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Palaeomagnetic signatures from geodynamo simulations

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Numerical geodynamo models offer a veritable “palaeomagnetists playground” of magnetic field behaviour with spatio-temporal coverage that would be impossible to obtain from measurements of the ancient geomagnetic field. Although they operate in a parameter regime that is very far from the Earth’s core, such models have nevertheless been widely claimed to produce Earth-like field behaviour. This claim, however, has only been widely tested on short timescales and the potential for such models to provide insight into how and why long term palaeomagnetic variations (in both palaeosecular variation and the time-averaged field) occur are lacking. For this study dynamo simulations operating under a broad range of input parameters for time periods far exceeding 100kyr have been used to generate pseudo-palaeomagnetic datasets. These have subsequently been systematically assessed and compared to real palaeomagnetic datasets from the last 5-20 Myr in order to ascertain their apparent realism. Field behaviour is observed to vary widely between models with the realism of models in certain respects (e.g. directional and intensity variability, average inclination anomaly, and the presence of reversals and excursions) tending to trade-off with their realism in others. We explore potential means to rank the models in terms of their overall reliability and also attempt to exploit their extensive spatio-temporal coverage to provide insights into the behaviour of the geomagnetic field on long timescales and the usefulness of our palaeomagnetic datasets to define this.