Statistical analysis of the inclination shallowing observed in palaeomagnetic studies of recent (last 400 yr) lava flows.

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The Earth's magnetic field undergoes changes in both space and time at secular scale due to the geodynamo processes that take place in the outer core. For the last century, these variations (the so-called secular variation) have been directly recorded through geomagnetic observatories, repeat stations, satellites, and airborne magnetic surveys, providing an accurate picture of the geomagnetic field behavior. Extending the knowledge of the directional geomagnetic field into the past four centuries is possible thanks to the declination and inclination measurements taken by navigational routes. However, to go back in time, the use of palaeomagnetic data is necessary. From ~1600 AD up to the beginning of the 20th century, both kind of data, i.e. historical and palaeomagnetic data, provide us information of the geomagnetic field variation.

This work is focused on the last four centuries (~ 1600 - 1990 AD), for which both palaeomagnetic and historical data are available. Palaeomagnetic data (from both archaeological artifacts and lava flows) are compared with the predictions of the GUFM1 global model that has been developed based on the historical data from shipboard and navigational cruises. As a first result, such comparison shows a statistical agreement between the archaeomagnetic data and the directions given by the geomagnetic field model. However, when comparing separately the volcanic data with the model predictions, a marked inclination shallowing is observed. These systematically lower inclination values have been already pointed out in local palaeomagnetic studies (Italy, Mexico, and Hawaii) for the last century, by comparing recent lava flows with the present geomagnetic field (IGRF model). Here, we show how this inclination shallowing is statistically presented at world-wide scale for the last 400 yr with a mean inclination deviation of around 3º lower than the historical geomagnetic field model predictions.