15 Mar 2011

# Numerical modeling of Tohoku-Pacific Earthquake Tsunami (Ver.3)

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## 1. Tohoku-Pacific Earthquake

### （1）USGS (http://earthquake.usgs.gov/)

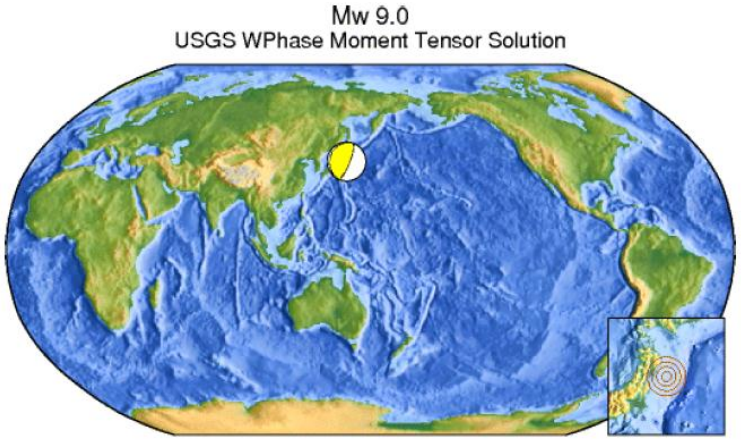
NEAR EAST COAST OF HONSHU, JAPAN

11/03/11 5:46:23

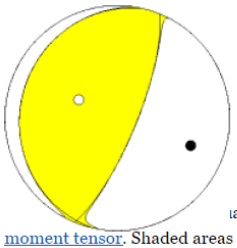
Epicenter: 38.321 142.369
MW 9.0

USGS/WPHASE CENTROID MOMENT TENSOR
11/03/11 05:46:23.00
Centroid: 38.321 142.969
Depth 24 No. of sta:256
Moment Tensor; Scale 10**22 Nm
Mrr= 1.82 Mtt=-0.13
Mpp=-1.69 Mrt= 1.34
Mrp= 3.17 Mtp=-0.56
Principal axes:
T Val= 3.88 Plg=59 Azm=295
N = 0.03 2 201
P = -3.92 30 110

Best Double Couple:Mo=3.9*10**22
NP1:Strike=193 Dip=14 Slip= 81
NP2: 22 76 92



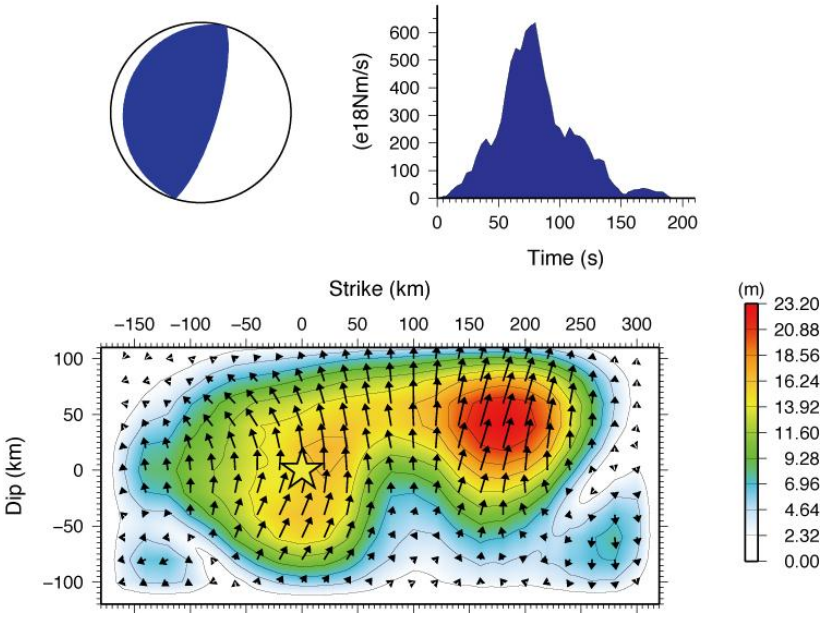

Date: 11 MAR 2011
Time: 5:46:23
Epicenter: 38.321 142.369
Depth: 24 km



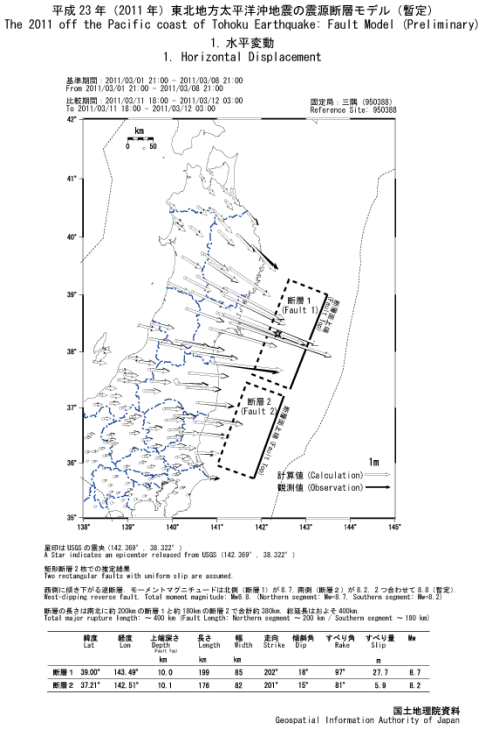
al representation of the style of faulting (focal mechanism) derived from the estimated moment tensor. Shaded areas show quadrants of the focal sphere in which the P-wave first-motions are away form the source, and unshaded areas show quadrants in which the P-wave first-motions are toward the source. The dots represent

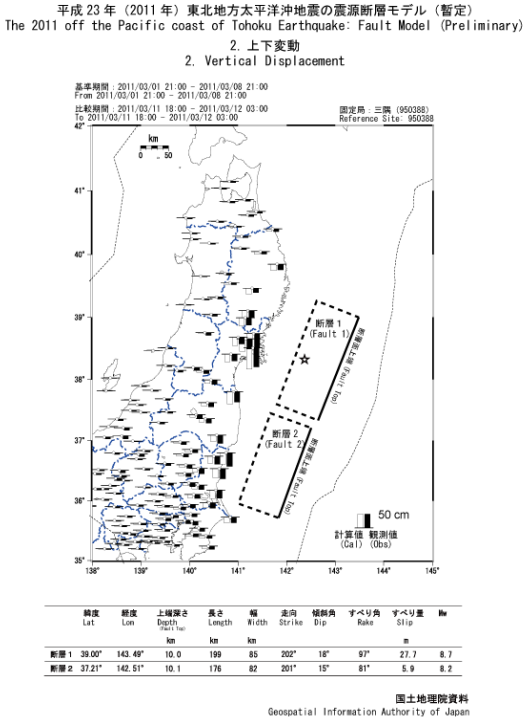
（２）Dr.Yagi's model - version 2（http://www.geol.tsukuba.ac.jp/~yagi-y/EQ/Tohoku/）

(Strike,Dip,Slip) = (195.0, 15.0, 88.6)
Moment = 0.3560E+23(Nm); Mw = 9.0
Variance = 0.18288
Depth = 30.00(km) ; Vrmax = 2.50(km/sec)




（３）Geospatial information authority of Japan
(http://www.gsi.go.jp/cais/topic110313-index.html)

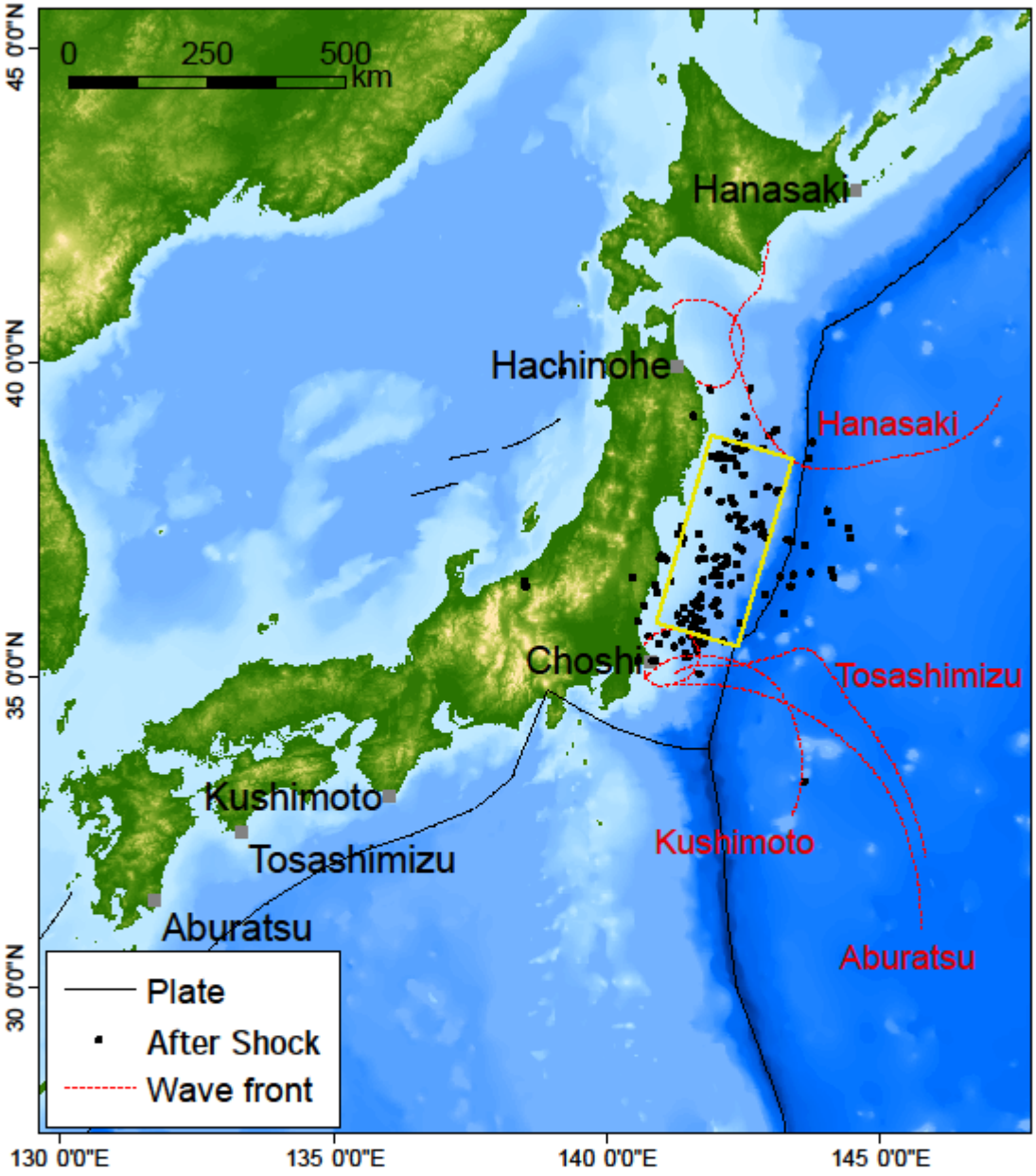


2． Wave front inferred from the arrival time of tide gauges

・Wave-ray analysis

・Grid size ( $\Delta x$ = 3250m)



