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Quantifying the stress sensitivity of a volcanic edifice using an active time-lapse seismic experiment

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Continuous time-lapse monitoring techniques based on noise correlation are a relatively new monitoring tool that can be applied in volcano seismology. These methods can, in principle, be used to track continuous velocity changes associated with stress variation in the system. Despite the negative impact of noise source variability on stress-related velocity change estimates, there are several examples in the literature of the successful application of this methodology. A key challenge is to find a way to connect these seismological velocity changes to other disciplines that model stress changes associate with fluid migration, dyke injections etc. This requires an estimation of the stress-sensitivity of the volcanic edifice so that observed velocity change can be directly converted to stress changes. Here we present results from a specifically designed active time-lapse seismic experiment on Tenerife Island (Spain), where repeating seismic sources (every 15 minutes) coupled with measurements of Earth tidal and atmospheric forcing are used to estimate stress sensitivities of upper edifice volcanic materials. We determine stress sensitivities that are several factors higher than for crustal rocks and find evidence for strong atmospheric and hydrological coupling which drive the temporal evolution of rock stiffness.