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Presentation Title:
Impact of a Massive Earthquake on Groundwater Level

Abstract :

Not only whole Japanese Archipelago but also many Southeast Asian countries are in serious peril of severe earthquakes as witnessed in the past, because it is situated in the Circum-Pacific Seismic Zone caused by the plate tectonics. Most of the megacities in Japan as well as other Southeast Asian countries are located on the alluvial plains where the ground is very soft and especially vulnerable for groundwater related disasters like landslides and liquefactions. Since groundwater is a crucial water resource for most of the cities around the world, it is very important as the first step to understand and evaluate the impact of a massive earthquake on the groundwater levels for developing disaster risk deduction countermeasures for land subsidence and liquefaction. However, so far, almost no such studies have been carried out mainly because no densely distributed groundwater level observations were available at a short time interval when a huge earthquake occurred.

In Tokyo Metropolis, the hourly groundwater levels have been observed at 42 sites sine 1952 in order to mainly monitor the land subsidence situation. When the Great East Japan Earthquake occurred on March 11, 2011, which was the strongest earthquake on record in Japan (the 4th biggest in the world) with a magnitude of 9.0 (Mw), large fluctuations of confined and unconfined groundwater levels were observed at 102 observation wells in Tokyo, although Tokyo is located around 400 km away from the epicenter.

In this study, taking full advantage of the unique rare case data from the dense groundwater monitoring network in Tokyo, we identify the fluctuation patterns of groundwater levels caused by the Great East Japan Earthquake using Self-Organizing Maps (SOM). Interestingly, both abrupt rise and sharp drawdown patterns of groundwater level were identified right after the earthquake for most of the wells. After abrupt rise or drawdown, the groundwater fluctuation patterns during the month are classified as one of the three typical patterns: keeping the rise or drawdown, recovering gradually to the original level, and over recovering more than the original level. The causes of those patterns are also investigated in this study.