

Inter-Calibration of LOS magnetograms from Mount Wilson, Kitt Peak, GONG, WSO, and MDI

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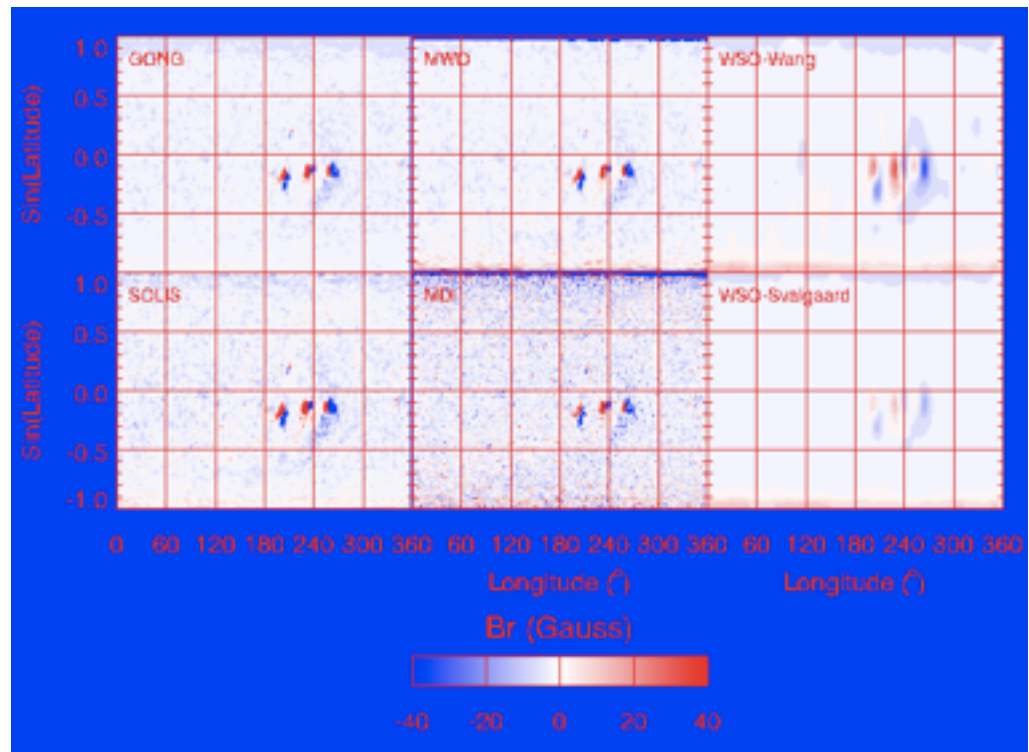
Stanford University, Stanford, CA

and

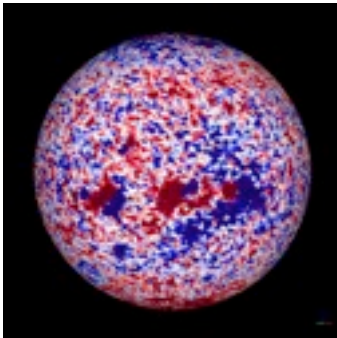
Luca Bertello

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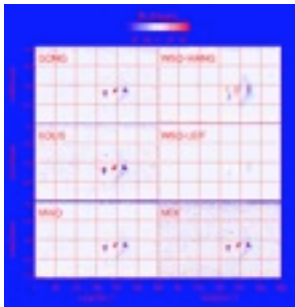
UCLA, Los Angeles, CA



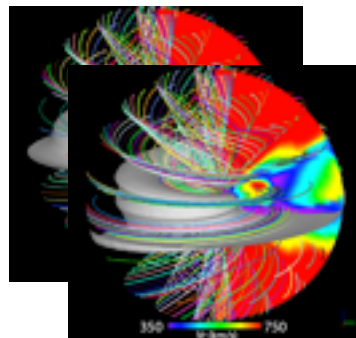
This talk explores the sensitivity of different magnetic field inputs into global numerical models



There are currently no “ground truth” observations of the radial photospheric magnetic field.

