HIGH-RATE GPS: APPLICATIONS TO EARTHQUAKES AND VOLCANOES

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Abstract

Today GPS networks installed around the world are used to quantify long-term plate rates and the temporal and spatial complexities of crustal deformation at plate boundaries. Daily position precisions of several mm and long-term position rates of 0.1 mm/yr are routinely reported. These kinds of precisions are the outcome of 20 years of sustained development of observable models, a global tracking network, and an accurate terrestrial reference frame. But many geophysical problems require positioning at intervals much smaller than these standard "one-day" GPS results. The focus of this talk will be sub-daily positioning applications, specifically using GPS to measure displacements during and after earthquakes and volcanic events. The methods I have used to analyze high-rate GPS data vary depending on the geophysical signal and the frequencies and amplitudes of the GPS error sources. For volcano applications, Kalman filtering can significantly reduce the errors due to multipath without suppressing the geophysical signal. I will discuss volcano results using the 2007 Father's Day eruption and intrusion dataset from Kilauea. Secondly I will discuss high-rate GPS as applied to seismology. Smoothing or averaging as shown for the previous cases is not a reasonable GPS analysis strategy for ground motions during an earthquake, and thus alternate multipath mitigation techniques must be used. Fortunately, the repetition of the GPS orbit can be used to develop empirical multipath corrections, significantly improving the precision of high-rate GPS solutions. I will focus on the Tokachi-Oki dataset, discussing both measurements of the seismic signal and early post-seismic deformation.