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Consequences of local surface load variations for volcanoes monitoring: Application to Icelandic subglacial volcanoes.

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Surface load variations occur frequently in the vicinity of volcanoes inducing deformations and stress field perturbations that might be recorded by geophysical monitoring. One of the main limitations of risk assessment from volcanoes continuous monitoring is our ability to establish whether or not a given perturbation of the signal is a precursor announcing an eruptive event. To obtain maximum benefits from the geophysical monitoring of volcanoes, it is therefore of prime importance to discriminate the perturbations induced by surface load variations and the one caused by shallow magma movement which is often the sign of a forthcoming eruption. It is also essential to understand the influence of surface perturbations on the shallow plumbing system behavior. Numerical models are performed to calculate the displacements as well as Coulomb stress changes induced by the combined effect of the ice load variation and the consecutive magma pressure re-equilibration. We show that, whereas the displacement response of a surface load variation is only slightly influenced by the presence of a magma reservoir inside the crust, the seismicity rate perturbation strongly depends on the magma reservoir shape and state. It follows that discrimination of displacement induced by surface load variations and motion due to magma movement can be performed considering two distinct sources of deformation and calculating the load effect by integration of Green's function for a laterally uniform crust. Another consequence is that variation of seismic activity recorded, bring constraints on the magma reservoir. Finally considering a rupture criterion in tension, we characterize the influence of surface load variations on eruption likelihood. The model developed is applied to two active Icelandic subglacial volcanoes: Katla and Grìmsvötn.