## 3. Fault Parameter

| | Mw | Latitude | Longitude | D | L | W | strike | dip | slip | depth | note |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Model 1 | 9.1 | 39.30 | 144.20 | 20 | 400 | 150 | 193 | 14 | 81 | 3 | (1) |
| Model 2 | 9.0 | 37.18 | 143.12 | 21 | 150 | 150 | 195 | 15 | 88.6 | 10 | (2) |
| | | 39.14 | 143.94 | 16 | 220 | 150 | 195 | 15 | 88.6 | 10 | |
| Model 3 | 8.8 | 39.00 | 143.49 | 27.7 | 199 | 85 | 202 | 18 | 97 | 10 | (3) |
| | | 37.21 | 142.51 | 5.9 | 176 | 82 | 201 | 15 | 81 | 10.1 | |

※ Reference

(1) http://iisee.kenken.go.jp/staff/fujii/OffTohokuPacific2011/tsunami.html

(2) http://www.geol.tsukuba.ac.jp/~yagi-y/EQ/Tohoku/

(3) http://www.gsi.go.jp/common/000059085.pdf

## 4. Tsunami model

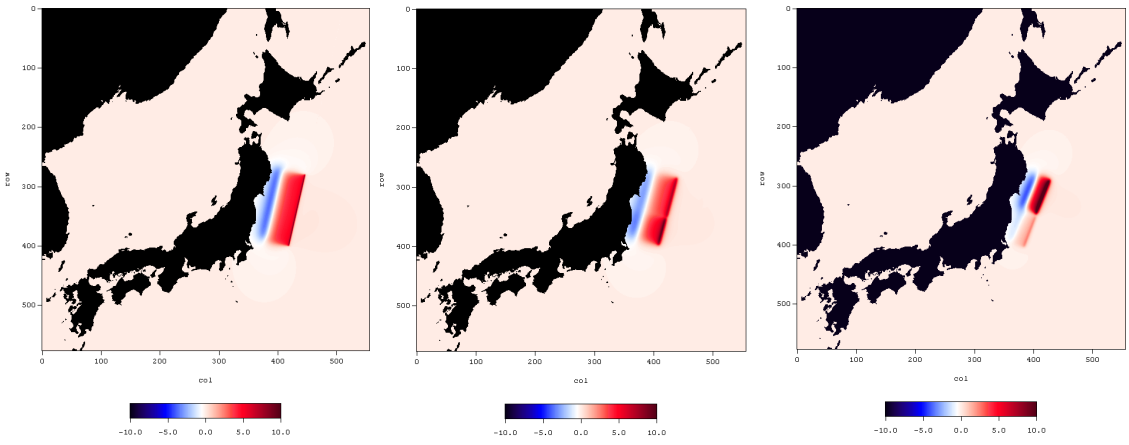
・Non-linear long wave equation

・Grid size for the model validation : $\Delta x = 3250$m

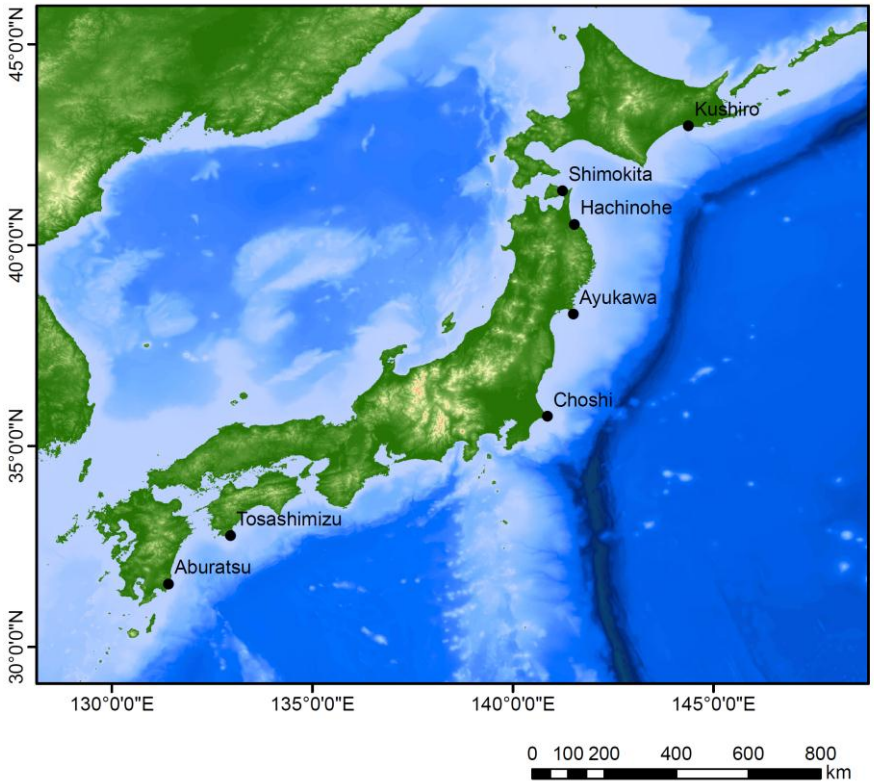
・Grid size for the tsunami propagation and inundation : $\Delta x = 50$ ― 1350m

## 5. Initial water elevation of the tsunami

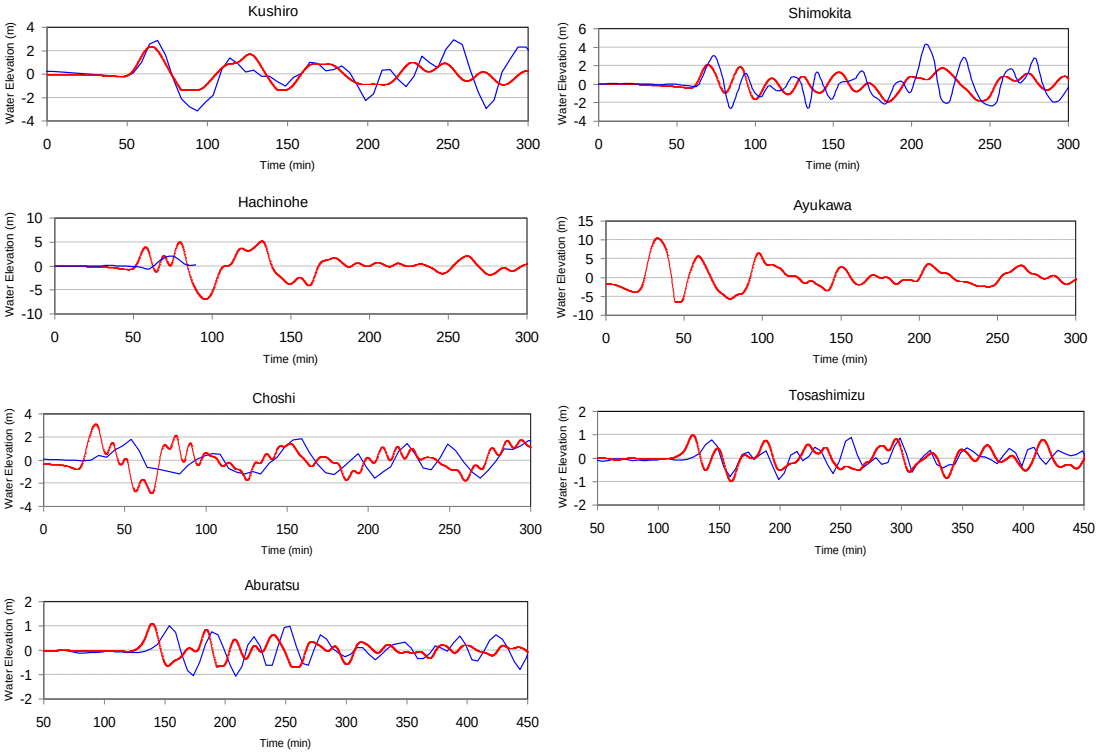
(Model 1) (Model 2) (Model 3)



