Tectonics in East Asia - Simulation based on unified GPS displacement data - Part II

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Tapponnier and Molnar [1976] advocated an indentation theory for the tectonics of East Asia, which explains geological structures well such as distribution of strike-slip faults. The following studies have been divided into two schools: a rigid body-block motion model and a continuous deformation model. However, the ultimate conclusion is not reached yet. In order to elucidate the tectonic motions in East Asia, many researchers have recently derived GPS velocity fields in the area. We first combined published GPS velocity field, as well as velocities that were obtained by our own GPS measurements. Unified velocity field with respect to the stable Eurasian continent shows that the deformation spreads out in a fan shape near the Himalaya. Marked deformation is seen in the east of Tibet, where Sichuan-Yunnan tectonic province shows a magnificent rotation of velocities from east to south, and it further rotates in the north of Thailand. As a whole, it seems that the motion in the Asian continent is governed by blockwise rigid body movements, though internal or along-fault deformations might be significant.

We then modeled the velocity field by a combination of rigid block rotation, elastic deformation due to slip deficit and intra-block strain component. Segregation of components may enable us to see how the collision of the Indian plate affects the velocity field in East Asia. Result shows that relative motion of each rigid block spread out in a fan shape near the Himalaya reflecting integrated velocity field. This suggests that horizontal push by the Indian plate may be a controlling force for the deformation in East Asia. However, the Amurian plate shows southward movement suggesting that the Amurian plate is not be affected by Indo-Eurasia collision.

The residual velocities at each GPS site are generally very small. Yet significant intra-block strain component remains in the northwest of Tarim basin, Himalaya, Sichuan - Yunnan tectonic province, the area of 40 degrees north latitude where south of the Amurian plate. These areas are consistent with high straining areas in a global strain rate map obtained by Kreemer et al. [2003].

Since the study area of East Asia is so large that the effect of sphericity may not be negligible. Ideally, the inversion software should be written in the spherical coordinate system. Sun et al. [1996] formulated for calculating surface deformation due to dislocation embedded in a spherical earth. Fu and Sun [2006] adopted the theory to calculate global co-seismic displacements caused by the 2004 Sumatra-Andaman earthquake. We will use Sun et al.'s dislocation theory to evaluate the sphericity of the earth.