



## Analysis of GPS-measured deformation before, during, and after the 2004-2008 dome-building eruption of Mount St. Helens, Washington

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Subtle, widespread, and temporally decaying inward and downward movement of surrounding GPS monitoring stations accompanied the 2004-2008 dome-building eruption of Mount St. Helens. This deformation pattern reversed at the end of the eruption, when the magma storage system started to repressurize. We use a tectonic model to remove steady background deformation and predictions of a variable slip subduction model to remove transient deformation from the August 2009 episodic tremor and slip (ETS) event. We analyze residual volcanic deformation observed at all campaign and continuous GPS stations near Mount St. Helens to estimate spatial and temporal variation, and then find the best-fitting, elastic half-space finite source model and estimate model parameter uncertainty. We extend this analysis to estimate the effects of topography on the model parameters. We observed no volcanic deformation before the start of unrest on September 23, 2004, but the monitoring network, except for one station, was infrequently measured. The post-eruption inflation is well constrained by the PBO network of CGPS stations. The timing of the August 2009 ETS transient deformation is well constrained by nearby PBO borehole strainmeters. To assess future changes in the distribution of subsurface mass, we established in August 2010 a 16-station Mount St. Helens gravity monitoring network. Most of the network is co-located with CGPS stations, and it includes both a tie to an absolute gravity station established by the National Geodetic Survey at Johnston Ridge Observatory, 8 km NNW of MSH, and several base stations outside the deforming area.