Numerical Highway to the Earth's core

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High resolution numerical simulations of the geodynamo are required to capture the rapid dynamics of the magnetic field observed around our planet.
To reach extreme parameters in our simulations, we have developed a technique that avoids to compute long transients by choosing initial conditions that are close to the statistical equilibrium state.
Those initial conditions are obtained by applying previously established scaling laws to the output of a lower resolution simulation at parameter further from the Earth's core.

This procedure can be repeated to achieve simulations that are closer and closer to the conditions of the Earth's core, paving the road of a numerical highway to the Earth's core.

We have been able to reach highly critical dynamos at Ekman number 10^{-7}, where the magnetic energy starts to become larger than the kinetic energy. Fast variations of the magnetic field can be observed at the Earth's surface, while the flow exhibits tall and thin structures under the strong global rotation, with a wide range of excited scales.