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Recent contributions of gravimetry to studying volcanic unrest or reactivation

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Volcanic unrest or reactivation manifests itself among other phenomena by a gravimetric signature in terms of temporal gravity changes observable on the topographic surface. Here we take a look at the applicability and benefits of two recently developed gravimetric inversion approaches in interpreting time-lapse gravity changes observed in restless volcanic areas. The first, developed by Prutkin, consists of several data processing steps, such as optional trend removal and optional depth-wise separation of sources and their signal decomposition based on a triple harmonic continuation numerical procedure, followed by the inversion based on mass line segments approximation. The second, developed by Pohánka, adopts n-harmonic functions and their properties to facilitate an automated iterative procedure yielding solutions in terms of homogenous source bodies of complex shapes. We demonstrate the applicability and benefits of both inversion methodologies on a case study situated in the Central Volcanic Complex (CVC) of Tenerife, Canary Islands, based on the gravity changes observed during the 2004–2005 unrest [1].

The Prutkin inversion approach has been described in detail in [2], while the approach of Pohánka in [3]. Both the approaches produced inversion results that strongly indicate a hybrid unrest, in which a magmatic intrusion or rejuvenation by fresh magma entered a zone about 5 km to the NW of the twin stratovolcanoes of the CVC, Teide and Pico Viejo, at the depth of roughly 6 km below sea level, associated with upward and side-ways migration of hydrothermal fluids into shallower parts of the caldera. The gravimetric picture of the sources of this hybrid unrest was constrained seismically with data on the seismic unrest of this period and its interpretation [4].

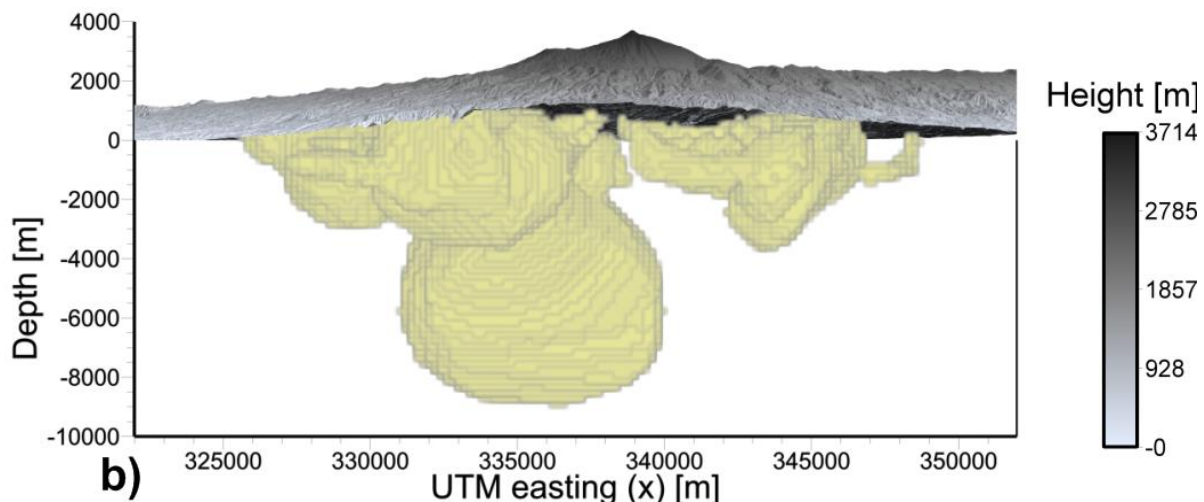


Figure 1: The harmonic inversion solution for the 2004/5 Teide unrest gravity changes.

Pros and cons of both inversion approaches will be discussed in the presentation, as well as suggestions for follow up work and directions for possible future developments.

References:

- [1] Gottsmann J et al. (2006) Geophys. Res. Lett., 33, L20311, doi:10.1029/2006GL027523
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- [3] Pohánka V, Vajda P, and Pánisová J (2015) Contrib. Geophys. Geod. 45(2): 111-134
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