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Quantifying the current unrest of the Santorini volcano: Evidence from a multiparametric dataset, involving seismological, geodetic, geochemical and other geophysical data

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The Santorini volcanic center is the most active volcano system in the Southern Aegean Volcanic Arc, characterized by very rare Plinian eruptions (minimum time interval of 20Kyrs) and more frequent Vulcanian-type eruptions in historic times (e.g. 3 eruptions in the 20th century). Though the Coloumbo submarine volcano, located roughly 8km to the NE of the main Santorini island caldera, is the most active volcanic center, with continuous seismicity and hydrothermal activity, since the beginning of 2011 the main Santorini volcano has gone through a period of unrest. The most detectable symptoms of this unrest, as they are recognized by the local people, are small earthquakes (M<3.5) inside the Santorini caldera, with the largest ones (M>2.8-3.0) being quite strongly felt along the caldera rim villages.

We examine the main characteristics of this unrest by using seismicity information from a local seismological network, in operation before the unrest initiation. This dataset is complemented by other important information such as geodetic measurements (using a network of permanent and temporary stations, also in operation before the unrest start), geochemical information concerning CO_2 and H_2 emissions, and a local network of tide gauges providing sea temperature changes and sea level changes. The results show that a previously identified but inactive near-vertical NE-SW tectonic line, known as the Kameni line, has been activated at a length of $\sim$5-6km and a depth extent of 4km. This activation is a response to a magma uplift that occurs to the north of this line (that crosses the intra-caldera Palea and Nea Kameni islands), which has resulted in significant relative displacements, both horizontal and vertical, locally of the order of 15-20cm until know, as confirmed by GPS and sea level data. Significant sea temperature changes are also observed along the fault zone, probably due to hydrothermal fluids originating from the main fault crack network. The observed quantities show an excellent spatial and time correlation, with deformation accelerations signaling an increase of the earthquake activity, temperature fluctuations, etc., verifying the magmatic origin of the observed unrest. Finally, a preliminary assessment of the associated earthquake hazard is presented, considering different rupture scenarios of the activated fault zone.