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Multiple inflation events at Akutan volcano, Alaska, from GPS observations

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Detecting anomalous volcanic activities helps constrain characteristics of eruption cycles. We have developed a signal detection tool, called Targeted Projection Operator (TPO), to monitor surface deformation with Global Positioning System (GPS) data. We assume that deformation events of a volcano have similar spatial patterns but with different amplitudes. This assumption is reasonable because a deformation source (e.g., a magma chamber) is relatively stationary in space but its strength varies in time. TPO projects GPS position time series onto a pre-determined spatial pattern (or "target") and calculates the amplitude of the projection at each epoch. Large amplitudes imply that an event occurs with a spatial pattern similar to the target. We have applied the TPO technique to monitor surface deformation of Akutan volcano, Alaska, using GPS data from the Plate Boundary Observatory (PBO) stations collected during 2005-2016. The 2008 inflationary event was used as a target. We detected three inflationary events occurred in 2011, 2014 and 2016. The last event is larger than the first two but smaller than the 2008 event that has maximum horizontal displacement of about 9 mm. The three events are significant in TPO detection because changes in the amplitude of projection are larger than the root-mean-square (RMS) error from relatively quiet periods. A simple Mogi model, as well as the pattern similarity, indicates that the deformation source of Akutan volcano has remained stationary in space during the 11-year period of observation. However, the source has activated episodically as inflationary events, which suggests that magma has accumulated in the magma chamber continually and magma accumulation could eventually cause the next eruption.