Geophysical Research Abstracts
Vol. 12, EGU2010-1759, 2010
EGU General Assembly 2010

Contributions from the geophysical flow simulation experiment 'GeoFlow': fringe patterns of convection and their spatio-temporal behaviour in rapid rotating and non-rotating spherical shells

Birgit Futterer, Sandy Koch, and Christoph Egbers

Brandenburg University of Technology Cottbus, Dept. Aerodynamics & Fluid Mechanics, Cottbus, Germany (futterer@tu-cottbus.de, ++49 355 69 4891)

Thermally driven convective flows in spherical shells are a central issue of geophysical fluid dynamics, i.e. discussing fluid flow of the planet's interiors with its contribution especially to action of dynamos in the cores. For the problem of spherical Rayleigh-Bénard convection in a self-gravitating force field a reasonable amount of research work exists. Most of these studies are in the area of theoretical and numerical simulation analysis. Topic of the 'GeoFlow' experiment is the investigation of convection in rotating, self-gravitating spherical shells. The central symmetry buoyancy field is generated by means of a spherical symmetric electric field acting in a dielectric insulating liquid. Herewith microgravity conditions are necessary. The GeoFlow experiment was running in relevant conditions inside European COLUMBUS module of International Space Station ISS from August 2008 until January 2009, delivering data for convection in spherical shells for no, low, intermediate and rapid rotating cases. Here we present the experimental alignment with numerical data bases for the non-rotating and rapid rotation case.

The non-rotating case is characterized by a co-existence of several stationary supercritical modes, with a strong influence of initial conditions leading to axisymmetric, octahedral/cubic or pentagonal solutions. Transition to chaos is in form of a sudden onset. Experimental data supports the numerically validated influence of initial conditions in showing the octahedral mode as most preferred stable state. Well-known issue of rapid rotation is the alignment of convective cells at the tangent cylinder due to the domination of centrifugal forces against the self-gravitating buoyancy field. This is the first time that an experiment includes both influences. Hence experimental data reach the regimes of rapid rotation, the system shows very clearly the centrifugal effects by patterns in form of columnar cells.