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Temporal resolution of internal magnetic field modes from satellite data

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We aim to obtain a modal decomposition of the internal geomagnetic field. In order to do so, we perform a principal component analysis of two virtual observatory datasets, with 4-month sampling time, from the CHAMP (2001–2009) and Swarm (2014–2017) satellite records. The spatial patterns of well-resolved modes calculated from the three field components all have internal origin as expected for these datasets, except for one Swarm mode. For both datasets, we find that the modes with the shortest timescales have also the smallest length scales as expected from a physical standpoint. Also, the energy ordering of the modes is from the least to the most variable, in agreement with independent results on the main field data spectrum. This is not achieved in regularised inversions of geomagnetic field data into time-varying spherical harmonic decomposition, where the highest degree terms have also the poorest time resolution. The improved accuracy of Swarm data is reflected in the lower level of the noise variance.