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A global estimate of the Earth's magnetic crustal thickness

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The Earth's lithosphere is considered to be magnetic only down to the Curie isotherm. Therefore the Curie isotherm can, in principle, be estimated by analysis of magnetic data. Here, we propose such an analysis in the spectral domain by means of a newly introduced regional spatial power spectrum. This spectrum is based on the Revised Spherical Cap Harmonic Analysis (R-SCHA) formalism (Thébault et al., 2006). We briefly discuss its properties and its relationship with the Spherical Harmonic spatial power spectrum. This relationship allows us to adapt any theoretical expression of the lithospheric field power spectrum expressed in Spherical Harmonic degrees to the regional formulation. We compared previously published statistical expressions (Jackson, 1994 ; Voorhies et al., 2002) to the recent lithospheric field models derived from the CHAMP and airborne measurements and we finally developed a new statistical form for the power spectrum of the Earth's magnetic lithosphere that we think provides more consistent results. This expression depends on the mean magnetization, the mean crustal thickness and a power law value that describes the amount of spatial correlation of the sources. In this study, we make a combine use of the R-SCHA surface power spectrum and this statistical form. We conduct a series of regional spectral analyses for the entire Earth. For each region, we estimate the R-SCHA surface power spectrum of the NGDC-720 Spherical Harmonic model (Maus, 2010). We then fit each of these observational spectra to the statistical expression of the power spectrum of the Earth's lithosphere. By doing so, we estimate the large wavelengths of the magnetic crustal thickness on a global scale that are not accessible directly from the magnetic measurements due to the masking core field. We then discuss these results and compare them to the results we obtained by conducting a similar spectral analysis, but this time in the cartesian coordinates, by means of a published statistical expression (Maus et al., 1997). We also compare our results to crustal thickness global maps derived by means of additional geophysical data (Purucker et al., 2002).