IAGA V-MOD minutes, Cape Town, South Africa
Date: Monday, 12.00-13.30, 28-Aug-2017

Chairs: Erwan Thebault (Uni. Nantes, FR), Patrick Alken (NOAA/Uni. Colorado, USA)

0. Adoption of the agenda: agreed

1. Data available for field modelling

Swarm data are available usually within 4 days of collection. ESA will issue a new baseline
dataset in Spring 2018 (Rune Flogerhagen, ESA, Session A09).
Other satellite data include DMSP and ePoP. DMSP F15 has accurate magnetic data and
location data until 2013. DMSP F16-18 have free available magnetic data but poor
ephemeris (or location) data, so position accuracy is no better than 1km. High-accuracy
ephemeris is not publicly available. ePoP is now part of the Swarm mission (as Swarm-E) but
usually only collects data at the poles and during a couple of orbits per day.
Ground observatory data are available in a number of formats and cadences (hour, minute,
second) from various sources including ESA AUX_OBS_2 dataset which is updated regularly

The status of the USGS observatory programme is officially unchanged from the start of the
summer, but a new budget item has now been agreed by the House though it needs joint
approval by the Senate. This is positive news and the revised budget to maintain the
network will hopefully be approved later this year.

2. Review of IGRF-12
Erwan Thebault showed a plot of the average disagreement between the IGRF-12 and its
candidates and the CHAOS-6 field model. The difference is around 20-25 nT/yr so far (at
2017.6). This is mainly due to the influence of a jerk at the 2014.5-2015 point during which
many models were derived which has caused the instantaneous secular variation to be
poor.

3. Definition of IGRF-13
Dr. Thebault present two pie charts showing the general background of IGRF-11 and IGRF-12
users as per citation records (around 100-110 separate users in total). The main research
areas were geophysics, followed by engineering and aeronautical/astronomical users. A
smaller set included other users such as medicine or life sciences and space
weather/ionosphere.

A long discussion took place over the position paper developed by Dr Frank Lowes to better
define the intent of the IGRF with regards to what is meant by the 'main' or 'internal' field.
Dr. Lowes suggested explicitly disallowing the induced ionospheric field from the model as
well as the primary ionospheric and magnetospheric, and tidal fields. He suggested
maintaining the core, lithosphere and quasi-static ocean flow. A suggestion for a new
definition as quoted from the Lowes paper was put to the attendees.

- **Within its spatial and temporal truncations, the IGRF aims to model (only) those
  magnetic fields whose primary origin is inside the Earth, specifically the fields**

produced by the core, the lithosphere, and the (quasi-) steady motion of the oceans

Prof. Richard Holme (Uni. Liverpool, UK) thought that most users did not want any significant change in the definition of the model. More sophisticated users would understand the limitations and drawbacks of the IGRF and would use professional models or buy specific services to account for the inaccuracies at various temporal and spatial scales. Dr. Manoj Nair (NOAA, USA) stated that 80% of their users (at NOAA) were looking for compass declination values for their location, so did not require better accuracy. Dr. Gauthier Hulot (IPGP, FR) argued that the induced field was not large (a few nT) and that it would not be wise to make the model more complicated as users expected some sort of average field for their location.

Also, Prof. Nils Olsen and Dr. Chris Finlay (DTU Space, DK) argued it would be difficult to remove the effects of the internal induced ionospheric field and achieve the definition suggested by Dr. Lowes' paper. In addition, apply such a strict requirement would probably produce an obvious 'step' in the Gauss coefficients of the model.

However, alternative voices such as Dr. Sabaka (NASA Goddard, USA) agreed with the Lowes paper but questioned whether the definition of the IGRF should be physical (as in this position paper) or observational (as would apply to the majority of users and modellers). He suggested most users would in reality prefer an observational definition.

