Identification of the Common Technical Methodologies and the Mutual System of the Database and the Observation Network of Earthquake and Tsunami

Tsunami Warning by Japan Meteorological Agency on March 11th, 2011

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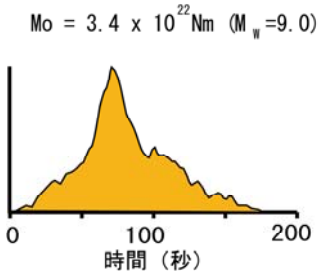
OT March 11th, 2011 14:46:18
N38.1035 E142.8610
D:23.74km Mw9.0 Mj8.4

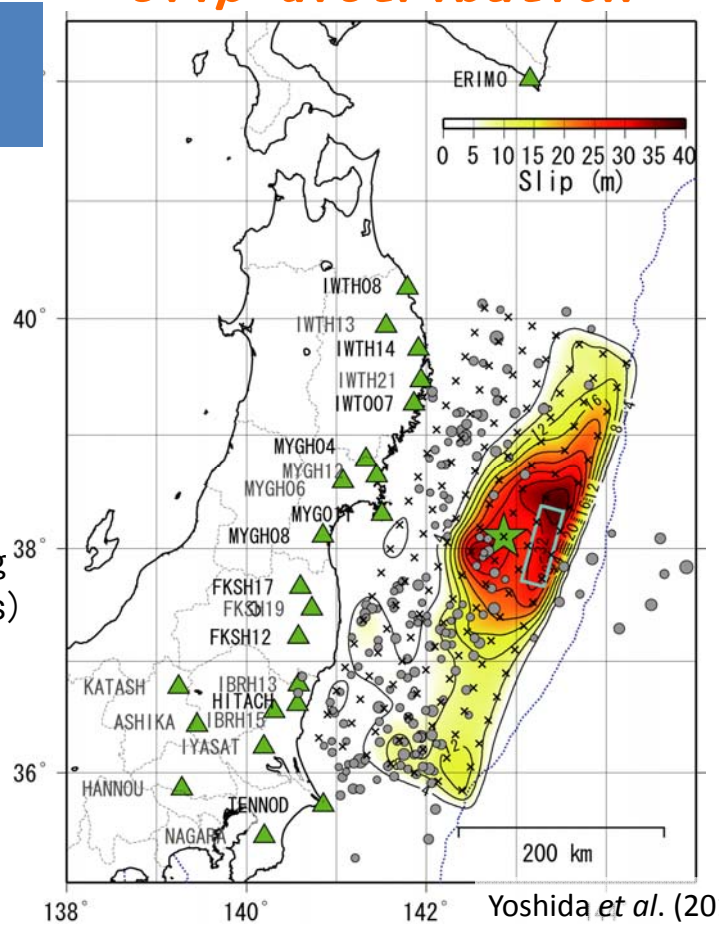
Source time function



◎Slip estimated from long period seismic wave(T>10s)

