# *Release and validation of the High Definition Geomagnetic Model 2011*

- Overview of HDGM2011
- Comparison with IGRF, BGGM
- Validation against aeromagnetic and marine data
- Estimated model uncertainties
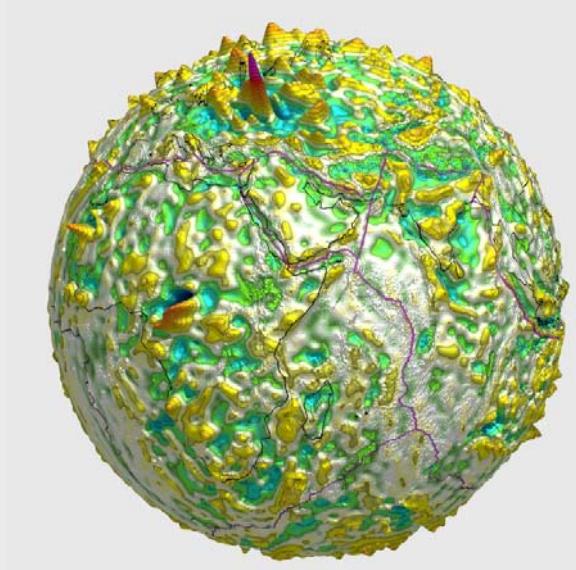
Stefan Maus and Manoj Nair (NOAA/NGDC)
Benny Poedjono (Schlumberger)
Shola Okewunmi (Chevron)

Copenhagen, Mar-4 2011

Release of HDGM2011

Release date:	December 1st, 2010
Validity:	1-Jan-2000 to 31-Dec-2011
Components:	• Main field and secular variation to degree 15 • Crustal field to degree 720 (>56 km wavelength) • External field of degree 1
Web site:	http://ngdc.noaa.gov/geomag/hdgm.shtml
Pre-HDGM:	NGDC Pomme-4.3 (released mid 2007), http://www.geomag.org/models/pomme4.html

Geomagnetic Reference Models

|	Updated	Main field	Secular change	Crustal field	External field
World Magnetic Model (WMM)	5 years	12	12	No	No
International Geomagnetic Reference Field, (IGRF)	5 years	13	8	No	No

Numbers are spherical harmonic degrees. The higher the degree, the better the resolution of the model.

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High Definition Geomagnetic Model (HDGM)	**yearly**	15	15	**720**	1

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Omission error: IGRF
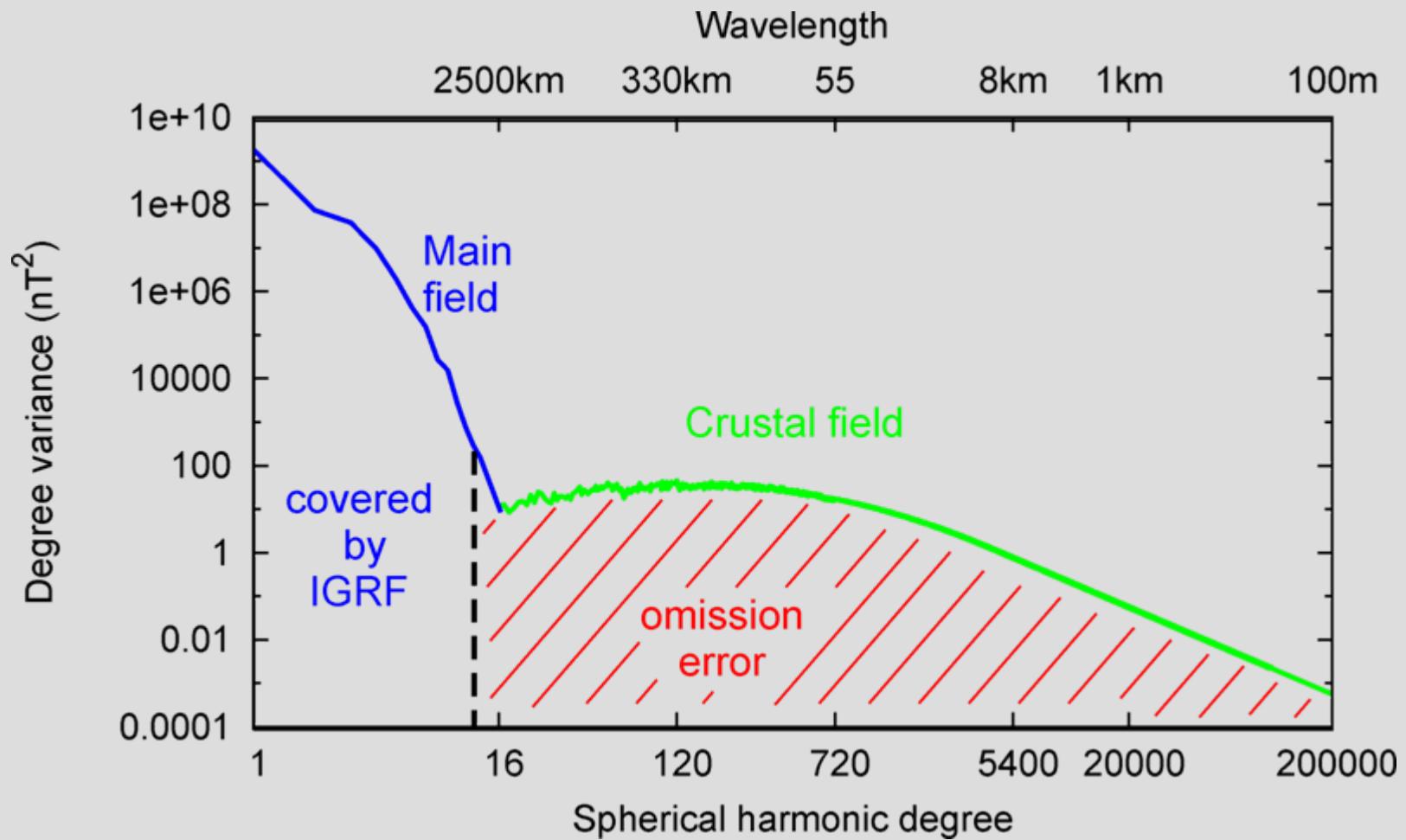
Omission error: BGGM
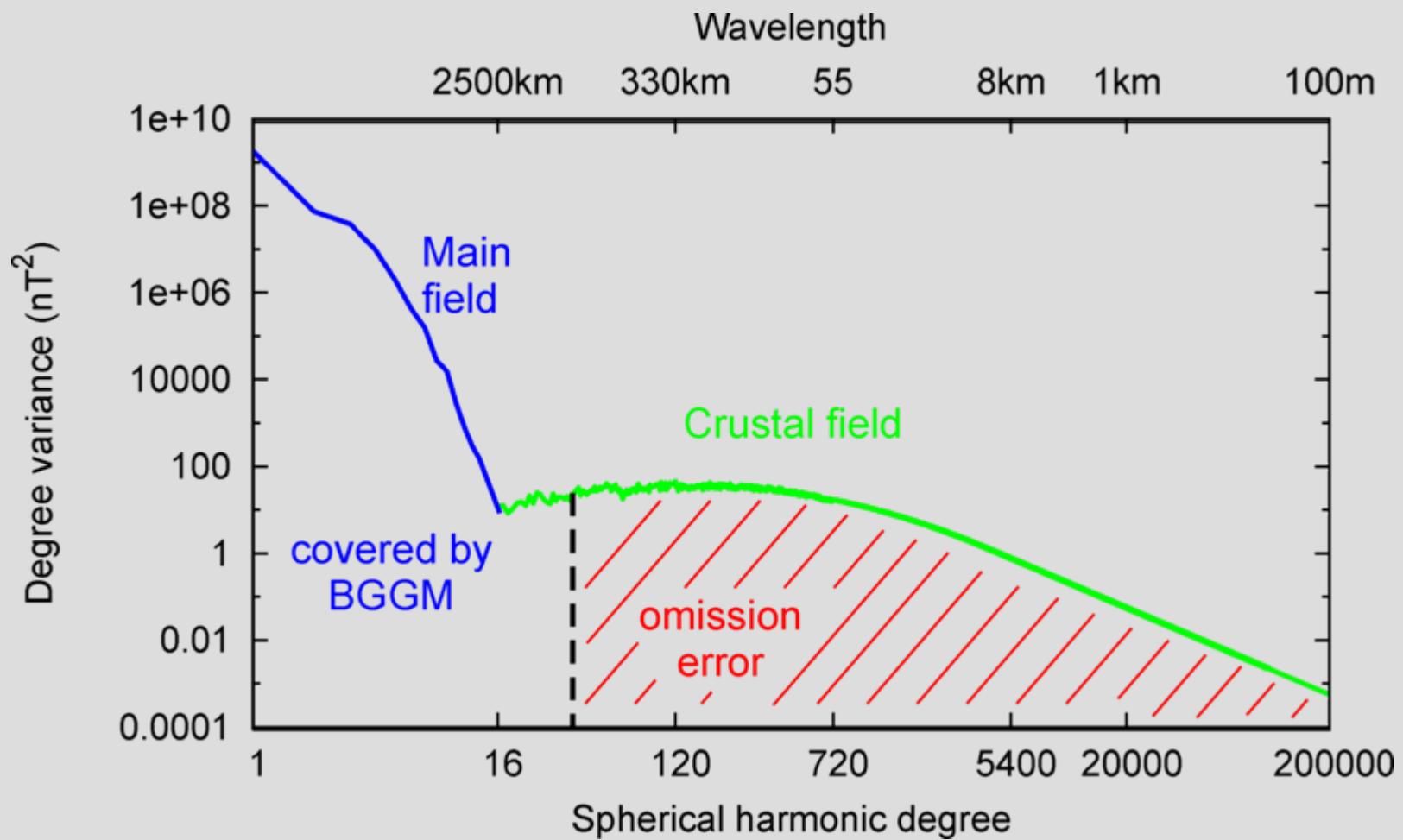
Omission error: HDGM
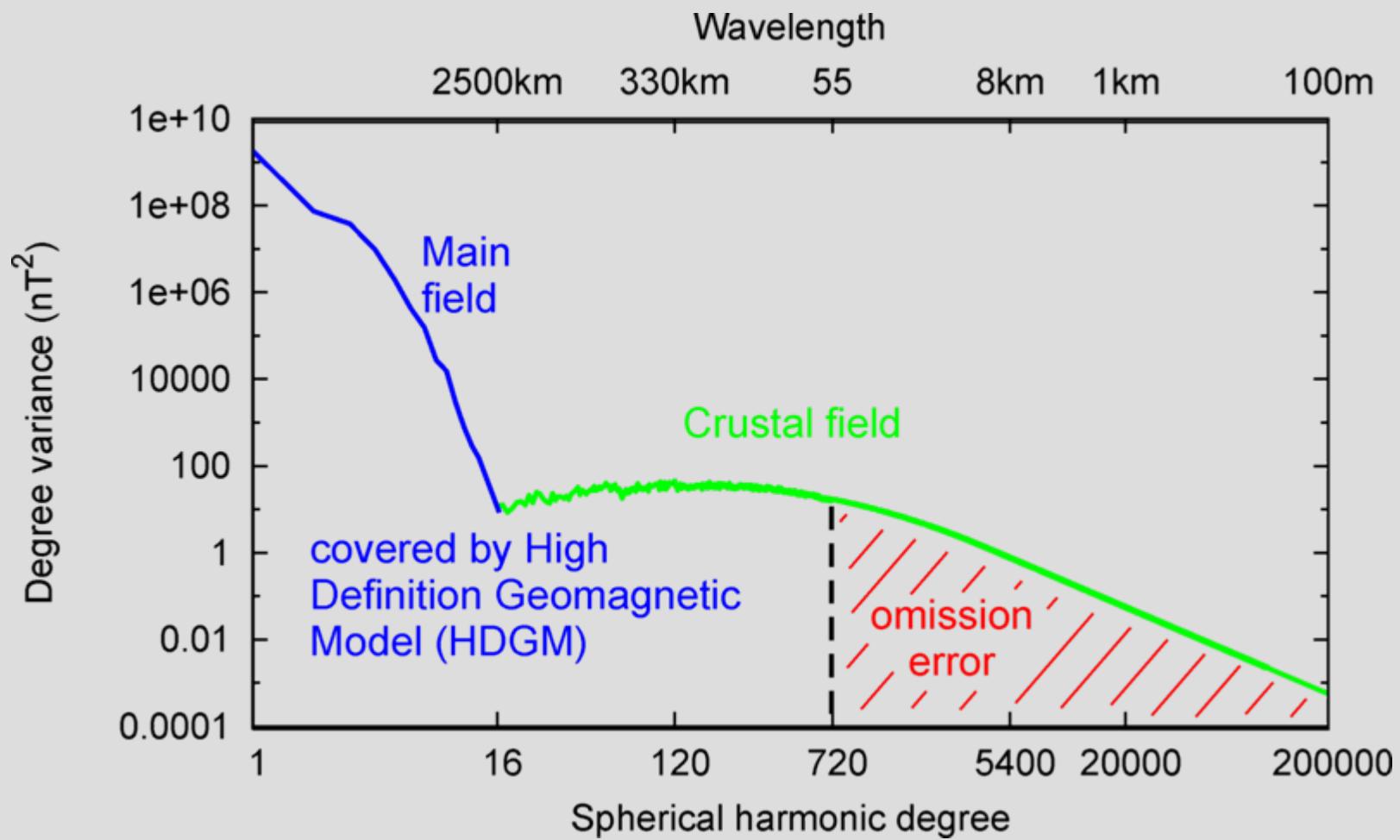
Comparison of BGGM versus HDGM

