

Recent BGS activities for the Swarm DISC

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The British Geological Survey (BGS) is responsible for the fast-track magnetospheric field model product (MMA_SHA_2F), geomagnetic observatory data (AUX_OBS*2_) products, Level 2 CAT-1 product validation and quick-look MAG_QL and EFI_QL, as part of the consortium of institutes making up the Swarm Data Innovation and Science Cluster (DISC). We summarise these activities and provide updates since the last presentation at the ESA Living Planet Symposium in Prague, May 2016.

Of greatest significance is the introduction of 1-minute and 1-second resolution observatory data products, delivered with a 4-day lag. We continue to see the increasing quality of Level 2 CAT-1 products as the mission progresses.

1. Geomagnetic observatory data

BGS started issuing new observatory 1-minute and 1-second data products in October 2016 to complement the existing hour-mean product^[1]. The products are produced daily with a 4-day lag and regular updates are made if new data are found. These data consist of definitive or quasi-definitive data from INTERMAGNET^[2] observatories from October 2012 and are made available, together with the hourly product, on the BGS anonymous FTP server at: ftp://ftp.nerc-murchison.ac.uk/geomag/Swarm/AUX_OBS/

A summary of spatial (Figure 1) and temporal (Figure 2) coverage of all observatory data products is shown below.

