

Geodynamo modelling of double diffusive convection

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The secular cooling of the core and its cristallization induce thermal and chemical inhomogeneities in its external liquid part. The chemical and thermal transport equations are of the same form but they are characterized by diffusivities, which differ from one another to several order of magnitude. This specific kind of convection is called double-diffusive convection and was deeply studied in the case of ocean, where salinity and heat provide two different sources of density anomalies. Unfortunately, only a limited number of studies consider these two sources of buoyancy in the case of planet interiors. The most common approach, called codensity, considers that only one transport equation has to be solved. Recent improvements in numerical methods enable the study of the double-diffusive convection. In the present work, we perform a series of 70 numerical dynamo models varying both the total buoyancy power and the fraction between thermal and chemical convection. We show that simulations with a more powerful chemical convection become multipolar with a weaker total convection than the thermal one. To better understand the breakdown of the dipolarity, previous studies propose that the dipole collapse might be due to an increasing role played by inertia in the dominant force balance characterised by a parameter named the local Rossby number Ro_L . The relevance of this parameter applied to the geodynamo has been however questioned. Here we find that Ro_L indeed poorly captures the transition between dipolar and multidipolar dynamos. Instead the symmetry properties of the convective flow characterised by the fraction of the kinetic energy density contained in the equatorial symmetric part of the flow and the total kinetic energy density proves to be a significant parameter to quantify this transition.

Keywords : Magnetism, transport phenomena