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Extending global continuous geomagnetic field reconstructions on timescales beyond human civilization

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Reconstructions of the geomagnetic field on long timescales are important to understand the geodynamo processes in the Earth's core and validate the field behavior observed in numerical simulations. A compilation of paleomagnetic sediment records and lava flow data was used to constrain the first global, time-dependent, geomagnetic field model spanning the past 100ka (GGF100k). We introduced smoothing kernels in the forward modeling to account for the different temporal resolution of the paleomagnetic sediment records and to fit higher resolution records better. The GGF100k model shows comparable spatial, but less temporal resolution compared to available Holocene geomagnetic field models. Using the GGF100k model we studied the dipole moment variations over the past 100 ka, the paleosecular variation activity, the time-averaged field, the evolving structure at the core-mantle boundary, and criteria for Earth-like behavior in geodynamo simulations. Axial dipole moment variations show a good agreement with the paleointensity stacks GLOPIS-75 and PISO-1500. The lowest dipole moment over the past 100 ka is observed during the Laschamp excursion at 40.9 ka BP, with a value of 2.44×10^{22} Am^2. The Laschamp field instability starts when reverse flux patches appear in low to mid latitudinal regions at the core-mantle boundary and then move towards the poles. The inverse flux patches enter the tangent cylinders and fluctuate inside for about 2 ka at different periods, first in the Northern hemisphere at 41.4 ka BP and then about 2.5 ka later in the Southern hemisphere. Apart from the Laschamp excursion that is recorded in most of the sediment records, other excursions appear only in limited regions and cannot be characterized as global events.