Geophysical Research Abstracts
Vol. 20, EGU2018-13694, 2018
EGU General Assembly 2018

Analysis of ground deformation due to geothermal exploitation at Reykjanes, Iceland, 2003 to 2016

Michelle Parks (1,2), Freysteinn Sigmundsson (2), Ómar Sigurðsson (3), and Andrew Hooper (4)

(1) Icelandic Meteorological Office, Reykjavík, Iceland (michelle@vedur.is), (2) Nordic Volcanological Center, Institute of Earth Sciences, University of Iceland, Reykjavík, Iceland, (3) HS Orka, Svartsengi, 240 Grindavík, Iceland, (4) Centre for Observation and Modelling of Earthquakes, Volcanoes and Tectonics (COMET), School of Earth and Environment, University of Leeds, Leeds, UK

Geothermal power plants in Iceland supply ∼24% of the country's electricity requirements and 90% of its heating requirements. This study is concerned with long-term monitoring of ground deformation in the vicinity of the Reykjanes power plant. The Western Reykjanes Peninsula is situated in an active rift zone – the onshore extension of the Reykjanes Ridge – where highly oblique spreading of the North American and Eurasian plates occurs at a rate of ∼19 mm per year. The volcanic systems in this region comprise of central volcanoes and associated NE-SW trending fissure swarms and geothermal areas. The first geothermal well was drilled here in 1956, followed by the intermittent drilling of 22 wells between 1968 and 2006 (including 14 deep production wells). A new geothermal power plant at Reykjanes began operation in May 2006 and since then an additional 12 wells have been drilled for production, injection and exploration. Local deformation commenced shortly after the onset of production, observed on both GPS and Interferometric Synthetic Aperture Radar (InSAR) observations.

We use images acquired by the Envisat and TerraSAR-X (TSX) satellites, from 2003 to 2016, to derive constraints on the cumulative ground deformation at the Reykjanes geothermal area, Iceland, and compare these results to production data acquired from observation wells in this region. We undertake Persistent Scatterer (PS) InSAR, utilising both ascending and descending Envisat and TSX satellite tracks covering the 2003-2016 period. Time series of range change along line-of-sight (LOS) from the ground to the satellite show the characteristics of on-going ground deflation in the vicinity of the Reykjanes power plant. The average LOS velocities from ascending and descending tracks are decomposed into estimates of near-vertical and near-east displacements. Geodetic modeling is undertaken using sources of simple geometry within an elastic halfspace to determine the optimal sources for the observed contraction throughout 2005-2016. The observed deformation signals from InSAR, both their spatial and temporal character, are compared to extraction of water/steam from wells in the area and measured pressure changes to obtain an improved understanding of the response of geothermal reservoirs to utilisation and pressure changes within the crust.