Magnetization Distribution for the Schlüter P. Lunar Magnetic Anomaly

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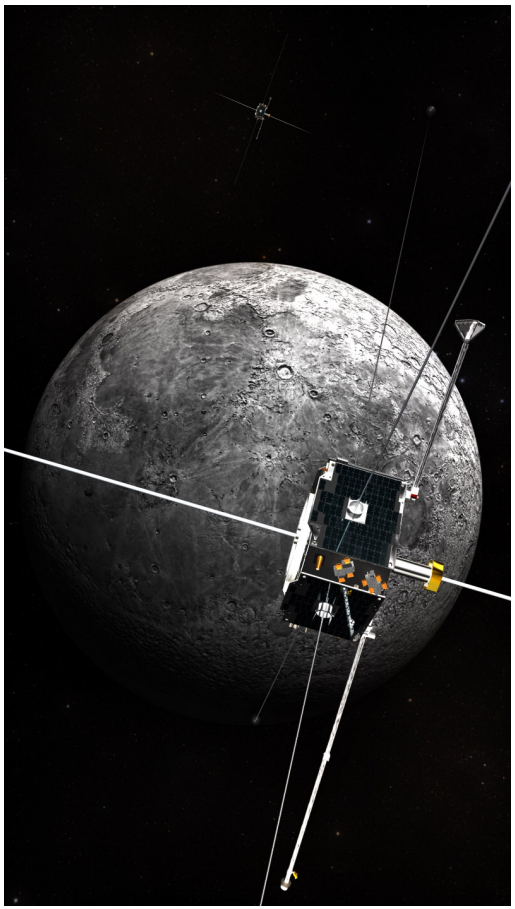
1. Detection of the SP magnetic anomaly
2. Correlation with the terrain elevation and with the gravitational field
3. Distribution of the magnetized material inside the crust