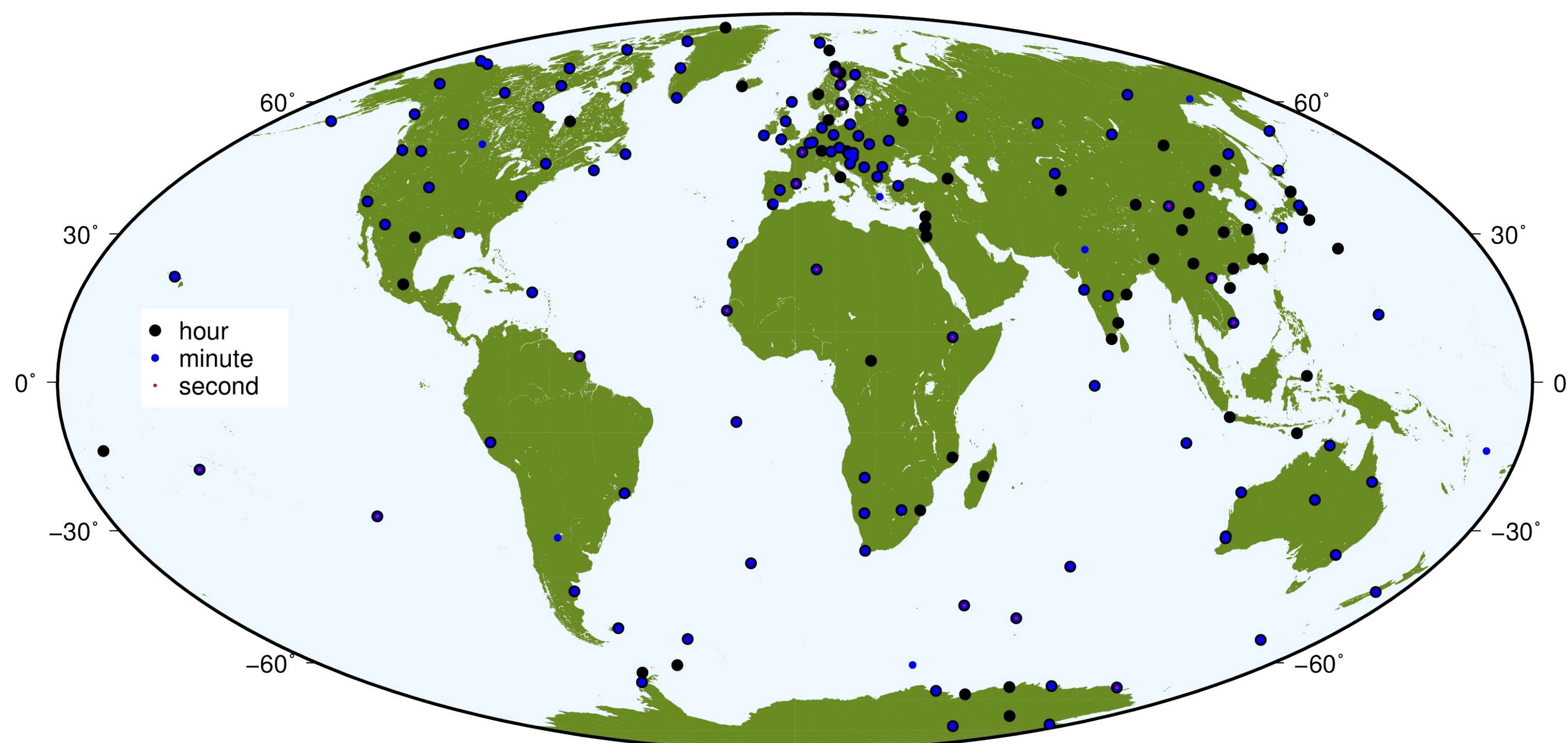


Figure 1. Observatories that have contributed hour-, minute-, and second-mean data to the AUX_OBS_2_, AUX_OBSM2_, and AUX_OBSS2_ products, respectively.

