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Variation of viscosity contrast for convection experiments in spherical shells as part of geophysical flow simulation experiment 'GeoFlow II'

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Thermal convection in spherical geometries is of interest in geo- and astrophysical research. To catch aspects of temperature dependent viscosity with a spherical experiment, we consider the fluid motion in a gap between two concentric spheres, with inner spherical shell heated and outer spherical shell cooled. A central symmetry buoyancy field is set-up by means of a high voltage potential in microgravity conditions, and a dielectric insulating liquid is used as working fluid in the spherical cavity. In the Geophysical Flow Simulation experiment named GeoFlow II we will use 1-Nonanol as the working fluid, having such a temperature dependent viscosity. During the GeoFlow I experiment, which was running on the International Space Station from July 2008 until January 2009, the shells were filled with a silicone oil with approximately constant viscosity.

The preparation of GeoFlow II experiment considers numerical simulations as well as experimental tests for the variations of thermal forcing (variation of Rayleigh number) with the specific viscosity contrast of 1-Nonanol. Previous numerical simulations have been performed with a constant viscosity. In the following we consider a more realistic ansatz in terms of a temperature dependent viscosity. Especially for the realization of the experimental runs the following procedure has been developed and tested. Increasing the viscosity contrast accompanied by decreasing Ra and vice versa is implemented by variation of the experimental working environment. Images of the tested runs as well as reached viscosity contrast demonstrate very clearly that the experimental fluid acts in combination of variation of working environment and variation of temperature difference.