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A Finite Element Study of the Andean Subduction Zone

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To contribute to the understanding of the frictional behaviour and the seismic coupling the between oceanic crust and the mantle in the Andean subduction zone, we constructed a three-dimensional finite element model (FEM) of the subduction which is constrained by the present-day surface deformation.

Our model is implemented with the commercial multi-purpose FEM software ANSYS. It covers a large area (23°S-34°S and 59.5°W-85.5°W) and is therefore spherical. The numerical model includes the precise geometry of oceanic and continental crust as well as of the moho. The surface is defined by topography data. Our dynamical subduction model is driven only by the gravitational force. The prestressed initial model for the subduction maintains the topography up to millimetre level. The three-dimensional modelling yields a low Coulomb friction between slab and continental crust and slab and mantle, respectively.

As a result of the precise geometry of slab and moho, spatial non-uniform distributed asperities are visible which evolve in time. We conclude that the complex geometry plays an important role for the seismic coupling and the change from sticking to sliding of the slab and hence for the occurrence of earthquakes. The friction coefficient for the interfaces between oceanic crust and continental crust and oceanic crust and mantle, respectively, is limited by 0.05.