Geophysical Research Abstracts
Vol. 14, EGU2012-1174, 2012
EGU General Assembly 2012

Spectral and spatial decomposition of crustal and core magnetic field models using Slepian functions

C.D Beggan (1), K.A. Whaler (2), J. Saarimäki (2), and F.J. Simons (3)

(1) British Geological Survey, Geomagnetism, Edinburgh, United Kingdom, (2) School of GeoSciences, University of Edinburgh, United Kingdom, (3) Department of Geosciences, Princeton Univeristy, USA

Models of the core and crustal magnetic field are typically represented using spherical harmonic coefficients. Rather than spherical harmonics, spherical Slepian functions can be employed to produce a locally and also globally orthogonal basis in which to optimally represent the data in a region up to a given degree. The region can have any arbitrary shape and size and does not necessarily need to be connected. The Slepian functions can be tailored to be either band- or space-limited, in theory allowing a trade-off between spectral and spatial concentration in the region and leakage beyond.

We use Slepian functions to separate the MF7 crustal field model into its oceanic and continental regions in order to investigate the spectral content of each. Spherical harmonic coefficients are transformed into Slepian coefficients, separated into the appropriate regions and transformed back to spherical harmonic coefficients representing the space-limited extent of the oceans and continents. The spectral power of each region is examined over spherical harmonic degrees 16-72.

We also apply this technique to optimally separate the gufm1 core field model into two regions: the non-contiguous areas described by anomalous slow deep mantle shear-wave velocities and its complement. The spectral power of each region is examined over degrees 2-14.

In addition, as the separation produces leakage in the spatial and spectral domain between spherical harmonic degrees, we examine the coupling between the regions. This allows us to judge how robust the solutions are. We show that Slepian functions tend not to produce robust decompositions when models with non-white spectra are used or when the range of spherical harmonics degrees is limited (i.e. the core field). However, they are very well-suited to decomposition of models that have approximately equal power at and extend over a large range of degrees (i.e. the lithospheric field). This technique is thus also applicable to a large number of quantities modelled using spherical harmonics.