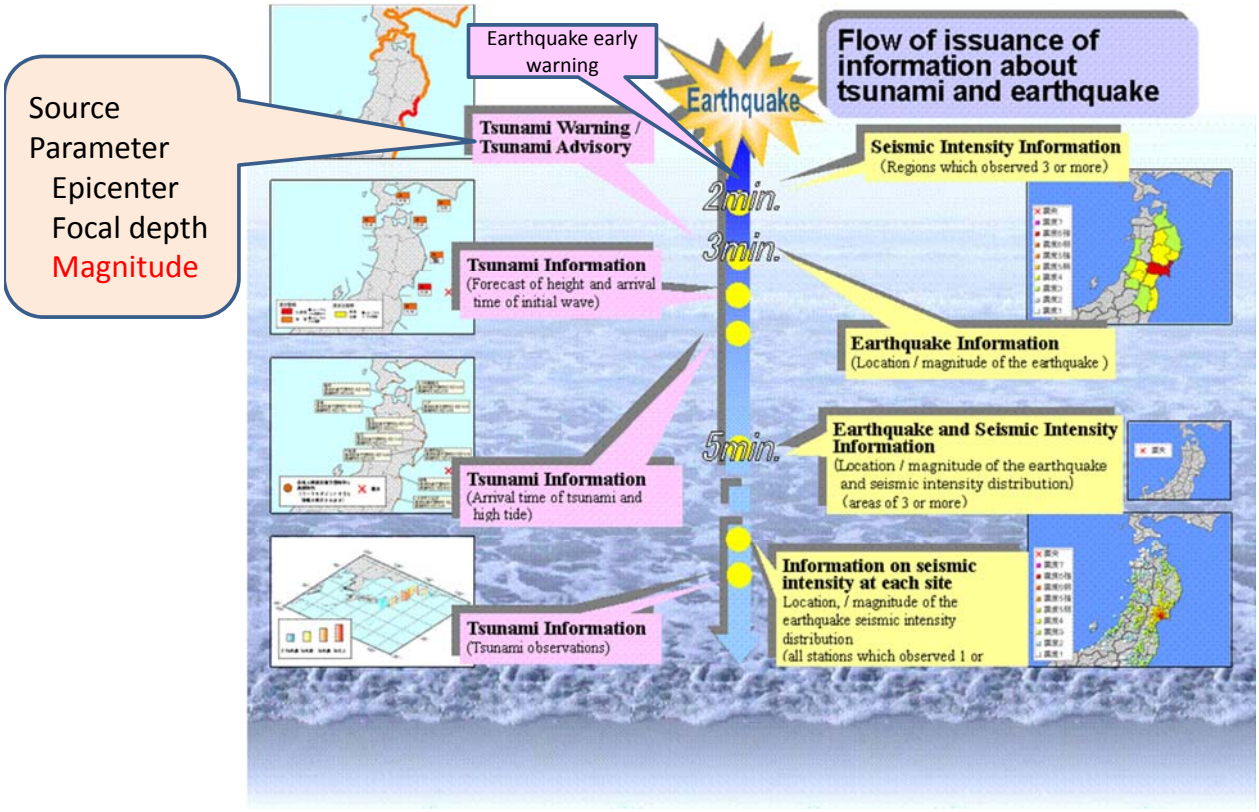
Large tsunami source (Hayashi *et al.*, 2011)
Stations for the analysis
Aftershocks(M≥5)
Mainshock

Slip distribution



Yoshida *et al.* (2011)

Information from JMA on Earthquakes



http://www.seisvol.kishou.go.jp/eq/eng/fig/info.html

JMA: OT 14:46:18 N38.1035 E142.8610 D:23.74km Mw9.0 Mj8.4
USGS: OT 14:46:23 N38.3220 E142.3690 D:24.4 km Mw9.0 Ms8.3

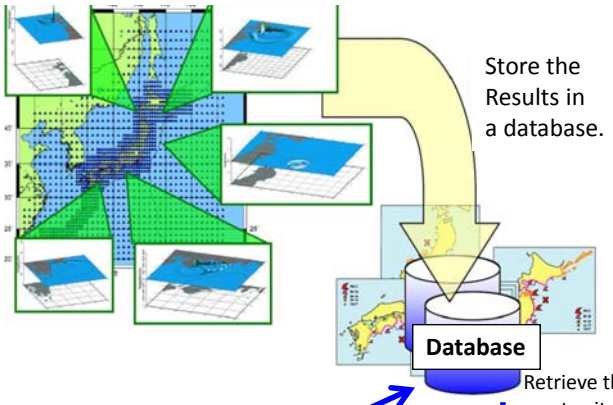
- 14:48 (JMA) Seismic intensity information
- 14:49 (JMA) Tsunami warning (Iwate, Miyagi, Fukushima Prefecture), seismic int. inf.
  - N38.0 E142.9 D:10km M7.9
- 14:50 (JMA) Tsunami information (expected arrival time, height, etc.), seismic int. inf.
- 14:50:12 (3.8 minutes) NEIC hypocenter
  - OT 14:46:21 N38.16 E143.25 D:60km
  - NEIC real time processing system (Hydra)
  - Based on eight arrivals in Japan, Korea, China
- 14:51 (JMA) Seismic intensity information
- 14:51:07 (4.2 minutes) PTWC Observatory Message
  - Mwp7.5 (five station)
- 14:53 (JMA) Information on earthquake (hypocenter, seismic intensity)
- 14:54:45 (8.3 minutes) NEIC Hydra
  - Mwp8.5
- 14:56:03 (9.7 minutes) PTWC Tsunami Bulletin Release
  - OT 14:46:00 N38.00 E142.90 D:10km M7.9 (the same as the JMA report)
- 14:59:00 ATWC Tsunami Bulletin Release
  - The same as PTWC (JMA)

