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Preface

In this special issue of *Earth, Planets and Space*, papers related to the construction of the eleventh generation International Geomagnetic Reference Field (IGRF-11) are collected. The IGRF is an internationally-agreed reference model of the Earth's magnetic field produced under the auspices of the International Association of Geomagnetism and Aeronomy, one of seven constituent associations of the International Union of Geodesy and Geophysics. It is widely used not only for a variety scientific purposes ranging from space physics to exploration geophysics, but also by private individuals and commercial organisations who require a reference model in order to utilize the geomagnetic field as a source of directional information.

An update of the IGRF is thus an enterprise of considerable general interest. IGRF-11 extends the previous tenth generation model with a new definitive geomagnetic reference field model (DGRF) for epoch 2005.0, a new reference model for epoch 2010.0 and a new predictive secular variation model for 2010.0–2015.0. Note that explicit details concerning the IGRF-11 model, such as maps and coefficients, have previously been published in the article by Finlay *et al.* (2010) so they are not duplicated in this issue. Users may obtain the IGRF-11 model coefficients in electronic form, software for evaluating the model, and a 'health warning' concerning the use of IGRF-11, online at http://www.ngdc.noaa.gov/IAGA/vmod/igrf.html.

The papers appearing in this special issue provide explicit details concerning the candidate models contributing to IGRF-11, the evaluation and weighting of the candidate models carried out during the derivation of IGRF-11, and other related geomagnetic field modelling issues. The papers by Olsen *et al.*, Maus *et al.*, Hamilton *et al.*, Chambodut *et al.*, Thébault *et al.*, Lesur *et al.* and Kuang *et al.* describe the steps carried out by various teams to derive their candidate models. The data used, the modelling methods employed, and the diagnostic tests carried out are documented in these papers. The article by Kuang *et al.* is a noteworthy first attempt to use a geodynamo simulation (constrained by the assimilation of geomagnetic field models) to predict future secular variation. It will be of great interest to see how the predictions made by this team compare to the more conventional predictions by the other teams in the upcoming five years. There is no paper dedicated to the IZMIRAN candidate model, but a description of this candidate may be found online at http://www.ngdc.noaa.gov/IAGA/vmod/candidatemodels.html. Model coefficients for all candidates as well as various test models can also be found at this location. The article by Finlay *et al.* describes the operation of the IGRF-11 task force, summarizing the statistical evaluations carried out. It also reports the weightings used to derive the final IGRF-11 models. An alternative perspective is given in the article by Chulliat and Thébault who describe attempts to compare the candidate models directly with satellite and observatory data.

The remaining articles deal with field modelling issues relevant for future improvements of the IGRF. The paper by Silva *et al.* deals with the question of whether the truncation degree of the predictive secular variation should be extended from spherical harmonic degree 8 to degree 13 in future IGRF generations. A possible step towards improved secular variation predictions using core surface flows and ensemble Kalman filter techniques is explored by Beggan and Whaler. The article by Matzka *et al.* reports a new aeromagnetic survey of the Arctic along with comparisons to the EMAG2 global compilation; including the influence of crustal field could be of interest in future geomagnetic reference field models. The article by Qamili *et al.* describes the derivation of a regional reference model for Albania and South-eastern Italy and comparisons with IGRF-11. Finally the paper by Lühr and Maus describes possible modulations of the magnetospheric ring current related to solar activity level, and proposes an external field model which can be used to correct geomagnetic field measurements for such effects.

The IGRF is the product of a major collaborative effort between field modellers and the institutes involved in collecting and disseminating magnetic field data from satellites and from observatories and surveys around the world. In this regard we wish to thank the authors of the papers presented here, and the many individuals behind the organisations involved in operating magnetic survey satellites, observatories, magnetic survey programmes and World Data Centres. We would also like to thank the reviewers of the papers for all their efforts, EPS Chief Editor Kiyoshi Yomogida for his support with this special issue and Makoto Uyeshima who kindly served as guest editor for the paper of Finlay *et al.*

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