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Results from 10 years of absolute gravity measurements at Mt. Etna volcano (Italy)

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High-precision gravity measurements are especially important in volcano monitoring, since they can detect underground mass redistributions induced by magmatic processes. In volcanic areas, gravity measurements are usually carried out using relative spring gravimeters. However, under harsh environmental conditions that characterize the summit zones of most active volcanoes, instrumental effects may prevent the collection of data with appropriate quality. In order to accurately measure small gravity changes due to volcanic processes (a few to a few tens of μGal), repeated absolute gravity (AG) measurements have been performed at Mt Etna (Italy) using IMGC-02 and Microg LaCoste FG5#238 gravimeters, since 2007 and 2009, respectively. The network for AG measurements has grown over the years and currently includes 14 stations, evenly distributed around the volcano, at elevation between 1500 and 2850 m. Even though the use of absolute gravimeters on active volcanoes implies many di[U+FB03]culties (transport of the instrumentation, constraints on the measurement site, etc.), AG measurements may successfully replace or integrate relative gravity surveys.
Here, we present the results of repeated AG measurements over a 10-year interval (2007-2017) when Etna exhibited different styles of activity. The AG measurements were repeated roughly once a year and evidence a gravity increase (2007–2012) – decrease (2012–2017) cycle affecting the whole volcano, with an average amplitude of about 20 μGal and a maximum positive variation of approximately 70 μGal at PDN station (2820 m asl). Comparison with ground deformation data shows that the observed gravity changes are not due to elevation changes, but, rather, to the gravitational effect of magma storage/withdrawal below the volcanic pile. AG measurements were also compared with relative gravity data collected (i) through spring gravimeters, in the framework of almost monthly campaigns, and (ii) through a superconducting gravimeter that has continuously recorded gravity at SLN station (1740 m a.s.l.) since 2014.