

Relative plate motion on plate interface considering intra-plate deformation

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1. Introduction

Evaluating earthquake potential requires knowing relative plate motion on the plate interface. Generally, several previous studies used the relative plate motion velocity, which is rigid plate motion using Euler pole. Actually, subducting plate has intra-plate deformation, such as bending-unbending, uniaxial elastic deformation, isotropic compression and so on. In this study, we estimate relative plate motion velocity on the plate interface with intra-plate deformations.

We proposed the estimating method of the relative plate motion velocity on the plate interface with the intra-plate deformation (Sasajima and Ito, 2012, Meeting of the geodetic society of Japan). In this study, we present spatial distribution of relative plate motion velocity on the Pacific plate interface with intra-plate deformation.

2. Method

A changing of relative plate motion velocity on the plate interface relates strain rate with intra-plate deformation. We describe quantitatively strain rate due to the intra-plate deformation. In order to describe quantitatively strain rate, we use an orthogonal curvilinear coordinate system, that X-axis is along the direction of subducting plate and Z-axis is orthogonal of X-axis. In this study, we consider three types of intra-plate elastic deformations as follow

- [1] Bending-unbending
- [2] Uniaxial tension or compression along direction of subducting plate motion
- [3] Isotropic compression

So, we convert strain rate to plate motion velocity change, we obtain the velocity changing due to intra-plate deformation.

3. Result

We adapt this method to the subducting Pacific plate beneath Tohoku region. In consequence, we reveal that the estimated subducting velocity on the plate interface is about 10 ~ 20 percent faster than rigid plate motion velocity at large curvature of plate interface. Especially, the estimated subducting velocity is about 25 percent faster than rigid plate motion velocity at eastern Hokkaido region. The subducting Pacific plate at eastern Hokkaido is stretching along dipping direction. Moreover, our result is well consistent with the extensional velocity of outer-rise region, which is derived from displacement rate of normal fault [Iwabuchi, 2012, Zisin,65-1,9-20].

{Acknowledgement}

We use the JODC-Expert Grid data for Geography -500m and ETOPO1 produced by NGDC. Thank you very much for their courtesy.

Fig. Color contour is relative velocity of Pacific plate to North-America plate considering intra-plate deformation. Initial rigid rotation is given by ITRF2005. Blue solid line denotes the Japan Trench. Red solid line is deeper limit line which inter-plate earthquake occurs [Igarashi, 2001]. Black solid line is denotes the East-Western margin of subducting Phillipine Sea Slab [Uchida et al., 2009]

Keywords: Plate tectonics, Subducting velocity, Subduction zone, Bending-Unbending, Intra-plate deformation

SCG66-P03

Room:Convention Hall

Time:May 24 16:15-17:30

