

Within this Ph.D. project, we have developed and validated a modeling methodology for the evaluation of the influence of friction in regional and global models of tidal deformation in icy bodies. We focus on the role of friction in two specific scenarios: (i) strike-slip faults within Europa's ice shell (expanding the model by Kalousová et al. (2016)), and (ii) the frictional behavior of fault system known as 'tiger stripes' at the south pole of Enceladus, building upon the 3D model of Enceladus' ice shell developed by Souček et al. (2019).

Ad (i), we have developed a mathematical model predicting slip at the strike-slip fault, its neighboring bulk's deformation, and the region's thermal evolution driven by two dissipative processes. First, our investigation focuses on the mechanism of meltwater generation, where results indicate a limited potential for generating near-subsurface meltwater and its confinement to the fault region. Second, we confirmed the physical validity of the 'tidal walking' concept, a theoretical model for generating lateral offsets on Europa's strike-slip faults. We show that fault penetration across the entire shell or reaching a sufficiently low-viscosity zone is necessary for producing observable offset, which is unlikely under current european conditions. Also, our model's quantitative assessment of the associated surface heat fluxes indicates that measuring thermal anomalies on Europa's surface might lead to the differentiation of active faults.

Ad (ii), we extended the numerical model by Souček et al. (2019), by including Coulomb-type friction in the description of tiger stripes, which introduces a mechanical asymmetry in the response of faults between the periods of normal loading and unloading, resulting in a stress redistribution with potential geomorphological implications. We also observe an intriguing correlation between the brightness of the plumes and tangential displacement at the faults, and the strong dependence of Enceladus' tidal deformation on the friction coefficient. Finally, we present a proof-of-concept for incorporating a more realistic rate and state frictional model in future 3D models of Enceladus' ice shell.