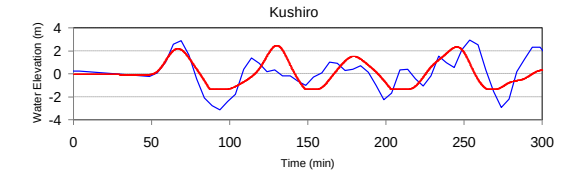
# 6 . Model Validation

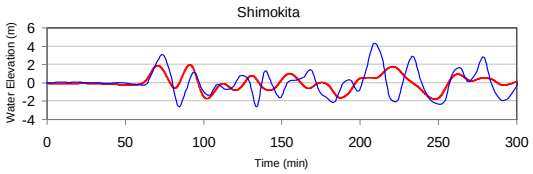


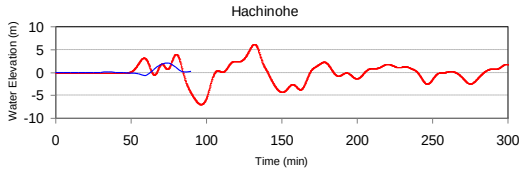

## (1) Model 1

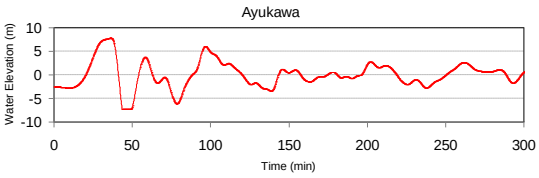


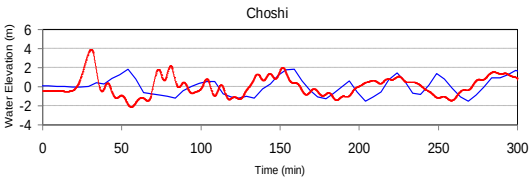
## (2) Model 2

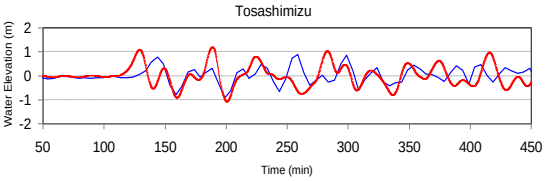


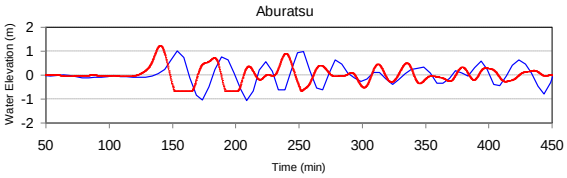



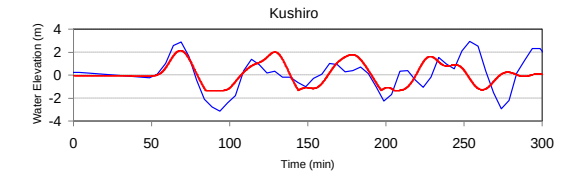



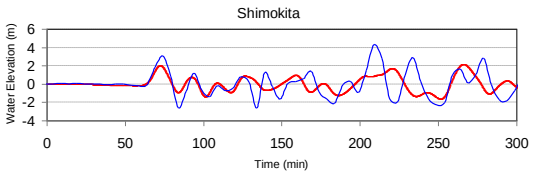



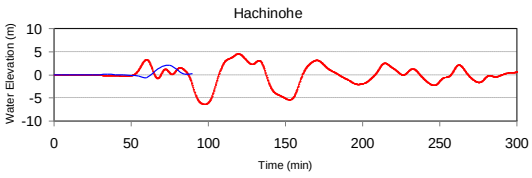



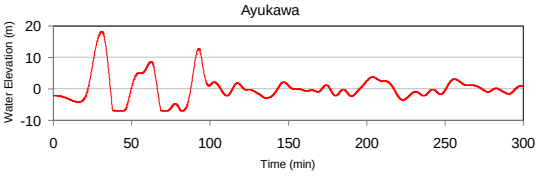



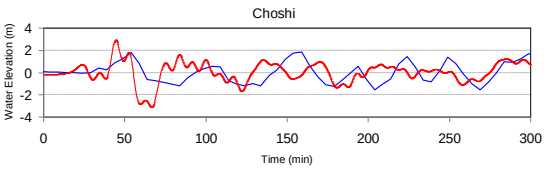

## (3) Model 3

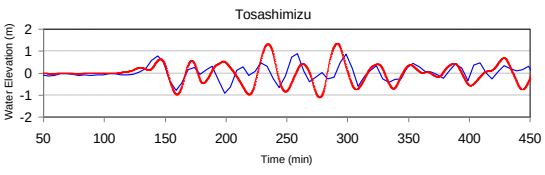


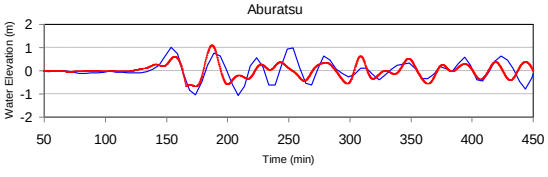



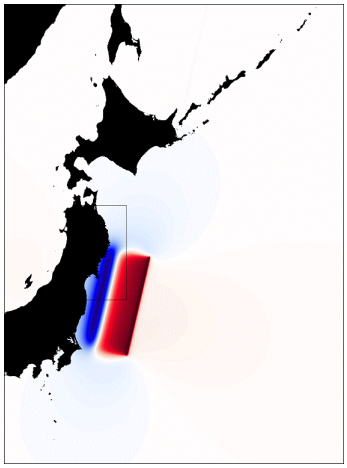



## 7. Tsunami propagation

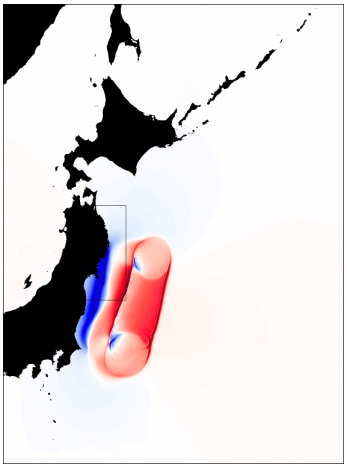
### (1) Model 1

・Snapshots of the water level

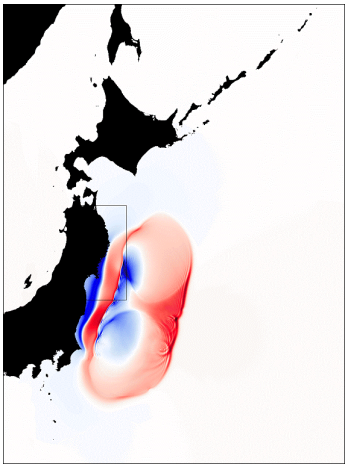
6min



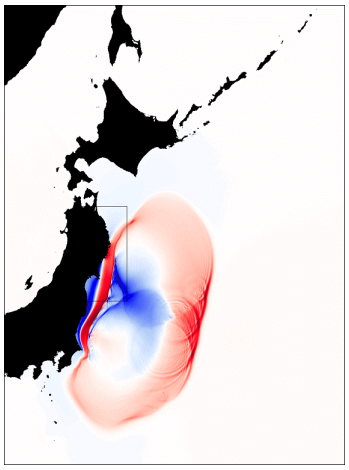
12min



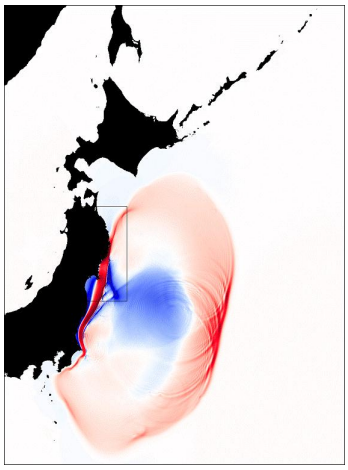
18min



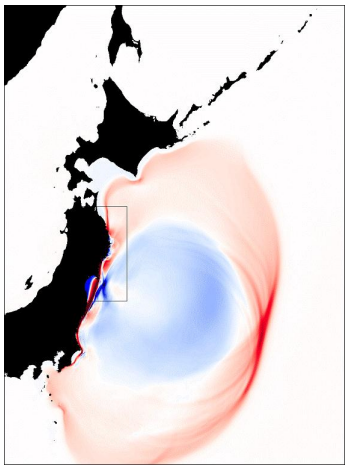
24 min

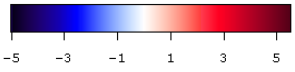


30 min

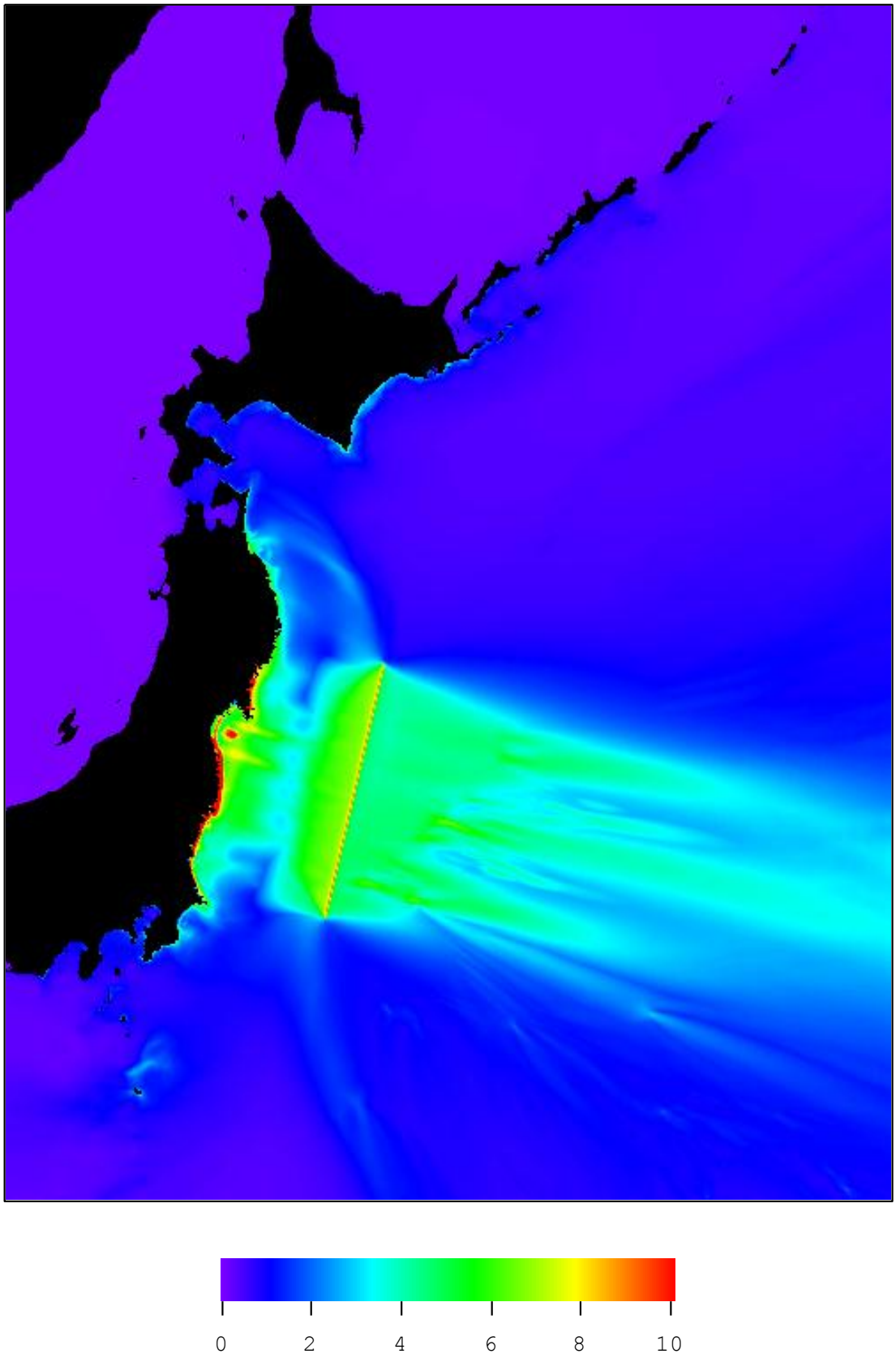


36 min





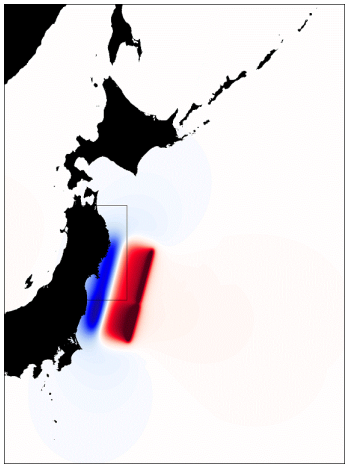
・Maximum tsunami height



(2) Model 2

・Snapshots of the water level

6min



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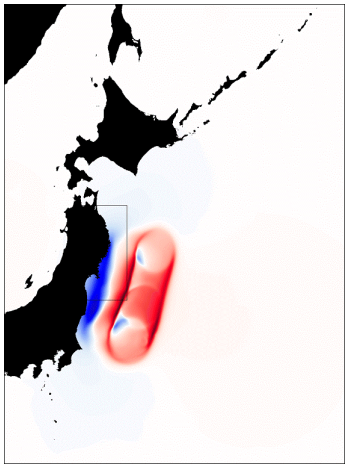

