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Sandy Koch, Uwe Harlander, Rainer Hollerbach, and Christoph Egbers
Germany (sandy.koch@tu-cottbus.de)

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Sandy Koch1, Uwe Harlander1, Rainer Hollerbach2, Christoph Egbers1,
1 Brandenburg University of Technology (BTU) Cottbus, Aerodynamics and Fluid Mechanics, Cottbus (GER)
2 Dept. of Applied Mathematics, University of Leeds (UK)
(sandy.koch@tu-cottbus.de, 0049 355 694895)

In geophysical fluids, such as the atmosphere, the oceans or the liquid core of the earth, periodic flows can be found on all scales. For planetary scales, such flows are caused by tidal forces that initiate waves of smaller scales. In rotating systems, inertial waves play a decisive role. These waves are the result of a subtle interplay between inertial and Coriolis forces. In case of multiple reflections, e.g. on the curved boundaries of a spherical shell, wave rays follow certain orbits [1,2], called wave-attractors. Generally they point to internal boundary layers that are detached from the boundaries. Inertial waves also generate mean flows [3]. Wave-attractor related internal boundary layers have been studied experimentally since about 10 years. Previous experimental studies of wave-attractors were performed in a rotating box [1], or a rotating cylindrical gap [4].We experimentally investigate such waves for spherical shell geometry, since for this geometry the theoretical understanding is restricted by the occurrence of singularities and a complicated Ekman layer structure.

The experiment consists of two co-rotating concentric spherical shells. The angular velocity of the inner sphere is varied in form of a sinus curve forcing the particles to be deflected from their rest position. Coriolis forces drive particles back to their initial position where they overshoot due to inertia. This mechanism gives rise to oscillations called inertial waves. The experiment is governed by two nondimensional numbers, the Rossby and the Ekman number, determined by the mean rotation and the viscosity. To control the wave excitation we vary the amplitude and frequency of the inner sphere′s modulation. We also vary the Ekman-number to study the impact of viscosity in the flow.

Preliminary results shown the generation of a range of frequencies in the equatorial region of the shell. We also find a vertically oriented layer, touching the inner sphere’s equator. This layer reminds on a Stewartson layer but shows a different spatial structure. At the moment we investigate due to which mechanism the frequencies are generated. We suggest that interacting inertial waves [5] are the reason for the observed phenomena.

References

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