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Regional geomagnetic main field and secular variation modelling using ground, satellite and marine cross-over data

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After the good results obtained from an attempt to generate a regional model for the secular variation of the total geomagnetic field for gaining a better knowledge of the field over oceanic regions, we now present a new regional model for the full vector main field and its secular variation from 1960.0 to 2000.0 over the North Atlantic Ocean. The distinct facts of our approach with respect to previous existing global models arise from the new information afforded by a collection and selection of marine cross-over data, along with the techniques that we propose for constructing the regional model, which include uncertainty estimates of the results. The marine data offer the possibility to gain better and robust knowledge of the field over large areas lacked of observatories over periods of time without satellite information. In addition to the marine data, we used observatory and repeat station data in the peripheral areas and satellite data from OERSTED, MAGSAT and the OGO series. All the data passed a rigorous selection in order to reject suspicious data and different random selections of satellite data were applied to reduce the effect of the satellite tracks. Due to the use of different altitude data, we obtained our model using the Revised Spherical Cap Harmonic Analysis (R-SCHA) in space and the penalized cubic B-splines in time. Taking advantage of the orthogonality of the basis functions, being particularly important in the inverse problem approach, we introduced two temporal and spatial regularization matrices with appropriate damping parameters, which are adjusted to assess the best compromise between the data fit and the model roughness. The obtained results show an improvement in terms of root mean square error when the regional model is compared with other global models for those epochs, such as the CM4, highlighting the importance of the use of the cross-over marine data in the oceanic regions.