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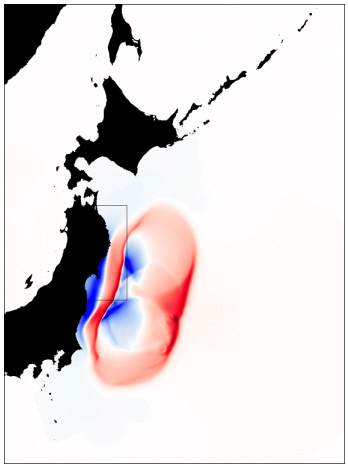

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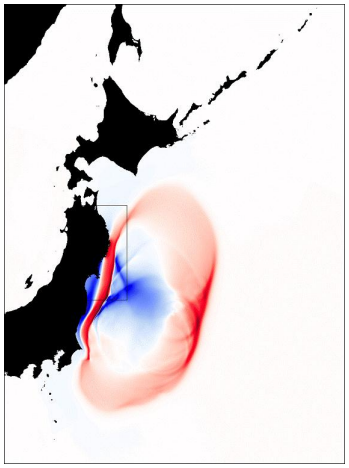

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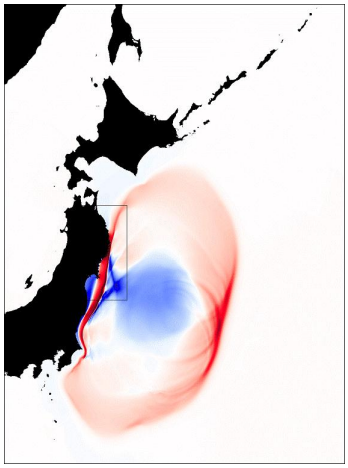
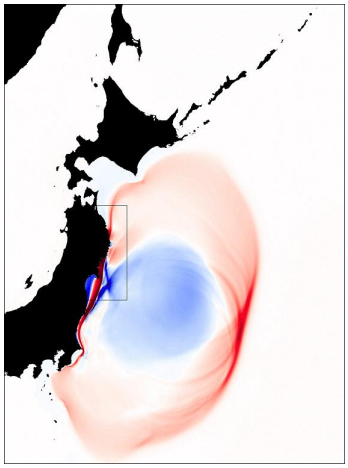
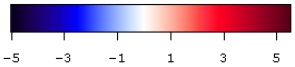
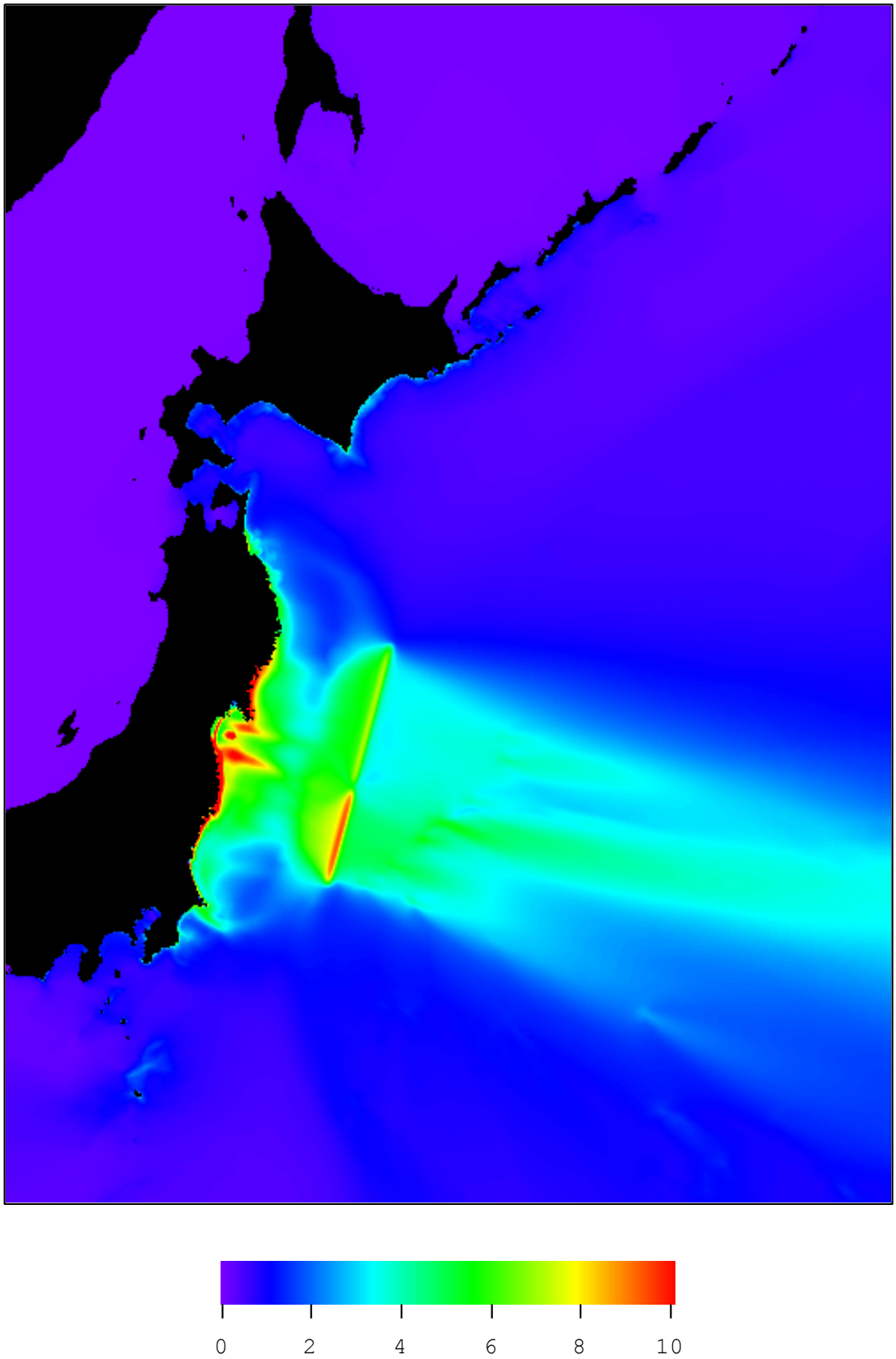


36 min





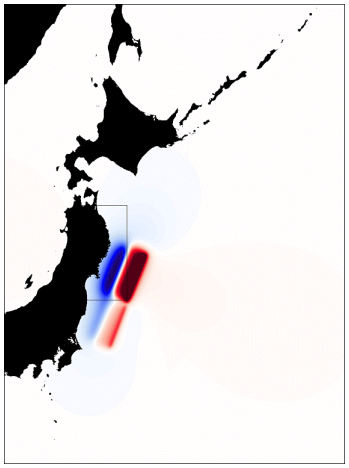
・Maximum tsunami height



(3) Model 3

・Snapshots of the water level

6min



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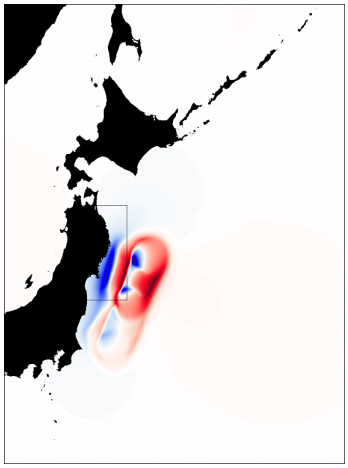

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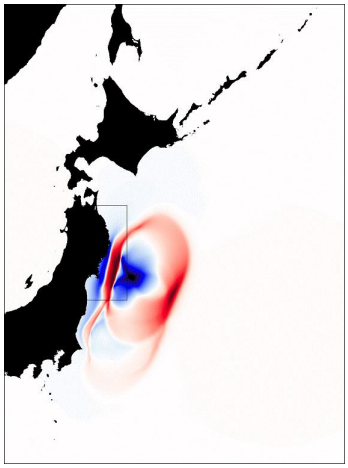

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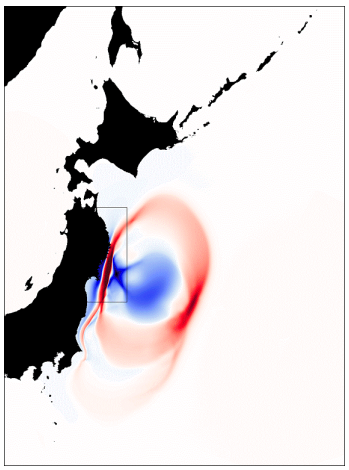
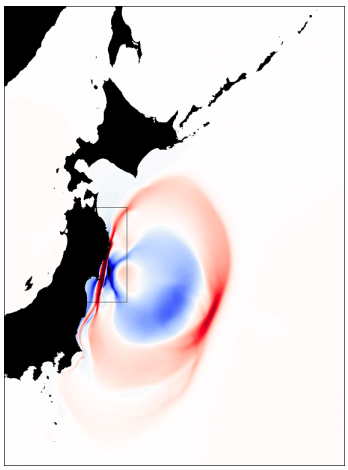


