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Response of normal faults to glacial-interglacial fluctuations of ice and water masses on Earth's surface

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Slip rate variations on normal faults may result from changes in surface loads during glacial-interglacial cycles and the associated flexure and rebound of the lithosphere (Hetzel and Hampel, *Nature*, 2005). The associated changes in the crustal stress field lead to a period of seismic quiescence during loading followed by temporal clustering of earthquakes during and after unloading. We present a suite of finite-element experiments to evaluate how the magnitude, the distribution, and the temporal evolution of the load as well as rheological parameters of the lithosphere and asthenosphere influence the response of a normal fault. The results show that the duration of the seismically quiet period during loading and the intensity of the slip rate increase during unloading are primarily controlled by the magnitude of the load. The time lag with which the fault reacts to the changes in loading is mainly determined by the viscosity of the asthenosphere. Parameters that play only a minor role for the response of the fault include the rate of load removal, fault strength, and the thickness of the lithosphere. Our results imply that earthquake recurrence models derived from the Holocene slip histories may not be representative for the long-term evolution of seismogenic faults.