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The effects of j\"{o}kulhlaups on glacier motion. Several case studies from Vatnaj\"{o}kull ice cap.

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We present continuous GPS observations from three different outlets of the Vatnajökull ice cap in Iceland, showing how glacier motion is affected by various type of jökulhlaup. Firstly, we present two GPS records from Skeiðarárjökull obtained in October-November 2004 and again in October-November 2010 during exponentially rising jökulhlaups (peak flow $\sim$3000 m^3 s^{-1}) from the Grímsvötn subglacial lake. Secondly, we show GPS results collected in October 2008 on Skaftárjökull during a fast rising jökulhlaup (peak flow $\sim$1300 m^3 s^{-1}) from the eastern Skaftá cauldron. Thirdly, we show observations from two GPS stations on Breiðamerkurjökull mounted along a flow-line 500 m apart. Observations there reveal a speed-up event in September 2010, related to a jökulhlaup of unknown source and magnitude. The common pattern of motion observed at the three sites is significant acceleration in horizontal motion combined with vertical uplift (decimeters to meters), associated with temporal accumulation of water at the glacier bed, and consequent subsidence due to water depletion. The timescales of these floods varies tremendously between locations. On one hand is the jökulhlaup from the eastern Skaftá cauldron in 2008 producing 0.8 m uplift over half an hour and sliding of 0.4 m in 15 min (compared to typical velocity of $\sim$0.2 m d^{-1}) at GPS station $\sim$5 km from the glacier margin. The most pronounced effects on glacier motion by this jökulhlaup were over in a few hours. On the other hand, is the jökulhlaup from Grímsvötn in 2010. A GPS station $\sim$8 km from the glacier edge recorded nearly three meters of uplift during the jökulhlaup, but in this case it occurred gradually over three and half days. The horizontal velocity over the same period remained between 2.5 and 4 m d^{-1}, around one order of magnitude higher than normal. The 2010 Grímsvötn jökulhlaup had significant effects on the movement of Skeiðarárjökull for more than 10 days. In this presentation we address the question of what causes this striking variability in the dynamic response of glaciers to subglacial flooding.