Declination on 1/1/2010 at mean sea level (degrees east)
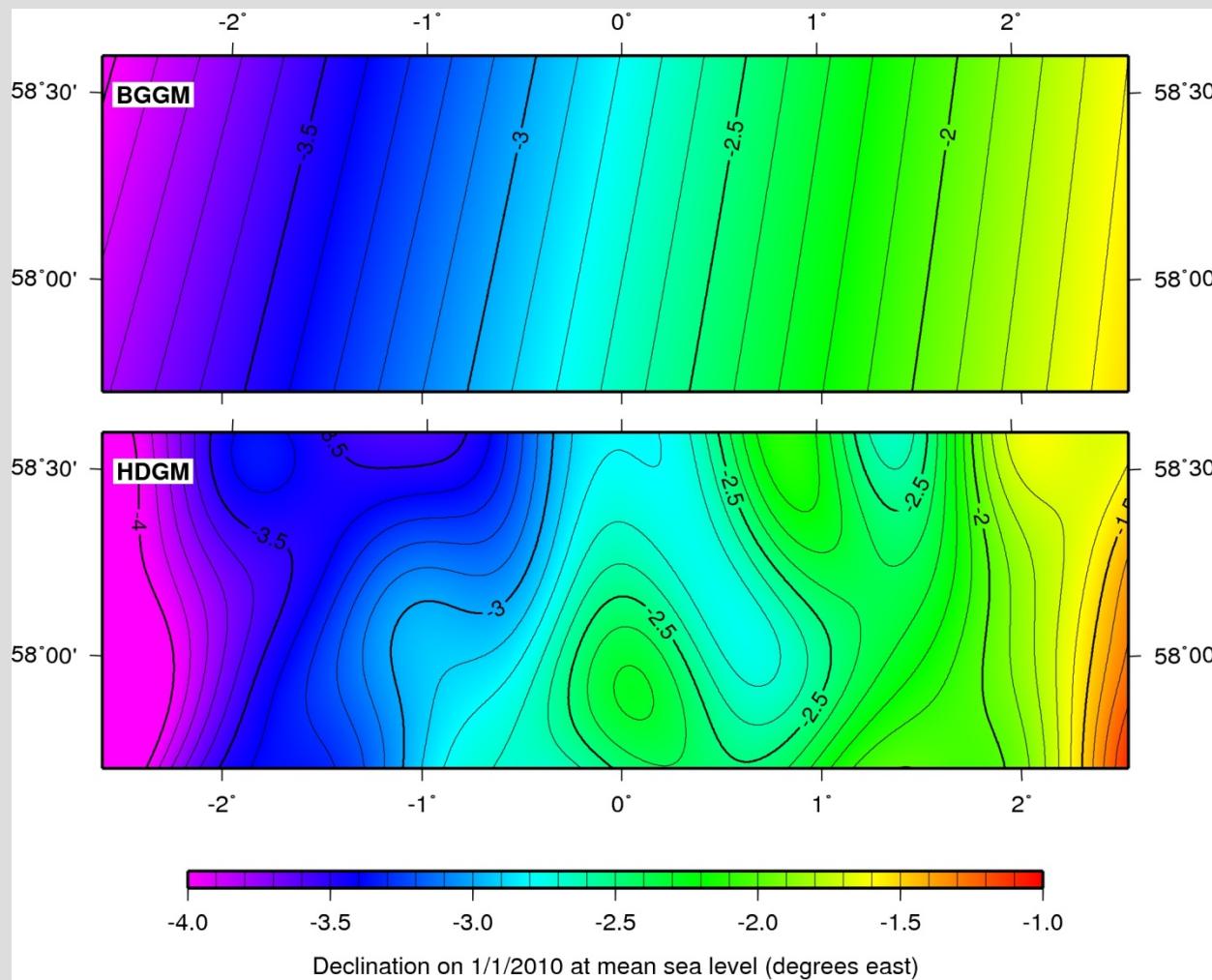
North Sea example: The HDGM enhances pointing accuracy by accounting for magnetic anomalies caused by local crustal anomalies

