Journal of Space Exploration

ISSN: 2319-9822

Perspective | Vol12 Iss1

Candidate Models for the 13th Generation International Geomagnetic Reference Field are Being Evaluated

Gillet Finlay*

Managing Editor, Journal of Space Exploration, Australia

***Corresponding author:** Gillet Finlay, Managing Editor, Journal of Space Exploration, Australia, E-mail: spaceexploration@scholarres.org

Received: January 4, 2023**,** Manuscript No. tsse-23-89182; **Editor assigned:** January 6, 2023, PreQC No. tsse-23-89182 (PQ); **Reviewed:** January 9, 2023, QC No. tsse-23-89182 (Q); **Revised:** January 15, 2023, Manuscript No. tsse-23-89182 (R); **Published date:** January 17, 2023**.** Doi: 10.37532/2319-9822.2022.12 (1).256

Abstract

The International Association of Geomagnetism and Aeronomy (IAGA) Division V Working Group V-MOD published the 13th revision of the International Geomagnetic Reference Field (IGRF) in December 2019. This revision includes two new spherical harmonic main field models for the epochs 2015.0 (DGRF-2015) and 2020.0 (IGRF-2020), as well as a model of predicted secular variation for the period 2020.0 to 2025.0. (SV-2020-2025). Candidates submitted by fifteen international teams were used to create the models. The differences between the majority of candidates can be explained primarily by individual modelling methodologies and data selection strategies. None of the candidates were so dissimilar that they should have been excluded from the final IGRF-13 As a result, the IAGA V-MOD task force chose two approaches: the median of the Gauss coefficients of the candidates for the DGRF-2015 and IGRF-2020 models, and the robust Huber-weighted model for the predictive SV-2020-2025 model. In this paper, we describe the evaluation of the candidate models and the methodology followed to derive the final IGRF-13 products.

Keywords: IGRF; Magnetic field modeling; Geomagnetism

Introduction

The International Geomagnetic Reference Field (IGRF) is a set of models that describe the large-scale internal magnetic field of the Earth. An international task force of geomagnetic field modelling experts agrees on the IGRF's spherical harmonic coefficients, which are typically updated every five years to account for temporal field variations originating in Earth's core. The IGRF task force is overseen by the International Association of Geomagnetism and Aeronomy (IAGA) Working Group V-MOD. The IGRF model is used in a wide range of applications by academia, government, and industry, including magnetic reference systems, long-term dynamics of the Earth's core field, ionospheric electrodynamics, and electromagnetic induction, local magnetic anomalies in the Earth's crust, surveying, and orientation are examples of space weather phenomena. The IGRF model is used in a wide range of applications by academia, government, and industry, including magnetic reference systems, long-term dynamics of the Earth's core field, ionospheric electrodynamics, space weather phenomena, electromagnetic induction, and local magnetic anomalies in the Earth's crust, surveying, and three-dimensional orientation. The IGRF-13 task force was formally elected on August 28, 2017 at an

Citation: Finlay G. Candidate Models for the 13th Generation International Geomagnetic Reference Field are Being Evaluated. J Space Explor.2022; 12(1).256

IAGA V-MOD Working Group business meeting in Cape Town, but several additional members joined later. The authors of this paper make up the entire IGRF-13 task force. On March 26, 2019, the task force issued an international call for contributions from 8 modelling teams for a new Definitive Geomagnetic Reference Field (DGRF) for epoch 2015.0 to Spherical Harmonic (SH) degree and order 13, a new provisional IGRF for epoch 2020.0 to SH degree and order 13, and a predictive constant Secular Variation (SV) forecast for the interval 2020.0 to 2025.0 to SH degree and order 8. The term "definitive" is used because the modelling teams used the best available datasets before and after the epoch, and any further significant improvement of these retrospectively determined models is unlikely. In contrast, when the community has a more complete understanding of the Earth's magnetic field for epoch 2020.0, the provisional IGRF model will be replaced by a definitive model in a future revision of the IGRF. The term "definitive" is used because the modelling teams used the best available datasets before and after the epoch, and any further significant improvement of these retrospectively determined models is unlikely. In contrast, when the community has a more complete understanding of the Earth's magnetic field for epoch 2020, the provisional IGRF model will be replaced by a definitive model in a future revision of the IGRF. 0. For DGRF-2015, a record eleven candidate models were received, twelve for IGRF-2020, and fourteen for the 2020-2025 SV forecast. The IGRF-13 call attracted fifteen international teams in total. The task force evaluated each candidate model using well-established methodologies in the fall of 2019. The internal field definition as requested by IGRF-13 is ambiguous. Previously, it was thought to include the core field, the long wavelength lithospheric field, the steady oceanic and tidal magnetic fields, and induced fields caused by time-varying external sources. Some teams attempted to separate the effects of the induced field during previous IGRF generations, arguing that it was not truly an internal field. However, a counter-argument presented at the IAGA 2017 DIV-V business meeting suggested that it is currently extremely difficult to remove the internally induced ionospheric field in a consistent manner due to insufficient resolution of Earth's global conductivity. We make clear how the final coefficient values are calculated. All candidate models, if not already provided in this format, were rounded to two decimal places for the DGRF-2015 and IGRF370 2020 coefficients. The Gauss coefficient median for each SH degree and order for the DGRF-2015 was calculated to two decimal places. Since there were an equal number of candidate models for the IGRF-2020, the median Gauss coefficient is determined by averaging the values of the two central coefficients, which can occasionally result in a result with three decimal places. The output of those coefficients with three decimal places of resolution was then rounded to two decimal places. Huber robust weighting computation output for the SV-2020-2025 model was rounded to two decimal places before output.

Conclusion

A suitable methodology for combining the 37 candidates for the 13th generation of the International Geomagnetic Reference Field (IGRF) that were submitted was determined after a thorough analysis of the candidates. 15 international teams in total submitted candidates for review. These teams submitted fourteen secular variation models for the forecast period spanning 2020.0 to 2025.0, twelve candidate main field models for the IGRF epoch 2020.0, and eleven candidate main field models for the definitive epoch 2015.0. The authors of this paper participated in a volunteer taskforce that conducted independent analyses and provided updates to the IAGA DIV V-MOD chair and co-chair. Both spectral and spatial comparisons, as well as comparisons to different data sets, were used in the analyses.