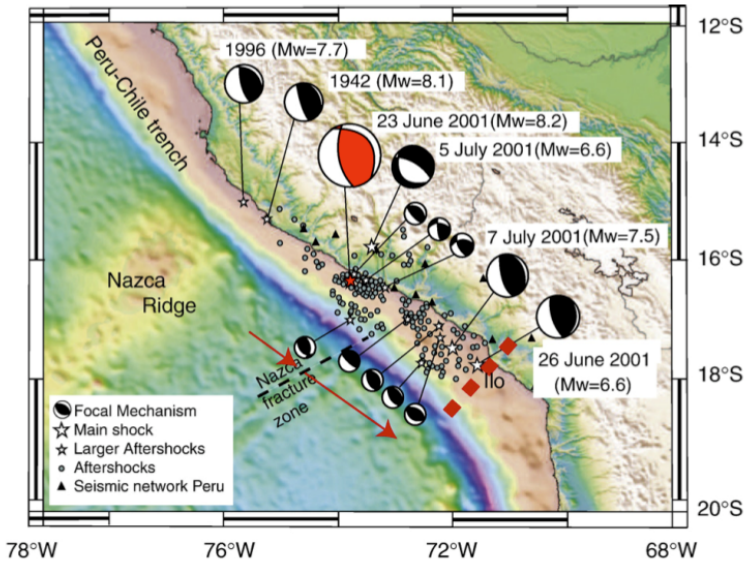
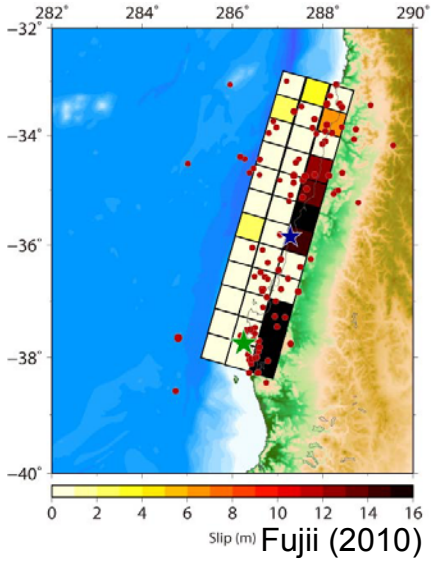
What we are going to do in 2010

■ We model seismic and tsunami source in 2001 Camana and 2007 Pisco earthquake and tsunami using inversion from observed data.



2010 Chile tsunami



Fujii (2010)

Tide gauge data and bathymetry data are provided from DHN

What we are going to do in 2010

■ To validate tsunami model, we collect field data of 2001 Camana event

→ we are going to do field survey from 17 to 19 in this trip

to collect house damage data and topographic data

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What we are going to do in 2010

■ Bridge related knowledge and human for the training between Japan and Peru

- Mr. Jiménez is ready to travel to Japan for the training of seismology and tsunami technologies in Japan.

Thank you

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What are we going to do in 2010

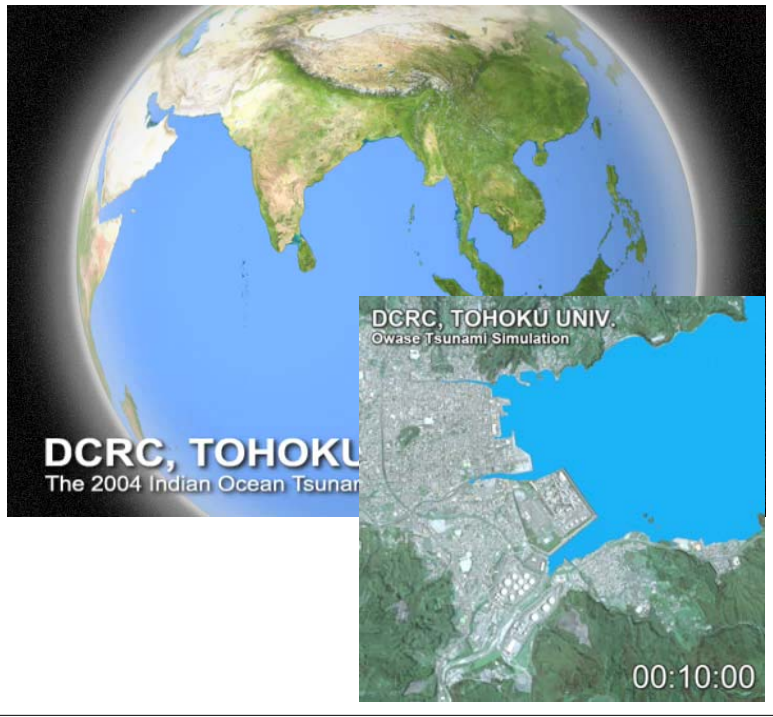
■ To assess tsunami damage in high tsunami risk area, we model tsunami inundation using nonlinear model.

