



Volume changes during the 2010 Merapi eruption calculated from TanDEM-X interferometry

Julia Kubanek, Malte Westerhaus, and Bernhard Heck

Geodetic Institute, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany (Julia.Kubanek@kit.edu)

Estimating the amount of erupted material during a volcanic crisis is one of the major challenges in volcano research. One way to do this and to discriminate between juvenile and non-juvenile fraction is to assess topographic changes before and after an eruption while using area-wide 3D data. LiDAR or other airborne systems may be a good source, but the recording fails when clouds due to volcanic activity obstruct the sight. In addition, costs as well as logistics for local observatories are high. When dealing with dome-building volcanoes, acquiring the data gets further complicated. As the volcano dome can change rapidly in active phases, it is nearly impossible to collect data at the right time. However, when dealing with gross volume change estimates, at least two data sets – taken directly before and after the eruption – are essential.

The innovative bistatic German Earth observation mission TanDEM-X is of great importance to overcome some of these problems. Two almost identical radar satellites TerraSAR-X and TanDEM-X fly in a close formation, taking pictures of the same place on the Earth surface at the same time (bistatic mode). This results in two nearly absolutely coherent images. As the radar signal penetrates clouds, digital elevation models (DEMs) of the area of investigation can be generated without problems even with cloud cover. A time series analysis of the DEMs derived in bistatic mode therefore opens the possibility to assess volume changes at active dome-building volcanoes.

We analyze the volume changes due to the hazardous Merapi eruption in 2010. The eruption started on October 26, 2010. During the eruption, the 2006 lava dome was destroyed. A new lava dome was built and destroyed again at the end of the eruption in November 2010. We show a series of DEMs derived from Merapi by TanDEM-X SAR-interferometry taken before and after the 2010 eruption. The bistatic SAR images are acquired from ascending as well as descending orbits highlighting the NE-SE and NW-SW sectors of the edifice, respectively. We use the DEMs to give values of the volume change at the summit caused by the 2010 eruption. As the TanDEM-X mission is an innovative mission, the present study serves as a test to employ data of a new satellite mission in volcano research. An error analysis of the DEMs to evaluate the volume quantifications was therefore also conducted.