Altitude dependence of geomagnetic external fields using Swarm and ground observatories data

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The separation of different sources in the geomagnetic field signal measured at satellite altitude is still an open issue. One approach to tackle this problem may be non-parametric statistical methods, such as the Principal Component Analysis (PCA). Here, PCA is applied to Virtual Observatories (VO) geomagnetic time series, computed from an enlarged Swarm dataset covering all local times and geomagnetic activity levels, from January 2014 to December 2019. For each 30-days time window, an Equivalent Source Dipole mathematical model is fitted to the data to reduce a cloud of satellite data points inside a cylinder to one single 'observation' at its axis and 500 km altitude. A VO mesh is constructed with 3394 VOs, with 2 degrees radius each and 3.5 degrees apart in latitude. We study the distribution of satellite data among the cylinders to test if any spatial or temporal sampling asymmetries can be present in the VO dataset and propagate to the PCA results. We also compare observed time series at ground level with VO time series at satellite altitude for the same latitude and longitude. After subtracting a main field model to both series, comparison of the residuals can give further insight on the dependence of external fields with altitude, with a 30-day time resolution.