EPSC, Riga, Sep 2017

Magnetic field data

ARTEMIS



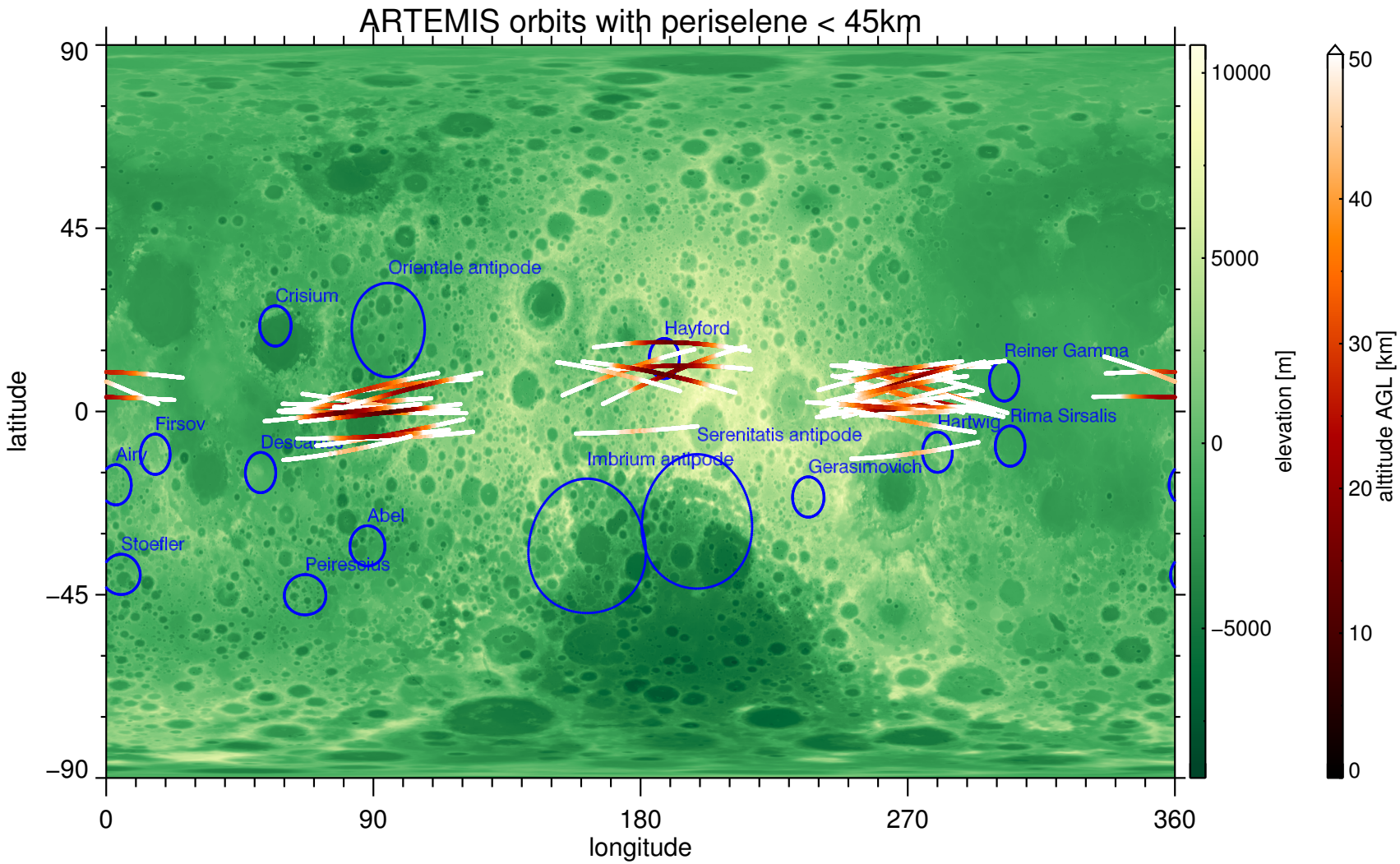
- extension of 5-sc THEMIS magnetospheric mission
- two sc on highly elliptical equatorial orbits
- altitude AGL 9 km to 2×10^4 km
- 3-axis FGMs
- sensitivity: 0.01 nT
- sampling rate: up to 128 Hz

Requirements for crustal field measurements

- Low altitude measurements (below 100 km AGL)
- Quiet environment (Moon in the tail lobes or in the solar wind)
- Spacecraft on the night side of the Moon
- Multiple passes over the same area
- Measurement of the unperturbed magnetic field

ARTEMIS orbits below 45 km (2011 - 2017)

