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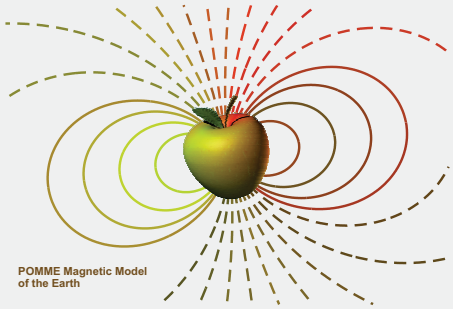
Geomagnetic Field Modeling from Swarm Multi-Satellite Measurements

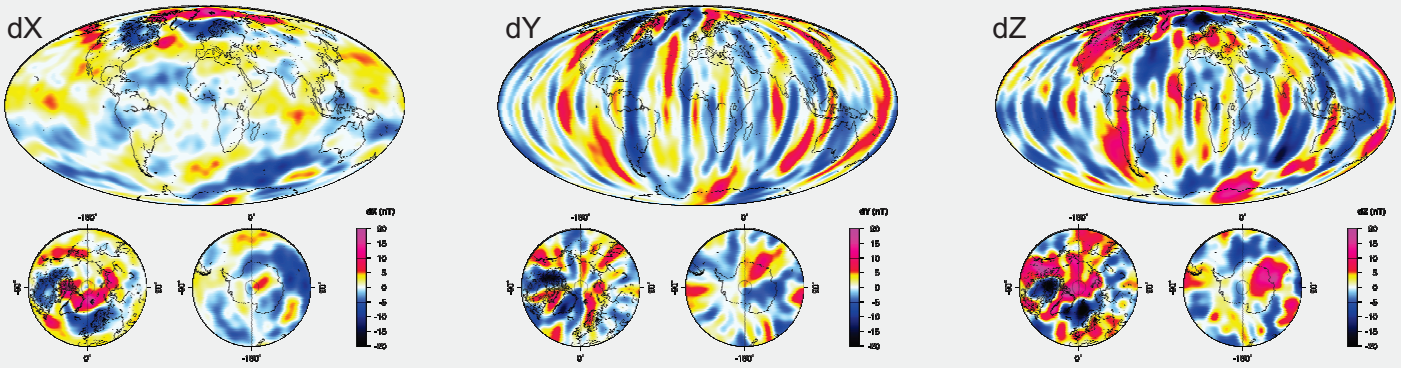
Stefan Maus and Arnaud Chulliat, CIRES, University of Colorado, Boulder



The model POMME (Maus et al., 2010) represents the geomagnetic field from the Earth's surface to an altitude of a few thousand kilometers

- The time variations of the internal field are given by piece-wise linear spherical harmonic (Gauss) coefficients of the magnetic potential
- The external field is parameterized using Dst, F10.7 and the IMF
- The latest 10th generation of POMME was produced from CHAMP satellite vector magnetic measurements from July 2000 up to September 2010, Oersted satellite total field measurements from January 2010 to June 2014 and Swarm satellite vector magnetic measurements up to the end of 2015.

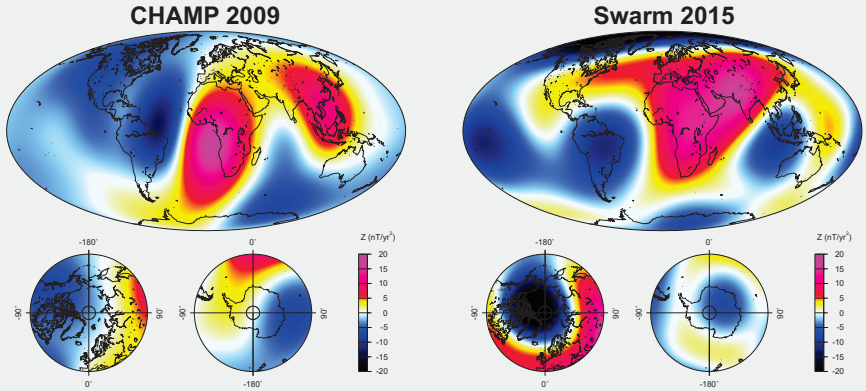
Differences Between Independent Swarm A and Swarm B Main Field Models



The above images show the differences between two independent models from Swarm A and Swarm B projected forward to January 1st, 2017 at the Earth surface for the magnetic Northward (X), Eastward (Y) and Downward (Z) components.

- POMME is meant for operational use, e.g. for the calibration of ground and space-based magnetometers. It provides not only the historical field but also a fairly accurate forward prediction of the magnetic field for over one year into the future.
- The differences shown in the above images provide a conservative estimate of the errors in the POMME-10 model, which was produced from a combined data set of Swarm A and Swarm B measurements.
- The larger differences in the Y and Z components may be due to magnetometer attitude uncertainties (Maus, 2015)

Monitoring Secular Acceleration (SA) with CHAMP and Swarm



Images of the vertical component secular acceleration (SA) at the Earth surface for CHAMP (left) and Swarm (right).

- Since one needs at least 2-3 years of data for a reliable estimate, the latest SA for CHAMP was in 2009.3, while the earliest estimate for Swarm is in 2014.9, with a gap of over 5 years.
- The Swarm-only SA model (right) was estimated from only 2 years of Swarm measurements and is therefore not yet as reliable as the model from CHAMP. Differences between the two images are believed to reflect actual changes in the secular acceleration, at least at low latitudes.
- Images show SA to harmonic degree 10, with a Hann window applied.

Time series of the SA provide insight into fluid motion and waves at the surface of the outer core.

- Analyzing 10 years of CHAMP measurements, Chulliat et al. (2014, 2015) found evidence for a standing wave pattern at the top of the core under the Atlantic Ocean
- With more than 2 years of Swarm data now available, the SA time series can be continued.

References

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Maus S, Manoj C, Rauberg J, Michaelis I, Lühr H, NOAA/NGDC candidate models for the 11th generation International Geomagnetic Reference Field and the concurrent release of the 6th generation Pomme magnetic model, EPS 62, 729-735, DOI: 10.5047/eps.2010.05.004, 2010

POMME-10: http://geomag.org/models/pomme10.html