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# Re-examination of the 1983 tsunami with the measured data in Korea

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## 1. Introduction

Tsunamis generated by earthquakes along the Japanese coast on the possible boundary between the Eurasian and the North American plates have caused significant damages to the Japanese and Russian coasts, and damage to the Korean coast as well. For example, at noon on the 26th May 1983, a huge earthquake occurred in the northern coast of Akita and the accompanying tsunami attacked the eastern coast of Korea, after propagating over the in the Japan (East) Sea. Especially at the Imwon port, the most significant damage; two persons killed and twenty houses damaged, was reported. In this paper, by the nuemrical simulation with the fine meshed data in Korea, we re-examine the tsunami along the eastern Korean coast, which was recently reported by NIDP (1999), providing with the detail damage and tsunami behavior.

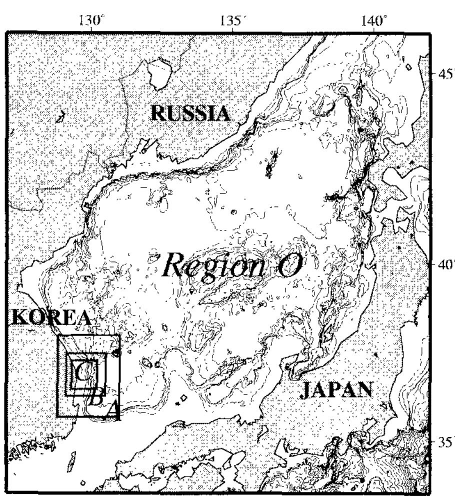



**Figure 1.** Nested grid system for the tsunami numerical model in the Japan (East) Sea.

## 2. Numerical Model

We constructed the nested grid system with the fine resolution bathymetry data shown in Figure 1 in order to simulate the whole process with generation, propagation and runup. The sub-regions are dynamically connected each other with spatial grid ratio of 1:3. The minimum grid size is 41 m at the Region C shown in Figure 1. Among the several proposed fault parameters for the 1983 Japan (East) Sea earthquake, the Aida Model-10 (Aida, 1984) is now selected to estimate the tsunami source, since the model is reported as the best to explain the tsunami heights along the Japanese coast.

## 3. Numerical Condition

Next, the governing equation and final sub-region along the Korean coast should be carefully determined. Now we assume the two different equations; linear long wave and shallow water theory, and sub-regions with 123 m and 41 m of spatial grid size. By comparing the calculated results with the measured, we will fix the best condition for the numerical model. The four cases with the different conditions are selected to be compared, shown in Table 1.

**Table 1.** Numerical conditions and calculated results of Aida's mean value and standard deviation for four cases (相田, 1977).

| | Numerical condition | Mean (K) | Standard deviation (κ) |
|---|---|---|---|
| Case 1 | Linear, dx=123m | 1.30 | 1.35 |
| Case 2 | Linear, dx=41m | 1.22 | 1.27 |
| Case 3 | Non-Linear, dx=123m | 1.34 | 1.40 |
| Case 4 | Non-Linear, dx=41m | 1.14 | 1.26 |

## 4. Numerical Results and Discussion

Numerical simulations for four cases are carried out and their results are shown in Figure 2. Although we can understand the distribution of the calculated tsunami heights, it is difficult to discuss the reliability for them. The Aida's parameter (相田, 1977); geometric mean value and standard deviation, is introduced to select the best condition for the model. The result is shown Table 1, suggesting the case 4 is the best of them, most close value of the mean to the unity and the smallest deviation.

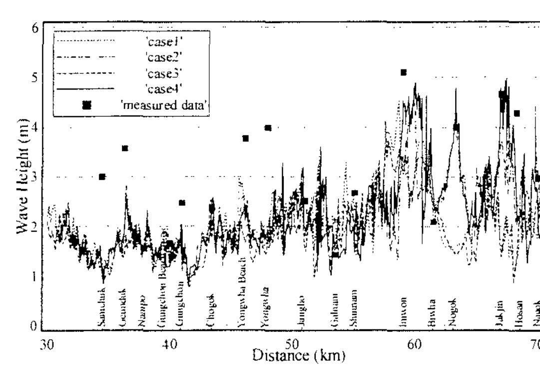
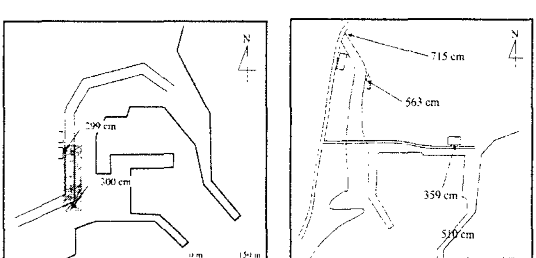



**Figure 2.** Comparison between measured tsunami runup heights and calculated tsunami wave heights along the eastern Korean coast for four cases.