# Crustal magnetic field as seen by CHAMP satellite

Vertical component of the magnetic field

MF7 model
Animation by
Rother and Maus
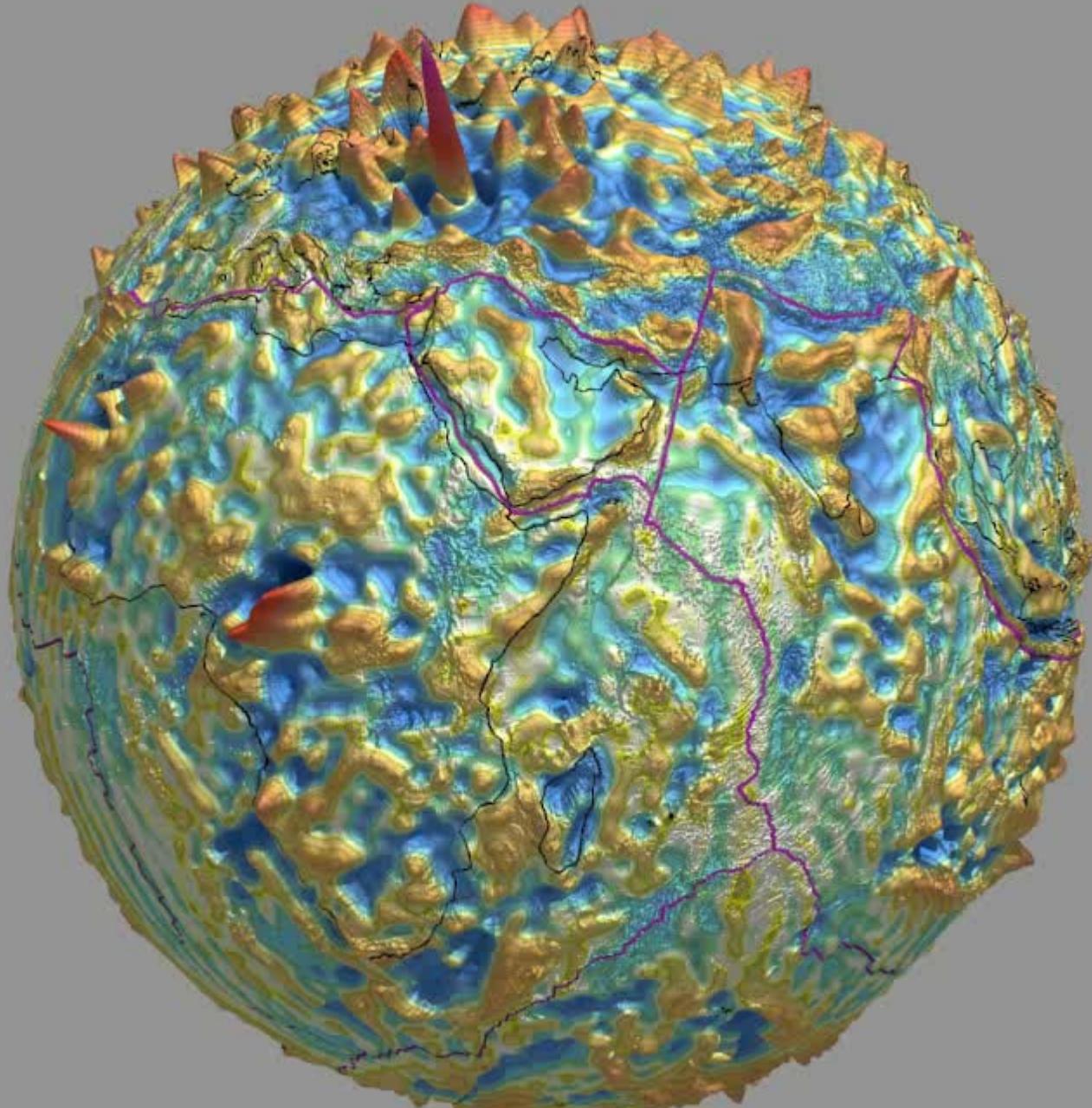
Earth Magnetic Anomaly Grid (EMAG2)

Compiled from satellite, airborne and marine magnetic measurements
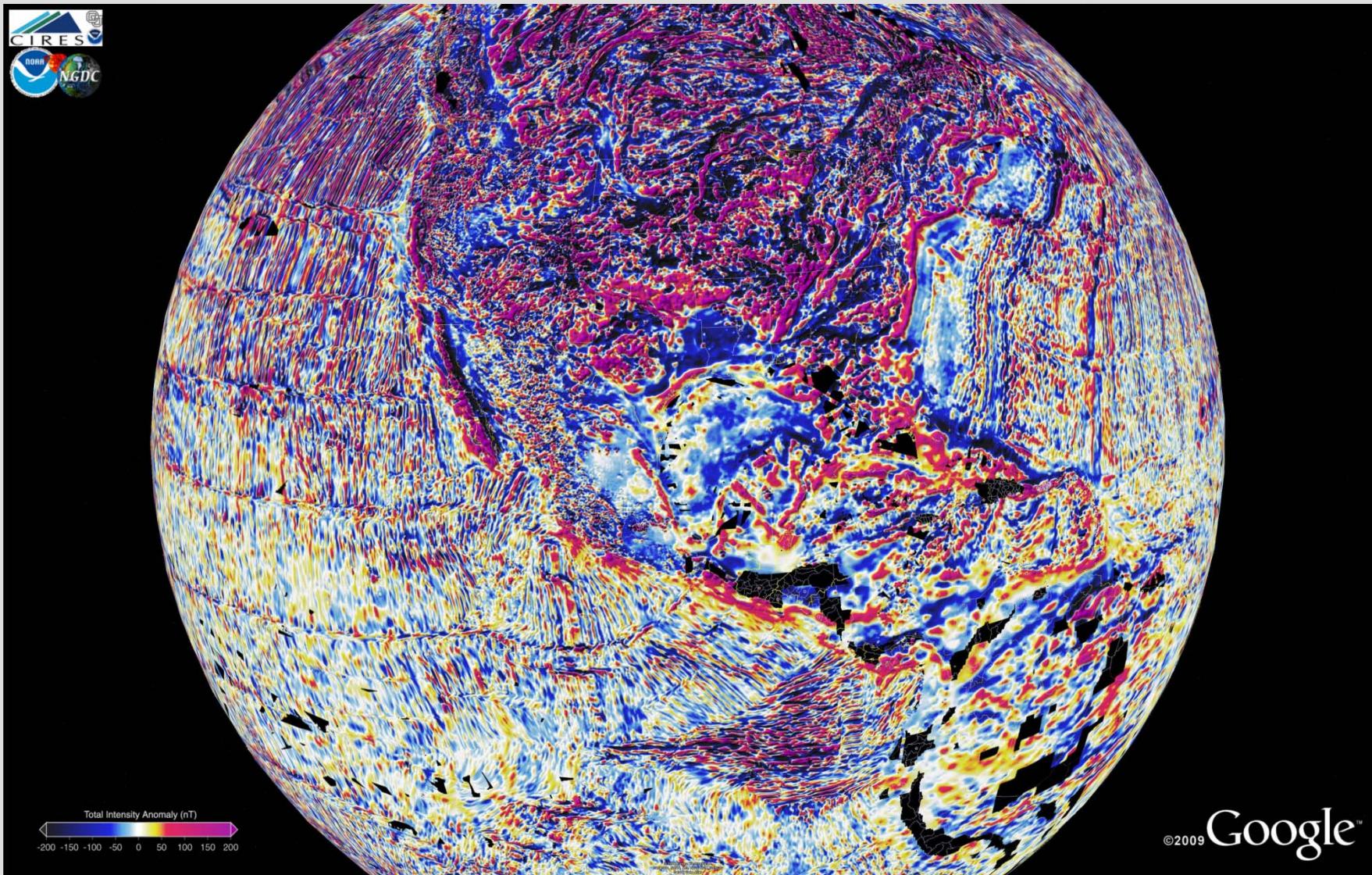
HDGM2011