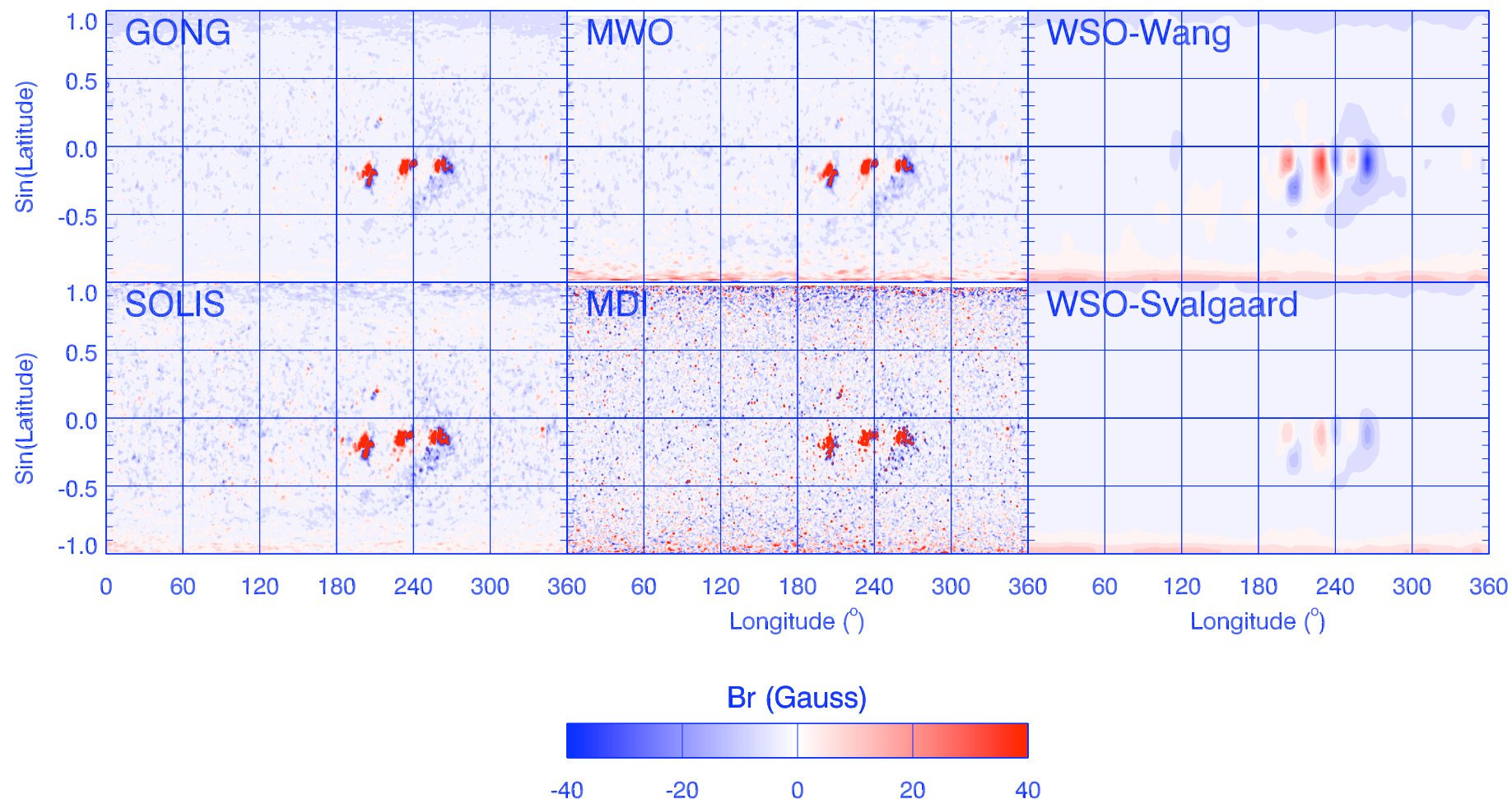


Often, there isn't a simple relationship between photospheric magnetic fields from different observatories.

