

Ground Deformation of Santorini Volcano (1992-2012) based on SqueeSAR™ Analysis and GPS Measurements

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The Santorini Volcano is one of the largest Quaternary volcanic centers in the Aegean located in the central part of the Hellenic Volcanic Arc. The system has been in a quiet state the last 60 years, until January 2011 when the volcano reawakened, starting producing higher seismicity rates and showing a radial ground deformation. In the following, the ground deformation is presented since 1992, based on the advanced SqueeSAR analysis, local DGPS network and continuous recording GPS (CGPS) stations on the island. The spatial deformation of the System during the "quiet" period 1992-2010 deduced by joint interpretation of ERS1&2 and ENVISAT images of ascending and descending geometry. This period, Palea Kammeni was getting uplifted (2-3 mm/yr), characterized by an increasing rate of uplift, whilst the adjacent Nea Kammeni was subsided (up to -3 mm/yr) with increasing rates. The above two islets even though they are considered as a single volcanic center they exhibit a different type of vertical motion. The rest of the study area showed a velocity field varying from -1 to +2 mm/yr and sub-millimeter acceleration field values, indicating a linear deformation during this period. Combining ascending and descending radar data, the vertical and horizontal (E-W) component of the velocity field were determined. Several deformation patterns were identified: The two main tectonic features, the Columbo and the Kammeni lines at the northern and central part of the system, the Alpine basement at the SE part of Thera, and a pattern associated with the graben basin at the southern part, consistent to earlier AMT work and the recently compiled Gravity Anomaly Map. The remeasurement periods of the GPS network (established in 1994) resulted in the calculation of the strain field, and velocity deformation patterns consistent to the SqueeSAR analysis results. The deformation study for the "active" period 2011-12 was based: (i) on the SqueeSAR analysis of ENVISAT images of ≈ 39 deg LOS angle, and (ii) the processing of CGPS and DGPS data. Mogi point-source modelling suggests an expanding (magmatic) sphere (radius ≈ 150 m) located ≈ 1.5 km north of Kammeni at a depth of $3.7(\pm 0.3)$ km, matching the observed displacement vectors. However, the seismicity seems to have lately drastically decreased, and a velocity decrease at some CGPS station components is also noticed. If that situation continues, the volcano may not reach any further state of alert in the near future.