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Gravity-driven deformation of Damavand volcano detected through InSAR time series

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The detection and monitoring of gravity-driven volcano deformation is vital for understanding volcanic hazards, such as landslides, lateral blasts and debris avalanches. Although deformation has been detected at several large active volcanoes (e.g. Mt. Etna, Vesuvius, Kilauea), these systems also exhibit persistent magmatic activity, obscuring the gravity-driven signals of ground motion. In this study, we present a first InSAR deformation time series at the dormant Damavand volcano in northern Iran, over the period of 2003 through 2008. The high resolution data show a lateral extension of the volcano at the relative rate of up to $\sim$6 mm/yr accompanied by a subsidence at the rate of up to $\sim$5 mm/yr at the volcano summit. We find that lateral motion of the east flank is more significant than that of the west flank. On the basis of past understanding and modeling of deforming volcanoes elsewhere, we interpret this new evidence to reveal long-term slow gravity-driven deformation, possibly in the form of gravitational spreading, at Damavand. This persistent deformation activity is well expressed, although no volcanic activity was ever reported in history. This finding shows that magmatic activity is not required for spreading and highlights the importance of identifying long-lived gravity-driven deformation for hazard assessment at dormant or inactive volcanoes.