The physics governing the long-term seismic cycle in subduction zones remains elusive, largely due to the inaccessibility and complex settings of subduction zones, as well as due to the short observational time span. The main goal is to benchmark a geodynamic numerical approach by comparing simulation results to an innovative analogue gelatin model featuring realistic rheology and friction. We examine in particular the periodicity and source parameters, derived from stresses and strain rates, and quantify wedge and seismic behaviour as a function of fault rheology and subduction velocity.

The fluid-dynamic numerical method involves a plane-strain finite-difference scheme with marker-in-cell technique to solve the conservation of momentum, mass, and energy for a visco-elastic rheology (code I2ELVIS). The simulated laboratory setup is comprised of a triangular, visco-elastic crustal wedge on top of a subducting slab, which includes a seismogenic zone that is constantly moved toward a backstop.

Preliminary numerical and analogue results show a crustal wedge moving landward at decreasing velocities during the interseismic-equivalent phase, thereby uplifting the rear of the wedge, while stresses build up mainly at the bottom of the seismogenic zone. Stresses are released during the coseismic phase in which a slipping event nucleates close to the down-dip tip and mainly propagates upward. Wedge velocities show a direction reversal, depicting a short, dominantly seaward motion during the event. These characteristic features of both approaches are in agreement with GPS observations. Finally, an extension toward large-scale, geometrically more realistic models is made to facilitate the comparison to and implications for nature.