Declination Anomaly

Declination anomaly (degrees)
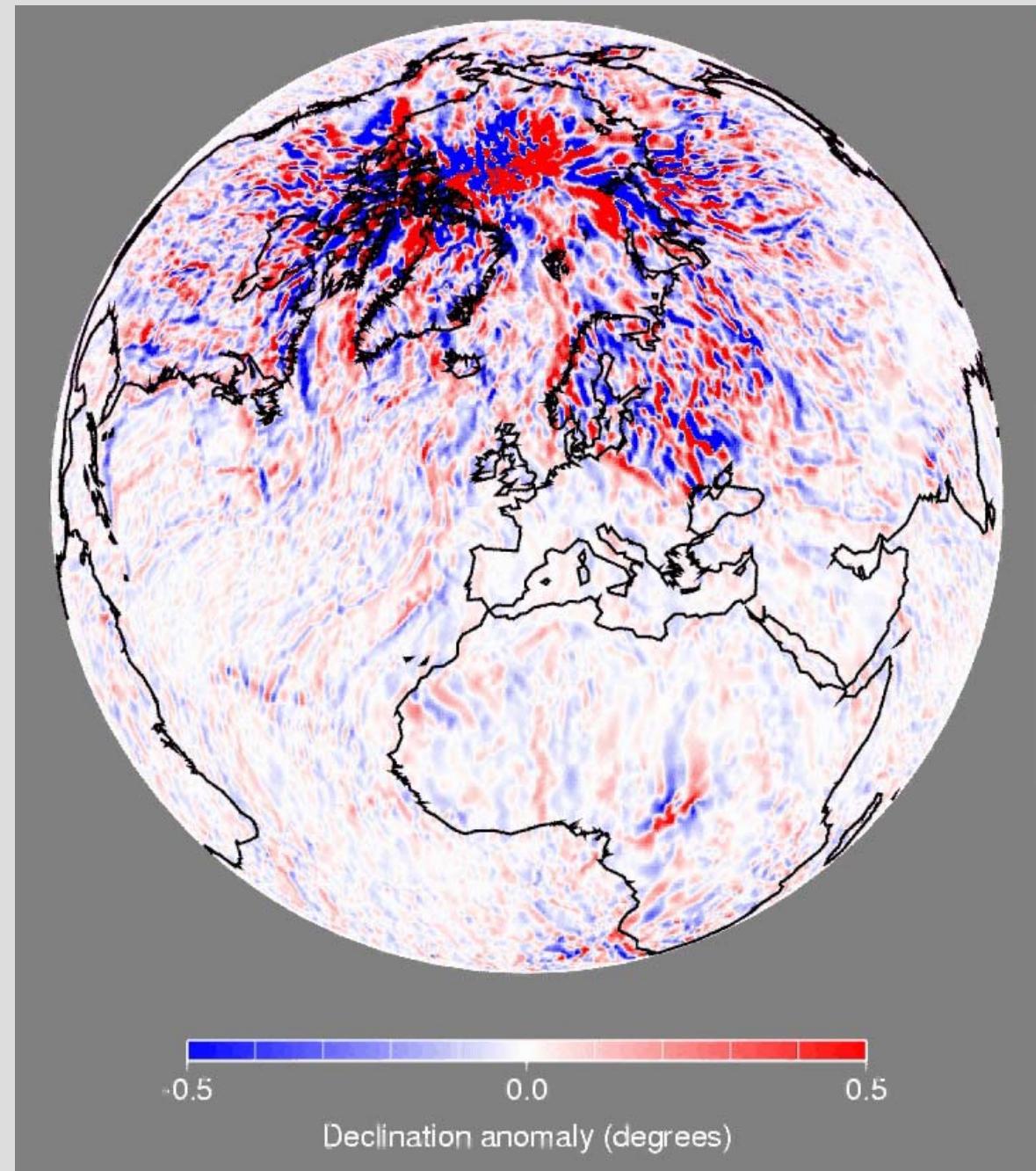
Model validation

Aeromagnetic data:

- Rick Saltus (USGS)

- Nils Olsen (DTU)

- Peter Milligan (Geoscience Australia)


Marine magnetic data:

- Udo Barckhausen (BGR)