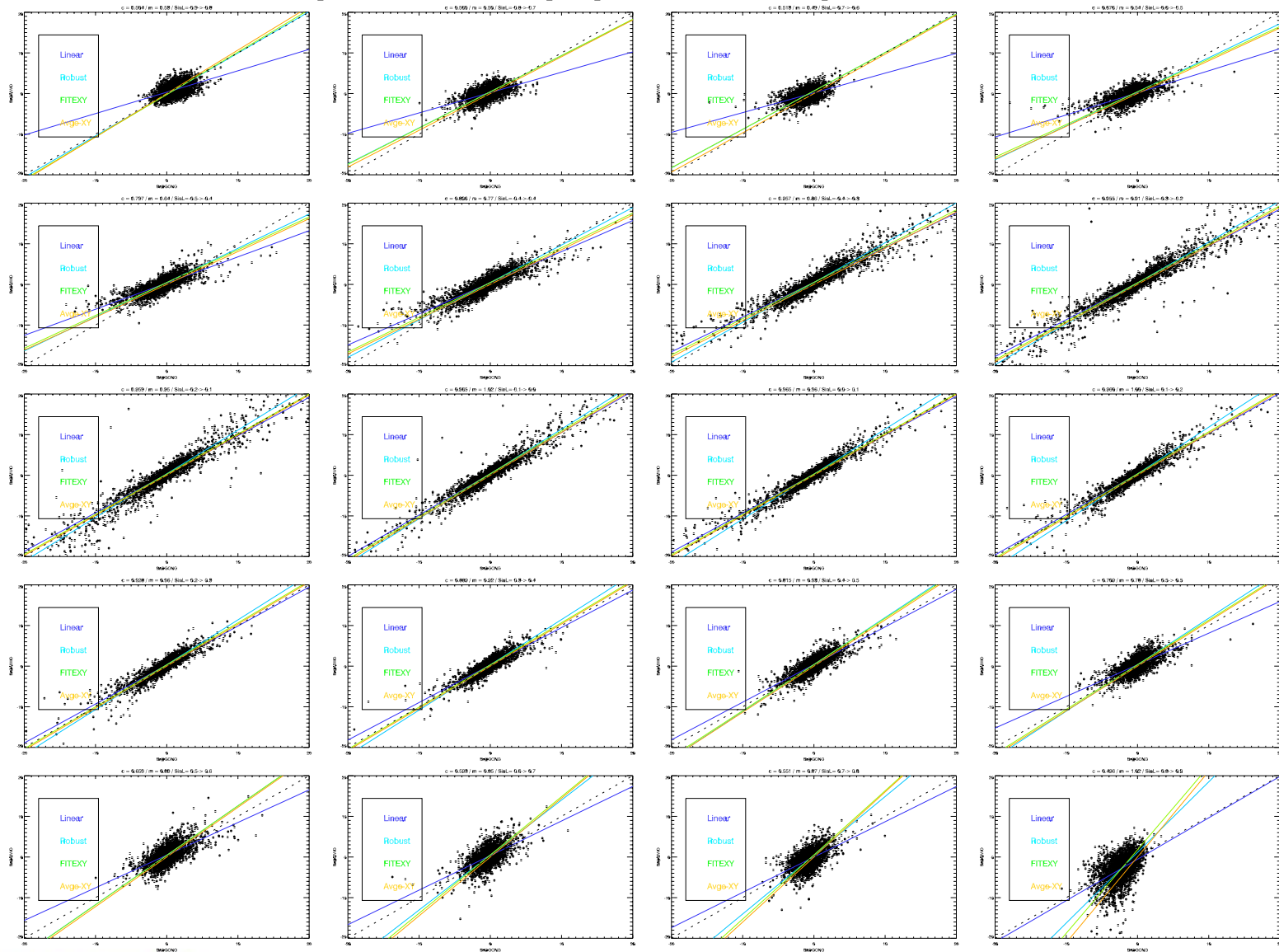


Different inputs produce substantial differences in the computed structure of the solar corona and heliosphere, and the open flux, in particular.

