GEF Report: Loan 952. Capturing a new phase of unrest at Santorini volcano, Greece.

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Abstract.

Loan 952 supported the deployment of three cGPS receivers to augment geodetic studies of the first episode of active deformation and seismicity of the modern era at Santorini volcano, Greece. The instruments were deployed from July to October 2011, and were used primarily to complete a dense re-occupation of the twelve Greek Military Triangulation Points on Santorini. Processing of these data, and comparison with the earlier occupations of the same network (in 1955 and in the 1980's), provide the critical evidence that the episode of inflation at Santorini which took place from January 2011 – July 2012 was indeed the first major episode of deformation a this volcano since 1955; and most probably since the last eruption, in 1950. A report of our analysis of the geodetic data, combined with an analysis of the InSAR data for the period 2010-2012 has recently been published in Nature Geoscience.

Background.

In early 2011, during fieldwork by a PhD student, Michelle Parks, we became aware that an episode of unrest was beginning at the Greek island volcano of Santorini. Santorini is a classical caldera volcano, which experienced a major explosive eruption about 3600 years ago. Since that time, activity at the volcano has slowly built a steep-sided edifice of dacite lava in the centre of the caldera. This edifice first broke the surface in an eruption about 2000 years ago, and over the past 500 years the volcanic island of Nea Kameni has enlarged significantly in the course of five major eruptions. Although the eruptions themselves have been well described (e.g. Fouque, 1879; Pyle and Elliott, 2006), very little has been recorded relating to the unrest of the volcano in between eruptions: in fact, most of the sparse information in the literature relates only to 'precursor' seismicity and rapid uplift that occurred within a few weeks to months of an eruption starting. Thus, from the outset it was apparent that the new phase of unrest was a great opportunity to understand what happens to large caldera volcanoes in between eruptions. Once we had been able to confirm that the seismicity within the caldera was also accompanied by significant ground deformation (as observed both by InSAR, and from the evidence of the small number of operating cGPS stations on Santorini in early 2011), we applied to NERC for Urgency Funding to support an intensive campaign of field measurements, and to the GEF for some cGPS receivers to augment our fieldwork.

The field-intensive phase of measurement ran from June to October 2011, and included both campaign-style GPS measurements, as well the installation (with Greek colleagues from the National Technical University of Athens, NTUA) of several new permanent cGPS receivers, and field measurements of soil-gas flux. The activity included both junior and senior researchers from Oxford; researchers from Greece, and, for a period in September 2011, an intensive phase of campaign measurements by our 4th-year undergraduate class, who were visiting Santorini as a part of their field training.

The primary objectives of the field campaign were to capture the early stages of a continuing phase of unrest on Santorini, Greece. NERC Urgency funding and the GEF loan enabled us to perform the following tasks:

Table 1. Locations of GPS stations occupied during the field campaign.

In September 2011, we reoccupied 12 Hellenic Military pillars, using a pool of equipment from both GEF and NTUA. Sites were occupied for a minimum of 3 hrs, and we also used GPS observations from 3 permanent stations (SNTR, WNRY and DSLN) in processing and we have short baselines from these cGPS sites to the pillars.

Station	Latitude (N)	Longitude (E)	Elevation (m)
S010	36.21252436,	25.21330701,	169.724
S021	36.24149660,	25.25506509,	274.442
S022	36.24160327,	25.23415153,	161.797
S023	36.24260140,	25.28445544,	88.054
S028	36.25357382,	25.20482795,	330.438
S029	36.26017076,	25.26526602,	112.637
S030	36.25577835,	25.25197147,	402.967
S031	36.26409242,	25.26368758,	95.186
S034	36.27102646,	25.25253956,	352.469
S035	36.27422935,	25.23009615,	176.528
S302	36.22069714,	25.27496485,	602.479
S304	36.27483270,	25.24207002,	366.029

Table 1

Equipment provided by GEF for Santorini 2011 campaign GPS surveys	
3	Choke ring antennas and connector cables
3	Leica receivers
3	Tripods
3	CF cards for receivers
1	Copy of Leica GeoOffice Software and Dongle
3	Solar Panels
3	Solar Regulators and battery cables
2	Alloy containers
2	Battery chargers
3	External batteries and cables