$$\frac{\partial \eta}{\partial t} + \frac{1}{R\cos\theta}\left[\frac{\partial M}{\partial \lambda} + \frac{\partial (N\cos\theta)}{\partial \theta}\right] = 0$$

$$\frac{\partial M}{\partial t} + \frac{gh}{R\cos\theta}\frac{\partial \eta}{\partial \lambda} = fN$$

$$\frac{\partial N}{\partial t} + \frac{gh}{R}\frac{\partial \eta}{\partial \theta} = -fN$$

t: Time, λ: Longitude, θ: Latitude, g: Gravity acceleration, η: Water level, h:Water level, M,N: Flux, R: Radius of earth, f: Coriolis coefficient



Objectives and Goals

- To assess the potential tsunami disaster and its impact to the Peruvian coast
- To develop practical technologies to mitigate tsunami risks in Peru
- Implementation to the plans for disaster mitigation of Peruvian government
- Contributions to Pacific tsunami disaster mitigation strategies

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Things to discuss

■ Tsunami damage assessment

Collecting field survey data (2001 Camana event)

→ we are going to do field survey from 17 to 19 in this trip

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Things to discuss

- What are we going to do in 2010
  - Peru side
    - Tsunami numerical simulation (Mr. Jiménez).
    - Present status on tsunami research and practice in Peru from Pisco and Camana is investigated (Prof. Ocola)
    - Tsunami issue in Peru (San Marcos Univ. Prof. Ocola, DHN , Mr. Jiménez) is reported.
    - GPS information (SIRGAS project/IGN) by Prof. Ocola

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Things to discuss continued [3]

- Bridge related knowledge and human for the training between Japan and Peru
  - Mr. Jiménez travel to Japan
- Data bridging
  -
  -
  - civil defense
- Purpose of field survey by Dr. Yanagisawa
  - call to city hall
  -
  -

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Things to discuss continued [1]

- From observation of the tsunami damage by Prof. Ocola
  - Building (house) failure modes
  - Erosion
  - Localization in affected areas
    - topography
    - run up along a river
  - Historical earthquakes
  - GPS; seismic gaps
    26 sites and 1 st in Arequipa by IGP ?
    40 sts in future by institute of geograph… ? cf. Japan
  - IRD
  - Prof Zavala forces

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Things to discuss continued [2]

- Comments from Mr. Jiménez
  - bathymetry / topography
  - tidal data at Pisco, San Juan, Matarani and …
  - numerical computation scheme
  - tsunami source
  - 2001
  - 2007

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Things to discuss [1]

- Study area …
  - One historical event for model verification/validation(Camana, Pisco)
  - Two potential scenarios (Callao, Chimbote, Pisco, Ilo harbor ; important ports industrial commercial places and exposures)
- Data we need
  - Merged bathymetry /topography grid in study areas (30 meter grid form North Pisco, South Pisco should be requested, Camana is already prepared)
  - Field survey results for model validation (Pisco, Camana)
  - Building polygon for structural damage estimation
  - Population data for fatality estimation

