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Proper lower boundary condition for geodynamo models

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Both, the release of light elements and of latent heat from Earth's growing inner core plays an important role in driving the geodynamo. However, many dynamo simulations use gross simplifications when implementing these important driving sources and combine temperature and compositional density variations into an artificial quantity often called codensity. Either fixed codensity or fixed codensity flux boundary conditions are then used at the interface to the inner core. Here we derive the proper boundary conditions in a double-diffusive model where both temperature and composition are treated seperately. The flux of light elements and latend heat from the inner core directly depend on the local inner core growth. The local growth rate, in turn, mainly depends on the local variations in temperature, i.e. on the local vigor of convection. This allows to formulate a dynamical boundary condition that we have implemented in our dynamo code. It naturally allows for lateral variations in inner core growth. First numerical runs were dedicated to exploring whether the fixed codensity or the fixed codensity flux conditions used in more classical approaches would lead to more realistic results. We find that the solutions for fixed flux conditions were much closer to the solution for the proper boundary conditions. Fixed condensity conditions tend to overestimate the lateral variations in inner core growth and also result in a smaller overall flow length scale than the fixed flux or new dynamical boundary conditions.