**Table 2.** Comparison between measured runup heights and calculated wave heights of the 1983 tsunami along the east Korean coast for the case 4.

| Name of points | Mea. height (m) | Cal. height (m) | $\log_{10}$ (mea./cal.) |
|---|---|---|---|
| Samchuk Port | 2.99 | 1.61 | 0.269 |
| Geunduk | 3.56 | 2.65 | 0.128 |
| Namapo | 1.55 | 1.54 | 0.004 |
| Gungchon Beach | 1.65 | 1.56 | 0.025 |
| Gungchon | 2.46 | 2.05 | 0.080 |
| Chogok | 2.36 | 2.52 | -0.028 |
| Yongwha Beach | 3.76 | 2.44 | 0.188 |
| Yongwha Port | 3.99 | 2.02 | 0.296 |
| Jangho Port | 2.50 | 2.59 | -0.016 |
| Galnam Port | 1.42 | 1.55 | -0.037 |
| Shinnam Port | 2.67 | 2.44 | 0.039 |
| Imwon Port | 5.10 | 4.90 | 0.018 |
| Biwha Port | 2.09 | 2.32 | -0.046 |
| NogokPort | 4.00 | 3.98 | 0.002 |
| Jakjin Port | 4.65 | 4.71 | -0.005 |
| Hosan Port | 4.28 | 3.78 | 0.054 |
| Nagok Port | 2.97 | 2.79 | 0.027 |

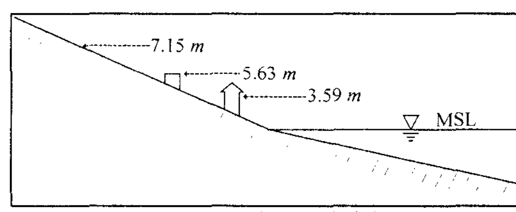
Table 2 shows the measured and calculated tsunami heights with the case 4, in which we can find 4 places with large discrepancies, more than 0.1 of value $\log_{10}$(measured/calculated); Samchuk port, Geunduk, Yongwha beach and Yongwha port. One of reasons for the discrepancy is the topography and bathymetry data that are more complicated and complex as to the resolution of 41 m grid size. Figure 3(a) shows the example of geometry and topography at Samchuk where we see the harbor facility such as break water and sea wall characterizing a local topography. Another reason is the boundary condition. We include the runup effect in the model, however the topography on the land is not enough to express the slope and land-use. Except for 4 places, we have good agreement with the measured, showing the appropriate models for the tsunami source and propagation of the 1983 tsunami.



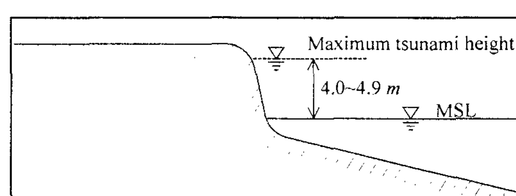

(a) Samchuk (b) Imwon

**Figure 3.** Measured tsunami runup heights at Samchuk and Imwon port.

The 1983 tsunami is the first one suffering heavy damage in the eastern coast of Korea since 17 century when the 1741 Oshima-ohshima tsunami attacked the coast. The people become now aware of the risk of tsunamis, which is, however, not evaluated scientifically. In the beginning of the risk evaluation, the process of the damage in Korea should be carefully studied. Imwon is the best place for tsunami research, because the most heavy damage was reported and detailed field observation was done by NIDP(1999), so that the data is available to study the behavior of the tsunami and discuss the damage. Figure 3(b) shows the geometry and measured runup heights at Imwon port where the tsunami runup heights of 3.59 m nearby the road along the coast, 5.1 m at the middle of the town and 7.5 m at the upper along the river. Figure 4 shows the runup heights and geometry along the line from the shallow sea to the inland and the calculated runup heights. Because of low accuracy of the land data in the simulation, we cannot compare the results inland, however can the data near the shore. The good agreement between measured and calculated heights along the shore is shown in Figure 4, indicating that the tsunami in the sea region is well reproduced by our model. The further analysis with the proper geometry and land-use on the land is required.




(a) Measured runup heights




(b) Calculated heights

**Figure 4.** Schematic explanations of tsunami measured and calculated heights at Imwon port.

## References

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