# A Characterized Fault Model estimated from the Tsunami height of the 2003 Tokachi-oki earthquake

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## 1. Purpose

NIED (National Research Institute for Earth Science and Disaster Prevention) has been conducting the project on the probabilistic tsunami hazard assessment along the coastline in Japan (Fujiwara et al., 2013, JpGU). We have already constructed characterized fault models and conducted probabilistic tsunami hazard assessment using the tsunami heights estimated by tsunami simulations along the Japan trench, Nankai trough and Sagami trough. We are currently conducting probabilistic tsunami hazard assessment along the Kuril trench. To carry out such an assessment, the framework of characterized fault models is needed to be effective. This can be verified if we confirm that a tuned characterized fault model reasonably reproduces the tsunami trace heights of historical earthquakes. To verify the validity and effectiveness of characterized fault models along the Kuril trench, we construct characterized fault models to reasonably explain the tsunami trace heights of the 2003 Tokachi-oki earthquake based on the tsunami receipt issued by the Headquarters for Earthquake Research Promotion (2017).

## 2. Method

Element faults with approximately 5km in length and 5km in width are configured on the surface of the Pacific plate beneath the Kuril trench to take account of fault slip on the curved surface of the subducting plate. The slip angle of each element fault is determined based on the direction of the relative motion between the Pacific plate and the North American plate. The source area is determined by delineating the source area of the 2003 Tokachi-oki earthquake shown in the long-term evaluation by the Headquarters for Earthquake Research Promotion (2004). A large slip area with 2 times of average slip amount is placed within the source area. The moment magnitude of fault models is assumed to be Mw8.3 according to the long-term evaluation, and the average slip amount was calculated using the corresponding seismic moment. These fault parameters are fixed, and the location, the aspect ratio and the area ratio of the large slip area are assumed to be unknown parameters, which are defined by the followings.

1. 3 large slip areas along the trench and 3 other ones in the direction perpendicular to the trench are placed around the area where relatively large slip of the 2003 Tokachi-oki earthquake is estimated by Tanioka et al.(2004) and Yamanaka and Kikuchi (2003).
2. The aspect ratios of the large slip areas are set to 0.9, 1.0 and 1.1 based on the slip distribution of the 2003 Tokachi-oki earthquake estimated by Tanioka et al.(2004) and Yamanaka and Kikuchi (2003).
3. The area ratios of the large slip areas with respect to the source area are set to 25%, 30% and 35% based on the slip distribution of the 2003 Tokachi-oki earthquake estimated by Tanioka et al.(2004) and Yamanaka and Kikuchi (2003).

Forward modeling is performed for the 81 characterized fault models in total.

## 3. Evaluation of the reproducibility of the models

The residual sum of squares is used to evaluate the reproducibility of the models. The tsunami height data of the 2003 Tokachi-oki earthquake were obtained from Japan Tsunami Trace database (Tohoku University, http://irides.tohoku.ac.jp/ project/tsunami-db.html) and selected according to Korenaga et al. (2013). The model with the smallest residual sum of squares is located at the western edge of the source

 

area. The area ratio of the large slip area of the selected model is 25% and the aspect ratio is 0.9. The geometric average K and geometric standard deviation $\kappa$ for the selected model are estimated to be 0.98 and 1.48, respectively. The selected model is considered to be a characterized fault model to reasonably explain the tsunami trace heights of the 2003 Tokachi-oki earthquake. To verify the effectiveness of characterized fault models, we are planning to construct characterized fault models to reproduce tsunami trace heights of historical earthquakes in the various regions around Japan.

This study is conducted as a part of the research project “Research on the hazard risk assessment for natural disaster” at NIED.

Keywords: 2003 Tokachi-oki earthquake, Characterized fault model, Long-term evaluation

 