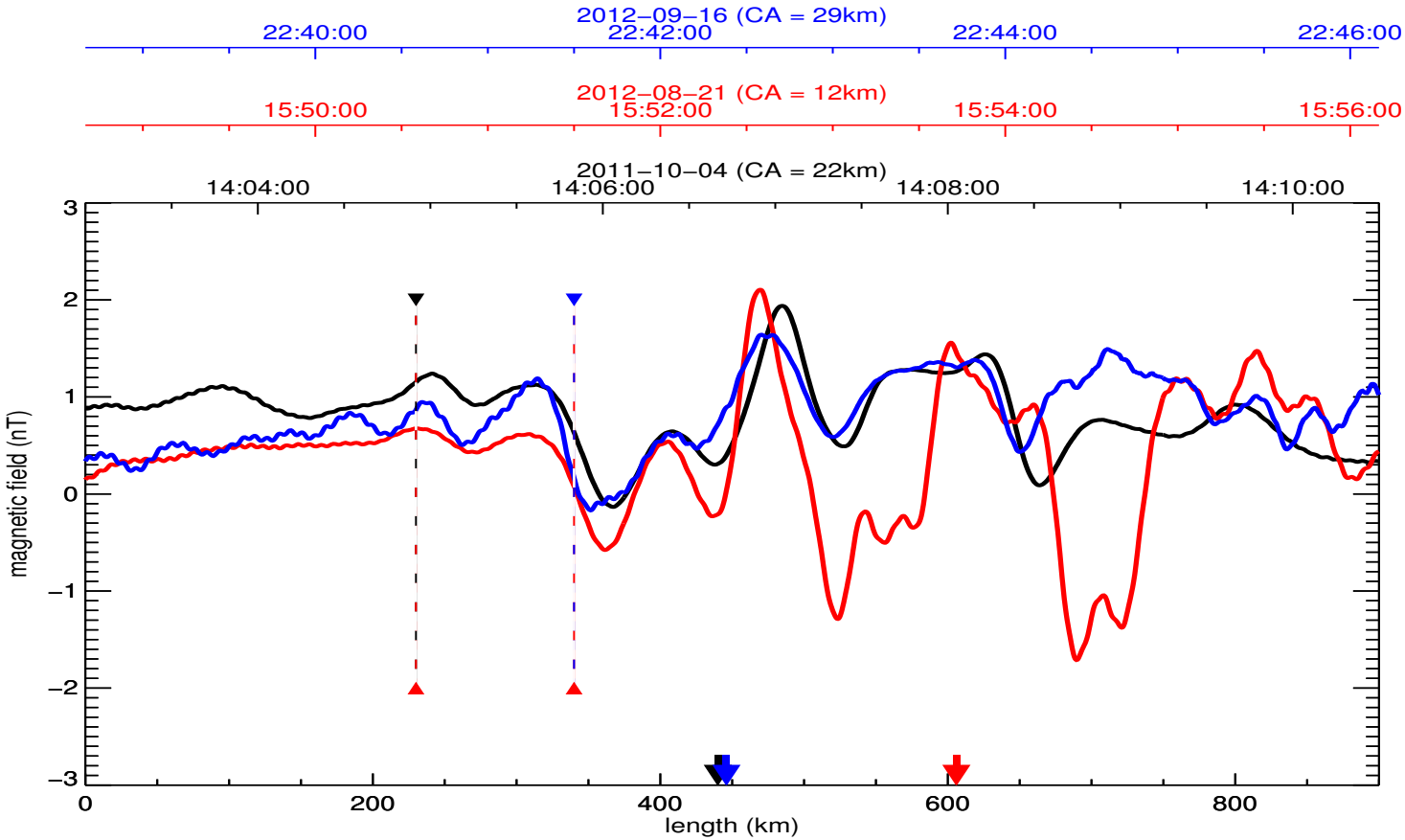
Total number: 47 orbits; Quiet conditions: 16; High correlation: 3



Lunar Reconnaissance Orbiter topography data from Planetary Data System

Schlüter P. magnetic anomaly

radial component of the magnetic field



Equivalent dipole rough estimation:

$\Rightarrow$ depth $d = 13\,\mathrm{km}$

$\Rightarrow$ surface field $B_0 = 36\,\mathrm{nT}$

$\Rightarrow$ magnetization $m = 80\,\mathrm{mA/m}$

Distribution of the magnetized material

(how to find it)

Compare the magnetic field variations with:

