Geophysical Research Abstracts
Vol. 21, EGU2019-16959, 2019
EGU General Assembly 2019

Deep-Seated Convection in Mercury‘s Core: Implications for the Hermean Dynamo

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Ever since the discovery of the internally generated magnetic field on Mercury during the first flybys of the Mariner 10 spacecraft back in 1974, its presence raised a lot of questions about the dynamo action generating the magnetic field of the sun-nearest planet. First magnetic field models revealed that the field strength is roughly 1% of the magnetic field strength on Earth, which was later confirmed by data of the MESSENGER mission. Furthermore the field shows a strong axial symmetry and is dipole dominated. However, the internal generation of such a weak, axisymmetric magnetic field cannot be explained by adjusting typical parameters like the Ekman number in dynamo models, since the resulting magnetic field is too strong and do not show the observed field morphology. One model to explain the Hermean magnetic field is a deep-seated dynamo proposed by Christensen (2006) and further investigated by Christensen & Wicht (2008) . In this model the upper part of the liquid outer core is stably stratified and therefore subadiabatic, such that convection is only present in the superadiabatic part underneath the stable layer. This configuration leads to a damping of the magnetic field due to a passive skin effect. This damping is more effective for higher magnetic field modes such that the observed field outside the core is dipole dominated, axisymmetric and shows a clearly weakened field strength compared to the field inside the core. In this study we present new direct numerical simulation of deep-seated convection for Mercury's outer core. We employ (magneto-)hydrodynamic simulations to achieve a fundamental understanding of the hydrodynamics of such a system configuration, first. Based on these findings, we present the necessary internal geophysical structure regimes of Mercury that provide a suitable magnetic field damping and conclude with first magnetohydrodynamic simulations exploring these regimes.