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

BREAKING THE WALL OF “Tsunami Forecast“

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RTi-cast, Inc. (University-based tech start-up)
Inundation of 561 km$^2$, 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, ¼ of annual budget (250 billion $)
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

- 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

1. Rapid determination of tsunami source model (Rapid estimation of coseismic fault model).
2. 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?
Real-time Fault Estimation using GEONET (GSI) RAPiD (Ohta et al., 2012, JGR)

GEONET 1,232 sites

![Map of Japan with GEONET sites](image)
RAPiD to REGARD (Kawamoto et al., 2017, JGR)
Nankai Megathrust
About 1200 slip distribution data obtained from GEONET (GSI)

1707 Hoei rupture (Mw8.7)
Full-Automatic Real-time Tsunami Inundation and Damage Forecast

GPS crustal measurement (Ohta et al., 2012)
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)

Damage Probability

Inundation Depth (m)

Wooden houses

Others (Steel, RC)

(c) Geospatial Information Authority of Japan (GSI)
Mapping products - Tsunami flow depth

Clients
- Central & Prefectural Governments
- Insurance Industry

Collaborators
- NTT
- JR Tokai (National Railway Company)
Mapping products - Population Exposure
Mapping products - Structural Damage
Creating a New Value of Forecast Information to Save Lives

Data Fusion with mobile-phone location data
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.