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The influence of climatically-driven surface loading variations on continental strain and seismicity

Tim Craig (1), Eric Calais (2), Luce Fleitout (2), Laurent Bollinger (3), and Oona Scotti (4)

(1) Institute of Geophysics and Tectonics, University of Leeds, Leeds, UK, (2) Laboratoire de Geologie, Department de Geosciences, Ecole Normale Superieure, Paris, France, (3) CEA, DAM, DIF, Arpajon, France, (4) IRSN, DEI/SARG/BERSSIN, Fontenay-aux-Roses, France

In slowly deforming regions of plate interiors, secondary sources of stress and strain can result in transient deformation rates comparable to, or greater than, the background tectonic rates. Highly variable in space and time, these transients have the potential to influence the spatio-temporal distribution of seismicity, interfering with any background tectonic effects to either promote or inhibit the failure of pre-existing faults, and potentially leading to a clustered, or 'pulse-like', seismic history. Here, we investigate the ways in which the large-scale deformation field resulting from climatically-controlled changes in surface ice mass over the Pleistocene and Holocene may have influenced not only the seismicity of glaciated regions, but also the wider seismicity around the ice periphery.

We first use a set of geodynamic models to demonstrate that a major pulse of seismic activity occurring in Fennoscandia, coincident with the time of end-glaciation, occurred in a setting where the contemporaneous horizontal strain-rate resulting from the changing ice mass, was extensional – opposite to the reverse sense of coseismic displacement accommodated on these faults. Therefore, faulting did not release extensional elastic strain that was building up at the time of failure, but compressional elastic strain that had accumulated in the lithosphere on timescales longer than the glacial cycle, illustrating the potential for a non-tectonic trigger to tap in to the background tectonic stress-state. We then move on to investigate the more distal influence that changing ice (and ocean) volumes may have had on the evolving strain field across intraplate Europe, how this is reflected in the seismicity across intraplate Europe, and what impact this might have on the paleoseismic record.