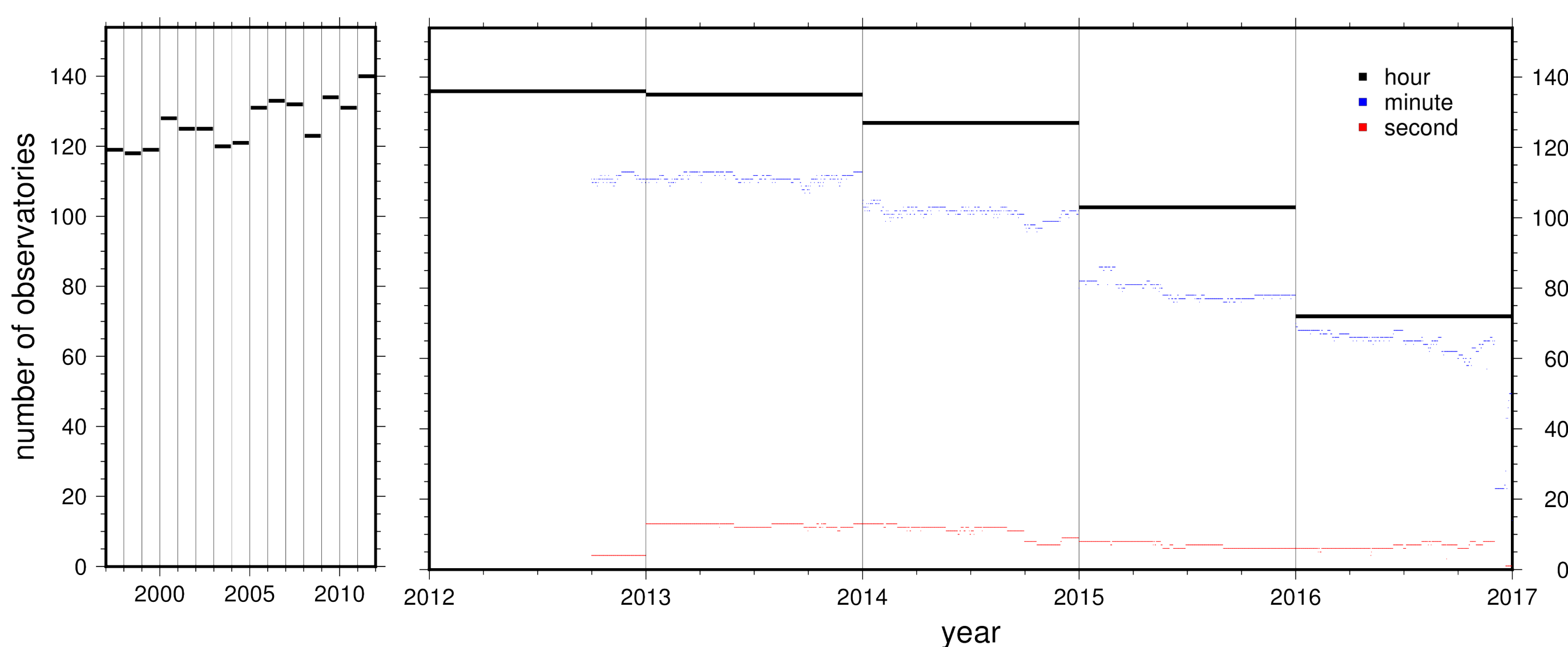


Figure 2. Number of observatories per product versus time contributing to hour-, minute-, and second-mean data for AUX_OBS_2_, AUX_OBSM2_, and AUX_OBSS2_ products, respectively.

The observatory data files have the following format and contents:

	AUX_OBS_2_	AUX_OBSM_2_	AUX_OBSS_2_
Sample rate	hour	minute	second
Start date	1997-01-01	2012-10-01	
Update rate	3-monthly	update product after: 1-month, 3-months, 6-months, 2-years, 4-years,	
File format	text		
Data channels	IAGA observatory code, geocentric latitude, longitude, radius, date and time Field components: geocentric-north, east, and geocentric-down		
	In addition, AUX_OBSM_2_ and AUX_OBSS_2_ have a channel to denote whether each datum is either definitive or quasi-definitive quality.		

2. Product validation

BGS provides the independent validation of Level 2 CAT-1 magnetic products. Core, lithosphere, ionosphere, magnetosphere and conductivity models are assessed and their veracity determined. A selection of example plots from recent (2017) validation reports is given in Figures 3–5 to illustrate the checks carried out before products are released to the community. The latest validations indicate a continued improvement in the quality of Swarm products.

As well as providing confirmation of model validity, such test can highlight useful scientific points. For example, Figure 3 indicates that more recent core models have diverged from the constant secular variation forecast of IGRF-12, Figure 4 suggests high latitude regions where external fields are not fully separated from those of the lithosphere, and Figure 5 indicates that the secular variation measured at ground observatories contains rapid secular variation not fully resolved in the short span of Swarm models so far (e.g. Z components at roughly 2015).

