Jezabel Curbelo.

Título: Exploring Approximations for Compressible Convection: From Oberbeck-Boussinesq to the exact equations.

Abstract: In numerical modeling of planetary and stellar convection, taking into account compressibility effects is crucial. However, using the exact equations may not be feasible due to the generation of fast acoustic waves, which distract from the slower convective motions caused by buoyancy. The Oberbeck-Boussinesq model simplifies the calculations by suppressing the acoustic waves making it easier for numerical simulations, but is so simple and pressure effects are relegated to a secondary role. Intermediate models, such as the anelastic and anelastic liquid models, have also been proposed to balance simplicity and accuracy.

We investigated compressible convection under several different approximations for the thermodynamic state as well as using the exact equations. We tested two different classes of equations of state (EoS): one where entropy depends only on density, resulting in nearly constant density and minimizing non-Oberbeck-Boussinesq effects, and the Birch-Murnaghan equations of state, which are realistic models for condensed matter like the Earth's mantle and core. Our study showed that dissipation is closely linked to the fraction of heat flow carried by entropy flux. Additionally, we observe that small-scale convection is prevalent in the flow structure.

Joint work with: Thierry Alboussière, Yanick Ricard, Fabien Dubuffet and Stéphane Labrosse.

Acknowledgments

We acknowledge the support of the RyC project RYC2018-025169, the Spanish grant PID2020-114043GB-I00 and PID2021-122954NB-I00 and the ``2022 Leonardo Grant for Researchers and Cultural Creators, BBVA Foundation''