30 min



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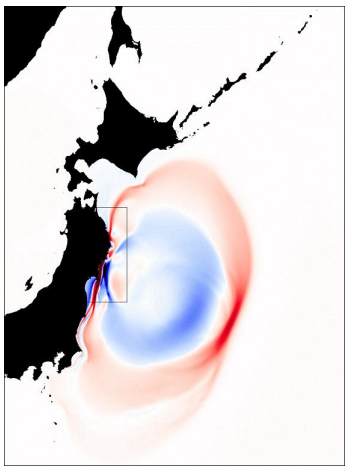
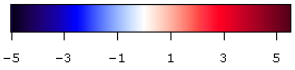
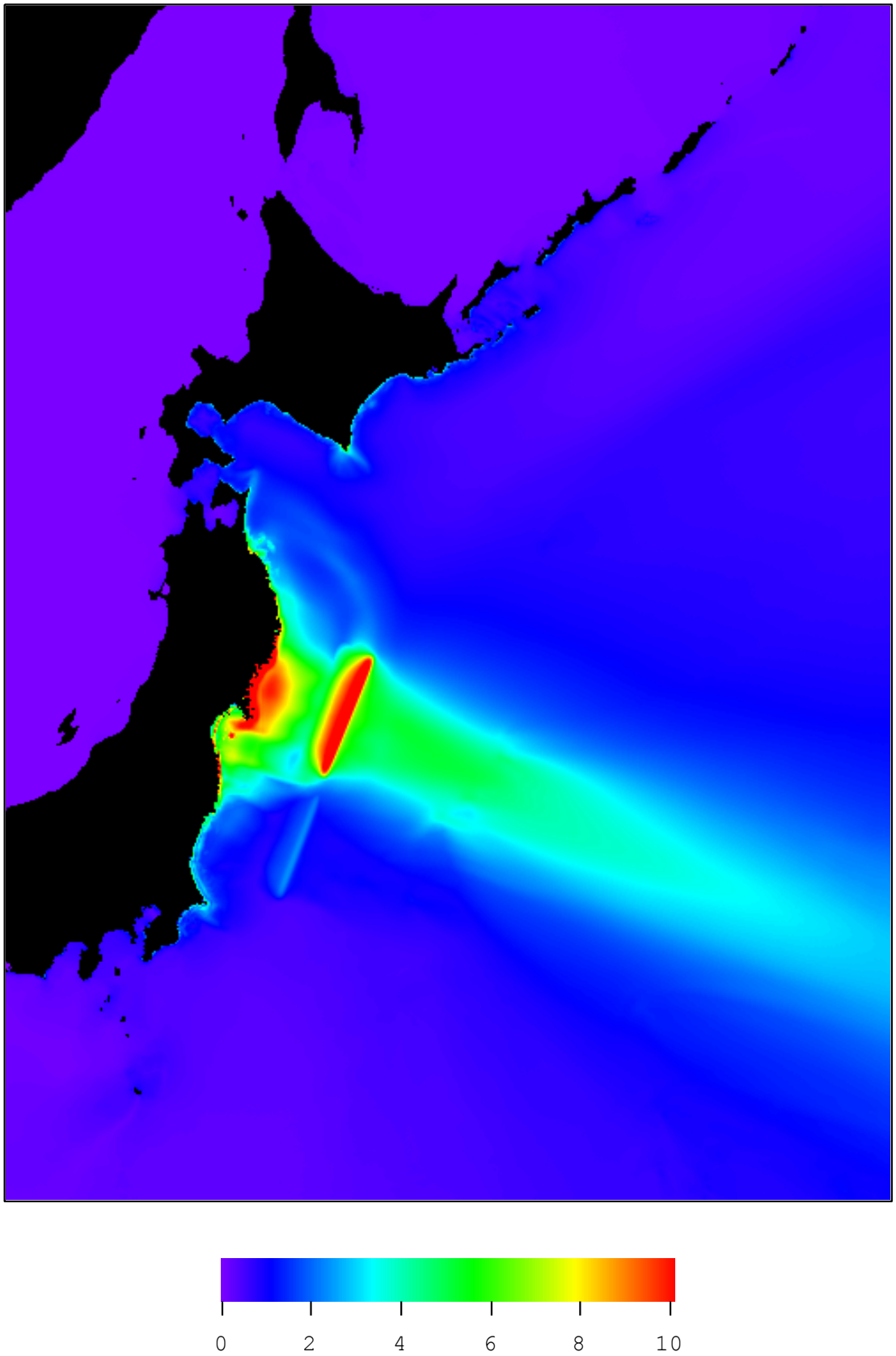


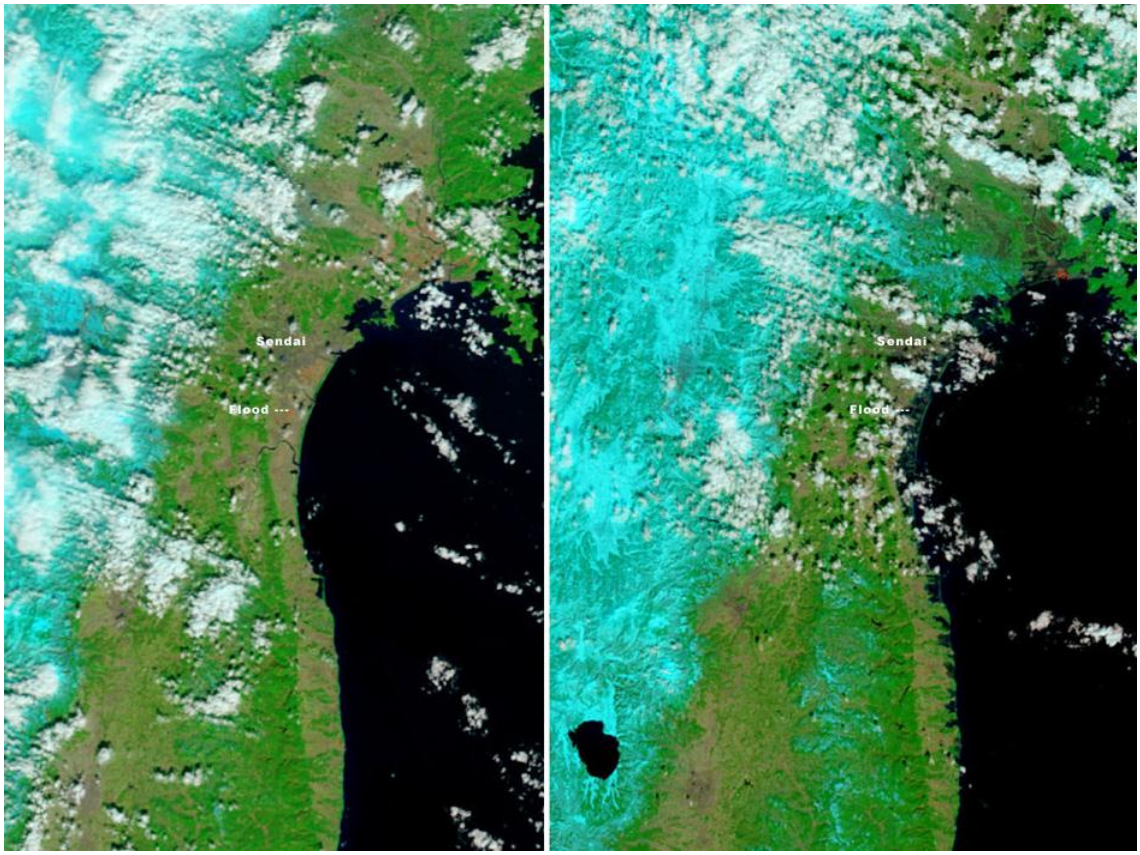


・Maximum tsunami height



9. Tsunami inundation in Sendai coast

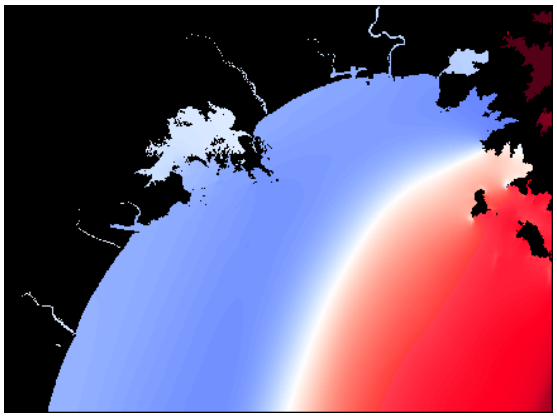
(1) Satellite image before and after the tsunami
(http://www.nasa.gov/multimedia/imagegallery/image_feature_1892.html)