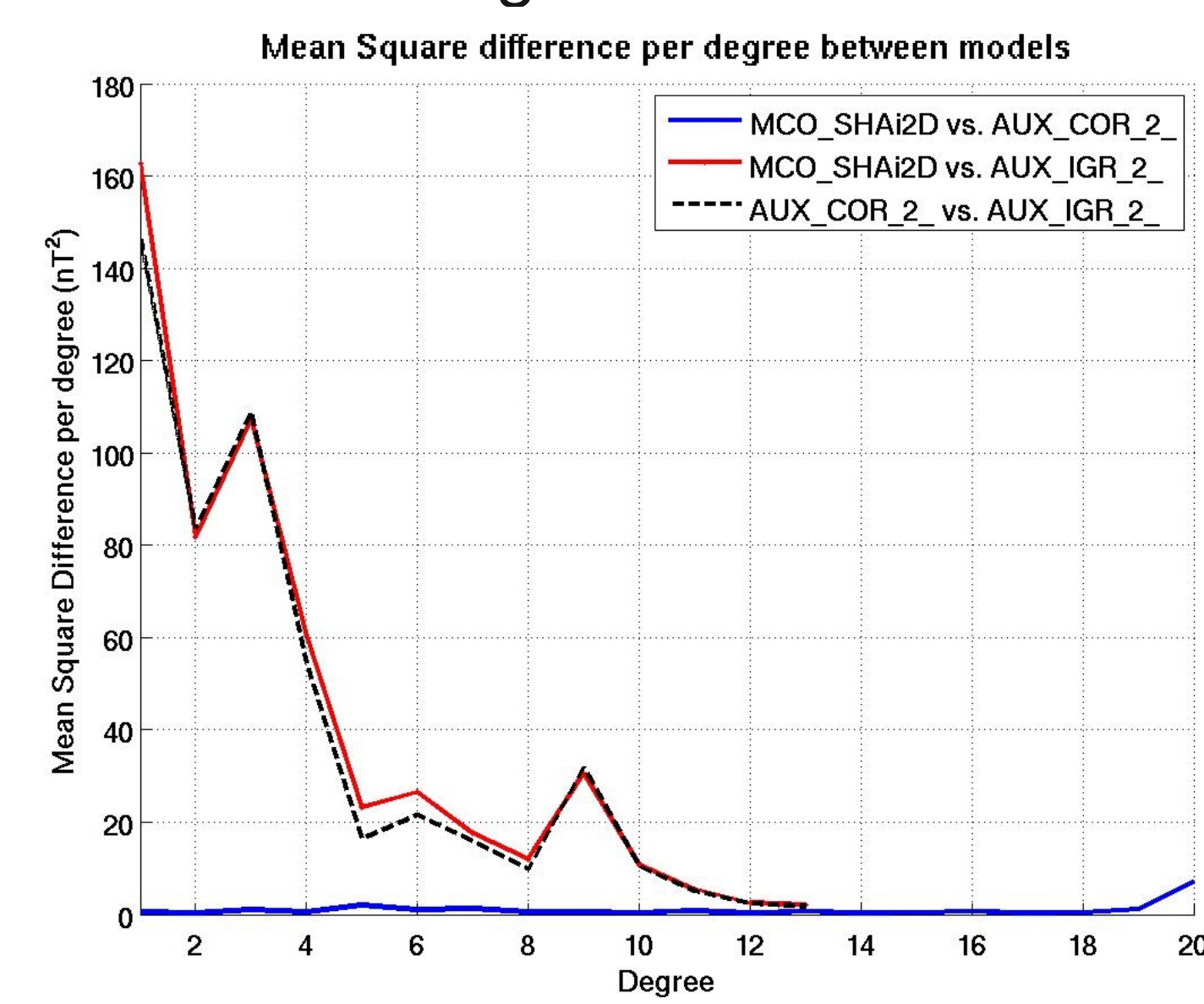


Figure 3. Mean, square differences between IGRF-12 (AUX_IGR_2), GFZ model (AUX_COR_2) and intermediate dedicated core model (MCO_SHAi2D) at 2016.5.

