

# ASAR Interferometry at Piton de la Fournaise, preliminary results

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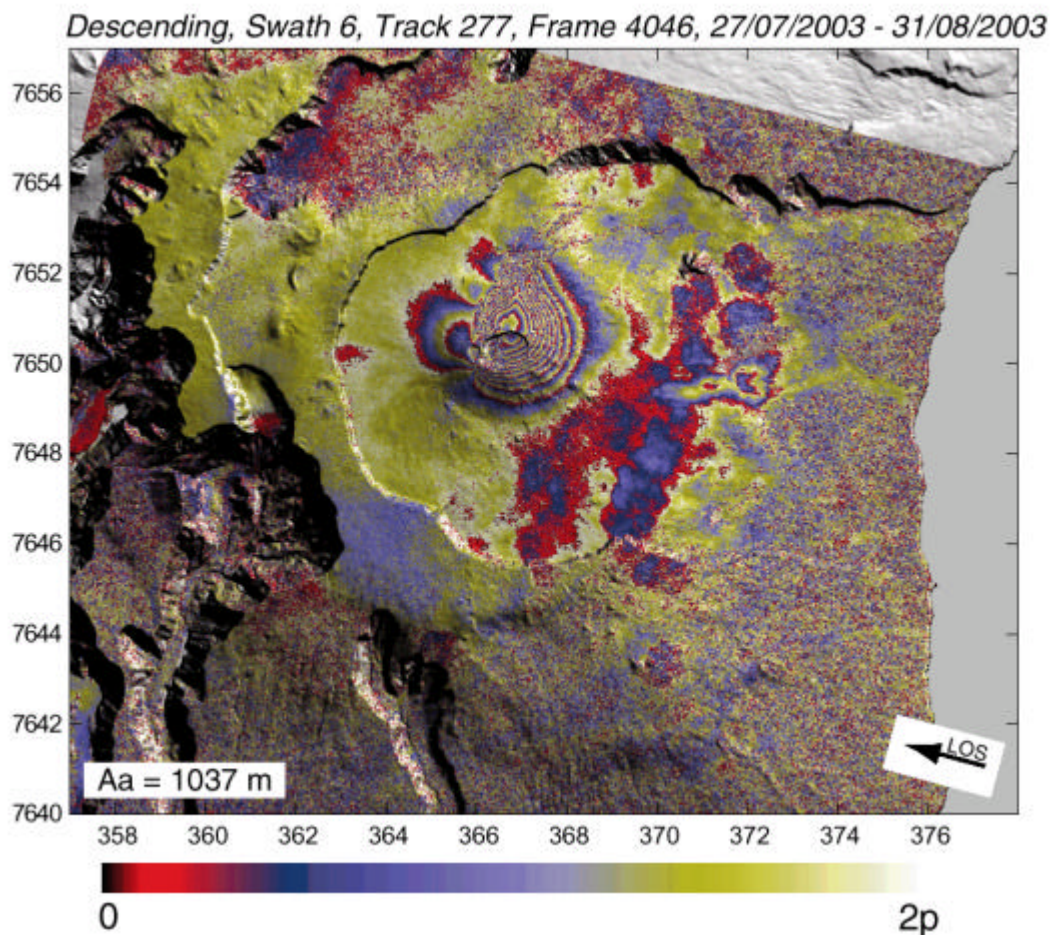
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Since the detection of surface deformation at Mount Etna, several geodetic studies have been performed on volcanoes with radar interferometric data acquired by the European ERS-1 and ERS-2 satellites, the Japanese JERS-1 satellite and the Canadian RADARSAT-1 satellite. Here we present the preliminary results of an interferometric study of Piton de la Fournaise volcano, Réunion Island, with Synthetic Aperture Radar images acquired by the ASAR-ENVISAT satellite. Launched in March 2002 by the European Space Agency, ENVISAT is an Earth observation dedicated satellite and its payload consists of a set of instruments for measuring the atmosphere and the surface through the atmosphere. One of these instruments is the ASAR radar designed to provide for continuity of the observations started with the SAR on board of the ERS satellites.

Piton de la Fournaise volcano is one of the most active volcanoes in the World. After an unusually long period of 65 months rest, the Piton de la Fournaise started erupting on March 1998. This event marks the beginning of a new cycle of activity which has continued until the present with an average eruption rate of more than two per year. On 22 August 2003, a new eruption started: at about 21h20, a first fissure opened at the summit of the volcano, in Bory crater; a second fissure opened at 22h10 on the north flank at about 2450 m altitude; at 23h30 a final fissure opened at 2200 m altitude on the north flank, about 50 m east of 1998 Piton Kapor. The eruption ended suddenly on 27 August (Staudacher, 2003).

By combining six ASAR images, acquired in ascending swath 2 and descending swath 6 and 7, we formed three interferograms spanning the period during which occurred the eruption. The interferograms exhibit clear fringes patterns centred on the Soufriere pit crater, on the external northern flank of the summit Dolomieu caldeira (fig. 1). As previously observed on Radarsat interferograms of the March 1998 eruption (Sigmundsson et al., 1999), the range change pattern is asymmetric with respect to the eruptive fissures. Up to eleven fringes occur in the area east of the fissures indicating a displacement of the ground towards the satellite of about 30 cm, while less than three fringes are visible west of the fissures indicating a displacement of the ground away from the satellite of about 7 cm. These displacements are interpreted as due to the propagation of a dike and to the opening of the eruptive fissures. They were modelled using a 3D mixed boundary-element method (MBEM) for elastic medium (Cayol and Cornet, 1997). The model consists of a synthetic dyke defined by six geometric parameters and a value of overpressure gradient. A neighbourhood algorithm was applied in order to explore the 7 dimensional parameters space (Sambridge, 1999). The best-

fit model is a  $67^\circ$  eastward dipping dike whose the bottom lies at around 1250 m a.s.l. (1350 m below the ground surface), and the top is connected to the eruptive fissures.



**Figure 1. ASAR interferogram imaging the ground deformations related to the august 2003 eruption at Piton de la Fournaise.**

This preliminary study provides new geodetic data that confirm the well known seaward displacement of the eastern flank of Piton de la Fournaise. It also demonstrates the total efficiency and high potentials of ASAR as a successor of ERS for interferometric applications.

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