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Deformation derived from GPS geodesy associated with Bárðarbunga 2014 rifting event in Iceland

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On August 16, 2014 an intense seismic swarm started below the eastern part of Bárðarbunga Caldera in the north-western corner of Vatnajökull ice-cap, Iceland, marking the onset of the first rifting event in Iceland since the Krafla fires (1975-1984). The migration of the seismicity was corroborated by ground deformation in areas outside the ice cap and on nunataks within the ice cap suggesting a lateral propagation of magma, from the Bárðabunga system. The sesimicity migrated out of the caldera forming a dyke with roughly three segments, changing direction each time until August 28 when the migration stopped around 10 km south of Askja Volcano, eventually leading to a short lived eruption in Holuhraun north of Dyngjujökull. A second fissure eruption started in Holuhraun on August 31 which is still ongoing at the time of this writing. In the months prior to the onset of the activity, subtle signs of inflation where observed on continuous GPS sites around the Bárðarbunga indicating a volume increase in the roots of the volcanic system. When the activity started on August 16, the deformation pattern indicated a simultaneous deflation centered within the caldera and a lateral growth of a dyke also reflected in the migration of seismicity along segments of variable strike. A maximum widening of 1.3 m occurred between stations on opposite sides of the dyke spaced 25 km apart. Significant movements where detected on GPS site more then 80 km away from the tip of dyke. Displacements indicated the fastest rate of widening at any time in the most distal segment of the dyke throughout its evolution. After the dyke stopped propagating, the inflation continued, decaying exponentialy with time. On September 4, five days into the second fissure eruption, the movements associated with the dyke where no longer significant. As the fissure eruption continues, a slowly decaying contraction is observed around the Bárðarbunga central volcano, both shown in the piston like subsidence of the caldera floor, observed on a GPS instrument located on the ice surface within the caldera, as well as in the region around the caldera outside and within the ice cap, with no detectable deformation associated with the formed dyke or the eruptive fissure. Prior to the onset of the activity, extensive GPS campaign measurements had been conducted in the area. These observations allowed us to constrain the deformation field directly associated with the rifting. This proved essential when adding new continuous sites during the active rifting hence tracking the dyke formation as it propagated. To better constrain the deformation field in real time, 8 hour coordinate solutions where processed in real time enabling sub-daily updates to track the rapid deformation associated with the rifting.