

Geologic versus geodetic uplift rate in Kii Peninsula: implications from geodetic data over the whole earthquake cycle

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It is well known that cyclic crustal movement occurs along plate subduction zones associated with megathrust earthquake cycles. However, the role of such crustal deformation cycle in producing long-term geologic crustal movement is not well understood. Along the southern coast of Kii Peninsula, a long-term uplift is inferred based on raised marine terraces and uplifted intertidal fossil assemblages. In this area, Shishikura et al. (2008) pointed that the long-term uplift pattern is different from the coseismic uplift pattern associated with the 1944 Tonankai and the 1946 Nankai earthquakes. In such a comparison, however, we need to take not only the coseismic change but also contribution of interseismic deformation into account.

We reconstruct the spatio-temporal distribution of vertical crustal movement in Kii Peninsula for the whole earthquake cycle along the Nankai Trough (1895-2010) based on leveling as well as tidal data using a geodetic inversion analysis with ABIC developed by Fukahata et al. (1996) and Sagiya (2000). We express spatio-temporal distribution of crustal deformation by a linear combination of basis functions in three dimensions (one in time and two in space). As a result, it is clearly demonstrated that there exists a residual uplift after the completion of one earthquake cycle in the southernmost part of Kii Peninsula. The residual displacement pattern is significantly different from the coseismic one. The cumulative uplift after the completion of one earthquake cycle is largest at Arafune-zaki, the southeastern side of the peninsula, and decreases to the northwest, while the largest coseismic uplift was observed in the southern tip (Kushimoto) and the tilt direction is northward. The amount of the maximum residual uplift is about 20cm and the average uplift rate over one earthquake cycle is 1.7mm/y. This uplift rate is consistent with the geologic value of 1-2mm/y estimated by Shishikura et al. (2008). Thus the result indicates that contribution of the residual uplift to the long-term uplift over earthquake cycles is significant and no episodic uplift event may be necessary in southern Kii Peninsula.