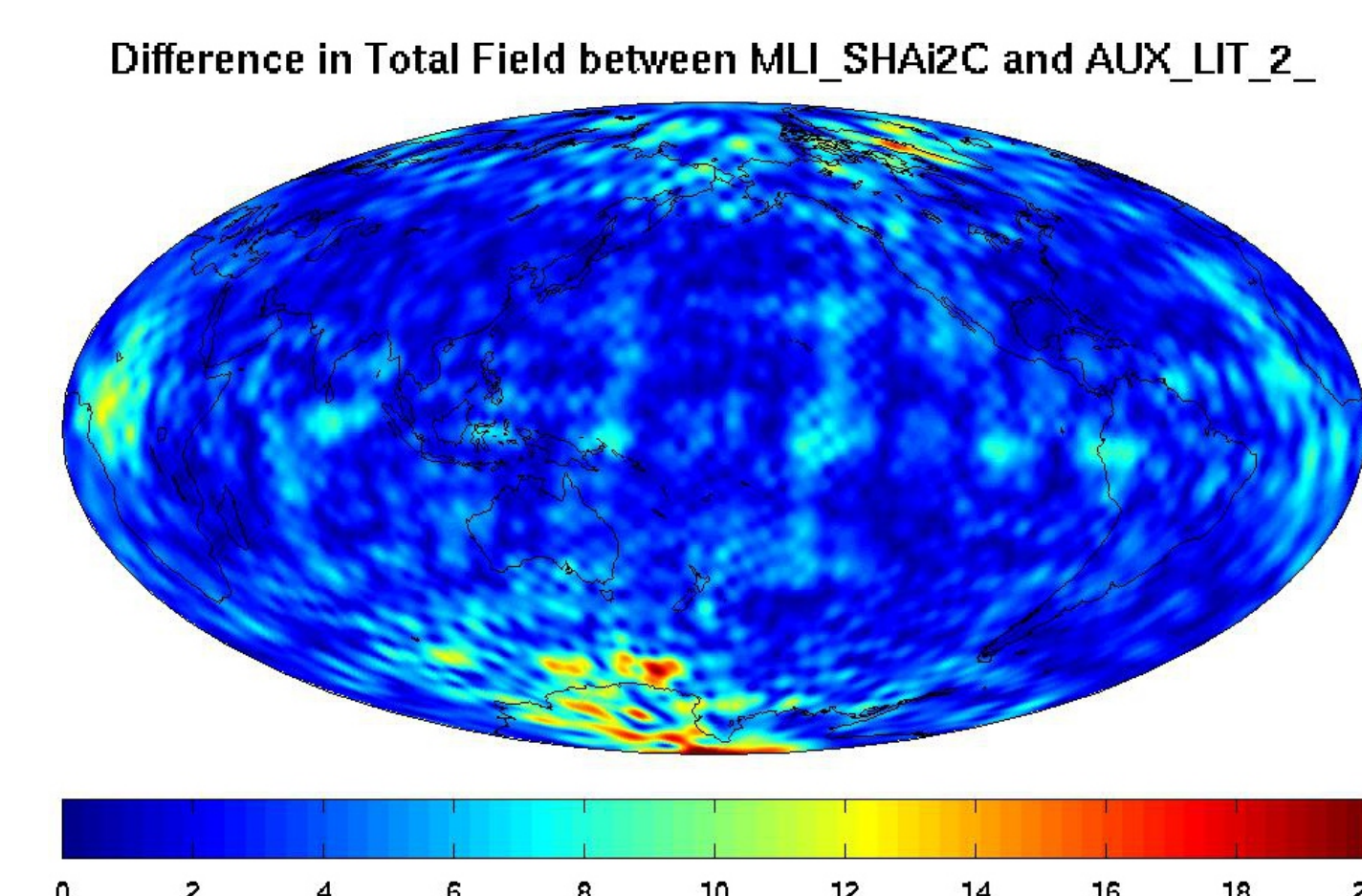


Figure 4. Total field difference (in nT) between comprehensive chain lithospheric field model (MLI_SHAi2C) and MF7^[3] (AUX_LIT_2_) to spherical harmonic degree 90.

