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The 2009 and 2010 eruptions and shallow intrusions at Piton de la Fournaise, La Réunion Island, seen by cGPS measurements

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The Piton de la Fournaise volcano at La Réunion Island in the western Indian Ocean is one of the most active volcanoes in the world. Its average eruption rate over the last 2 centuries is one eruption every 9 months. Between 1998 and 2010 thirty eruptions occurred and produced some 300×10^6 m^3 of lava flows. Since the 2007 collapse of 340 m of the Dolomieu caldera, the eruptive activity of the volcano changed with mainly the occurrence of numerous shallow intrusions preceding days or weeks small summit eruptions. In 2009-2010, Piton de la Fournaise erupted successively in November 5, December 14, 2009 and in January 2, 2010. The one day lasting November and December 2009 eruptions started from en echelon fissures close to the summit around its eastern and southern rims, respectively, whereas the January 2010 eruptive fissure opened on the western flank inside of the Dolomieu crater. These three eruptions produced less than 10^6 m^3 of lava, but generated large ground deformation, of up to 70 cm, recorded by the cGPS network of the volcano observatory and by cinematic GPS measurements.
The long term survey showed a small extent of the ground deformation field and the small ratios of base/summit displacements and vertical/horizontal displacements reveal the involvement of shallow dykes to fed these successive eruptions. The cGPS network allowed us to follow up precisely the pre eruptive ground deformations, the 40 to 90 minutes dyke propagation toward the surface, as well as the ground deformations after the vent opening. For the November and December 2009 eruptions, the dyke started below the western part of the Dolomieu crater, before propagating to the east and the south, respectively. For the January eruption, the dyke propagated along a more or less vertical pathway directly to the western part of the Dolomieu crater. The two previous dyke injections of November and December had increased the horizontal compressive stress of the eastern side of the Dolomieu crater and did not favoured a new propagation to the east.