Postseismic gravity change after the 2011 Tohoku Earthquake observed by superconducting gravimeters at Mizusawa, Japan

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In Mizusawa VLBI Observatory, NAOJ, we started continuous gravity observation with the superconducting gravimeters (SGs) since early 2009. First we used GWR Instruments' model TT70 #007 gravimeter and we replaced it with #016 on October 2017. Though the instrumental drift rate of the superconducting gravimeters are small, combination of SG observations and absolute gravity measurements are required in order to discuss long term gravity changes. We carried out absolute gravity measurements with the joint work of Earthquake Research Institute and Mizusawa VLBI Observatory every year since 2015. Fixing the SG drift rate by the absolute measurement data, we get the continuous gravity change data since 2014. The observed data were corrected with the ground water effect simulation results at first. Next the free air correction was given which is based on the GNSS observation result. The final observation result shows obvious increase of gravity with exponential decay. Estimating decay time constant and amplitude coefficient by applying nonlinear least squares method, we get the time constant of 648.9±17.6 day and the coefficient of -85.7±4.1 micro gal. On the other hand, the satellite gravity data GRACE/GRACE-FO gives different result. We calculated Mizusawa's gravity time series by using DDK3(240km) filter which is widely used. It shows similar gravity increase but the estimated decay time constant and amplitude coefficient are different. They are 3555.9 ±763.8 day and 14.9±1.6 micro gal respectively. We consider that the difference is caused by the difference in spatial sensitivity of two techniques. The ground gravity measurements are sensitive to small scale (50km-100km) phenomena. The satellite gravity measurements are not sensitive to small scale (shorter than 200km) phenomena.
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Keywords: postseimic gravity change, superconducting gravimeter, 2011 Tohoku Earthquake, satellite gravimetry

Date	FG5 serial no. (chamber no.)	# drop	SD (microgal)	g (microgal)	stat.	syst.
Jul-2015	212 (212)	8700	13.4	980146211.57	± 0.14	
Jun-2016	241 (212)	7731	30.5	980146212.17	± 0.35	
Jun-2017	212 (109)	10712	13.5	980146207.54	± 0.13	
Jun-2018	109 (241B)	9875	14.1	980146213.15	± 0.14	-8.6
Jun-2019	241 (212)	6564	26.6	980146201.94	± 0.33	
Oct-2020	241 (241)	7669	23.7	980146195.95	± 0.27	
Jun-2021	109 (109)	14809	8.4	980146199.90	± 0.07	

Table 1. Absolute gravity (above 130 cm above the floor) of every year from 2015 to 2021, measured with FG5 gravimeters.

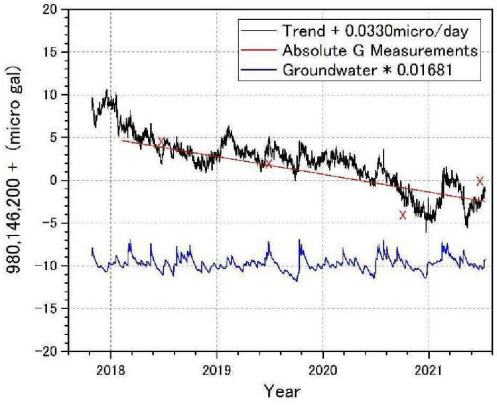

Fig. 1. Instrumental drift determination of SG comparing with absolute gravity data.

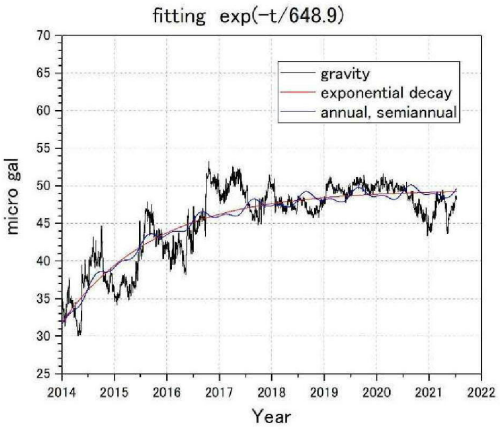

Fig. 2. Observed gravity change after correcting ground water and ground uplift changes.