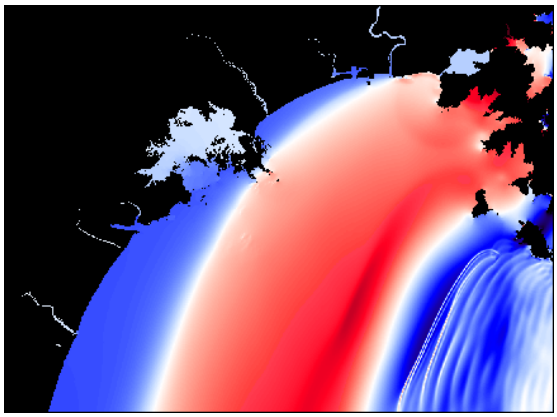
(2) Model 1

・Snapshots of the water level

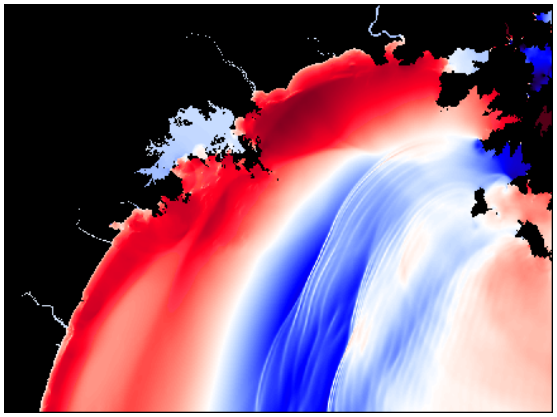
36 min



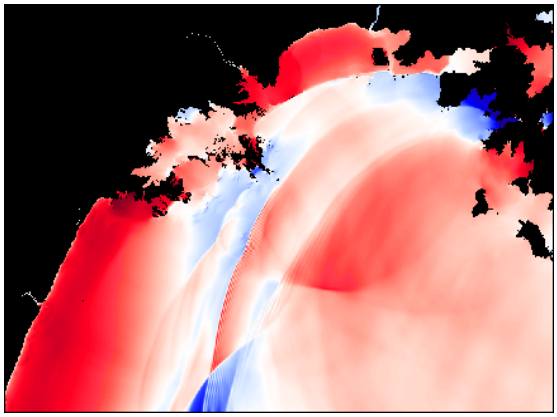
48 min



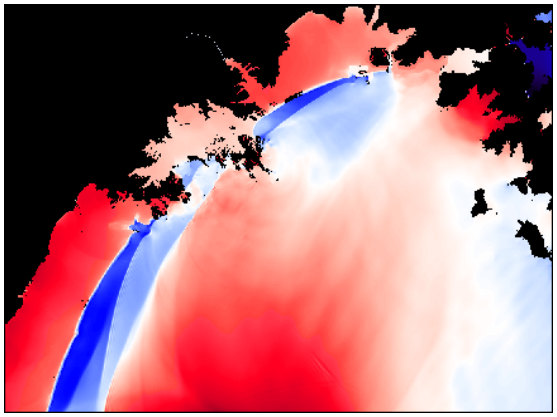
60 min



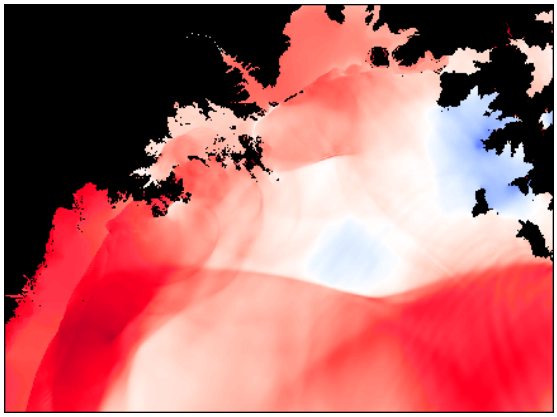
72 min



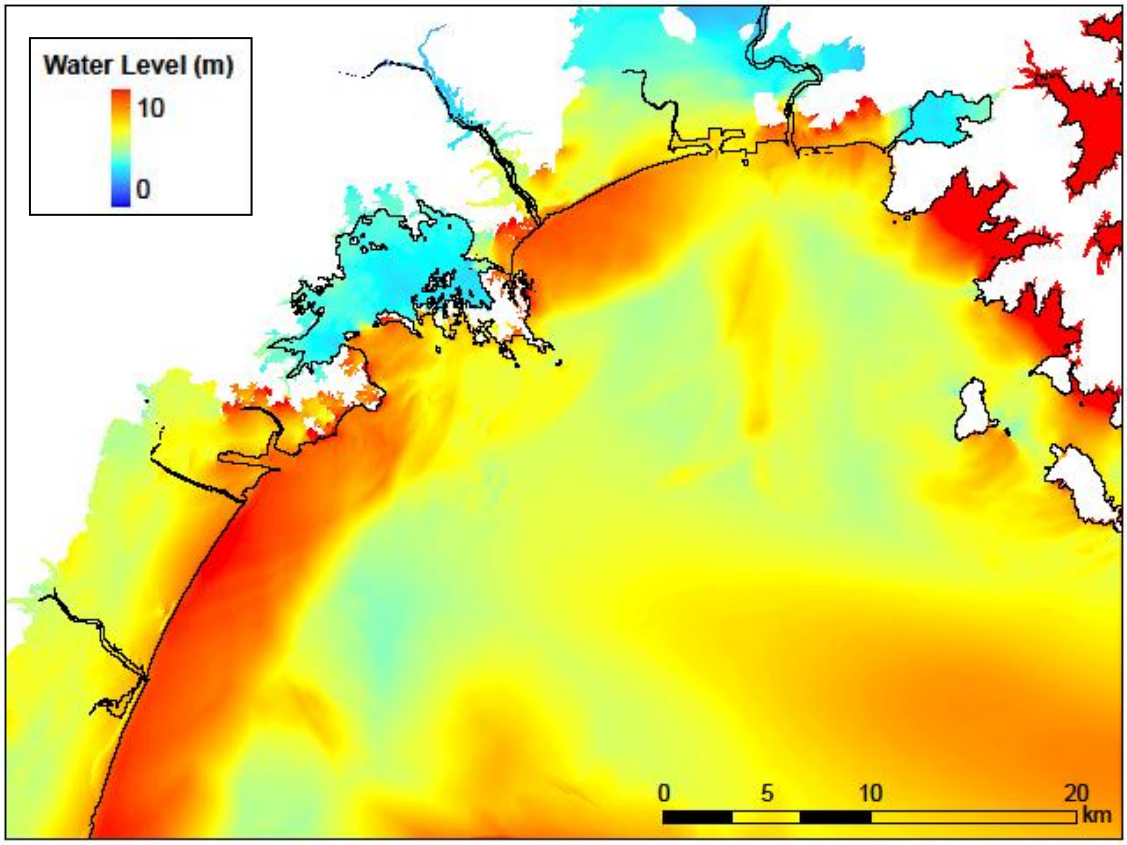
84 min



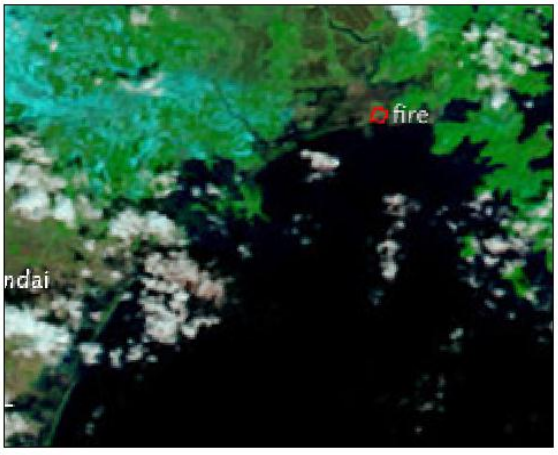
96 min

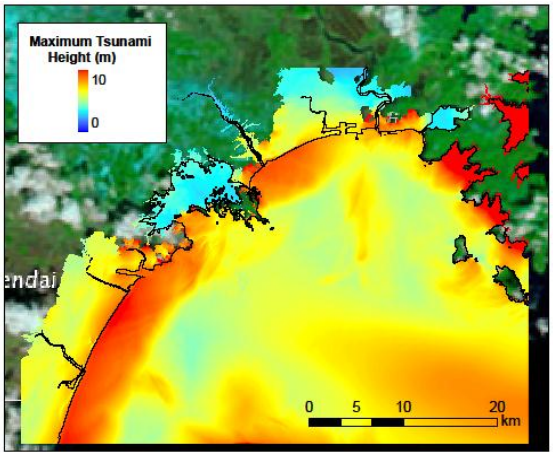


・Maximum tsunami height

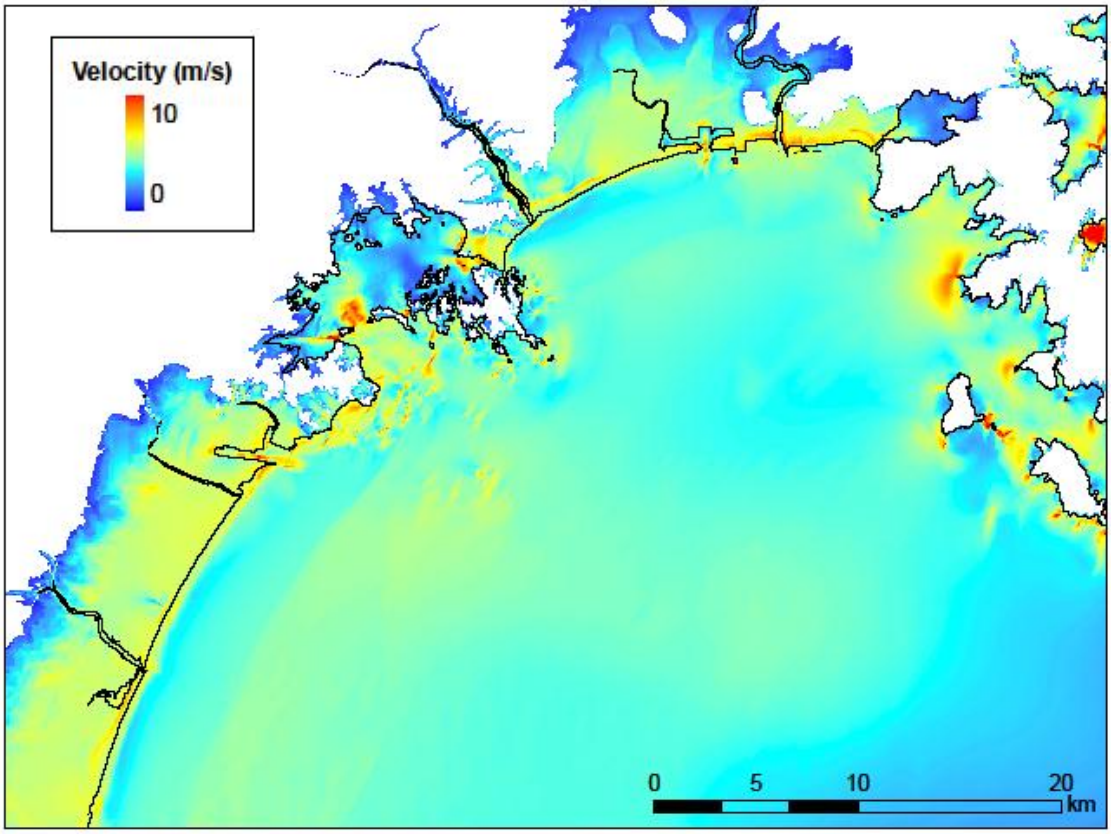



・Satellite image after the tsunami



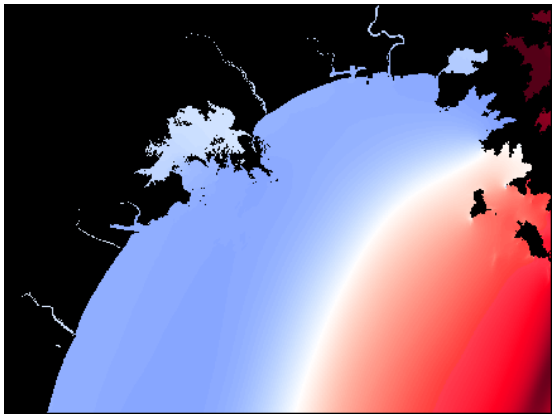