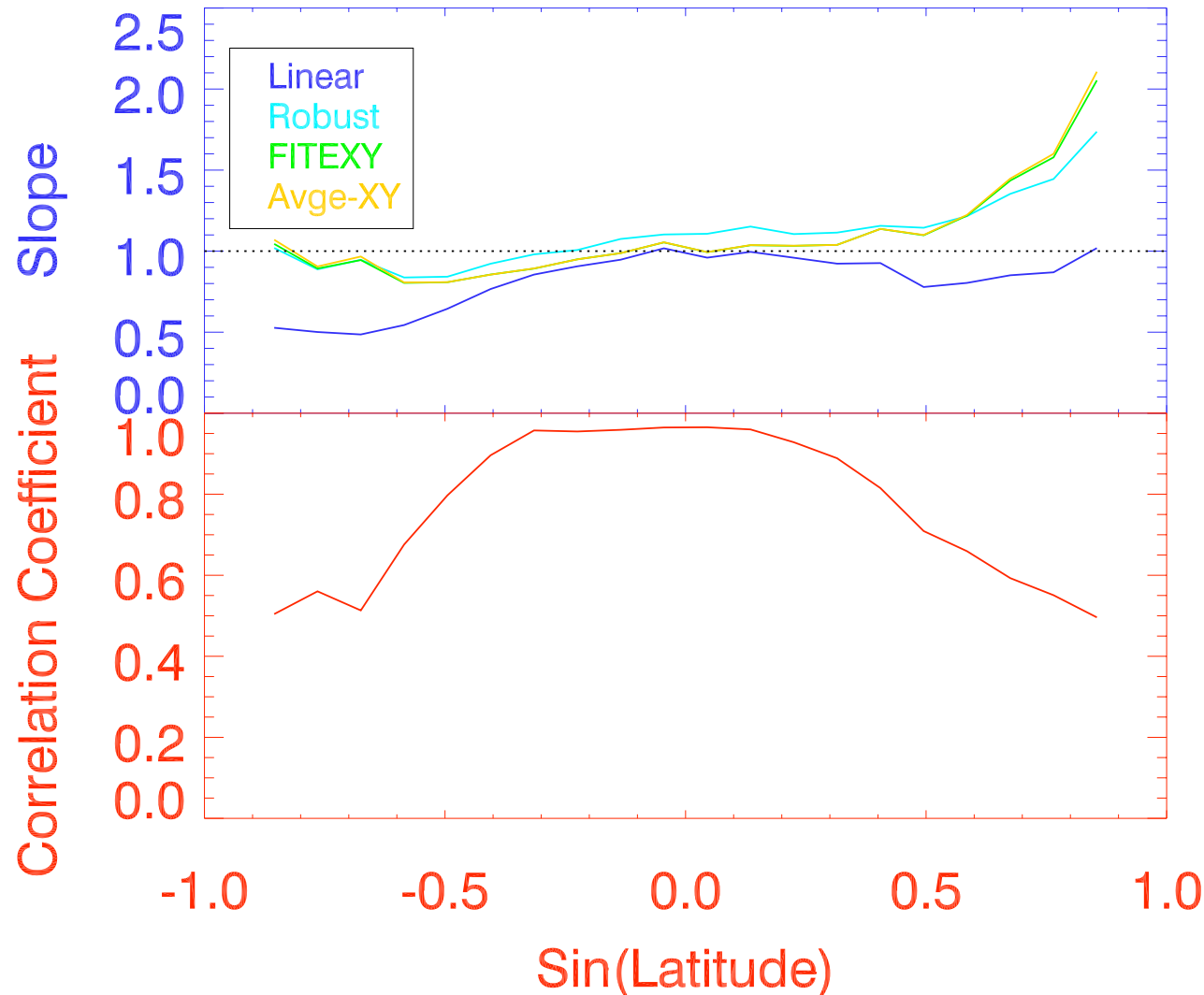
Synoptic maps from 5 observatories for CR2068 compare qualitatively well on the large-scale, but important differences exist between them.



Correlation of GONG (X) and MWO (Y) as a function of bins in Sin(latitude) (-1 to +1) for CR 2047.