Black : JMA、Blue : NEIC/PTWC result of processing、Red : NEIC/PTWC report

Tsunami Warning Dissemination

Establishment of Tsunami Simulation

Conduct Tsunami simulation for various epicenters, depths and magnitudes



Quickly Estimated Hypocenter & Magnitude

Forecast Grade		Levels of Estimated Tsunami Amplitude
Warning	Major Tsunami	3 m, 4 m, 6 m, 8 m, 10 m or greater
	Tsunami	1 m, 2 m
Advisory		0.5 m

Disseminate the first warning in 3 minutes

Tsunami forecast block

66 coastal blocks in total (basically, one for a prefecture)

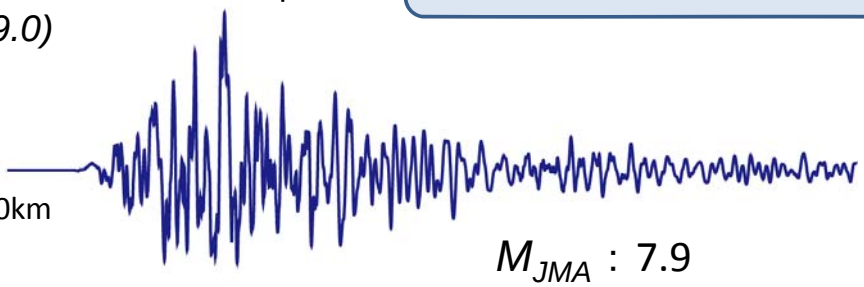
Magnitude saturation of M_{JMA}

Source deuration:180(s)

Displacement of 6(s) cutoff

2011 Off the Pacific Coast of Tohoku Earthquake
(M_{JMA}8.4, M_W9.0)

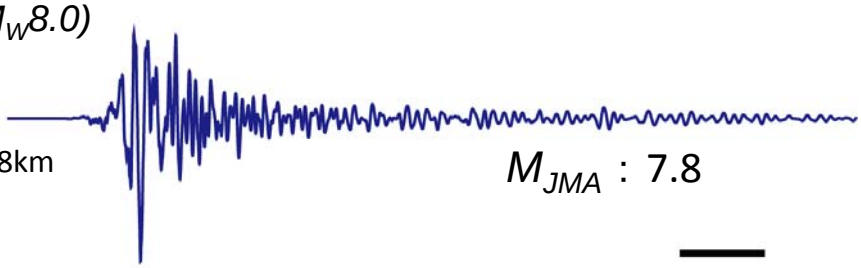
Station : N.SBTF
(EW-component)
Epicentral distance : 300km



