Unified Inversion Analysis of Geodetic Data in the Kanto Region: Concepts, Results and Interpretation

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The Kanto region, central Japan, is in a complex tectonic setting, where the Pacific plate is descending beneath the North American and Philippine Sea plates, and the Philippine Sea plate is descending beneath the North American plate and running on the Pacific plate at its eastern margin. Furthermore, the Philippine Sea plate is colliding with the mainland of Japan at the northern end of the Izu peninsula. Because of such a complex tectonic setting, crustal movements in the Kanto region are manifold from instantaneous coseismic movements to long-term tectonic deformation. The essential cause of these crustal movements is in mechanical interaction at the interfaces between the North American, Pacific and Philippine Sea plates. With a realistic 3-D plate interface model (CAMP standard model) we applied an inversion method based on a Bayesian model with direct and indirect prior information to various time-scale geodetic data, and estimated the coseismic slip distribution of the 1923 Kanto earthquake, the interseismic slip-deficit rate distribution, and the slip distribution of the episodic off-Boso slow slip events (Noda, Hashimoto & Matsu'ura, 2006). From these inversion results we revealed that the North American-Philippine Sea plate interface can be partitioned into four regions with different stress accumulation/release modes; that is, a) steady slip without stress accumulation in the northern Boso peninsula, b) intermittent stress release by a series of slow-slip events east off the Boso peninsula, c) sudden stress release by large interplate earthquakes along the northern Sagami trough at the recurrence interval of 200 years, and d) tectonic stress release by inelastic crustal deformation around the Izu-Mainland collision zone. We try to interpret such difference in stress accumulation/release modes as difference in the basic parameters (characteristic weakening displacement and characteristic healing time) of the slip- and time-dependent fault constitutive law (Aochi & Matsu'ura, 2002). The properties of seismic asperities (strength restoration rates, stress accumulation rates, and earthquake recurrence intervals) strongly depend on relative plate velocity, asperity size, and the fault constitutive parameters. Therefore, taking into account difference in size and fault constitutive parameters between the three asperities found through the inversion analysis, we can rationally explain the occurrence of the episodic slow-slip events with the interval of several years, the Taisho-type interplate earthquakes with the recurrence interval of several hundreds years, and the Genroku-type interplate earthquakes with the recurrence interval of several thousands years.