・Maximum tsunami velocity



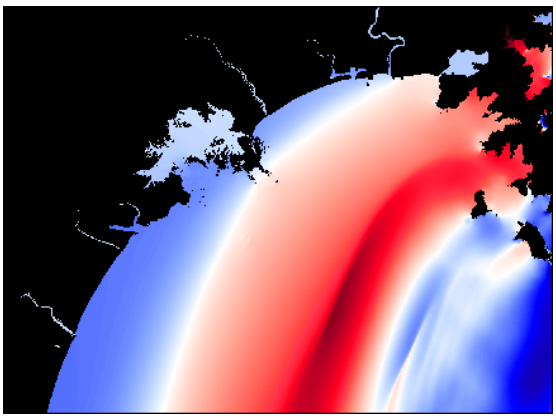
(2) Model 2

・Snapshots of the water level

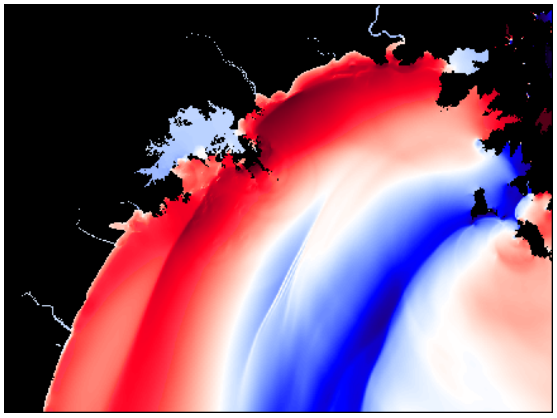
36 min



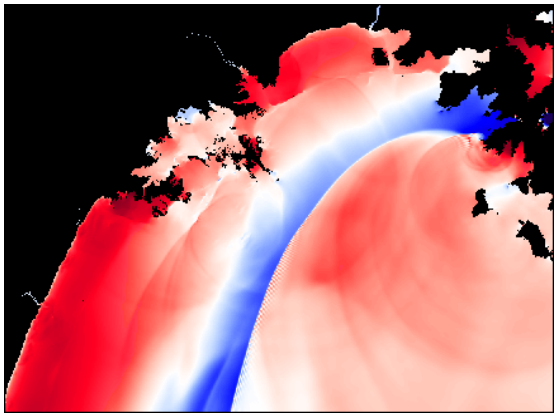
48 min



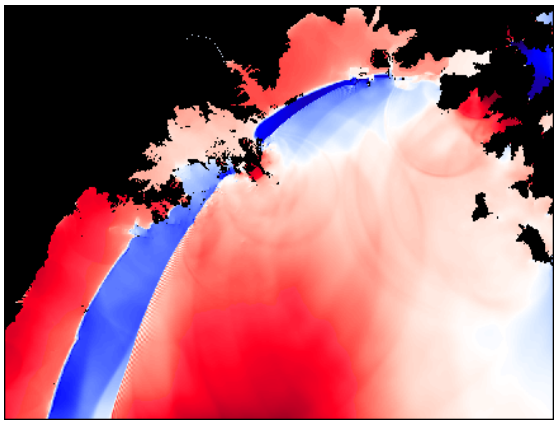
60 min



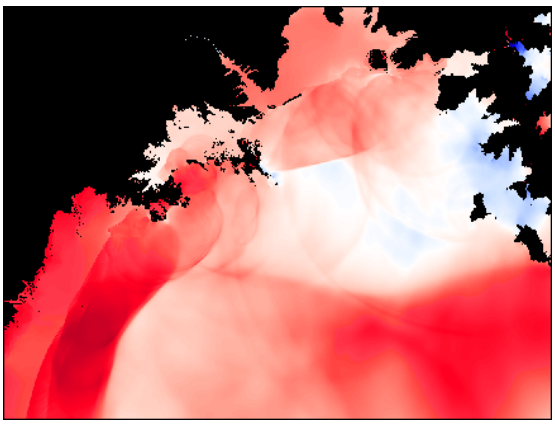
72 min



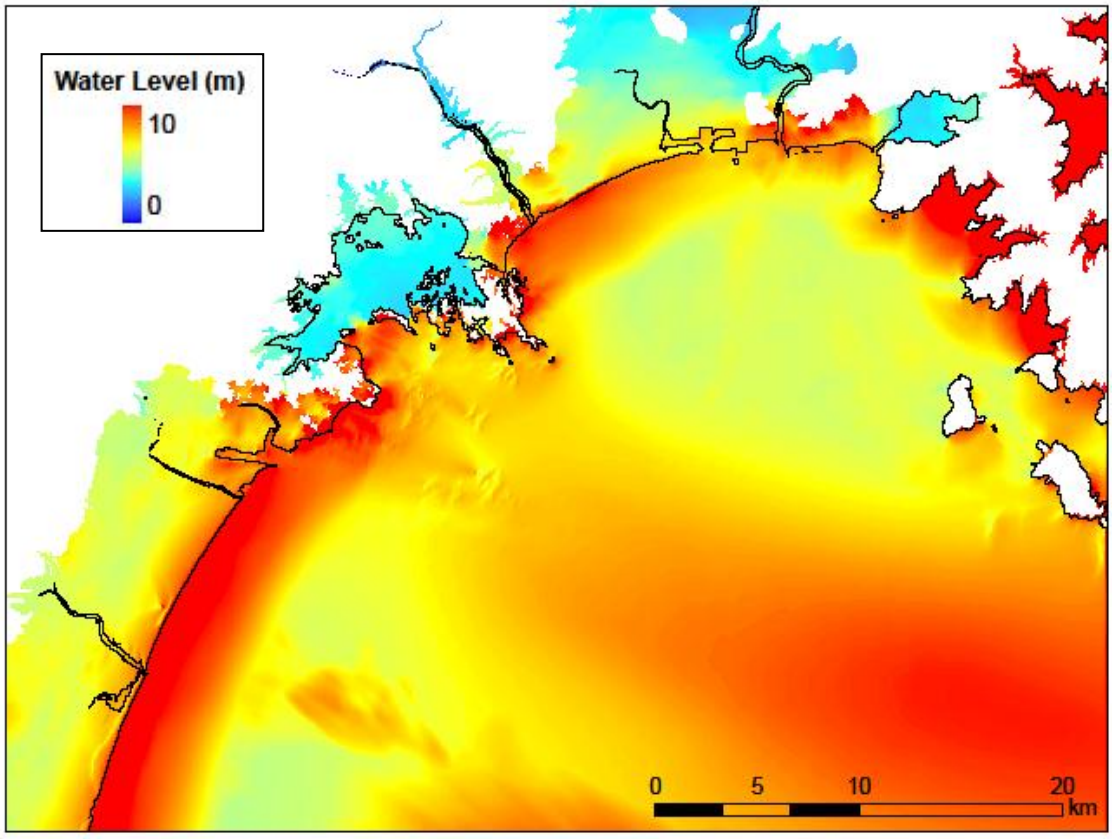
84 min



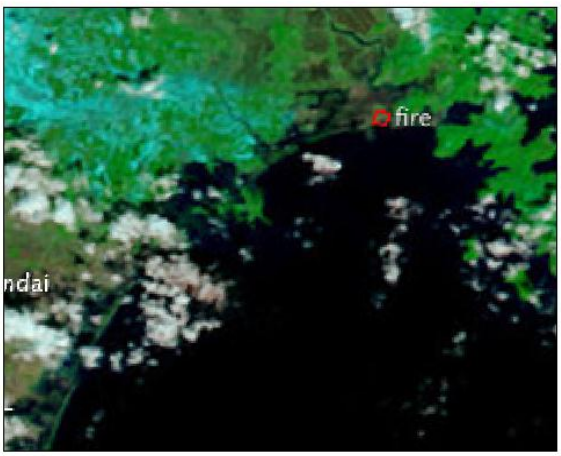
96 min

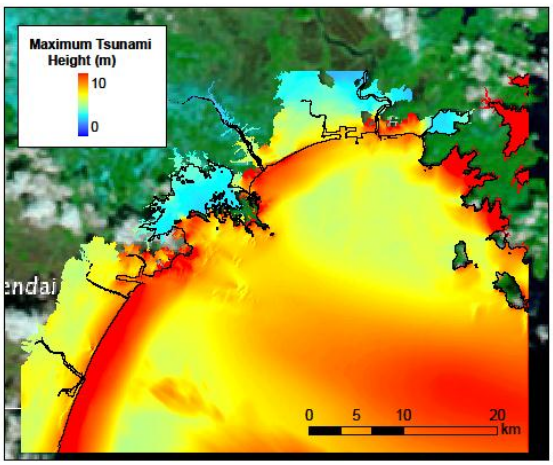


・Maximum tsunami height

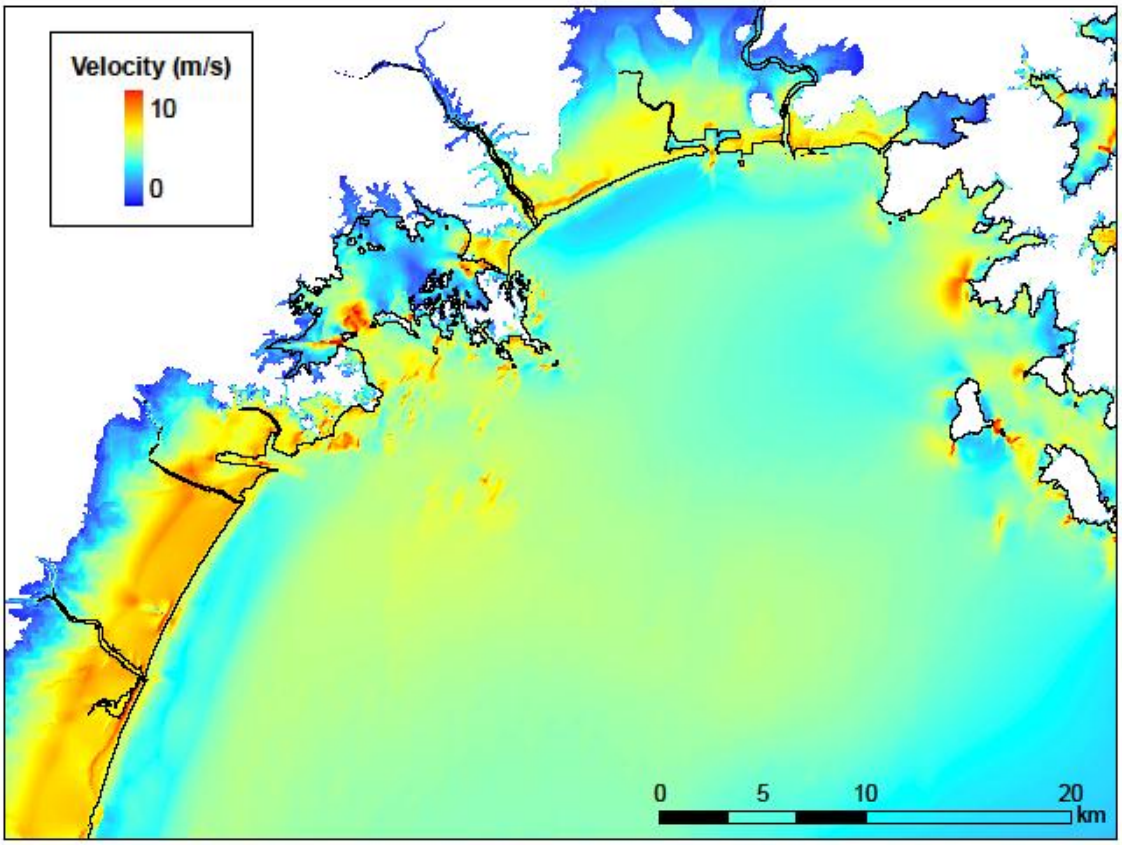



・Satellite image after the tsunami