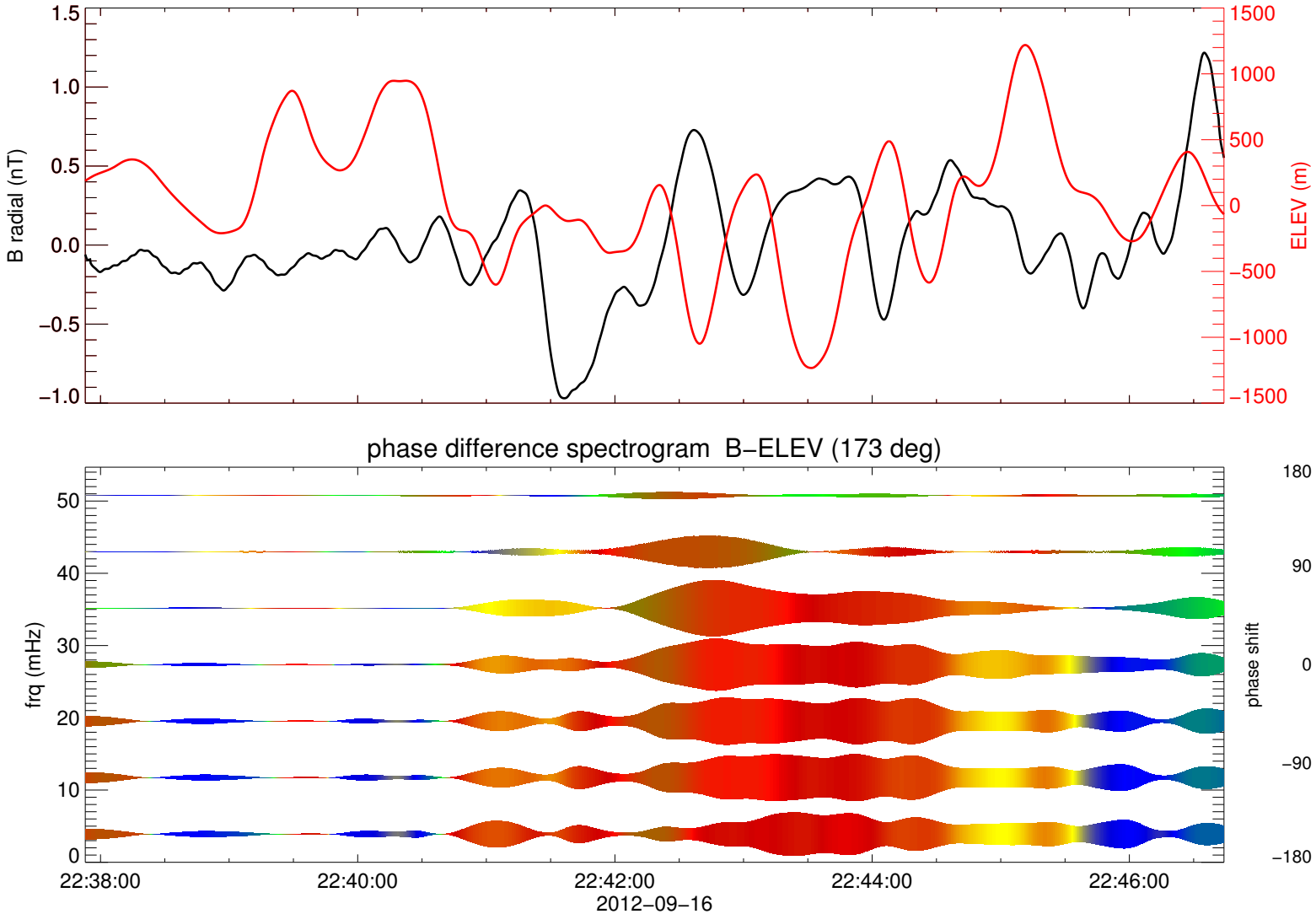
- Terrain elevation
- Free air gravitational anomaly
- Bouger gravitational anomaly

$\Rightarrow$ information on:

- Does the magnetization follow the terrain?
  (how close to the surface the magnetized material is?)
- How homogeneous is the magnetization at depth?
- Do materials with different density show different magnetization?

