

An attempt to observe gravity fluctuations caused by groundwater table response to tidal fluctuations by continuous gravity measurement near the coast

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Groundwater levels in coastal unconfined aquifers respond to tidal fluctuations. Therefore, gravity data obtained near the coast is expected to include gravity fluctuations caused by the tidal response to the groundwater table. We measured gravity and groundwater level continuously near the coast of Tomakomai, Hokkaido, and tried to observe the gravity fluctuation caused by the tidal response of the groundwater table. Two superconducting gravimeters were installed at two points 70 and 80 m from the coast. The elevation at both locations is 8 m. The scale factors of the two gravimeters were determined by comparison with another superconducting gravimeter whose scale factor had already been determined. Water level sensors were installed in wells drilled at two points 60 and 90 m from the coast. The observed groundwater levels showed diurnal and semi-diurnal variations. The amplitude was larger as the distance from the coast was shorter, suggesting that the tidal response of the groundwater table was observed. After removing the effects of ocean loading, diurnal and semi-diurnal fluctuations were found in the difference in gravity measured at the two points. In addition, a phase difference was observed between the fluctuation of the gravity difference and that of gravity from each gravimeter. This gravity fluctuation is considered to be due to the difference in amplitude and phase of the tidal response of the groundwater level below each measurement point. It is shown that information on gravity fluctuations caused by the tidal response of the groundwater table can be obtained by observing the difference in gravity at points at different distances from the coast.

Keywords: superconducting gravimeter, groundwater table, tide, coastal area, unconfined groundwater