Capturing Mauna Loa’s Current Reawakening - Integrated Geodetic and Numerical Investigations of Magmatic and Volcanotectonic Processes, Mauna Loa, Hawaii

Although its more recently active neighbor, Kilauea, has an extensive network of GPS stations, the coverage for Mauna Loa, Earth’s largest volcano, has been relatively sparse. In response to the onset of recent Mauna Loa reinflation, we have installed 11 additional continuous GPS (CGPS) receivers to provide denser coverage of the summit region and two flanking rift zones. This network should image future volcanic events on Mauna Loa and give new insights into structural and dynamic controls. Additionally, we have implemented a near real-time processing approach using the PAGES GPS software so that deformation events can be quickly identified for more detailed investigation. Preliminary solutions from this processing stream suggest that atmospheric heterogeneities present the most significant source of errors that must be assessed and mitigated in order to resolve the subtle or transient details of these events. We analyze InSAR and GPS data collected over Mauna Loa’s summit and rift zones to explore recent magmatic-tectonic deformation of the volcano. The InSAR data include RADARSAT and ENVISAT images that together comprise 77 scenes and 149 interferograms from mid-1999 to mid-2006. The GPS data include periodic survey measurements and a network of continuous stations that has grown to more than 20 instruments over the past several years. In general, the InSAR and CGPS data agree well. Stacks of individual interferograms are dominated by large (cm scale) motions associated with recent (2002 to present) inflation of Mauna Loa’s summit region. Our results also detect a 9×15 km region of ~0.5 cm/yr line-of-sight lengthening (apparent subsidence) along Mauna Loa’s Southwest Rift Zone (SWRZ). The feature is present in all interferograms, including those that span time periods prior to the initiation of summit inflation. We explore hypotheses to explain this anomaly including: a) persistent atmospheric artifacts, b) deep-seated SWRZ opening, c) flank mobility related to SE-directed translation above a decollement, or d) a combination of deep-seated SWRZ opening and flank mobility, similar to the mechanism invoked to explain deformation of the south flank of neighboring Kilauea volcano. Although atmospheric water vapor anomalies are certainly very large in the region, the type of closed-contoured feature observed in the InSAR data is not reproduced by our analysis of high-resolution weather models from the region, and we are led to favor a volcano-tectonic explanation for the subsidience.

References

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