Dr. Hulot talked about the users again, and noted that they were usually practical applicants of the field models, having a good understanding of the definition and limitations of the model for their purposes. They were usually able to calculate the errors themselves for their particular application. For example, the quasi-static field from the ocean is some 3-5 nT, depending on location, as stated by Dr. Vincent Lesur (IPGP, FR). This is negligible for most users. As the IGRF community already provide health warnings, a user should be able to make their own judgement as to accuracy or utility. Dr. Miquel Torta (Ebro, ES) wondered about a 'professional' model, but Prof Home pointed out that other institutes or commercial companies already provided such models. Dr. Thebault also noted that the IGRF is a community effort and as such is an agreed consensual model aimed mainly at scientific applications.

- Prof. Holme proposed the delegates follow the suggestions of Olsen and Finlay in particular:
    - Continue to include the ionospheric induced part in the IGRF-13 coefficients, but provide estimates of its size (e.g. as a function of local time and position), for example in an updated health warning
    - Users will thus be provided with our best current estimate of this known 'error' source

The proposal was seconded by Dr. Hulot and the motion was carried unanimously to maintain the *status quo*. In effect, there is no new definition of the IGRF but a series of bullet points will be placed onto the website for the call for the next IGRF candidate to

suggest what may or may not be included, though no candidates would be down-weighted by their choice of modelling parameters.

A final point to note was with regards to the recent ISO standard defining what is a geomagnetic field model. Dr. Alan Thomson (BGS, UK) suggested that as the present set of IGRF models meet the standard, then the next generation would also do so, given that major no change has been suggested. The ISO standard is more generally focused on the definition of the practicalities rather than the scope of a main field model (e.g. what are Gauss coefficient and the mathematical formulation of the problem).

It was suggested that the chairs converse with Dr. Finlay to define the feasibility of producing an error model of induced ionospheric source or otherwise.

4. Plans for IGRF-13

Presently, there are 9 institutes registered with Dr. Alken to participate in the call and evaluation of the next IGRF. Dr. Lesur and Dr. Ingo Wardinski also volunteered at the meeting to participate.

The committee will request a brief outline and information (a few sentences) about the data used and modelling technique and set of coefficient files to be submitted (e.g. DGRF-2015, IGRF-13 and IGRF-13SV) by each institute in April 2019. The rules about one model per institute still apply although collaboration between institutes is encouraged for the cross-checking and final evaluation.

Dr. Hulot noted that IPGP would like to investigate a Swarm ASM-V as well as VFM models which presents an issue for them as a single institute, but Prof. Holme pointed out that the rules encourage everyone to submit their best model. However, the
SV candidate models are often quite different, so this present a difficult case in terms of encouraging innovate new approaches for prediction.

The model rules as given at the meeting were agreed by the delegates.

A tentative timetable suggested submission of the candidate models by October 2019, with an evaluation period until November 2019.

5. World Digital Magnetic Anomaly Map (WDMAM)

Version 2.0 was released in 2015 and was a good improvement on version 1.0 with a large volume of additional data and modelling. Over the oceans there are still large regions which are missing surface based data and thus are filled by satellite data. Version 2.1 (or 3?) is being developed currently with new datasets are being provided to help. A call for new volunteers for the task force was issued with a couple of people denoting interest (TBC).

6. Future sessions at IUGG 2019

Dr. Aude Chambodut stated that IAGA would like to reduce the number of sessions proposed at IAGA meetings and to allow them to be amalgamated for the next conference in 2019. Hence, we were asked to suggest only two sessions and one joint one

Three sessions were proposed for the IAGA meeting in 2019 (conveners in brackets):

- **Planetary Magnetic Fields and Secular Variation (Ingo Wardinski, Vincent Lesur)**

- **Lithospheric Field Modeling and Tectonic Implications (Foteini Vervelidou, Stavros Kotsiaros)**

- **Joint with DIV I: Decadal and centennial forecasting of magnetic field change (Ciaran Beggan, Phil Livermore, Alexandre Fournier)**

7. Any other business

Dr. Thebault reminded delegates that the 2021 IAGA meeting location will be decided this week and is between bids from Hyderabad and Lisbon.

Meeting concluded at 13.20.