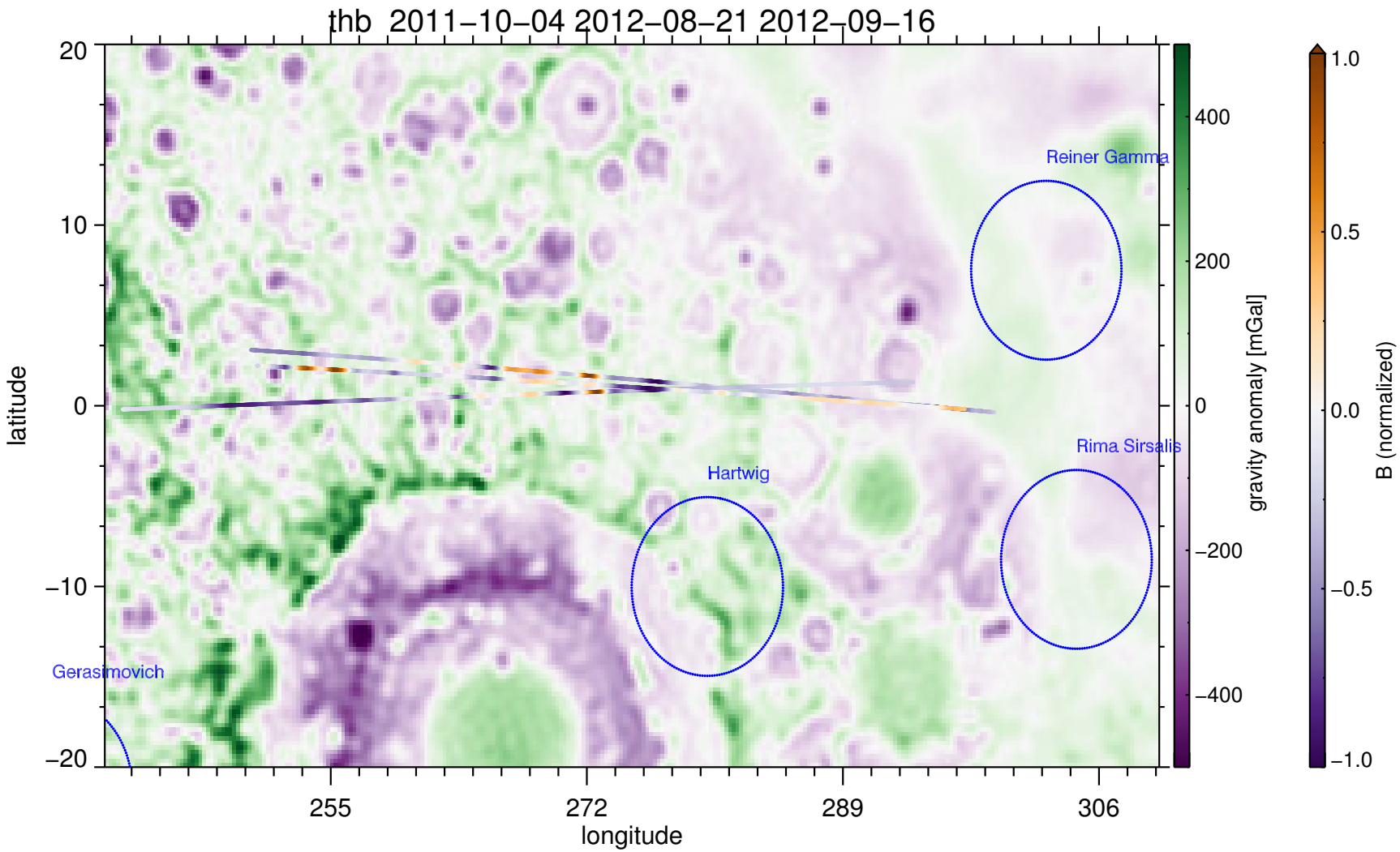
Relation with topography

Phase difference from cross-spectrum, PSD and coherence modulated



Lunar gravitational anomalies

