The CHAOS-4 geomagnetic field model

We present CHAOS-4, a new version in the CHAOS model series, which aims to describe the Earth's magnetic field with high spatial and temporal resolution. Terms up to spherical degree of at least $n = 85$ for the lithospheric field, and up to $n = 16$ for the time-varying core field are robustly determined.

More than 14 yr of data from the satellites Ørsted, CHAMP and SAC-C, augmented with magnetic observatory monthly mean values have been used for this model. Maximum spherical harmonic degree of the static (lithospheric) field is $n = 100$. The core field is expressed by spherical harmonic expansion coefficients up to $n = 20$; its time-evolution is described by order six splines, with 6-month knot spacing, spanning the time interval 1997.0-2013.5. The third time derivative of the squared radial magnetic field component is regularized at the core-mantle boundary. No spatial regularization is applied to the core field, but the high-degree lithospheric field is regularized for $n > 85$.

CHAOS-4 model is derived by merging two submodels: its low-degree part has been derived using similar model parametrization and data sets as used for previous CHAOS models (but of course including more recent data), while its high-degree lithospheric field part is solely determined from low-altitude CHAMP satellite observations taken during the last 2 yr (2008 September-2010 September) of the mission. We obtain a good agreement with other recent lithospheric field models like MF7 for degrees up to $n = 85$, confirming that lithospheric field structures down to a horizontal wavelength of 500 km are currently robustly determined.

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