

Reevaluation of horizontal crustal strain in the Tohoku District: a possible scale error in the baseline survey

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One of the causes of underestimating seismic potential of the 2011 Tohoku-oki earthquake (M9.0) was that E-W contraction in the Tohoku district was not clear in the strain distribution for 100 years. For the calculation of strain distribution, the triangulation survey results in the Meiji era was used as the reference coordinates. However, in the triangulation survey, only direction measurements among benchmarks are conducted, and the result may contain significant scale errors. The scale of the triangulation network is defined by baseline surveys. 15 baselines of 3-10 km length were directly measured using a steel baseline rod before the direction measurement. In the Tohoku district, they measured two baselines, the Shionohara baseline in Yamagata prefecture, and the Tsurunokotai baseline in Aomori prefecture. The original record of Shionohara baseline (5172m) exists in the archive of the Geospatial Information Authority of Japan. The maximum difference among 4 repeated measurements is only 14mm, implying a scale error of at most 2ppm. On the other hand, I found that the baseline was measured in May-June of 1894. On October 22, 1894, the Shonai earthquake (M7.0) occurred about 30km to the west of the baseline. A fault model calculation implies that the baseline might be elongated more than 50mm due to the coseismic deformation. In such a case, the scale of the triangulation network for the whole Tohoku district may be underestimated by about 10ppm, which could conceal the tectonic signal of E-W contraction in the strain distribution during 100 years.

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