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Origin of the distribution of plate size at the surface of the Earth

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Understanding how plate tectonics works on Earth lies not only in the description of the plate motions back in time (Seton et al., 2012) but also in the comprehension of plate topology itself. Today, the link between plate tectonics and mantle dynamics is acknowledged but we still don't know which parameters control plate tectonics topology and how.
Plate reconstructions of Earth's are static snapshots that do not allow the evaluation of the forces within the lithosphere and the mantle. In contrary, mantle convection models give access to a complete survey of data: velocities, viscosity and heat flow for instance. Hence we use a new approach: we apply plate tectonics theory at the surface of 3D spherical convection models producing self-consistently plate-like behavior.
First, we build convection models using StagYY (Tackley, 2008) with different strength of the lithosphere. Then, we use the Gplates software to interpret the surface tectonics of our models to obtain tectonic plates. It is hence possible to extract the number, the size, and the velocities of plates.
The results show a decrease of the plate number and plate velocities when lithosphere strength increases. The distribution of the size of plates is consistent with the observed repartition on Earth (Morra et al., 2013). Plates can be divided into two subsets, the smaller and the larger plates. The occurrence of the two groups are explained considering two origins for the morphologies of plates: (1) the large plates reflect the influence of the large scale mantle flow; (2) the smaller show the accomodation of the deformation by fragmentation. Indeed, we found that the smaller plates are located around the subduction zones and allow to accommodate relaxation of stresses and small scale flow in the vicinity of slabs.