M_{JMA} : 7.9

2003 Off-Tokachi Earthquake
(M_{JMA}8.0, M_W8.0)

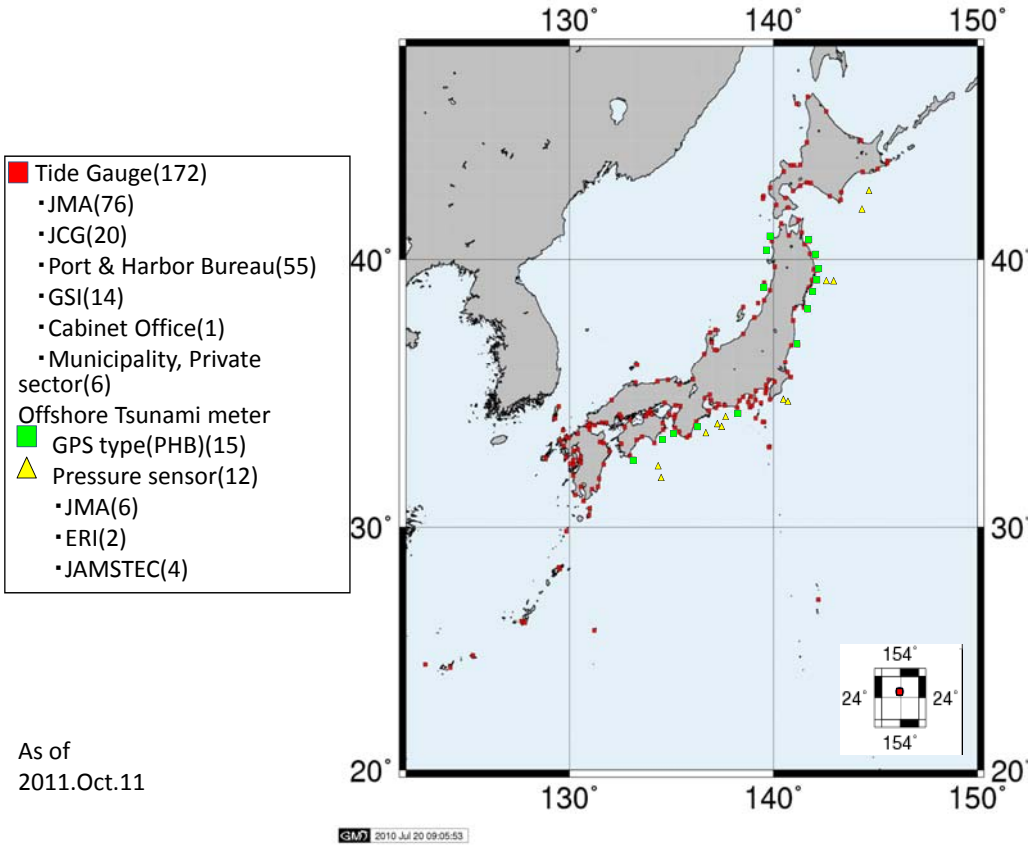
Station : N.NOPF
(EW-component)
Epicentral distance : 298km



