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Coupling lithosphere-mantle dynamics to the Cenozoic tectonic evolution in the Caribbean region

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Our research question focuses on how plate motions, plate subduction and inherited fault systems control the Cenozoic evolution of the central to eastern Caribbean region. Our present investigation concerns the Eocene tectonic reorganisation of the North America-Caribbean plate boundary zone and the initiation and further evolution of the lesser Antilles subduction. To this end, we employ 3-D thermo-mechanical modelling of plate boundary evolution and of subduction evolution. Our modelling is constrained by the absolute plate motions of the North and South American plates.

Numerical modelling of large and complex regions, such as the Caribbean region, over various length scales (100's of meters to 1000's of km's) using realistic (strongly nonlinear) rheologies requires state of the art numerical techniques. To solve such problems we are using the open-source finite-element mantle convection code ASPECT (Kronbichler et al., 2012), which incorporates many of the state of the art numerical techniques required for this kind of research such as adaptive mesh refinement, advanced linear and non-linear solvers, stabilization of transport dominated processes and it is at least scalable up to ten thousand cores. We will discuss particular implementations we developed to optimize ASPECT for this Caribbean project and show preliminary modelling results.