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Homogenization of the historical records of geomagnetic field components and geomagnetic K-index of the Magnetic Observatory of Coimbra

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The Coimbra Magnetic Observatory (COI) (Portugal) has a long history of observation of the geomagnetic field, spanning almost 150 years. Measurements of the geomagnetic field components started in 1866 and include the observations of all components: horizontal (H), downward vertical (Z), northward (X), eastward (Y), total field magnitude (F), inclination (I) and declination (D). These long instrumental geomagnetic records provide very important information about variability of measured parameters, their trends and cycles, and can be used to improve our knowledge on the sources that drive variations of the geomagnetic field: liquid core dynamics (internal) and solar forcing (external).

However, during the long life of the Coimbra observatory, some inevitable changes in station location, instrument's park and electromagnetic environment took place. These changes affected the quality of the data causing breaks and jumps in the series. Clearly, these inhomogeneities, typically of shift-like (step-like) or trend-like, have to be corrected or, at least, minimized in order for the data to be used in scientific studies or to be submitted to international databases.

The homogenization of the monthly and annual averages of geomagnetic field components has been done using visual and statistical tests (e.g. standard normal homogeneity test), allowing to estimate not only the level of inhomogeneity of the studied series, but also to detect the highly probable homogeneity break points. These have been compared with the metadata, reference series from the nearest geomagnetic stations and geomagnetic field models (e.g. CM4 and CHAOS3) in order to find and to set up the indispensable correction factors. Similar methods have been applied to the homogenization of the local geomagnetic K-index series (from 1952 to 2012). As a result, the homogenized geomagnetic monthly and annual averages of the series measured in COI are considered to be essentially free of artificial shifts and ready to be used by the scientific community.