# Call for IGRF-13 Candidate models

Dear modelers and evaluators,

Please consider contributing to the 13th generation International Geomagnetic Reference Field (IGRF-13). We seek candidate models for the following products:

1) Internal field (main field) for 2020.0 to spherical harmonic (SH) degree and order 13.
2) Predicted average secular variation for 2020.0-2025.0 to SH degree and order 8
3) Internal field (main field) for 2015.0 to SH degree and order 13

The requested numerical resolution of the coefficients is 0.01 nT for all products. This will allow calculation of the final models to a resolution of 0.1 nT. Each team that plans to submit candidate models is requested to provide a list of the products they intend to submit and a description of their methodology by August 1 2019. Each team should also prepare a more extensive description of their product for the time of their submission (October 1, 2019) that will help the evaluation of the IGRF candidate models.

## PUBLICATION

Earth Planets and Space will provide a special issue for IGRF-13 related publications. Note that Earth Planets and Space is an open access publication. For the IGRF-12 special edition see: https://www.springeropen.com/collections/igrf.

## DEADLINES

- August 1, 2019: Brief notice of intent to IGRF task force chair (Patrick Alken, alken@colorado.edu)
- October 1, 2019: Deadline for submission of candidate models.

## TEAM RULES

### Definitions

- A *team* is a group of individuals from one or several institutions that will propose one or more candidate models
- A team is led by an individual, called the *team leader*
- An institution is said to lead a team if the team leader belongs to this institution

### Rules

- Each team can submit only one candidate model per product
- Every lead institution/consortium can have only one team per product
- Every individual can lead only one team
- In order to facilitate collaboration (for example sharing of pre-processed data), it is possible for an individual to be a member of several teams.

## EVALUATION OF CANDIDATES

- The candidate models will be assessed by the IGRF task force in co-operation with representatives from the teams submitting the candidate models.
- Any scientifically plausible method of testing/analysis/validation is acceptable.
- See: https://earth-planets-space.springeropen.com/articles/10.1186/s40623-015-0273-4 for a summary article on the evaluation of the previous IGRF-12 candidate models.

## FURTHER COMMENTS AND INFORMATION:

1. The MAGNETIC REFERENCE RADIUS for the spherical harmonic expansion remains at 6371.2 km. This is an arbitrary reference radius and simply a convention.
2. We ask all modelers to submit models in the following format:
   # < institution>
   # Candidate for < product >
   # n m gnm hnm uncertainty_gnm uncertainty_hnm
   - For main field products, the spherical harmonic degree n runs from 1 to 13
   - For SV products, n runs from 1 to 8
   - The spherical harmonic order m runs from 0 to n
   - No additional header lines
   - The estimated uncertainty should where possible be a realistic estimate of the true uncertainty and not simply the formal error. A null entry should be made if no uncertainty estimates are available.
3. Further information concerning the Division V working group V-MOD can be found on the web site of IAGA at: http://www.ngdc.noaa.gov/IAGA/vmod/index.html

## SUGGESTED ADDITIONAL INFORMATION ABOUT CANDIDATE MODELS

We ask all teams to provide additional accompanying information about their models along the following lines.

- Which satellite, observatory and/or repeat station data sets were used?
- What were the data selection and rejection criteria?
- What weights were allocated to the different kinds of data?
- Was data weighted for equal spatial or temporal coverage?
- How was the forward extrapolation to 2020.0 carried out?
- How is the average secular variation from 2020.0 to 2025.0 predicted? Was the secular variation at 2020 taken, or was it forward extrapolated?
- If iterating the least squares process, what starting model used, and how many iterations were needed?
- If scalar data were used that required linearization of the inversion, what starting model used, and how many iterations were needed?
- What, if any, regularization was used, e.g., use of an a-priori model with specified (co-variance, or addition of some quadratic penalty function to the sum square deviation?
- What, if any, sources were co-estimated and removed? Were any a-priori models or information used in the co-estimation (for instance mantle conductivity models in the estimation of induced magnetospheric and/or ionospheric fields)?
- What was the method used to solve the least squares equations?
- What was the fit to the data?
- Please give some indication of the uncertainties of the resulting set of coefficients and how these were inferred (e.g., (co-)variances, possible known biases, etc)