Title : **Monitoring Topographic Changes and Ground Displacements at Volcanoes with TanDEM-X**

Executive Summary : **The amount of available radar data usable for InSAR applications has increased significantly over the last few years thanks to the successful launches of CSK, ALOS, TerrasSAR-X, RADARSAT-2 and TanDEM-X. All of these missions offer data covering a wide range of resolutions, polarisations, sensibilities to displacements, acquisition frequencies and geometries that, when combined, allow us to move closer toward operational InSAR monitoring of volcanic activity.**
Within this framework, the TanDEM-X mission appears to be the most promising, with it providing a high frequency revisit capability (5.5 days using both ascending and descending passes) and high horizontal resolutions (3 m for Stripmap data), as well as a tandem capability.

Our proposal aims to evaluate TanDEM-X data for repeat (every ~1-2 months) production of displacement maps and Digital Elevation Models (DEM) with high (~15 m) spatial resolution for two active volcanoes, Piton de la Fournaise and Karthala, under near-operational conditions.

Accurately measuring volcanic topography and its changes answers two challenging issues:

- **For most approaches used to evaluate and mitigate volcanic risk, the availability of an accurate DEM is a critical starting point required to obtain reliable results (flow models, for example, require an up-to-date DEM to allow path determination). Generation of up-to-date and accurate DEMs also supports reduction procedures for other routinely collected geophysical data.**

- **Measurements of topographic changes, occurring during an eruption, provide direct information for the volume of erupted material, and thus also for the mass flux and mass dynamics of the eruption. Quantification of topographic modifications, resulting from destructive processes such as pit-crater collapse or flank collapse, is also an important prerequisite for the modelling, and then the understanding, of volcano construction and system dynamics.**

Ground surface displacements on volcanoes often result from internal processes such as filling or emptying of magma reservoirs, pressurization of hydrothermal systems, or sill or dyke intrusion. Modelling of these displacements provides invaluable constraints both on location, geometry and dynamics of plumbing systems and on the mechanical behaviour of a volcanic edifice.

Our project will take advantage of the new capabilities offered by the DLR TanDEM-X mission, in particular the possibility of using TDX and TSX images acquired in bi-static mode to produce tandem interferograms. In this acquisition mode, two radar images are acquired, one by each satellite. Images are acquired simultaneously so that the tandem interferogram obtained by subtracting the two images is not affected by temporal decorrelation or by atmospheric disturbances. The slight positional difference between the two satellites means that we have two look angles which allows a "stereoscopic" capability. Hence, tandem interferograms can be used to calculate the topography for the imaged area, with a horizontal resolution of < 15 m. Theoretically, such topgraphies can be obtained every 11 days (every 5.5 days if we exploite both the ascending and descending interferograms).

In our project we also intend to use the tandem interferograms in a more conventional way to detect surface ground displacements related to volcanic activity.

We expect our project will benefit volcano observatories and will guide the design of future radar missions dedicated to Earth Observing and volcanic hazard mitigation. We have the support of the Observatoire de Physique du Globe de Clermont-Ferrand (OPGC) and of the Institut National des Sciences de l'Univers (INSU). Funding of 25 k€ has been requested from the French National Program of Spatial Remote Sensing in September 2010 (see the attached PNTS demand).

Results will be shared to the community through regular progress reports, scientific communications, publications in ISI journals and deliverables that will be distributed through a dedicated web-site.