Research Plan (Implementation Phase)

- Developing a fundamental procedure for mapping tsunami hazard
  - Training program (Tsunami modeling and mapping)
  - Warning, guidance and public education
- Strategic planning to mitigate tsunami risks and damage
  - Tsunami disaster mitigation program for Peruvian government
  - Tsunami countermeasures
  - Design for tsunami evacuation facilities
  - Tsunami evacuation strategies

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Things to discuss [2]

- Human resources… who is going to work on tsunami modeling? Schedule?
- Towards kickoff meeting, what are we going to do
  - Japan side
    - Tsunami propagation modeling to identify what the worst-case scenario is.
    - Tsunami damage assessment (Shoji)
    - Collecting field survey data (2001 Camana event)
  - Peru side
    - What has been done from Pisco and Camana.
    - Tsunami issue in Peru (San Marcos Univ. Prof. Ocola, DHN , Mr. Jimenez)

Study area

In Pisco, Structures have been damaged. Characteristics are different : Adobe, Quincha (at Pisco)

In Camana, Masonry (non-engineered concrete structures)

In Callao, Concrete buildings, Masonry of 3-5 stories, Adobe with thick walls, wooden house

Maybe we need different type of damage function.

Hopefully, we develop original damage function, and also we use existed ones from similar structural type.

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Lessons from Chimbote and Camana

- We need some measures to identify tsunami risks, such as intensity scale (I-VIII?) for public awareness.
- In terms of tsunami travel time …
- We need instructions what to do, what not to do.
- Tsunami run-up along river. Lots of eyewitness accounts from Camana river.
- How we visualize RISKS.

Data from DHN

- Field/observed data from Camana, Pisco, Callao, Chimbote
- Tide gauge records from historical events
- Bathymetry and Topography data
- Inundation charts

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To Do

- Potential tsunami source scenarios suggested by IGP ? (Northern Peru ; seismic gap ? Callao region ?)

Today's agenda

■ Worst case scenarios:
How can we determine worst case scenarios in Peru coast ?

■ Model validation:
- Target tsunami event is 2001 Camana tsunami.
- Observed data of 2001 tsunami is needed (tide gauge, tsunami height) to determine tsunami source model
- Bathymetry have been measured by DHN (Callao, Camana, Pisco, Chimbote). How about topography data ?

→ Field measurement in Camana is going to be done after this workshop.

■ Study area:
- This is determined from the results of worst case scenarios. But, Callao, Pisco and Chimbote are high tsunami risk area based on preliminary assessment (Potential tsunami exposure).

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Today's agenda

■ Tsunami simulation
- Who is going to work on tsunami modeling? Mr. Jimenez, ok?

■ Damage assessment
- Population data is required.
- GIS data related to building, road and other important structures are required.
- How can we estimate fragility function of buildings with variable type?

■Schedule ?

Joint resolution

- what are we going to do

  We are going to invite Mr.Jemenas for training the tsunami and earthquake.

- Bathymetry (Callao .. etc.) are shared.
- We will request IGP GPS data of ground motion

- Peru side

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Future study

- Potential tsunami source scenarios suggested by IGP ? (Northern Peru ; seismic gap ? Callao region ?)

note

- We are going to invite Mr.Jemenas to train the tsunami and earthquake.
- DHN

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Research Plan (Scientific phase)

- Assessing historical tsunami events and its impact in Peru
  - Tsunami sources
  - Tsunami hazard (Tsunami generation, near-shore propagation and coastal inundation)
  - Damage (Casualties, Structural damage)
- Indentifying potential tsunamis and the worst case scenarios
  - Tectonic settings and tsunami source scenarios
  - Potential tsunami exposure (Exposed population)
  - Potential impact
- Mapping tsunami hazard and its impact
  - Inundation modeling
  - Damage estimation (Casualties, Structural damage)
  - Hazard maps, Cartography

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Post-tsunami survey in Camana