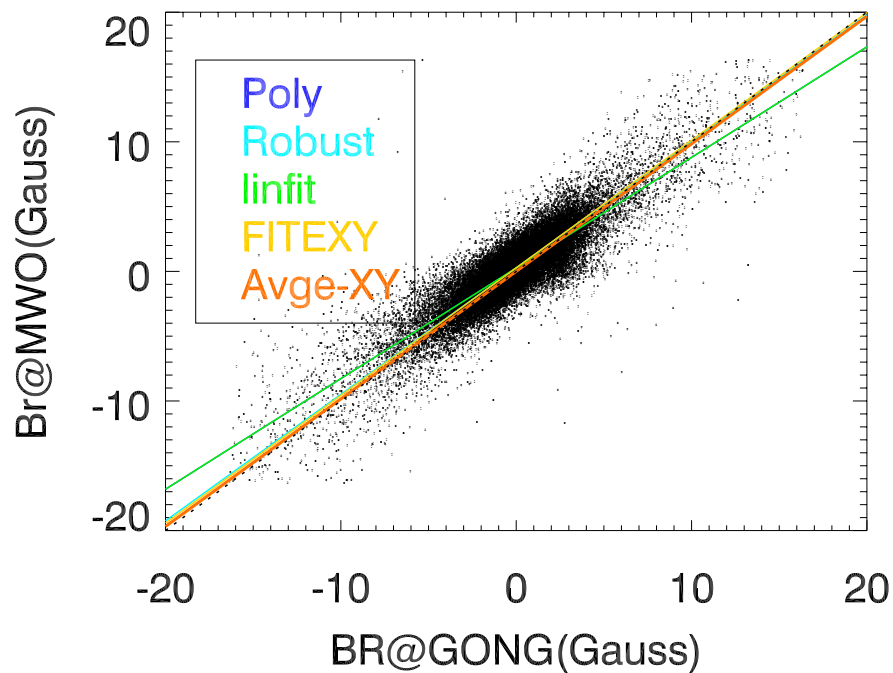


Best-fit slope to MWO/GONG data is 1.0. Correlation coefficient > 0.96 near equator (CR2047).

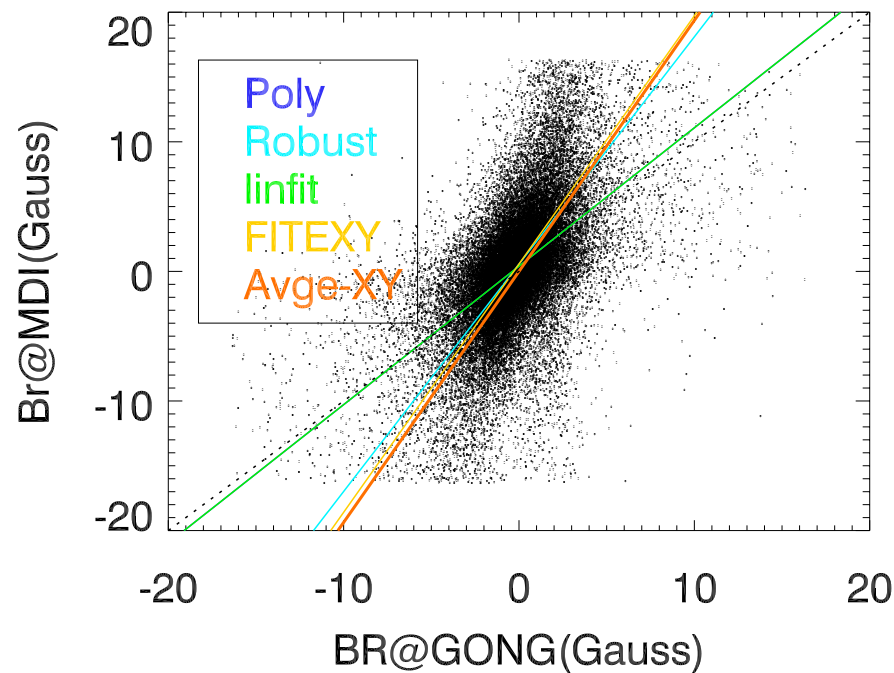


The correlation of GONG/MWO is generally much higher than GONG/MDI (CR 2047 shown).