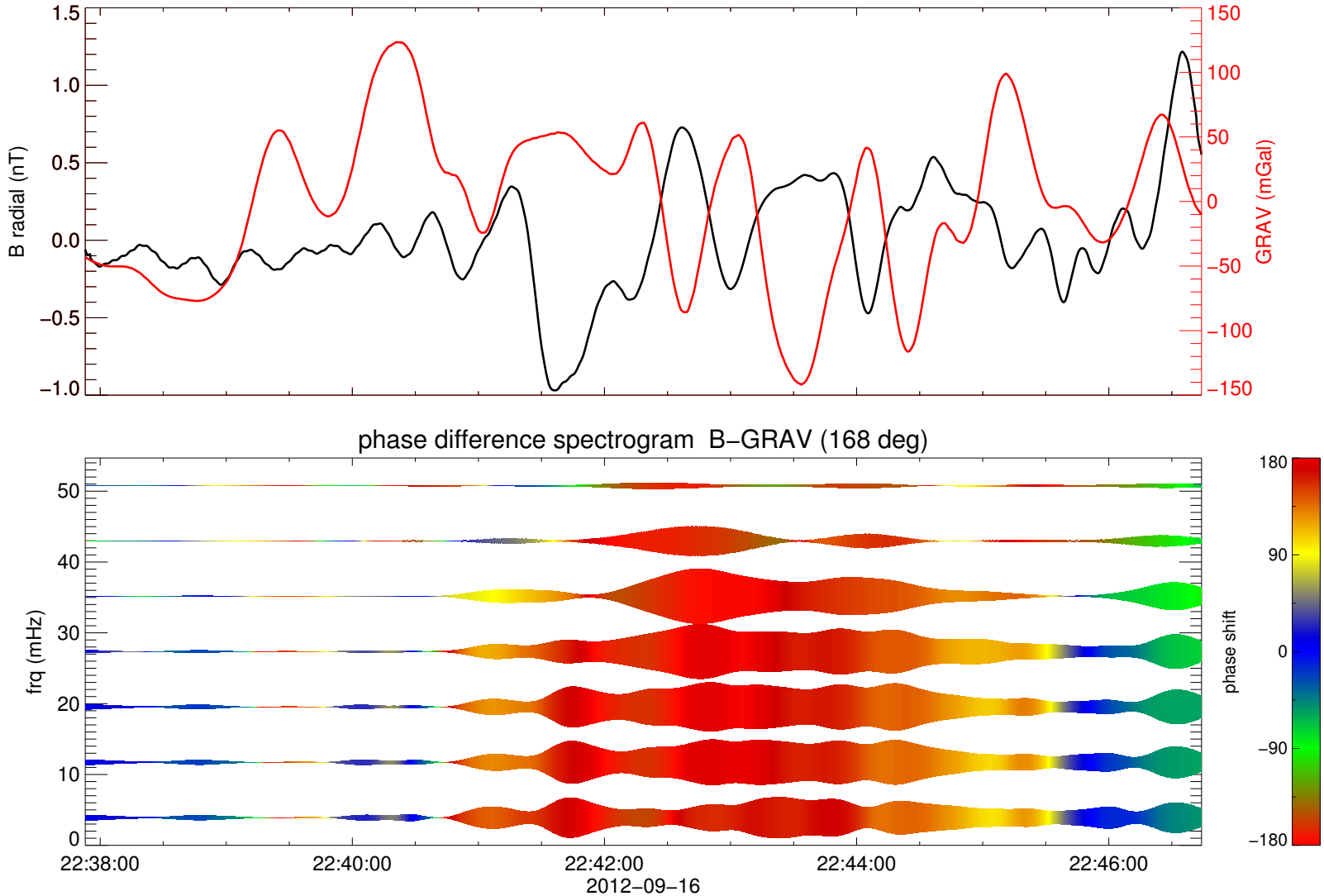
Free air, Schlüter P. region



Data from Gravity Recovery and Interior Laboratory (GRAIL) mission; http://pds-geosciences.wustl.edu

