Satellite synthetic aperture radar (SAR) interferometry (InSAR) has proven a valuable observational technique for imaging ground surface deformation of volcanoes. Over the past fifteen years the number and diversity of its application has been continuously increasing. While individual interferograms form the foundation for most InSAR analyses, InSAR time series analysis coupled with a diverse array of modelling techniques have expanded and deepened its potential for understanding volcano source processes and for volcano monitoring and eruption forecasting. We present an overview of recent applications of InSAR and InSAR time series, the latter using the small baseline subset (SBAS) approach, to volcano deformation source analyses. We will present recent observations and analysis from several volcanoes in Hawaii, Kamchatka, Italy, and the Americas using data from the European Space Agency’s Envisat, Japanese Space Agency’s ALOS, German Space Agency’s TerraSAR-X, and Italian Space Agency’s COSMO-SkyMed satellites. We will also present some initial results from the NASA UAVSAR airborne InSAR instrument. In particular we will focus on Kilauea, Hawaii, where we have rich InSAR data sets from the Envisat, ALOS, TerraSAR-X, COSMO-SkyMed systems. For Kilauea we will present numerical modelling results focussed on several key episodes of inflation and deflation (2003-2010) surrounding the 2007 intrusion. We will also summarize transient short-lived deflation-inflation events beneath Kilauea caldera imaged over time spans from 1 day (UAVSAR) to the multiples of the TerraSAR-X’s 11-day repeat interval. Kamchatka presents challenges to InSAR through its short snow-free period that limits temporal coherence and its vegetation that limits spatial coherence.