# Location of marine and aeromagnetic profiles
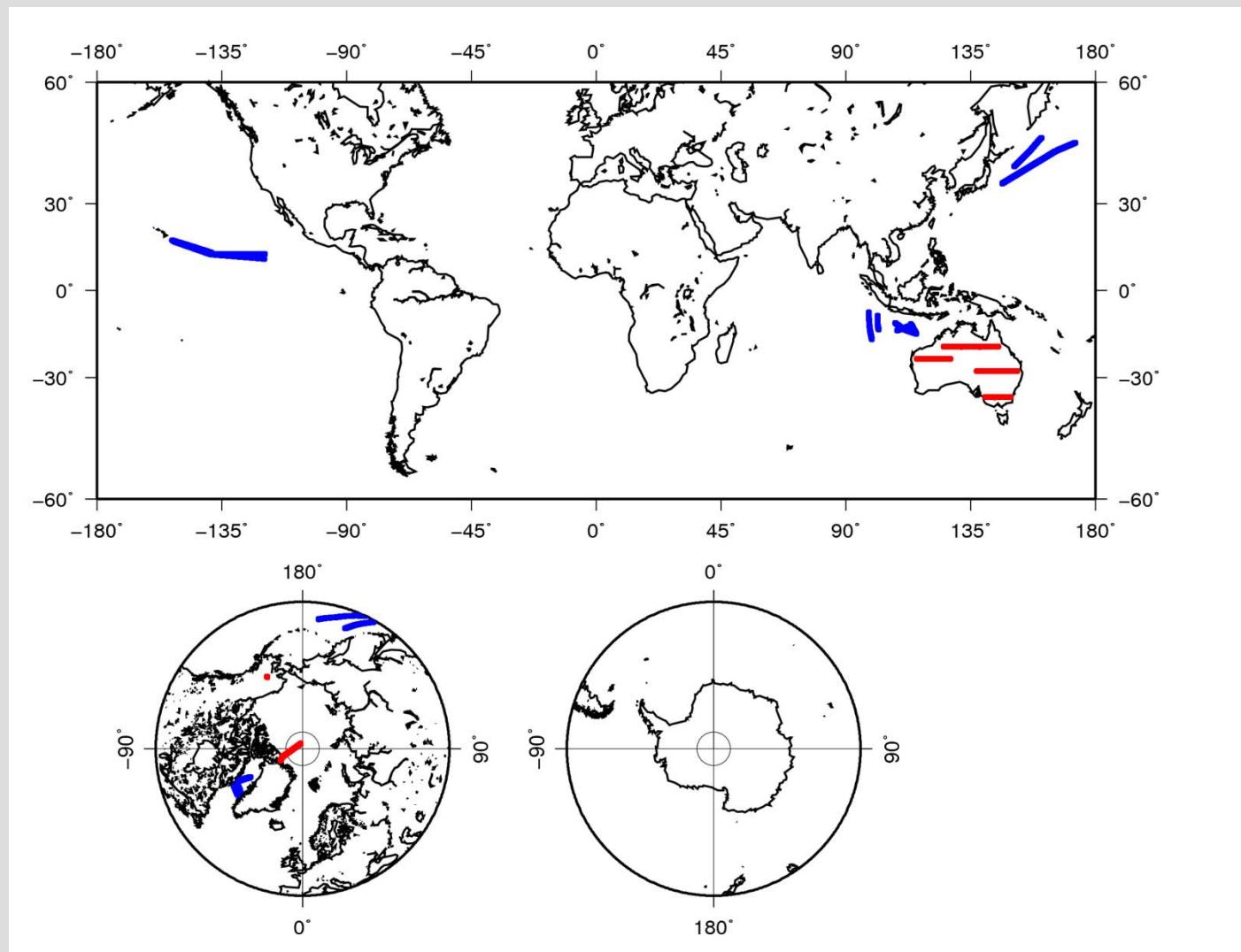
# Aeromagnetic profile (2009)
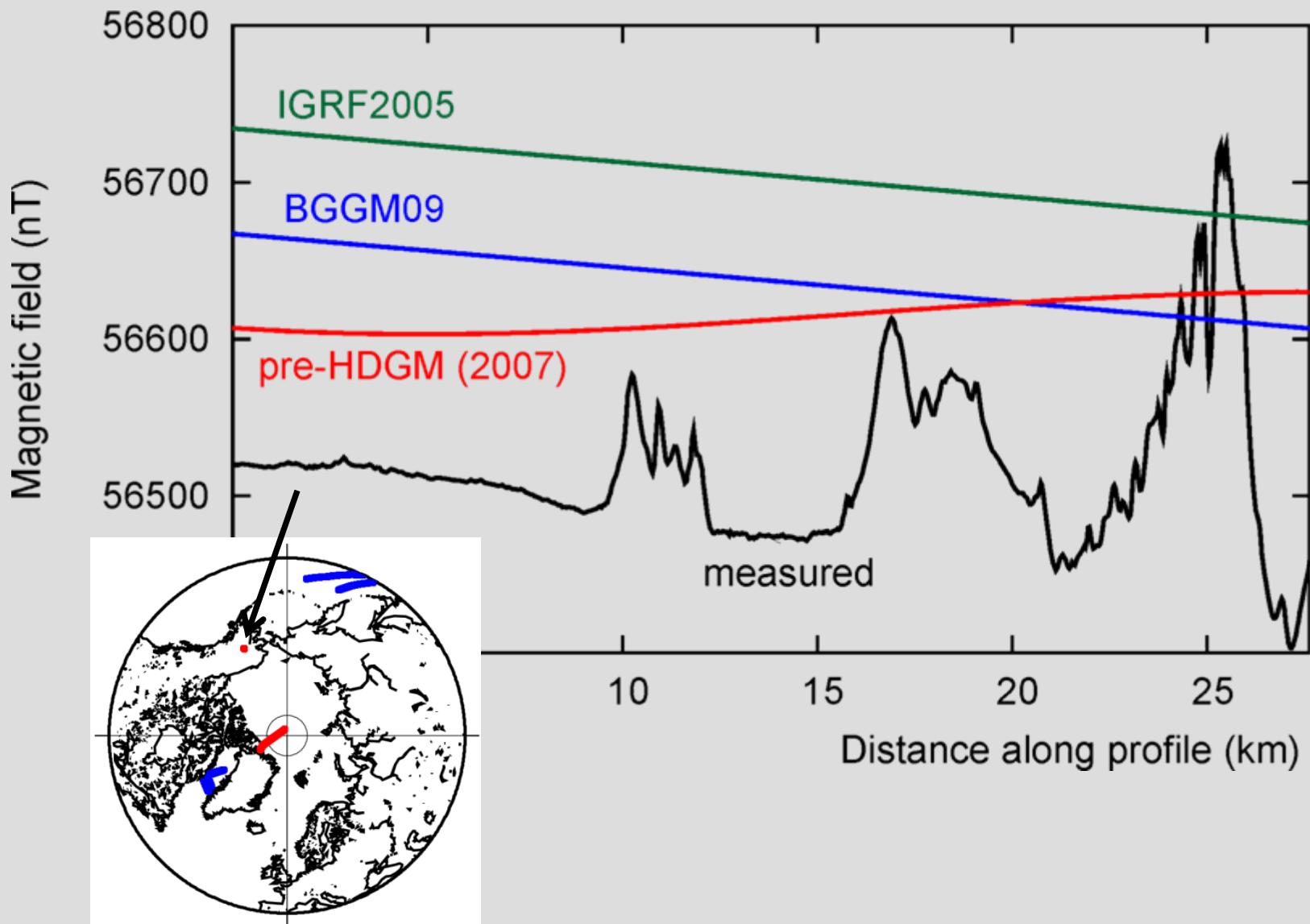
# Aeromagnetic profile (2009)
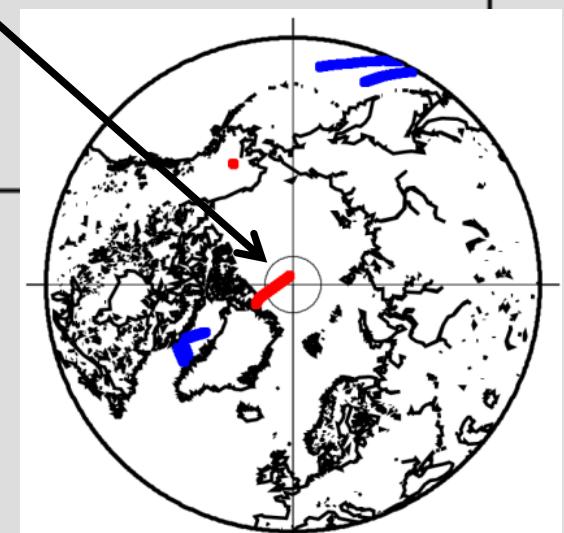