Geophysical Research Abstracts
Vol. 18, EGU2016-7898, 2016
EGU General Assembly 2016

Geomagnetic secular variation timescales under rapid rotation constraints

Maélie Coutelier (1), Hagay Amit (1), and Uli Christensen (2)

(1) Universite de Nantes, CNRS, Nantes, France (hagay.amit@univ-nantes.fr), (2) Max Planck Institute for Solar System Research, Göttingen, Germany

Based on geomagnetic observations, numerical dynamo simulations and frozen-flux theory it has been argued that the secular variation (SV) timescale of the magnetic field varies as 1\l (where l is the spherical harmonic degree), except for the dipole. The equatorial symmetry of the core flow, which is expected due to rapid rotation effects, allows SV timescale decomposition into symmetric and asymmetric parts. We show in geomagnetic field models and in numerical dynamo simulations that the 1/l scaling law applies for the symmetric and asymmetric timescales as well separately. In both observed and simulated data the symmetric/asymmetric SV timescales are smaller/larger respectively, than in that of the full dataset. The symmetric dipole time scale is well fitted by the 1/l law in the geomagnetic field models, but not in the dynamo models. The opposite holds for the symmetric quadrupole time scales. Assuming that the dynamo models are more representative of the long-term behavior than the geomagnetic field models due to the much longer averaging time of the former, this may suggest that during the historical era the symmetric dipole SV timescale was exceptionally large and the symmetric quadrupole SV timescale was exceptionally small. Since present-day symmetric dipole SV timescale is below the 1/l fit, this may further suggest that the nearly constant dipole tilt between 1840-1960 was anomalous. Failure to explain the dipole SV timescales (both axial and equatorial) by the scaling law may suggest strong diffusion effects for the lowest degrees. Overall, our analytical fits for the symmetric and asymmetric SV timescales provide new insight into the re-organization times of different length scales in Earth's outer core.