M_{JMA} : 7.8

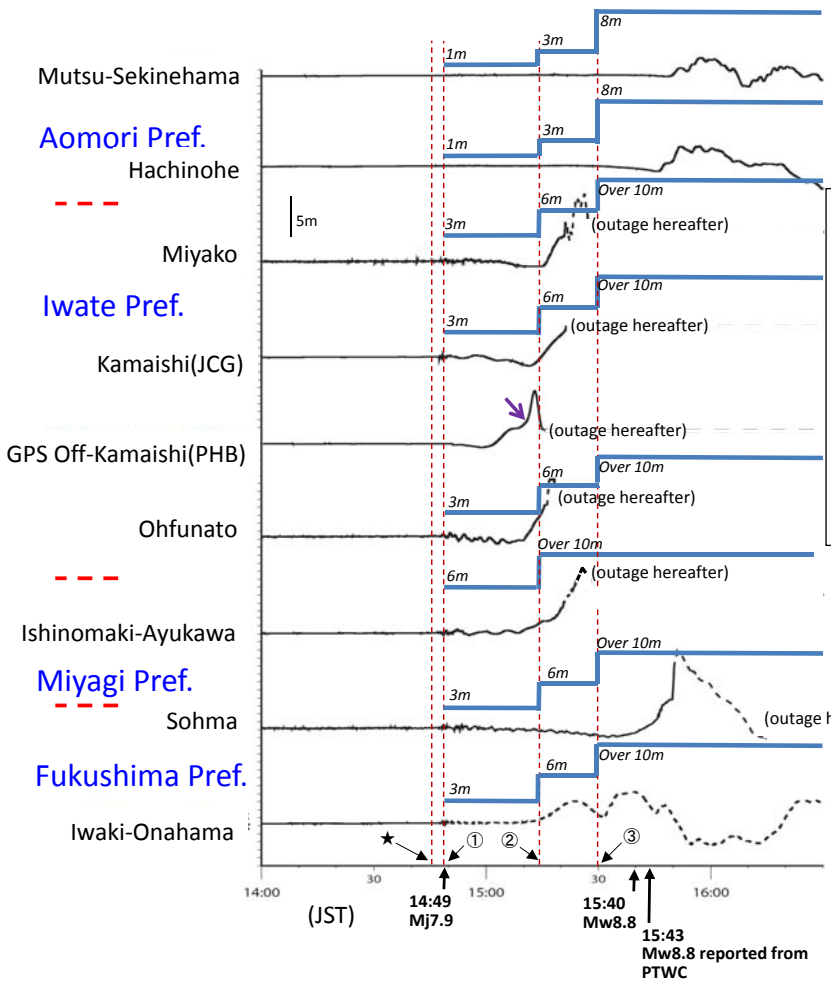
1 min

Sea Level Monitoring Stations (all are collected at JMA in realtime)



As of
2011.Oct.11

Tsunami Warning Updates
(Aomori to Fukushima Pref.)



★3/11 14:46 Eq. Occurrence

①3/11 14:49 Tsunami Warning Dissemination
Iwate 3m, Miyagi 6m, Fukushima 3m (Major Tsunami),
Pacific coast of Aomori 1m (Tsunami)

②3/11 15:14 Tsunami Warning Update