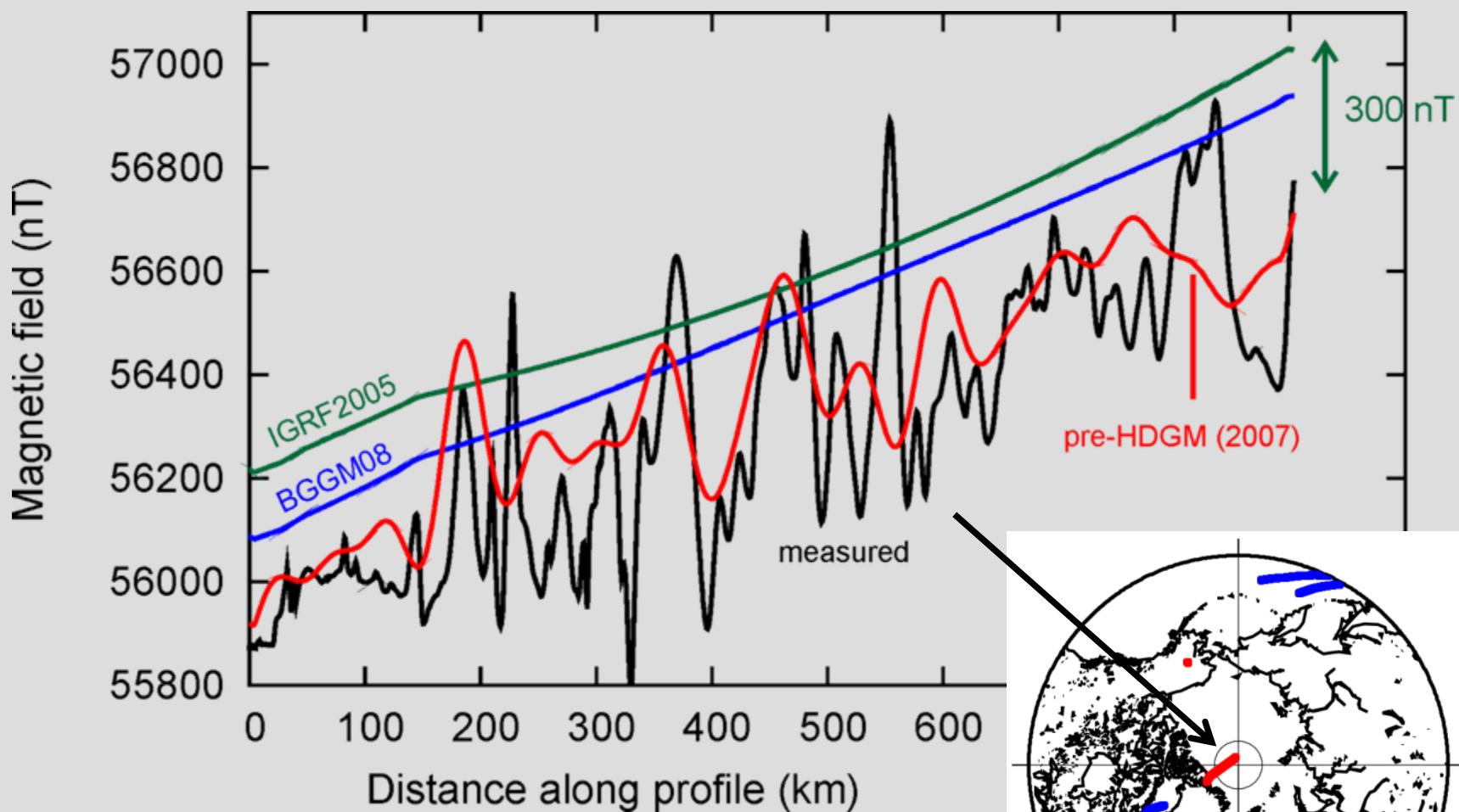
Marine magnetic profile (2008)
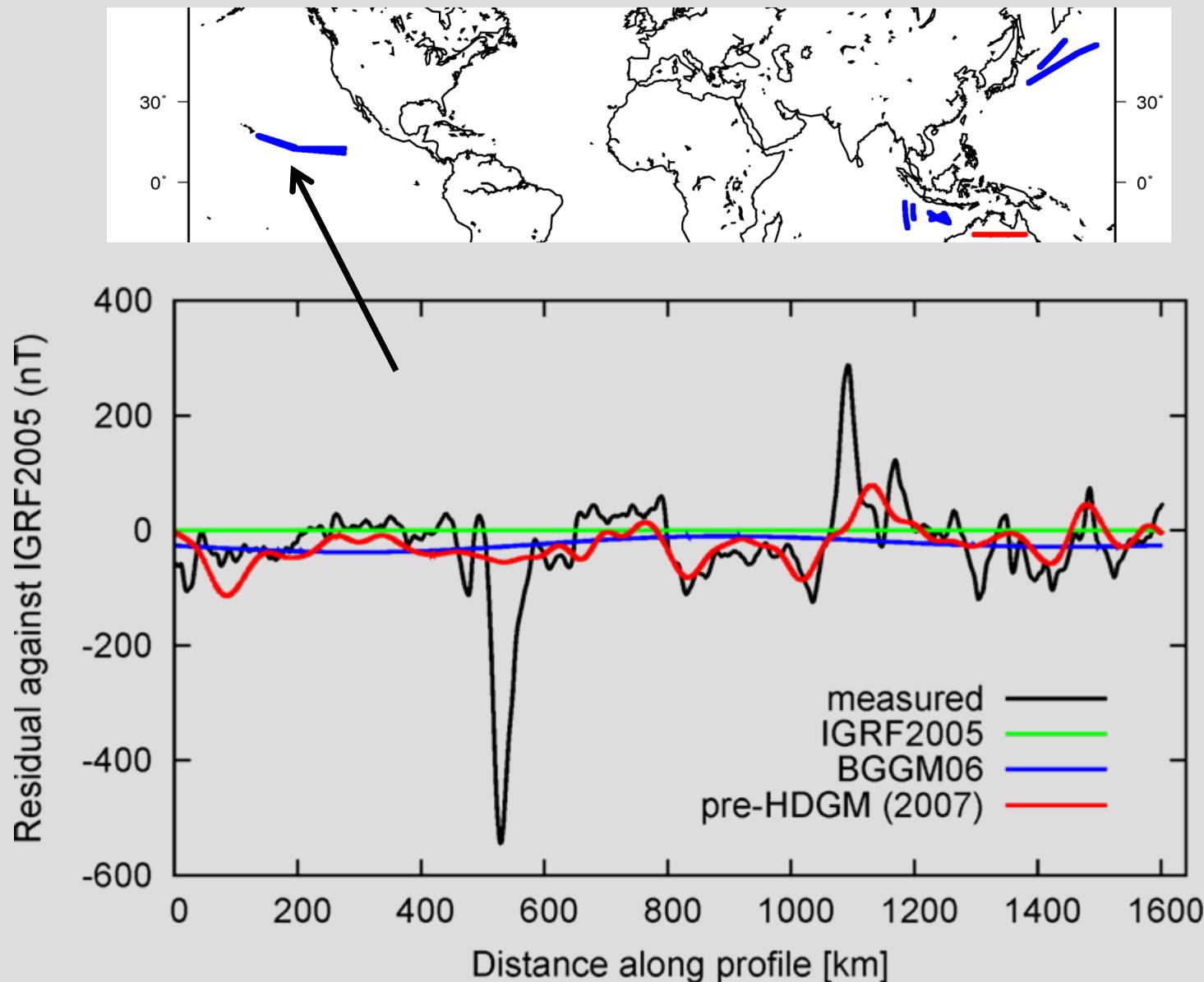
Long-range
Aeromagnetic profile
(2nd half 2007)
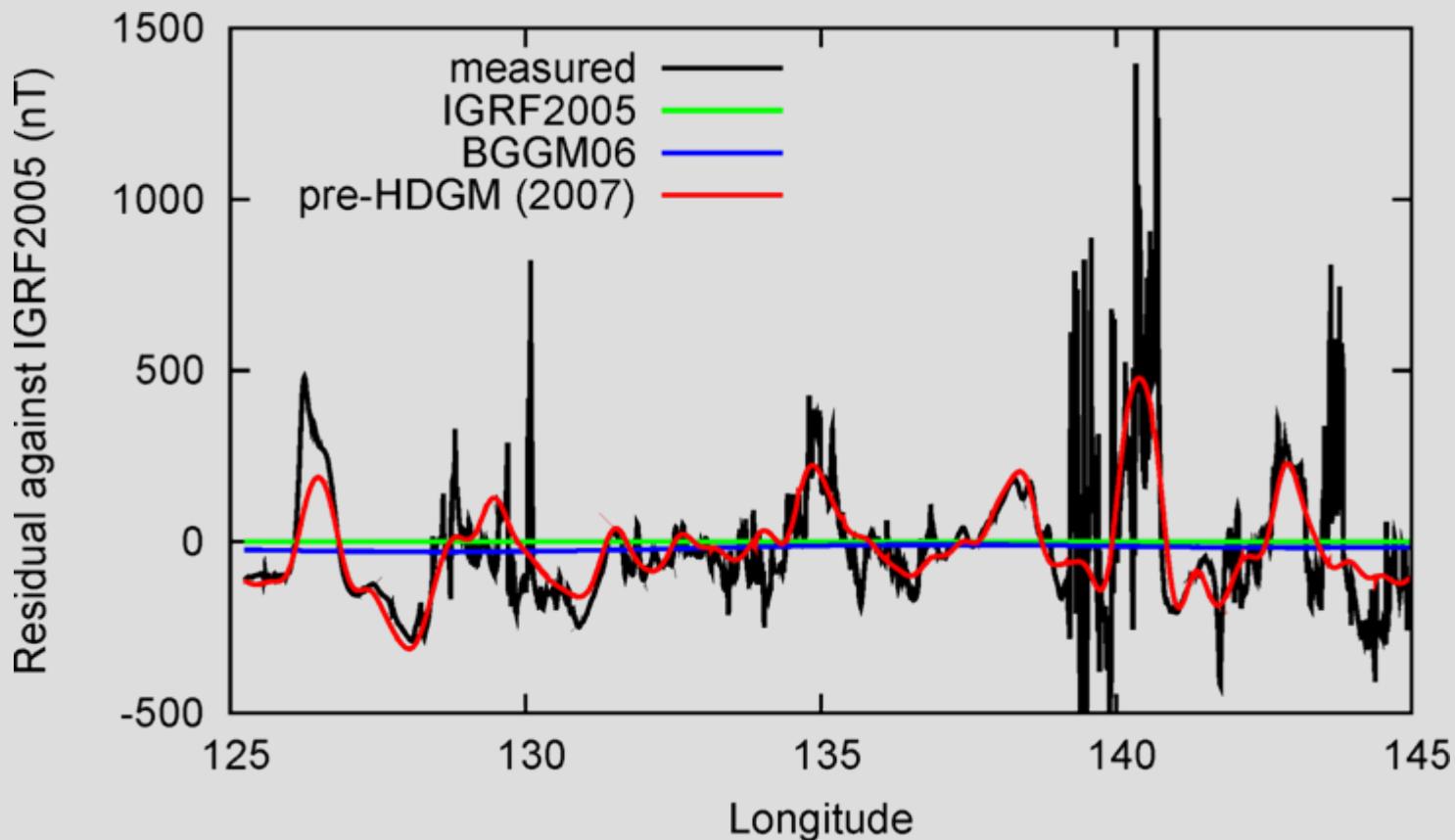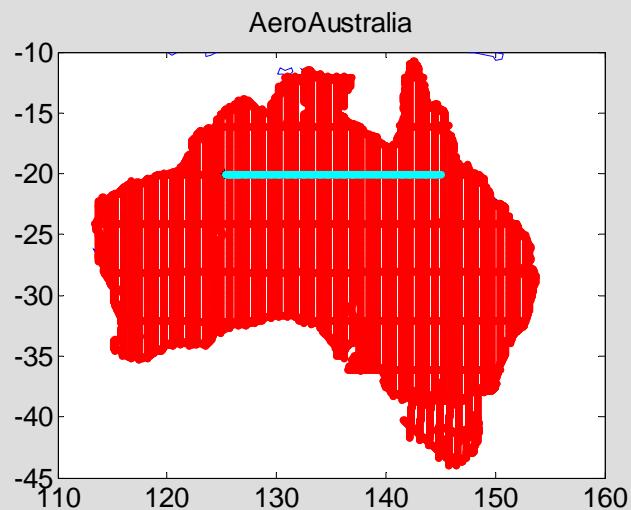