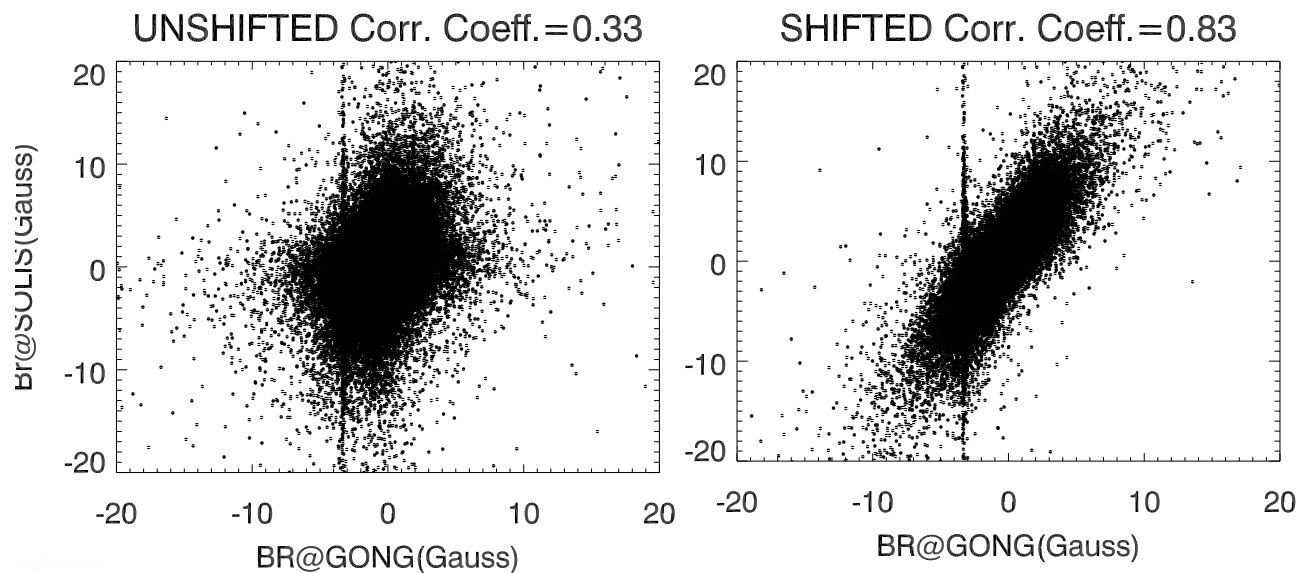
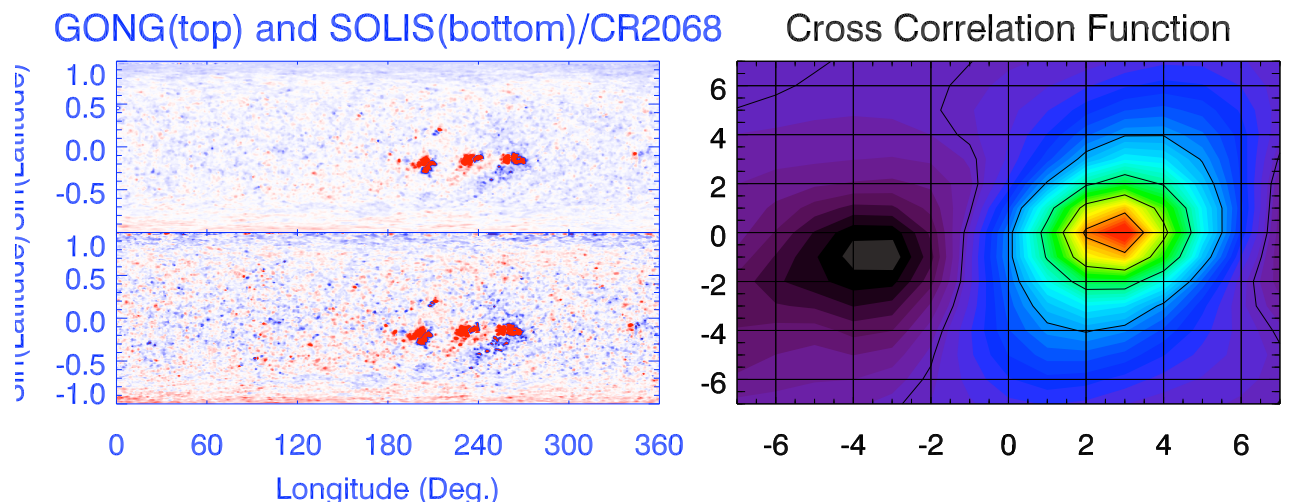
CR2047/c=0.87