Iwate 6m, Miyagi over10m, Fukushima 6m,
Pacific coast of Aomori 3m (Major Tsunami)

③3/11 15:30 Tsunami Warning Update
Iwate to Boso-peninsula over10m,
Pacific coast of Aomori 8m (Major Tsunami)

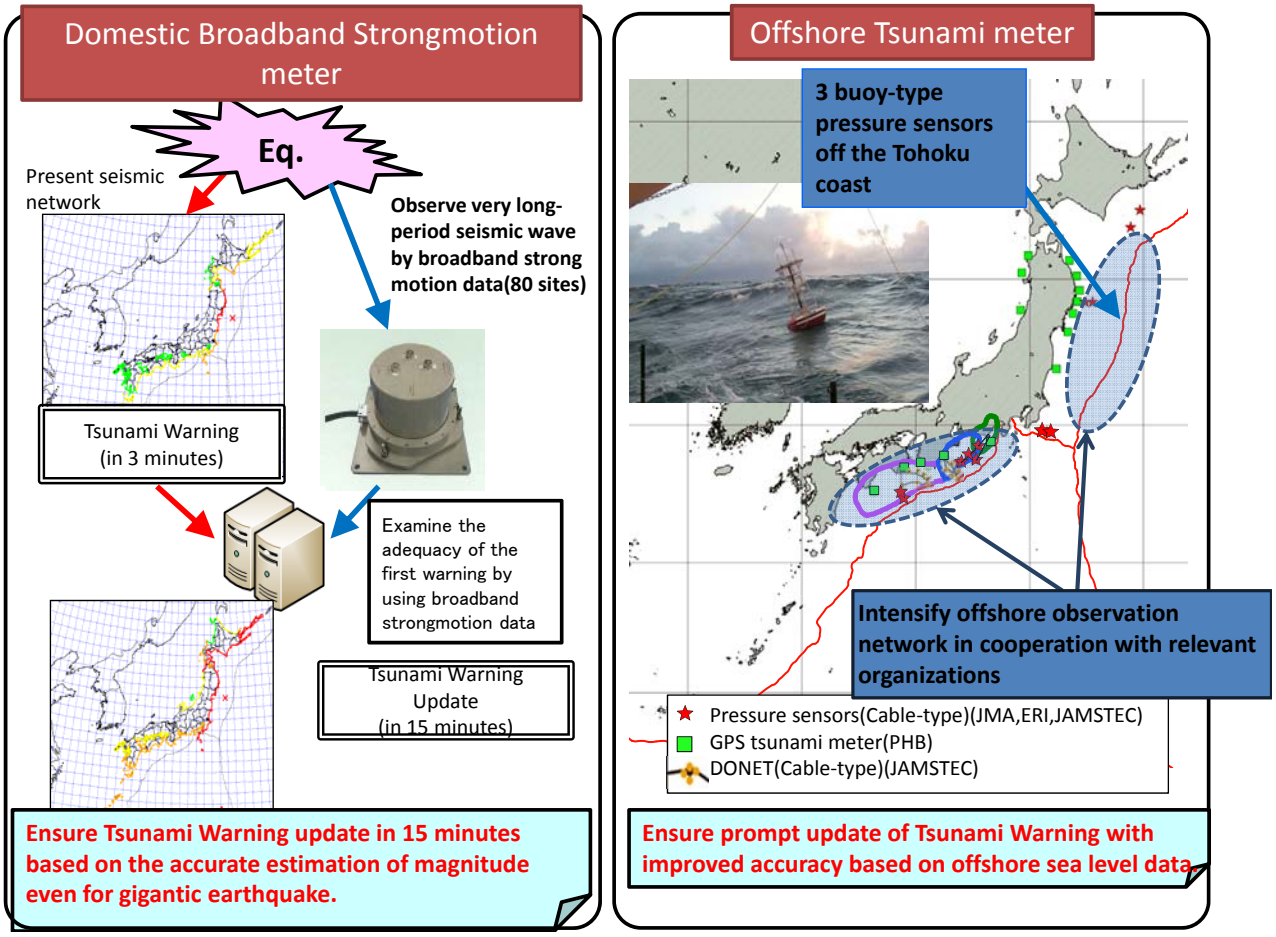
JMA updated Tsunami Warning NOT by earthquake magnitude estimation, but by observed tsunami heights at GPS Tsunami meters and tide gauges.