Long-range Aeromagnetic profile (2nd half 2007)
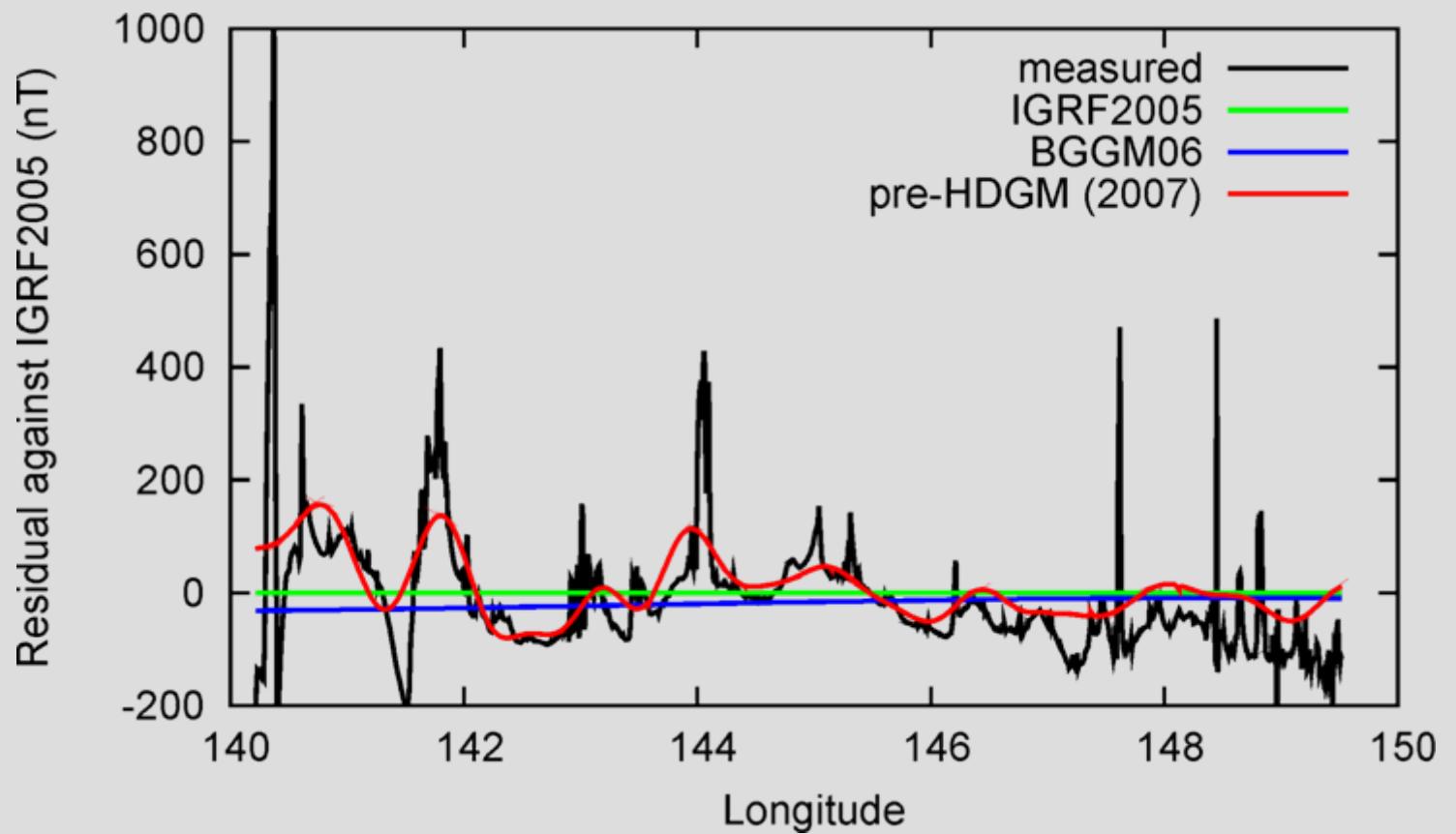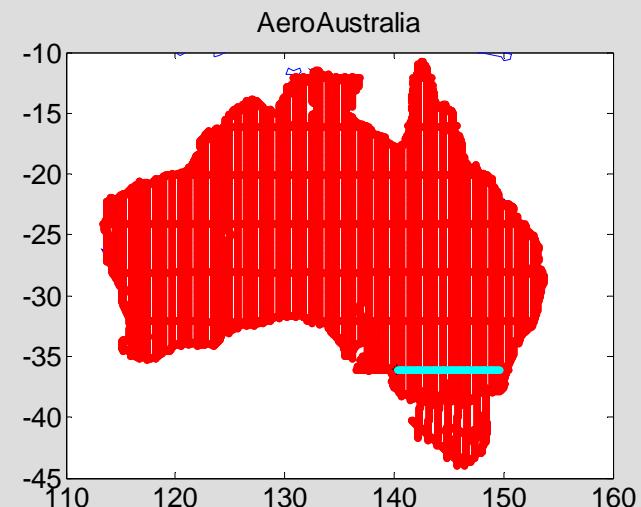
Model errors (1 sigma)
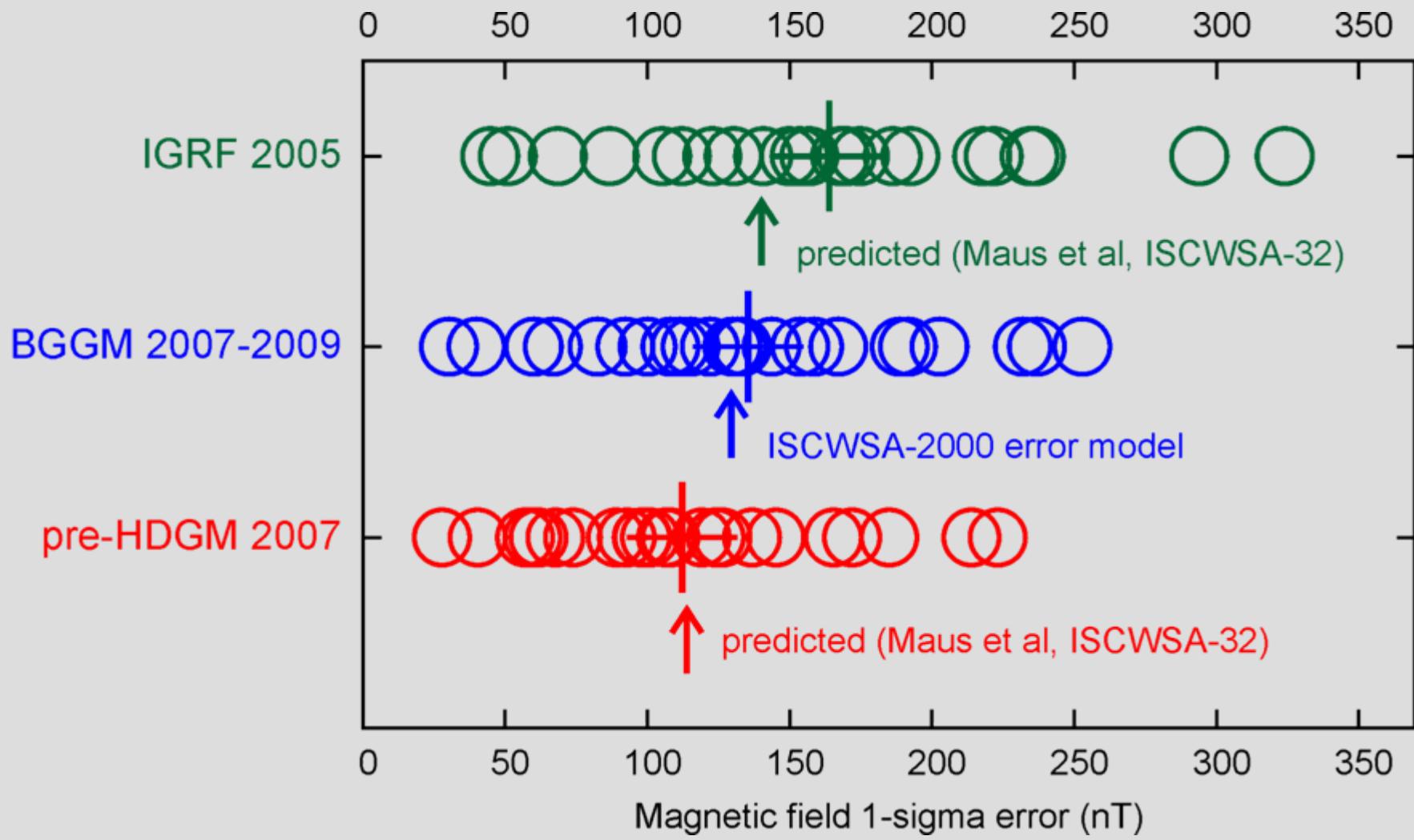
Model errors (68.3 percentile)