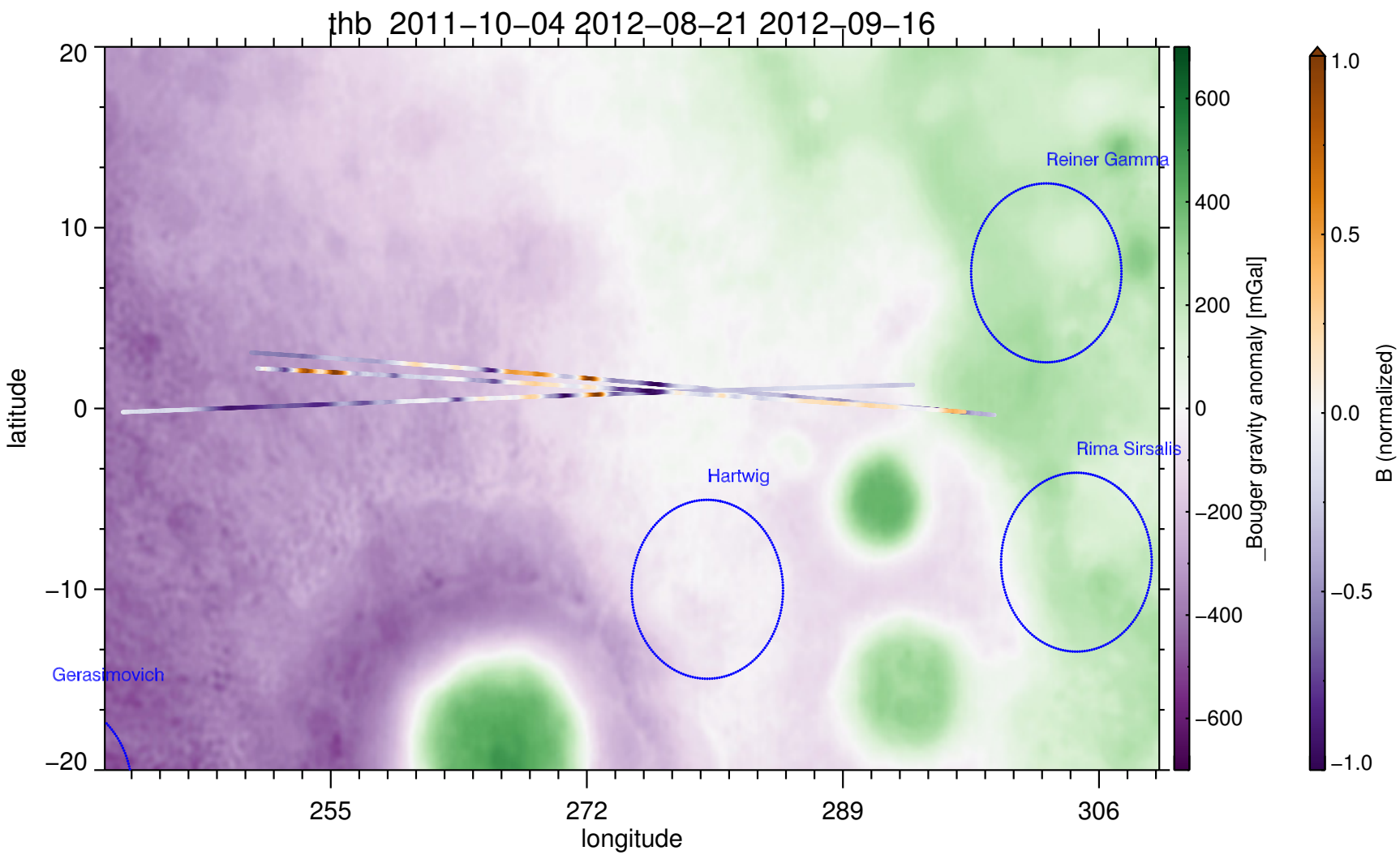
Relation with the gravitational anomalies

