Quantitative Evaluation of the AIST Groundwater-Level Observation Network to Detect Preslip of the Anticipated Tokai Earthquake

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Great earthquakes about magnitude 8 or more have been occurred along the Nankai and the Suruga trough, off central to southwest Japan, at intervals of 100 - 200 years (Ando, 1975). Recent events were the 1944 Tonankai (M8.0) and the 1946 Nankai (M 8.1) earthquakes along the Nankai trough after 90 - 92 years from the 1854 Ansei Tokai (M8.4) and the 1854 Ansei Nankai (M8.4) earthquakes, whereas no earthquake occurs along the Suruga trough after 1854. This anticipated earthquake is called Tokai earthquake, and the Japanese Government has been continuing an earthquake prediction program for the anticipated Tokai earthquake since 1978.

Japan Meteorological Agency (JMA) is responsible for the prediction of the anticipated Tokai earthquake, and has been monitoring crustal deformation using about 20 borehole strainmeters in the Tokai region. Geological Survey of Japan, the National Institute of Advanced Industrial Science and Technology (GSJ, AIST) has been monitoring groundwater levels at 4 - 15 wells since 1977 to contribute to the prediction of the Tokai earthquake.

Kato and Hirasawa (1999) proposed possible crustal deformation prior to the anticipated Tokai earthquake. They showed significant aseismic sliding (preslip) immediately before the Tokai earthquake using rate- and state-dependent friction laws and numerical simulations. They also inferred volumetric strain rate at the several JMA's borehole strainmeter sites, and made comparison with the noise levels of the strainmeter estimated by Kobayashi and Matsumori (1999). They concluded that the significant crustal deformation anomalies due to the preslip could be detected the borehole strainmeters by about one day before the Tokai earthquake.

In order to conduct quantitative evaluation of detectability of the AIST groundwater-level observation network to the preslip, we firstly investigate the noise levels in groundwater levels of one, three and 24 hours' differences in seven wells located in the Tokai region using the same definition of the noise level as that for the strainmeter data in JMA. We conclude that the minimum strain-converted noise level of the groundwater level is as large as the noise levels of JMA strainmeters, and the maximum is larger by a factor of five on the noise level of the strainmeters.

After that, we evaluate an ability of seven AIST groundwater observation wells to detect the preslip prior to the Tokai earthquake. As a result, we can detect anomalies of groundwater levels due to the M6.5 preslip underneath the land at the two of the seven wells 1-17 hours prior to the Tokai earthquake.