Using earthquake-derived seismic velocity changes to monitor strain at volcanoes

Alicia Hotovec-Ellis

The velocity of seismic waves normally varies as a function of location based on the physical properties of the subsurface. Seismic velocities can also vary as a function of time, usually on the order of a fraction of a percent. Most of these time-varying changes are thought to be due to the opening and closing of microcracks and/or pore spaces due to strain changes. Therefore, the study of temporal changes in seismic velocity lies squarely at the intersection of geodesy and seismology: stress changes elicit a response which can be measured with seismic techniques such as coda wave interferometry, or with geodetic techniques such as GNSS and tilt. Given the tendency for volcanoes to deform prior to eruption, researchers are currently working toward using observations of seismic velocity changes as a volcano monitoring tool. However, before it can be fully realized for real-time volcano monitoring, there is still much work to do to unravel the details of the relationship between the seismic velocity changes we observe and strain in subsurface. For example, velocity changes result from not only volcanically-induced strain, but from non-volcanic influences such as seasonal variations in hydrology or temperature as well as mechanical changes due to large tectonic earthquakes. In this talk, I'll discuss successes and remaining challenges for using seismic velocity change at volcanoes and the role of interdisciplinary datasets in that endeavor.