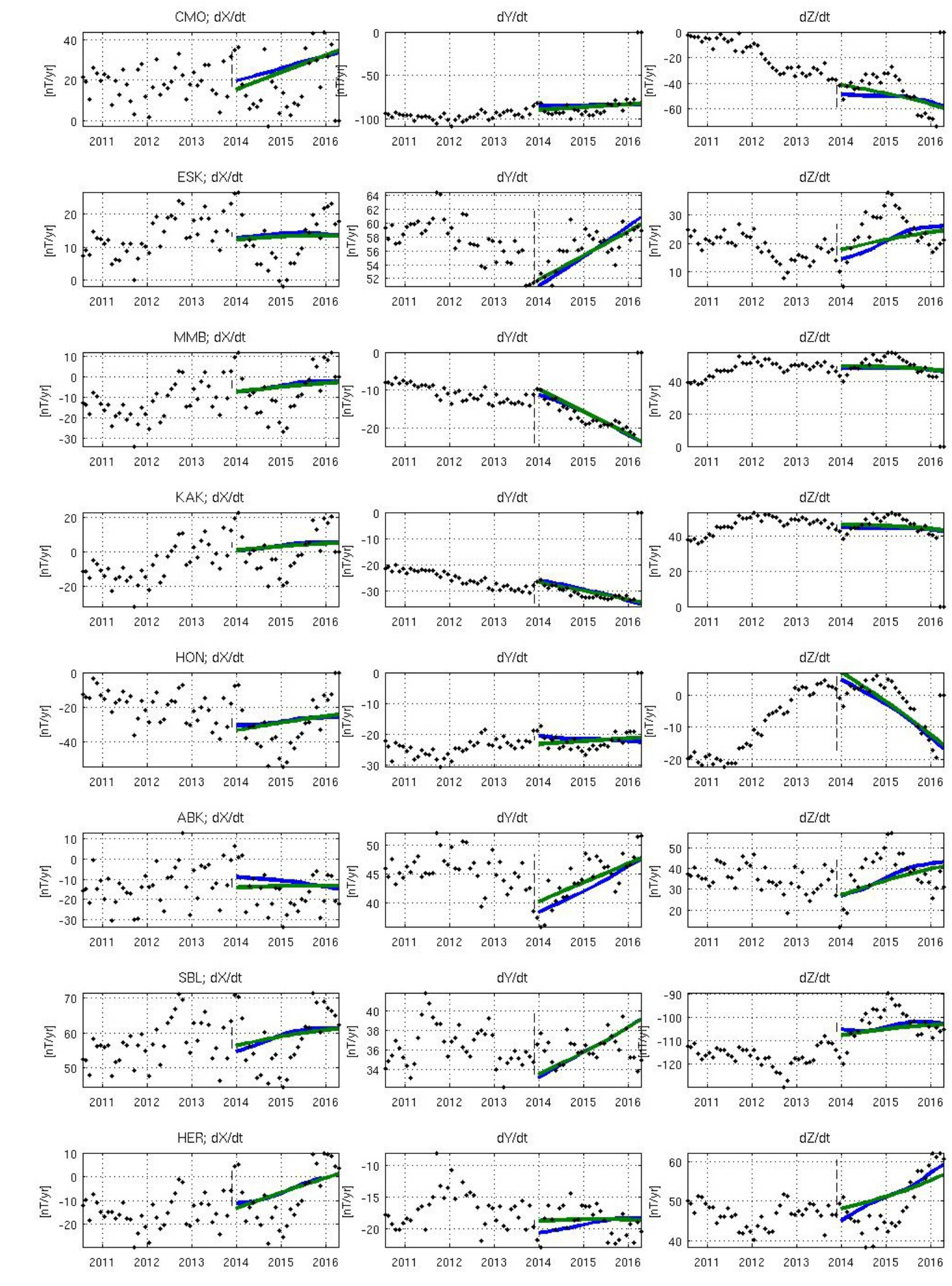


Figure 5. Comparison of secular variation of monthly means from AUX_OBS_2_, 'cleaned' of modelled external sources, and intermediate comprehensive (blue, MCO_SHAi2C) and dedicated (green, MCO_SHAi2D) core models.

3. Fast-Track Magnetospheric model and Quick-Look

The Fast-Track Magnetospheric Model and Quick-Look products continue to be produced on a daily basis.

Version 0106 of the Magnetospheric Model was released in March 2017. These are still based on baselines 0408/09/10 Level 1b data but with some additional data missing from version 0105 and with an updated (Swarm dedicated) core field model to more accurately isolate the magnetospheric signals going forward into 2017. The models continue to be available via the ESA servers.

The Quick-Look product provides various daily plots of Level 1b data to help identify any anomalous behaviour through regular reviewing. The Quick-Look products are not provided on the ESA FTP servers but can be provided upon request from BGS.

Acknowledgements

Data from the Swarm satellite mission for were provided by the European Space Agency (ESA), supported by ESA member states. Many institutes and agencies are involved in the operation of geomagnetic observatories around the world. The INTERMAGNET program and the World Data Centre for Geomagnetism, Edinburgh assist in the quality control and dissemination of observatory data.

References

- [1] Macmillan, S. and Olsen, N., 2013. Observatory data and the Swarm mission. *Earth, Planets and Space*, 65 (11), 1355-1362. 10.5047/eps.2013.07.011.
- [2] <http://www.intermagnet.org/>
- [3] Maus, S. (2010), MF7 lithospheric magnetic field model, <http://www.geomag.us/models/MF7.html>

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