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A precision tidal model for Montserrat (B.W.I) and insights on volcano-aquifer dynamics for the July 29, 2008 eruption at Soufrière Hills volcano

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The ongoing eruption of the Soufrière Hills volcano (SHV), Montserrat, provides an unprecedented opportunity to study complex processes at an active andesitic arc volcano. There is for example evidence from geodetic measurements that volcanic activity follows a cyclic pattern. At the same time, geodetic signals on a small island such as Montserrat are prone to be affected by tidal artefacts, which are difficult to remove using generic models for tidal loading.

Here, we present the first precision tidal model for Montserrat from continuous gravimetric observations on the island. Gravimeters were operated at 4 different stations between 2006 and and 2009 for a total of 240 days. The derived harmonic constituents allow geodetic data reduction for tidal effects at an unprecedented level. We achieve a reduction in the amplitude of diurnal and semi-diurnal gravity residuals by a factor of 5-10 to within $\pm$ 10 nm/s^2.

Evaluating gravity residuals coinciding with the start of the eruptive reactivation on June 29, 2008 by a Vulcanian explosion at SHV, we propose a joint perturbation source triggering both an aquifer response and the initiation of the eruption. The likely source is a pressurisation/depressurisation cycle in the shallow feeder system (dyke and/or conduit). We propose the Belham Valley fault to act as the mechanical and structural link between the feeder system and the aquifer.