The terrestrial planets have been extensively modelled by numerical simulations of convection in rapidly rotating spherical shells using the Boussinesq approximation. These models generate large scale magnetic fields which in certain parameter regimes resemble planetary magnetic fields, in particular, the geomagnetic field. It is not possible to reach the extreme parameter values of real planetary cores in the simulations, and it is unlikely that the correct planetary regime will be reached in the foreseeable future. Nevertheless, the asymptotic behaviour of the models in the limit of low Ekman number and low magnetic Prandtl number does seem consistent with the observed planetary fields. They therefore continue to be useful to understand the history and morphology of planetary fields. Recent issues that have been explored are the weak field of Mercury, the influence of the mantle on the geodynamo, and the death of the Martian dynamo.

The models can also be used to explore fundamental dynamo mechanisms: for example, why are planetary dynamos predominantly axial dipoles when experimental and theoretical dynamos often show transverse dipoles or quadrupolar dynamos? The Boussinesq dynamo models are well established, but compressible models based on the anelastic approximation, appropriate for giant planet dynamos, are now coming onstream. An international benchmarking exercise is underway to verify these new codes.