TOHOKU UNIVERSITY
Cyberscience Center
Cyberscience Center, Tohoku University

Enhancing Disaster Resilience by Real-time Tsunami Inundation Forecasting and Robust Information Dissemination

Background and Motivation

2011 Great East Japan Earthquake of magnitude 9.0

☐ **A large tsunami caused by the earthquake struck Japanese coasts.**

- Tsunami wave height: over 10m
- Highest run-up: 40m
- Inundation of 561 Km^2
- 18,549 fatalities
- 120,000 buildings destroyed

☐ **The most important lessons learned from the Great East Japan Earthquake.**

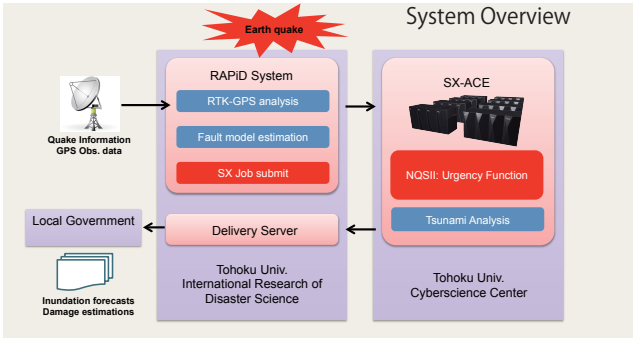
- **Require quick understanding of disaster situation for mitigation**


Damage caused by the Great East Japan Earthquake

Real-time Tsunami Inundation Forecast system

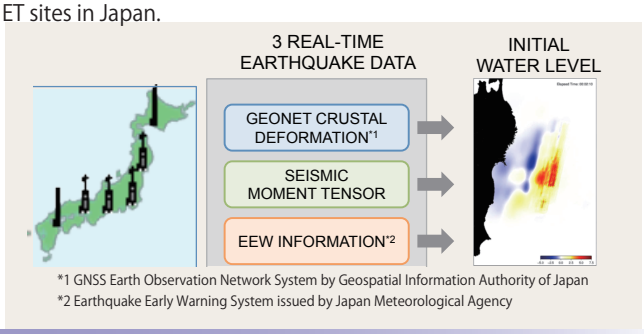
We established a new method of **real-time tsunami inundation forecasting, damage estimation and mapping with use of advanced sensor networks and modern computing power.** The method consists of fusion of real-time crustal deformation monitoring/fault model estimation, high-performance real-time tsunami propagation/inundation simulation with a vector supercomputer, and tsunami fragility curves for damage/loss estimation.

The method has recently accomplished "**10-10-10 challenge**" , to complete **tsunami source determination in 10 minutes**, **tsunami inundation modeling in 10 minutes** with **10 m grid resolution**.



STEP1 : ESTIMATION OF TSUNAMI SOURCE

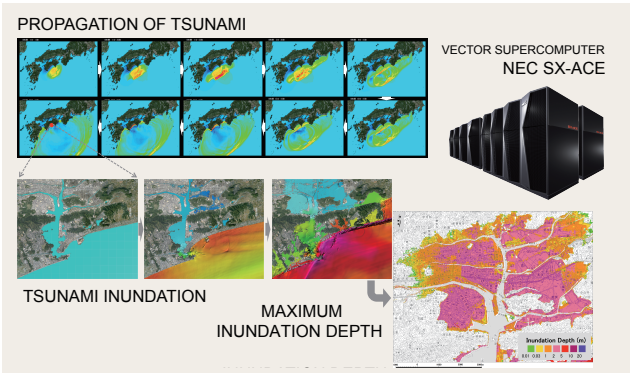
The first response of the system is to identify the tsunami source model by applying RAPiD Algorithm (Ohta et al., 2012) to observed RTK-GPS time series at GEONET sites in Japan.



*1 GNSS Earth Observation Network System by Geospatial Information Authority of Japan
*2 Earthquake Early Warning System issued by Japan Meteorological Agency

STEP2 : REAL-TIME TSUNAMI SIMULATION

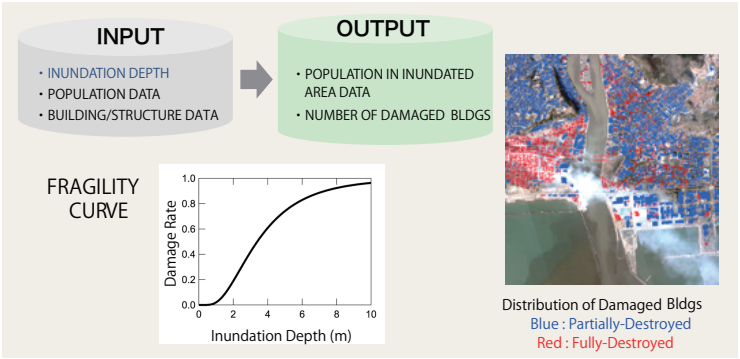
After the tsunami source is determined, the system moves on to running tsunami propagation and inundation model, which was optimized on **NEC SX-ACE installed at Tohoku University**, to acquire the estimation of time series of tsunami at offshore /coastal tide gauges to determine tsunami travel and arrival time, extent of inundation zone, maximum flow depth distribution.



The simulation model was improved so that it fits to HPC on SX-ACE, resulting in implementation of **six-hour tsunami simulation within 10 minutes with high-accuracy bathymetry and elevation data of 10 m grid resolution.** We also established **a system where computation resources of the supercomputer necessary for this real-time tsunami simulation will be allocated in a tsunami event on a priority basis.**

STEP3 : ESTIMATION of TSUNAMI DAMAGE

Given the maximum flow depth distribution, the system performs GIS analysis to determine the numbers of exposed population and structures using census data, then estimates the numbers of potential death and damaged structures by applying tsunami fragility curve.



The system starts trial operation in Kochi prefecture, one of at-risk coastal city against Nankai trough earthquake. In the trial operation, we verify the capability of the method as a new tsunami early warning and response system for stake holders and responders.

This work is promoted by research groups of Tohoku University, Osaka University, NEC Corp., Kokusai Kogyo CO., LTD., A2 Corp., and RTi-cast Corp.

Consortium Member
1 International Research Institute of Disaster Science (IRIDeS), Tohoku Univ.
2 Cyberscience Center, Tohoku Univ.
3 Research Center for Prediction of Earthquakes and Volcanic Eruptions, Graduate School of Science, Tohoku Univ.
4 Cybermedia Center, Osaka University
5 NEC Corporation
6 KOKUSAI KOGYO CO., LTD.
7 A2 Corporation
8 RTi-cast Corporation

(URL) http://www.ss.cc.tohoku.ac.jp/
(E-mail) musa@tohoku.ac.jp