We present a new experimental setup developed to model the flow in the region of the Earth Tangent Cylinder. Indeed, this flow is known to play a pivotal role in the dynamo mechanism that sustains the Earth magnetic field, and in the drift of its magnetic north pole. Our experiment reproduces the interplay in between magnetic, rotating and buoyant forces inside a transparent conducting liquid confined in an Earth like geometry, in an hemisphere heated up on the inside cooled down on the outside, filled up with sulphuric acid and spinning in a high magnetic field. This way, a flow governed by the MAC balance is visualised using Particle Image Velocimetry for the first time, whilst thermocouple measurements provide access to heat transfer between the heating core and the modelled Core Mantle Boundary (CMB). The apparatus was operated at Ekman number (ratio of the viscous force over the Coriolis force) of the order of $10^{-4}$ to $10^{-5}$ as well as Elsasser number (ratio of the Lorentz force over the Coriolis force) of the order of 0.1 to 1 and Rayleigh number (ratio of the buoyancy over the conductivities) up to 20 times critical. Without magnetic field, we recovered well-established scalings for the onset of plane convection in rotation, and scalings for the thermal wind associated to convection. Under the influence of the magnetic field, i.e. for Elsasser number larger than 0, we were able to show that convective plumes evolve to wider structures extending higher towards the pole, and that heat transfer from the solid core to the CMB are significantly enhanced as a result. An example of results obtain throughout our experiment is given by figure 1. It corresponds to a side view of the setup. The outside of the dome is cooled by running water. The inside of the dome is filled by sulphuric acid and warmed up at its centered by a heater. Thanks to PIV measurement, we can observed convective plumes along the Earth Tangent Cylinder. These findings are supported by scalings for the Nusselt number against the Elsasser number and Rayleigh number.
Author
Kelig Aujogue *
Coventry University

Alban Pothérat
Coventry University

Binod Sreenivasan
Indian Institute of Science

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