Model errors (1 sigma)

Magnetic field 1-sigma error (nT)
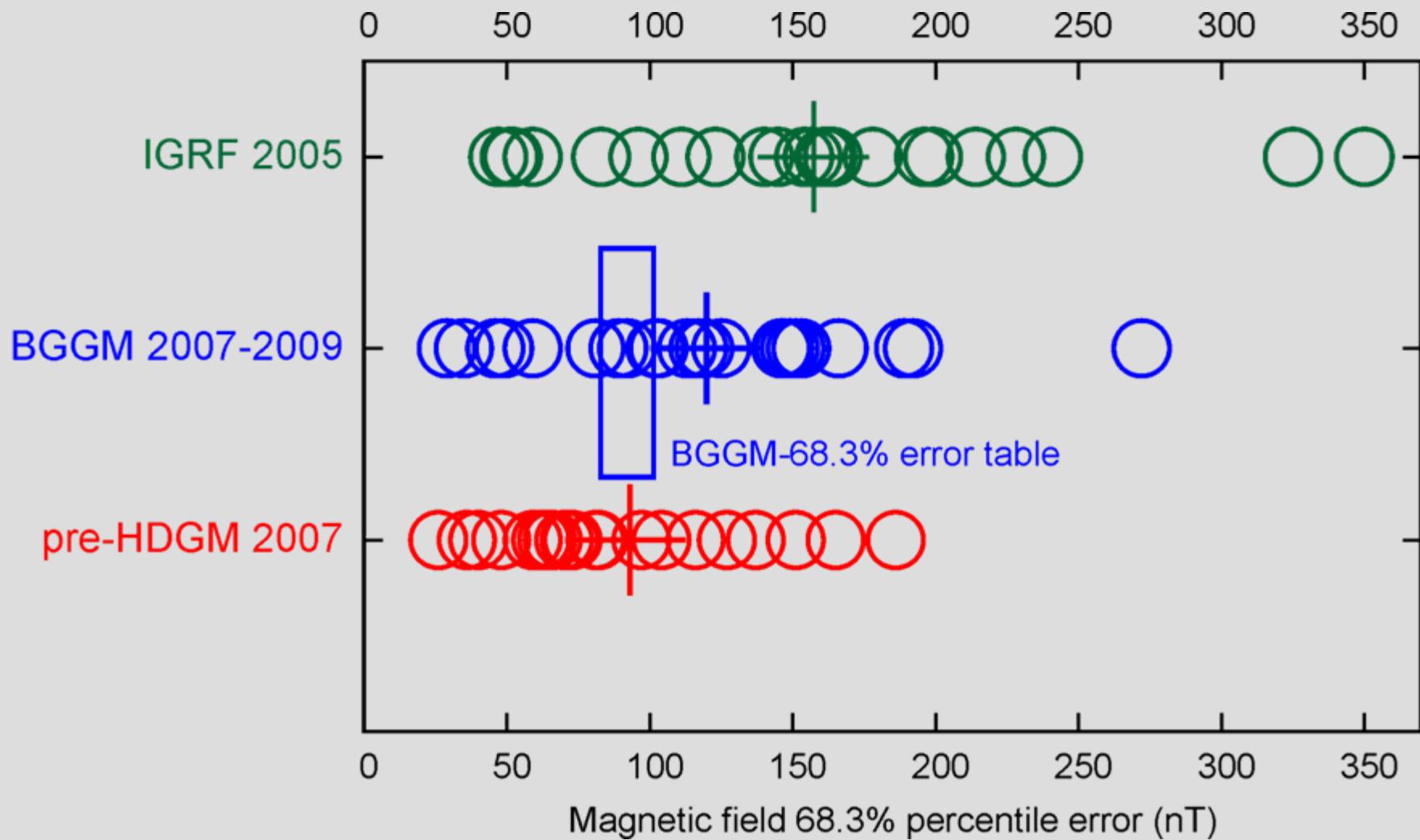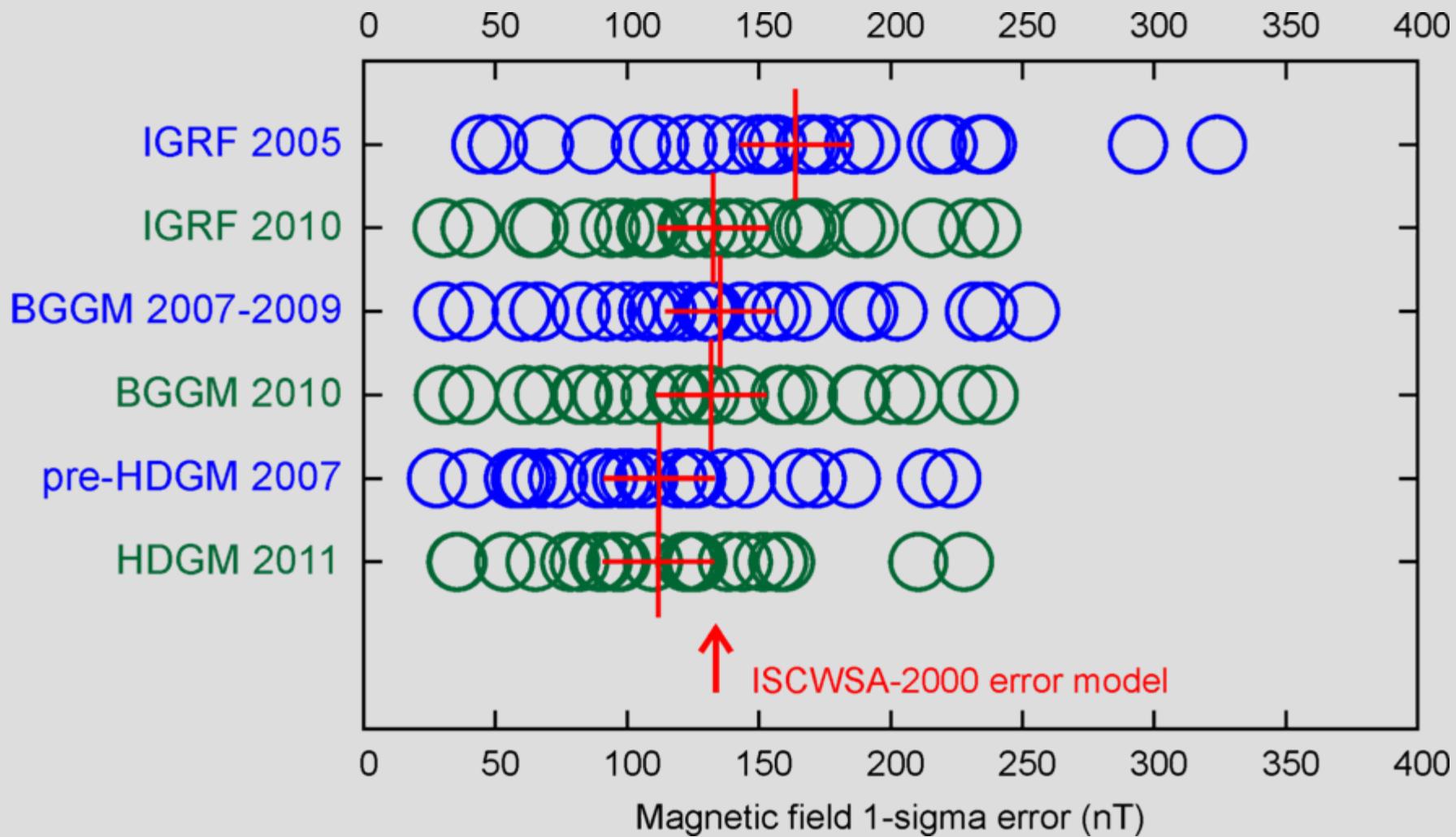
Conclusions

- HDGM improves geomagnetic referencing accuracy by accounting for regional crustal anomalies

- HDGM uncertainty (1 sigma):
  - Predicted 114 nT, found 112 nT in total field

- IGRF uncertainty:
  - predicted 141 nT, found 164 nT
  - But measurements all in 2nd half of 5-year lifetime

- BGGM uncertainty:
  - 136 nT, agrees with 130 nT of ISCWSA-2000
  - New BGGM error tables may be too optimistic

Presentation available at http://www.geomag.org/ISCWSA/