Monitored in realtime

Recovered data by on-site inspection

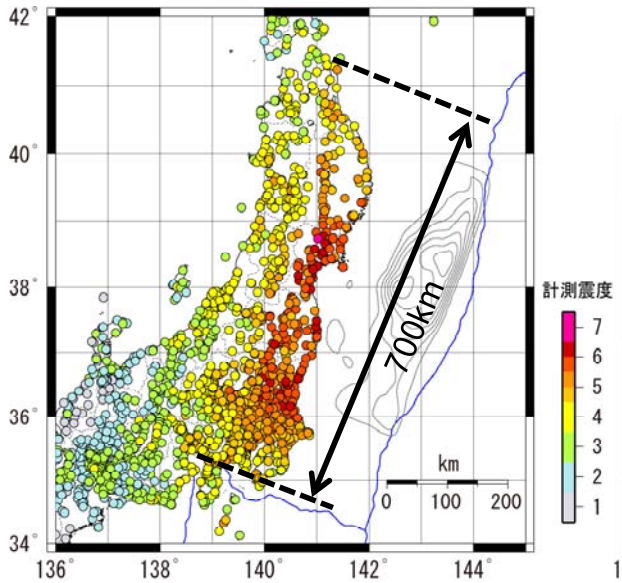
Forecast Tsunami height

Deployment of broadband strongmotion meter & offshore tsunami meter

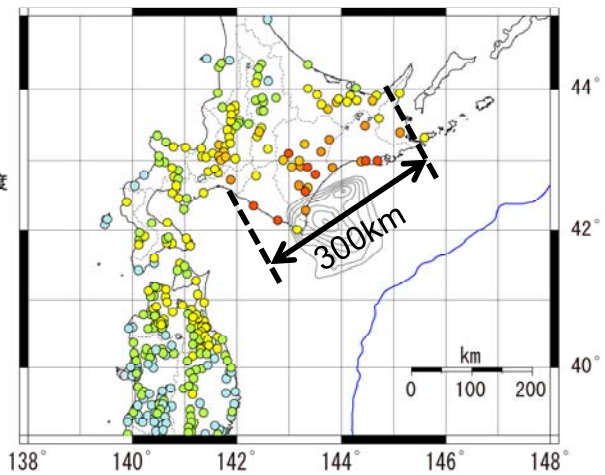


Magnitude estimation from span of strong motion area

2011 Off the Pacific Coast of Tohoku Earthquake

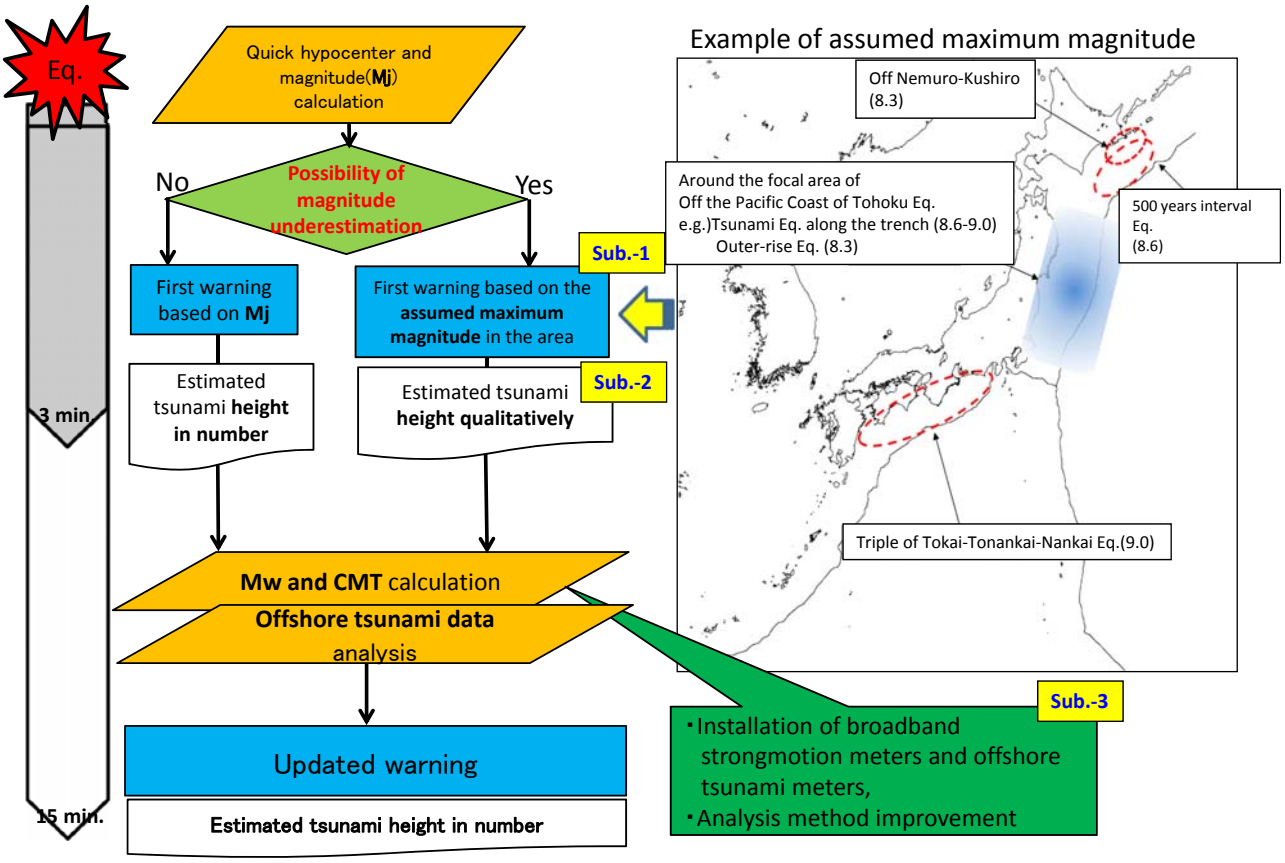


2003 Off-Tokachi Earthquake



The span of 5-lower or the greater of the JMA seismic intensity scale

General flow of planned improved Tsunami Warning Dissemination



Summary

- Tsunami warning on March 11ª, 2011
  - -Magnitude saturation due to the short cutoff period of seismic records and fail of Mw estimation due to over-range of broadband data.
  - -Tsunami warning was updated owing to GPS tsunami meters and tide gauges.
- Improvement of the tsunami warning
  - -Deployment of broadband strong motion seismometer and offshore tsunami meter.
  - -Prepare procedure for gigantic earthquakes.