High-rate GPS seismology in Iceland

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High-precision GPS is traditionally used for accurate (mm-scale) measurements of Earth´s deformation due to a variety of processes such as plate motion, glacio-isostatic-rebound, earthquakes, volcanoes, and geothermal deformation. However, GPS data can also be processed in a kinematic mode to capture rapid deformation such as seismic waves or co-eruptive volcanic signals. This requires higher sampling rates than the traditional 15 or 30 seconds used for daily positioning, typically 1 Hz or greater, thus termed ´high-rate´. These measurements can be especially useful for near-field large-scale motion because the GPS does not saturate, and is thus useful for studying earthquake source processes and parameters. However, the sensitivity of motion is much lower than for seismometers and usually no deformation is seen for earthquakes smaller than magnitude 5, also depending on the depth of the earthquake. High-rate (1 to 20 Hz) GPS data are collected at most continuous GPS stations in Iceland. Here we showcase several examples of the use of high-rate GPS data for research of seismic and volcanic processes in Iceland. The 2014-2015 Holuhraun eruption was accompanied by over 70 5.7>M>5 earthquakes on the rim of the Bárðarbunga caldera. A GPS station was installed in the ice-filled caldera and captured both the slow subsidence of the caldera and displacement seismograms at 20 Hz of many of the larger collapse earthquakes. The GPS seismograms add constraints in the interpretation of the caldera collapse and the generation mechanism of the earthquakes.