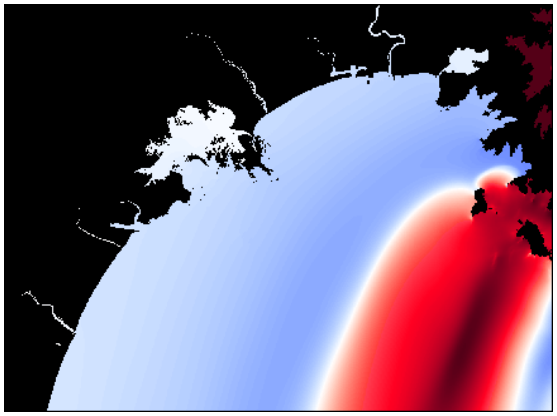
・Maximum tsunami velocity



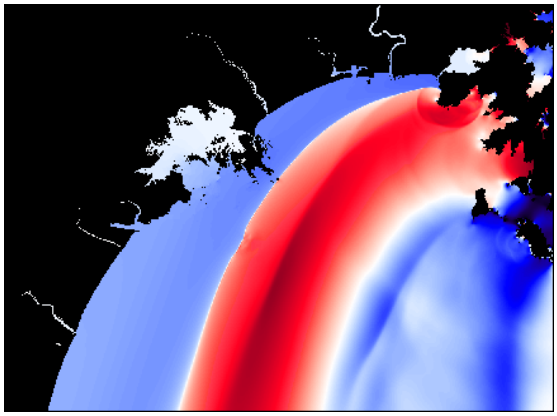
(3) Model 3

・Snapshots of the water level

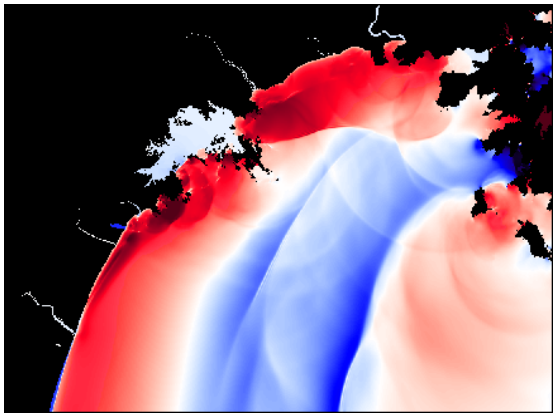
36 min



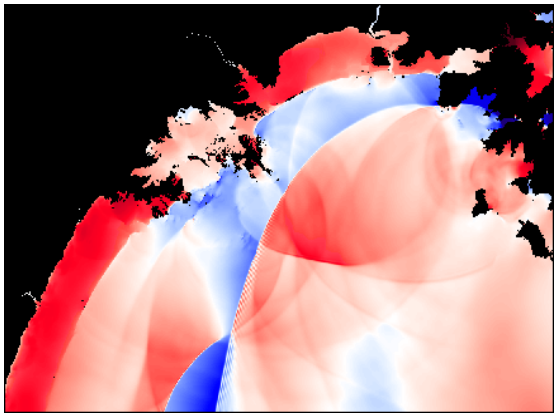
48 min



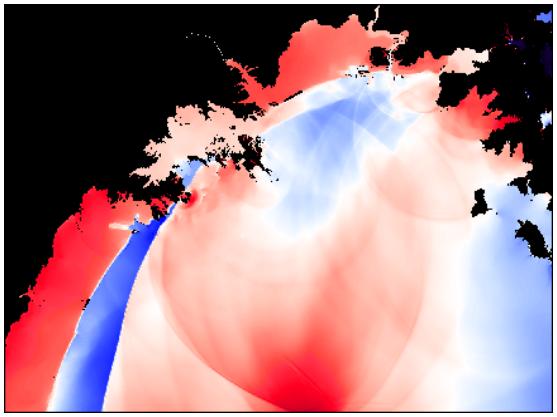
60 min



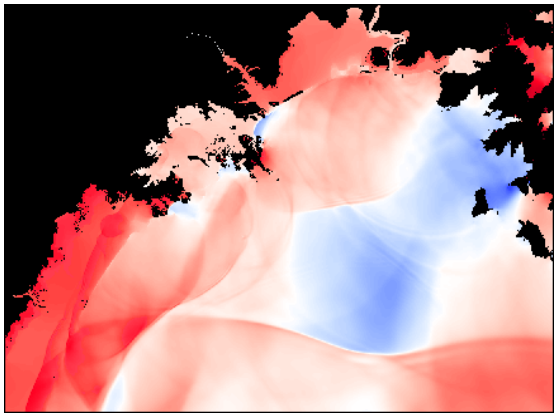
72 min



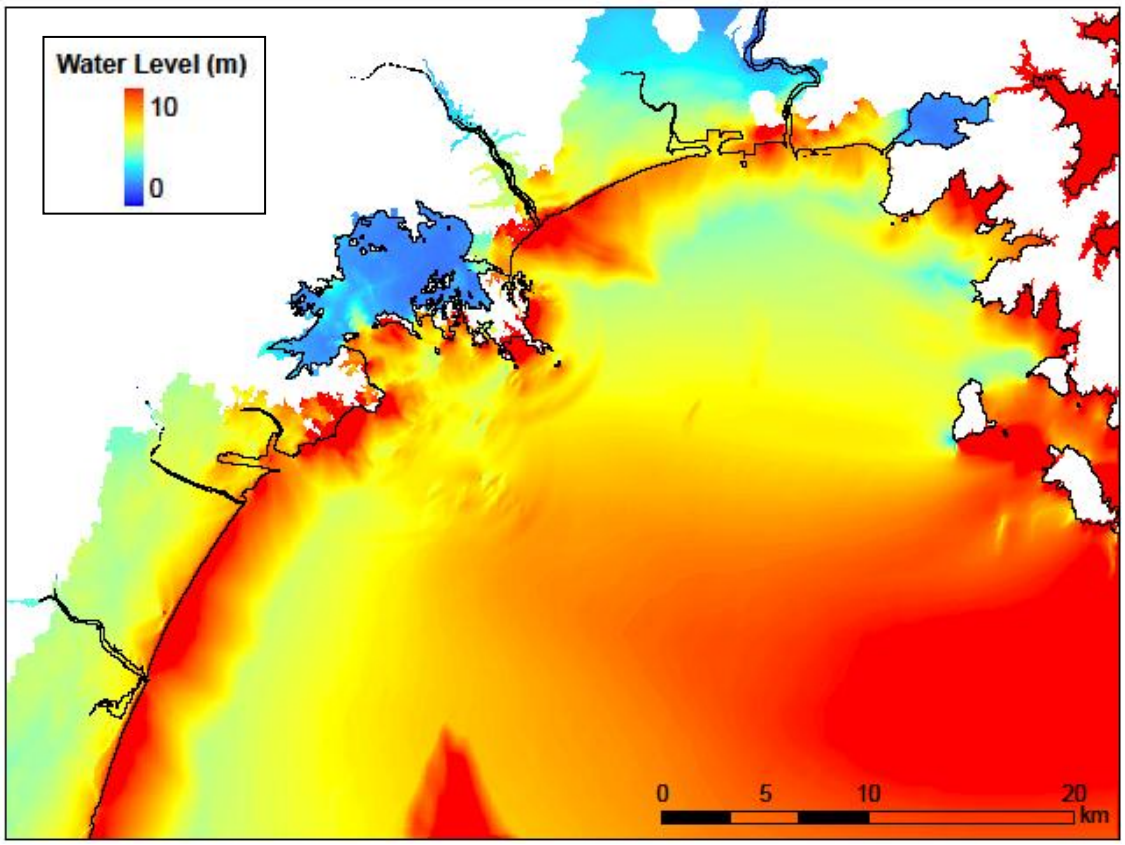
84 min



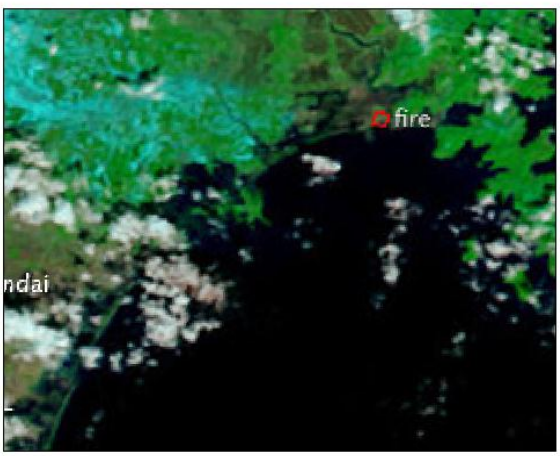
96 min

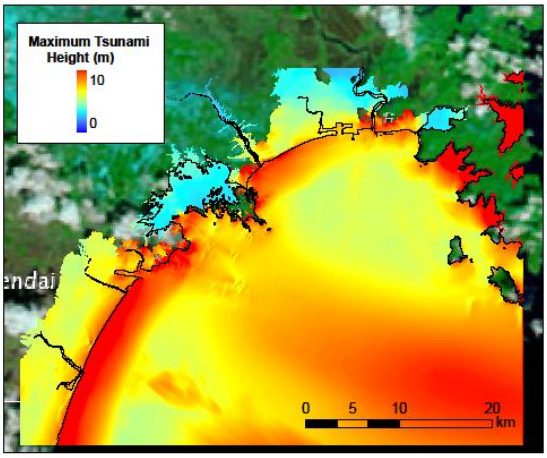


・Maximum tsunami height




・Satellite image after the tsunami



・Maximum tsunami velocity