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Geomagnetic jerks during the Swarm era and impact on IGRF-12

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Global geomagnetic field models can be used to study the dynamics of the core, aid satellite operation and make global digital navigation possible – from smartphones to guided drilling. While current models capture the long-period and large-scale features and variations of the core field well, it is often difficult to represent the poorly understood small-scale and rapid behaviour of the field, thus making prediction difficult. The mantle and crust filter small-scale spatial and temporal features originating in the Earth's core, and field sources external to the Earth contaminate the observations we have. Geomagnetic jerks represent the most rapid observed variations of the internal field, on the scale of months to years.

We investigate the occurrence and spatiotemporal characteristics of jerks in ground observatory data and a recent global field model, during the Swarm era. Previous reports suggest that global models show regions of high secular acceleration associated with the 2014 jerk and that expressions of this might be seen at European observatories post-2014. We find limited evidence of a jerk in European observatories around 2014, but do find globally widespread evidence, and our models of this signal are in agreement with independent field models. We also find evidence of a new jerk, after the 2014 event, in observatory data.

In response to these events we show the impact on early, and potential future, discrepancies between International Geomagnetic Reference Field (IGRF) predictions and observations in the period of 2015-2020 as a result of the unpredictable, non-linear secular variation of jerks now known to have occurred. With the 2014 jerk occurring during / immediately after the data collection period for IGRF-12 and a subsequent jerk occurring shortly after release, we highlight the deviation from observations, the comparable performance of both simple and complex predictive models and the importance of utilising the ability to regularly update field models. This is likely to remain the case until the rapid dynamics of the core are better understood.