A nation-wide tsunami inundation and damage forecast system in Japan

**BREAKING THE WALL OF "Tsunami Forecast"** 

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# 15:59:24;28

### Tsunami in Sendai, Japan on 11 March 2011

Inundation of 561 km<sup>2</sup>, highest run-up of 40 m 18,549 fatalities (3 % in the inundation zone) 120,000 buildings destroyed 23 mil. tons of debris, 10-20 times of annual waste amount 25 trillion JPY, <sup>1</sup>/<sub>4</sub> of annual budget (250 billion \$)

Japan Broadcasting Corporation (NHK)

# **Tsunami Warning Messages**

Warning	Dangerous coastal flooding & powerful currents possible	Move to high ground or inland
Advisory	Strong currents & waves dangerous to those in/ very near water possible	Stay out of water, away from beaches & waterways
Watch	Distant tsunami possible	Stay tuned for information Be prepared to act
Information Statement	No threat or very distant event & threat not determined	Relax

# **Critical Questions for Tsunami Forecast**



~minutes



~hours



~days

How extensive the tsunami penetrates ?(Where is the safe place ?)

How many people are exposed ?

How many structures/infrastructures are damaged ?

How extensive disaster relief activities should be deployed ?

♦ How much losses are ?

Challenges towards real-time tsunami inundation forecasting and damage mapping for near-field tsunami events

- Rapid determination of tsunami source model (Rapid estimation of coseismic fault model).
- Acceleration of tsunami inundation simulation with high-performance computing infrastructure (HPCI).
- 3. Establishing quantitative damage estimation and mapping methods to provide responders with mapping products.

# Why we need real-time forward simulation ?



Koshimura and Shuto (2015), Philosophical Transactions A

#### Real-time Fault Estimation using GEONET (GSI) RAPiD (Ohta et al., 2012, JGR)

Ing. lat. dep. len. wid. str. dip. rak. slp. opn.



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#### RAPiD to REGARD (Kawamoto et al., 2017, JGR) Nankai Megathrust About 1200 slip distribution data obtained from GEONET (GSI)



#### **Full-Automatic Real-time Tsunami Inundation and Damage Forecast** dep. len. wid. str. dip. rak. slp. opn. lat. Ing.



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## Nation-wide System in Central Government of Japan



#### **Disaster mode of supercomputer**

Immediately suspending other active jobs to execute tsunami inundation simulation automatically.



### **Anticipated Nankai Trough Earthquake Tsunami**



### Tsunami Fragility Curve Koshimura et al. (2014)





## Mapping products - Tsunami flow depth





#### Clients

- Central & Prefectural Governments
- Insurance Industry

#### Collaborators

- NTT
- JR Tokai (National Railway Company)

### **Mapping products - Population Exposure**



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### **Mapping products - Structural Damage**



#### **Creating a New Value of Forecast Information to Save Lives**



# Quasi-Zenith Satellite System (QZSS)





# Summary

- ➢Great Progress of real-time tsunami inundation and damage forecast technologies with use of dense observation GNSS networks and HPCI.
- How the real-time forecast capabilities should be used for saving lives?
- Increasing the forecasting reliability, with quick, accurate and robust communication with precise positioning.