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Continuous microgravity variations accompanying the onsets of the last flank eruptions at Etna volcano (Italy)

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Significant gravity variations were observed at continuously running gravity stations (1 minute sampling) of Etna, simultaneously with the onset of the 2002-2003, 2004-2005, 2006 and 2008-2009 eruptions. In time correspondence with these onsets we can distinguish different behaviors of the gravity variations.
The highly explosive flank eruptions occurred in 2002-2003 and 2008-2009 were marked by similar gravity changes. In particular, gravity variations displayed a very strong and fast gravity decrease that reached about 400 μGal in less than one hour. Successively, the mean value of the gravity signals started rising again at a high rate (roughly 100 μGal/hour in 2002-2003 and about 50 μGal/hour in 2008-2009).
Dissimilar behaviors were observed in the gravity changes during the passive flank effusions in 2004–2005 and 2006, both characterized by a slow initial evolution. The beginning of the 2004-2005 eruption was marked by a sudden gravity change with amplitude less than 10 μGal that was partially recovered after about 4 hours. While during the outbreak of the 2006 eruptions we observed only an increase in the noise component of the gravity signal until one order of magnitude with respect the background level, which is usually within ± 1 μGal.
These evidences from continuous microgravity sequences could highlight the temporal evolution of different intrusive mechanisms triggering the eruptions at Etna. Thanks to the frequent eruptive events and high gravity sampling rate, our observations offer an unique opportunity to investigate mass redistributions accompanying magmatic intrusions and to contribute to a more accurate evaluation of the hazard associated with the onset of Etna lateral eruptions.