1. Summary

We present a new magnetic declination map for 1600-1640 AD based on the compilation carried out by Athanasius Kircher (1602-1680) in his book “Magnes sive de Arte Magnetica” (The magnet or the magnetic art), published in 1641 and reprinted in 1643 and 1654. In this book Kircher presented a list of 524 observations of the magnetic declination made in different parts of the world, some of them were made by himself or by his supervision and other were compiled from navigators, other geomagnetic researchers or solicited by Kircher. He suggested in 1641 the possibility of drawing a magnetic map (Mapam Magneticam) that would present the values of declination on a world map, but he did not do so himself, this would have been the first magnetic map. We show here the magnetic map that he would have obtained.

Only in one of the five tables shown in his book, Kircher provided information on the longitude of the measuring point, the list of measurements given by Ioanue Teliero on his trip to the East Indian. In the rest of the data only latitude and geographical information, often very uncertain, is provided on the location of the observation point. In this work we have relocated these observation points and corrected few mistakes. A total amount of 375 observations can be considered as reliable and were used to draw a coherent magnetic declination map.

The new declination chart is compared with the expected values given by the GUFM1 model (Jackson et al. 2000) at the epoch 1638. The GUFM1 model is based in the compilation done by Jonkers et al. (2003) who used 3090 declination data for the time period between 1600 and 1640. Jonkers et al. (2003) did not use the 56 proper contributions of Kircher because not available information on the date measurement was provided in the Kircher's tables. However, after revision of the book, we are confident that those measurements were carried out in the 1600-1640 time period. It should be point out that few mistakes have been detected in the Kircher's compilation that were easily corrected.

2. Athanasius Kircher

Athanasius Kircher (1602-1680), was born in the small town of Gesa, near Fulda (Germany). He studied philosophy in Cologne and Koblenz. In 1630 he went to teach mathematics and ancient languages in the Jesuit College at Würzburg. At this time his interest in magnetism began. He was appointed professor of mathematics at the Roman College where he arrive in 1633 and where he spent the rest of his life.

Kircher stands out above all as a prolific writer with 32 books and some 23 manuscripts of works that were not published. In Kircher’s work one can see two main interests. The first is the search in ancient texts, especially those from Egypt. The second great interest concerned magnetism as the force which pervades the entire universe and constitutes the ultimate cause of all phenomena. In his studies Kircher used a combination of scholastic and Aristotelian physics with mathematical applications and a continuous recourse to experiments as demonstrative arguments, following the lines of the new experimental sciences.

3. The book “Magnes sive de arte magnetica” and declination data.

The book provides 5 Tables with declination data. Only one of them contains all the information, i.e., latitude, longitude and declination measurements. The rest of tables only provides latitudes and geographical information. We relocate all the information providing both latitude and longitude for the major part of the data. The estimated locations for the declination data of the five Tables are plotted in Figure 3a and an original section of the Table II in Figure 3b.

4. Declination chart based on Kircher’s compilation

Step 1. To check if the Kircher’s data were picked up between 1600 and 1640, we statistically compare these data with the GUFM1 predictions in the time interval 1590–1670. We perform a Monte-Carlo routine to associate random dates to the Kircher’s data in this time interval. Then, we synthesize declination data by using the GUFM1 model at those epochs and coordinates. After 106 iterations, we obtain the root mean square residuals between the Kircher’s data and the GUFM1 model predictions. The residual curve shows a clear minimum around 1600 – 1640, the expected dates for the Kircher’s data.

Step 2. We perform a global model using the Kircher’s declination data. For this purpose, a fix date of 1638 is assumed for all the data. The model is developed in spherical harmonic functions up to degree 10 with a spatial regularization in the core-mantle boundary. Since the only use of declination data cannot provide information about the first Gauss coefficient, we constrain the model with 100 synthetized intensity at those epochs. The obtained set of Gauss coefficients provides the declination map that better fit the Kircher’s data (Figure 5a). The declination map is compared with the GUFM1 model (Figure 5b) and the residuals are plotted in Figure 5c. The declination chart that Kircher would have obtained in 1641 (the first magnetic map) does not differ from the expected values given by GUFM1 model.

References


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