Free air, phase difference PSD and coherence modulated



Lunar gravitational anomalies

Bouger, Schlüter P. region



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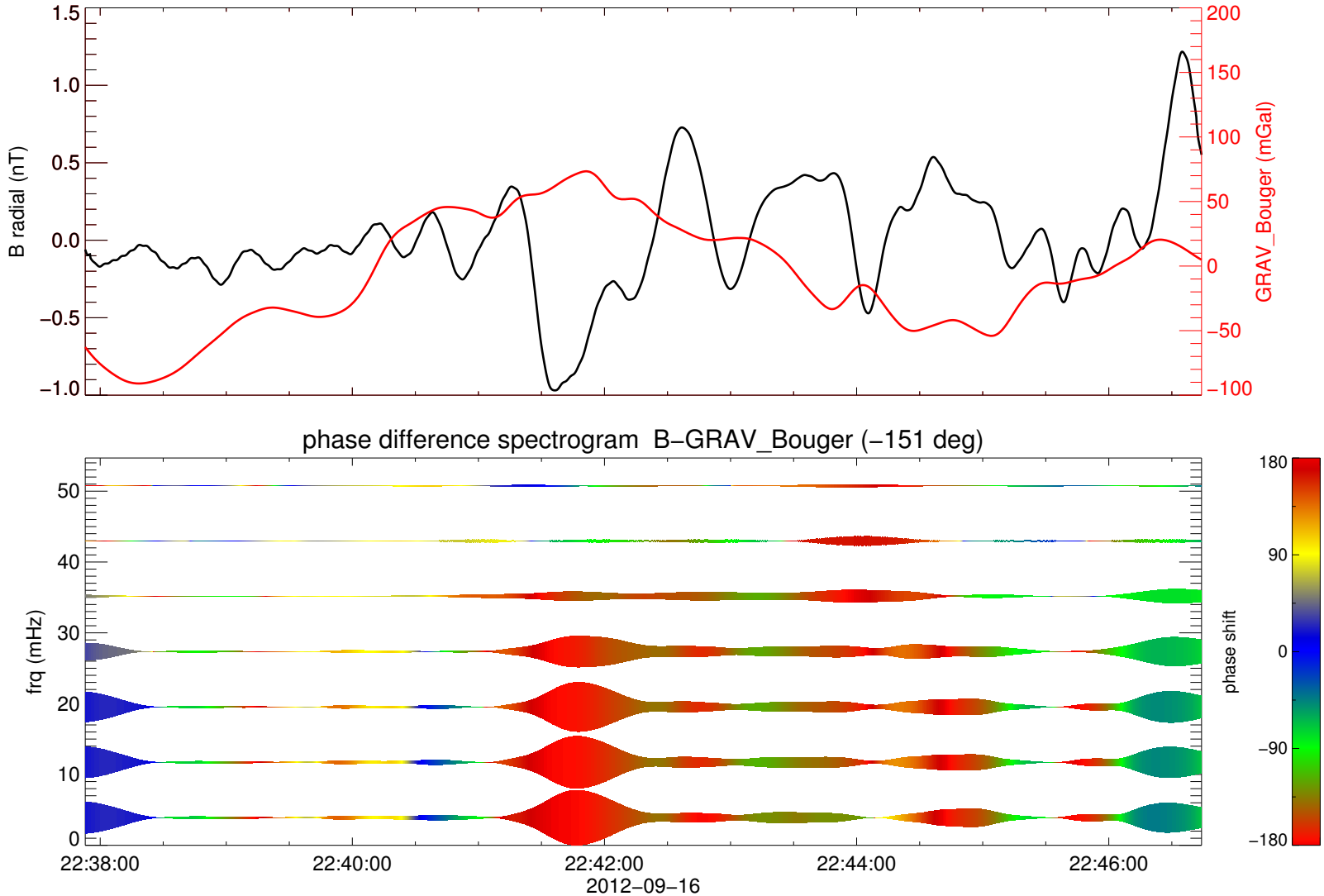
Relation with the gravitational anomalies

Bouger, phase difference PSD and coherence modulated



Weighted averages of phase differences

(degrees to $\pm$180)

Averages weighted with the PSD and coherence

	Elevation	Free air grav	Bouger grav
2011-10-04	26	49	34
2012-08-21	-31	-14	-5
2012-09-16	-10	1	-3

Summary

- New magnetic anomaly identified near Schlüter P. Crater
- SP surface magnetic field in the order of 50 nT
- SP surface crust magnetization in the order of 100 mA/m
- SP magnetic field is related with elevation and gravitational field
- SP magnetized material is present within the surface layer
- SP deep magnetization is related with the rock density