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Rapid time changes of the Earth´s magnetic field

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Ten years of continuous magnetic observations provided by the satellites Ørsted, CHAMP and SAC-C allow to determine the time changes of the core field better then ever before.

This study attempts to model rapid core field changes, especially regarding high temporal resolution (rapid field changes), and high spatial resolution of the first time derivative (linear secular variation). The model, called CHAOS-2, spans the time interval $1997.0 - 2009.0$ and is found from satellite data between February 1999 and December 2008 and annual differences of observatory monthly means between 1997 and 2006.

It describes the static field field up to spherical harmonic degree $N = 60$. The time depending part is modeled up to $N = 20$ by order-5 splines with 6-month knot separation. Co-estimated with the 15,600 coefficients describing the internal magnetic field is a large-scale magnetospheric field expansion (5,635 coefficients) and satellite instrument alignment parameters (567 parameters), resulting in a total of 21,802 model parameters which are estimated by *Iteratively Reweighted Least Squares*. The model is regularized by minimizing the time-space average of $\ddot{B}$ at the core surface.

CHAOS-2 is able to follow rapid field changes as observed by independent data from ground observatories and CHAMP-derived "virtual observatories in space", which suggests that core field changes occurring within only a few months are observable in magnetic data.