

Interferogram Formation for Large Deformation

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Sierra Negra volcano erupted from October 22 to October 30 in 2005. Three hours prior to the onset of the eruption, an earthquake (Mw 5.4) occurred somewhere near the caldera. The network of six continuous global positioning system (GPS) stations at the caldera of Sierra Negra stopped recording several hours prior to the earthquake (Geist, personal communication.). Interferometric synthetic aperture radar (InSAR) is applied to Envisat data to examine pre-eruptive uplift, faulting associated with the earthquake, co-eruptive subsidence, and post-eruptive uplift. By far the strongest deformation signal is that due to co-eruptive subsidence, which we estimate to be at least 4 meters. This large and complex deformation pattern, mostly confined to the caldera, complicates co-registration of the SAR images. Using existing conventional InSAR software (ROI, ROI PAC, DORIS, GAMMA) we were not able to properly co-register any of the SAR image pairs spanning the eruption. Rather

we have developed a rubber-sheeting algorithm for InSAR co-registration to better co-register the images and form intra-caldera interferograms. Using the algorithm we form a useful interferogram inside the caldera of the volcano (see Figure 1b). This method makes it possible to form interferograms of large complex deformation. This capability is true not only for conventional interferometry but also for any advanced techniques such as persistent scatterers InSAR [Hooper et al., 2004; Ferretti et al., 2001] and the multiple aperture InSAR [Bechor and Zebker, 2006].

References

- Bechor, N. B. D., and H. A. Zebker (2006), Measuring two-dimensional movements using a single InSAR pair, *Geophysical Research Letters*, 33(16), L16,311.
- Hooper, A., H. Zebker, P. Segall, and B. Kampes (2004), A new method for measuring deformation on volcanoes and other natural terrains using InSAR persistent scatterers, *Geophysical Research Letters*, 31(23), 5, doi:10.1029/2004GL021737.

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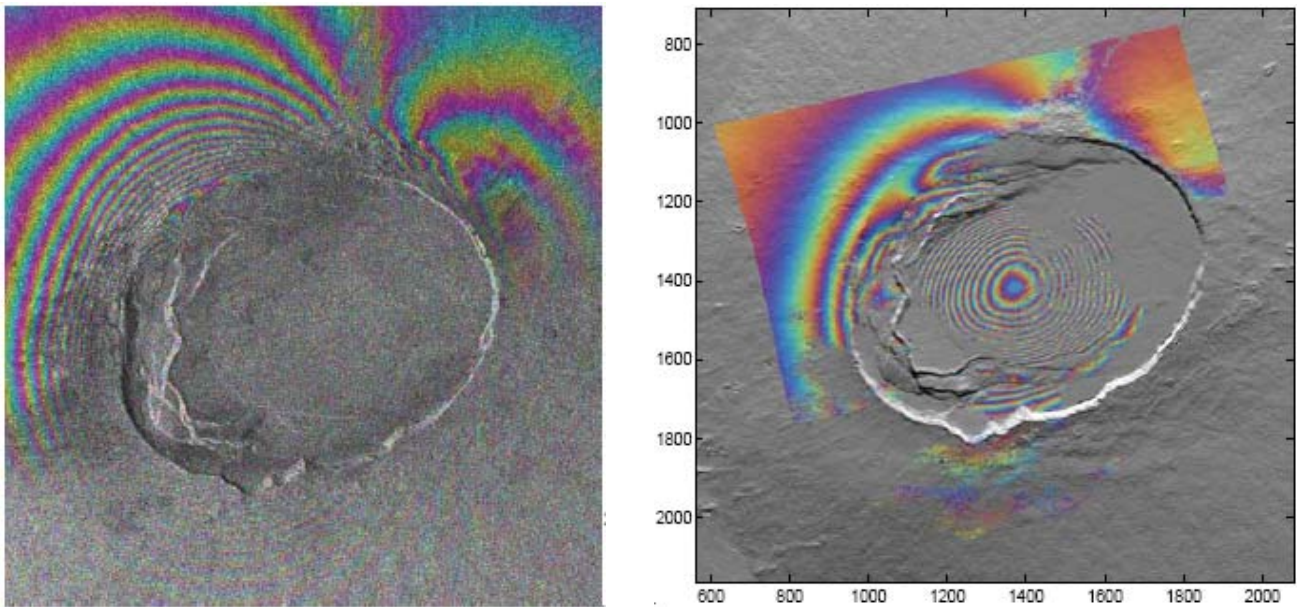


Figure 1. (a) Co-eruptive interferogram processed by GAMMA software using Envisat data (beam IS 5, track376, 051016 – 051120, Bperp = 100 m). (b) Result of rubber-sheeting interpolation for SAR image co-registration. (Unwrapped interferogram expressed with fringes of 20 cm interval.)