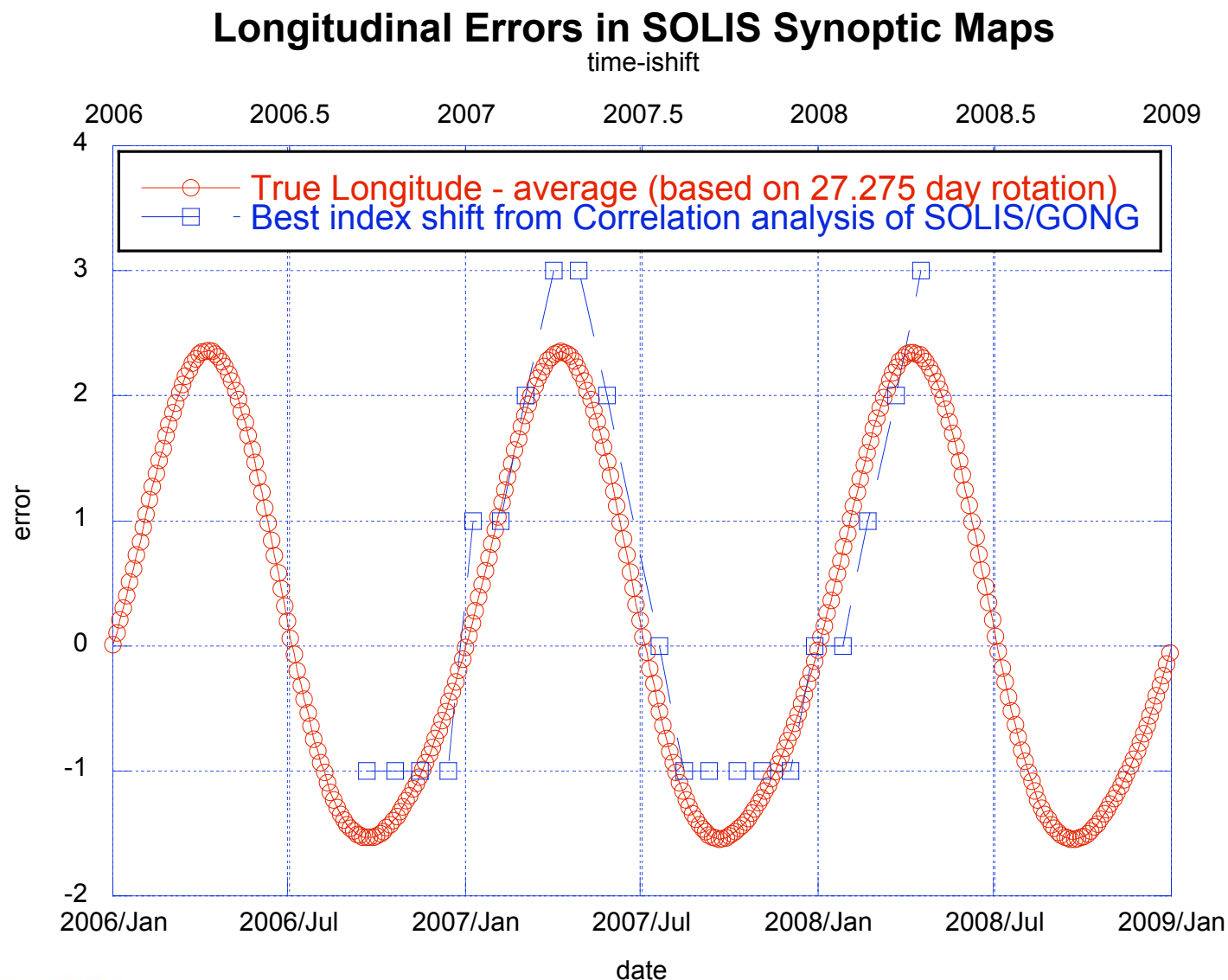
CR2047/c=0.56



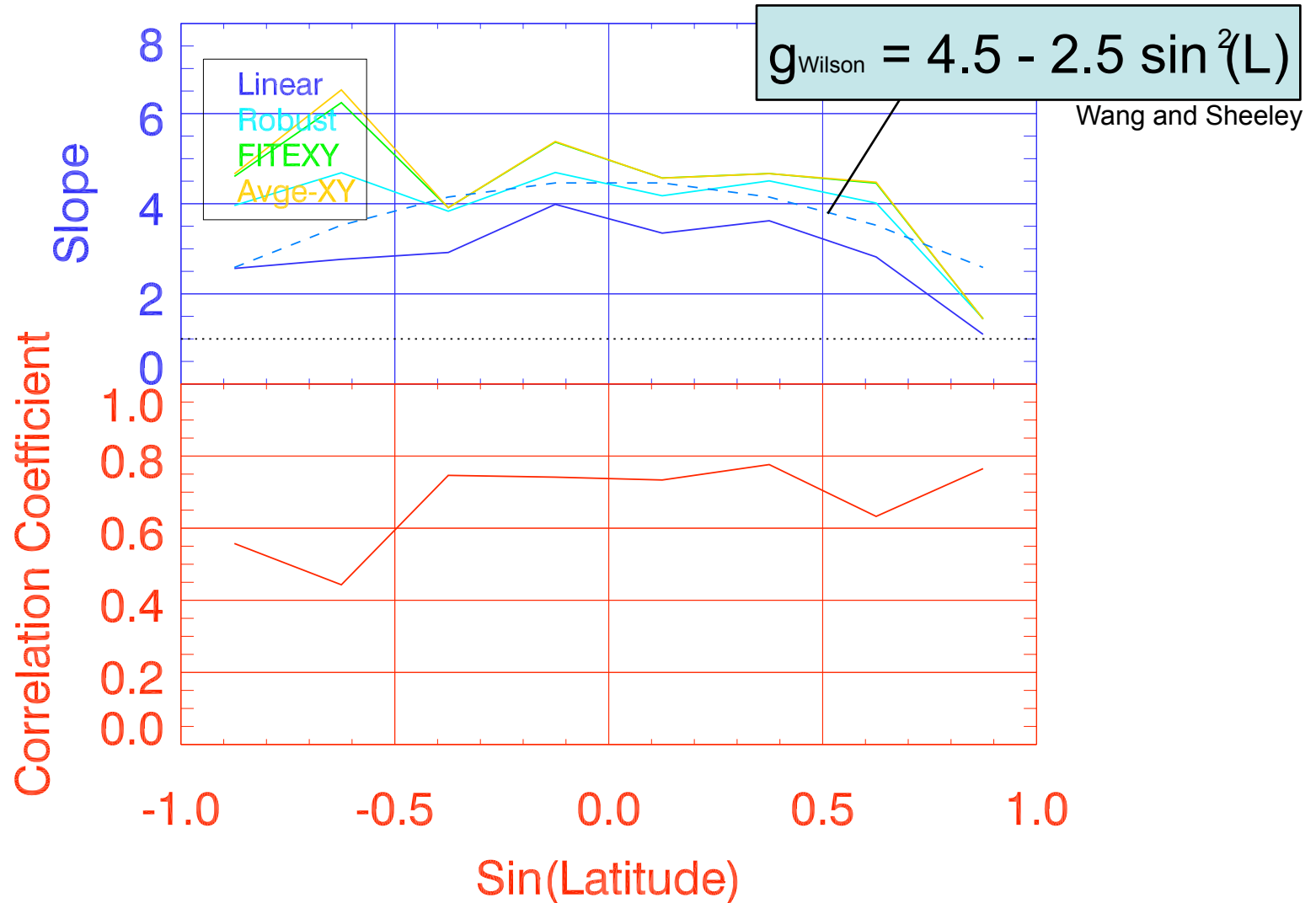
Correlation analysis of SOLIS/GONG: SOLIS offset from GONG diachronic maps by up to ~2.5 Deg.



The error in SOLIS data is likely due to an approximation in the computation of the instantaneous longitude of the observation.

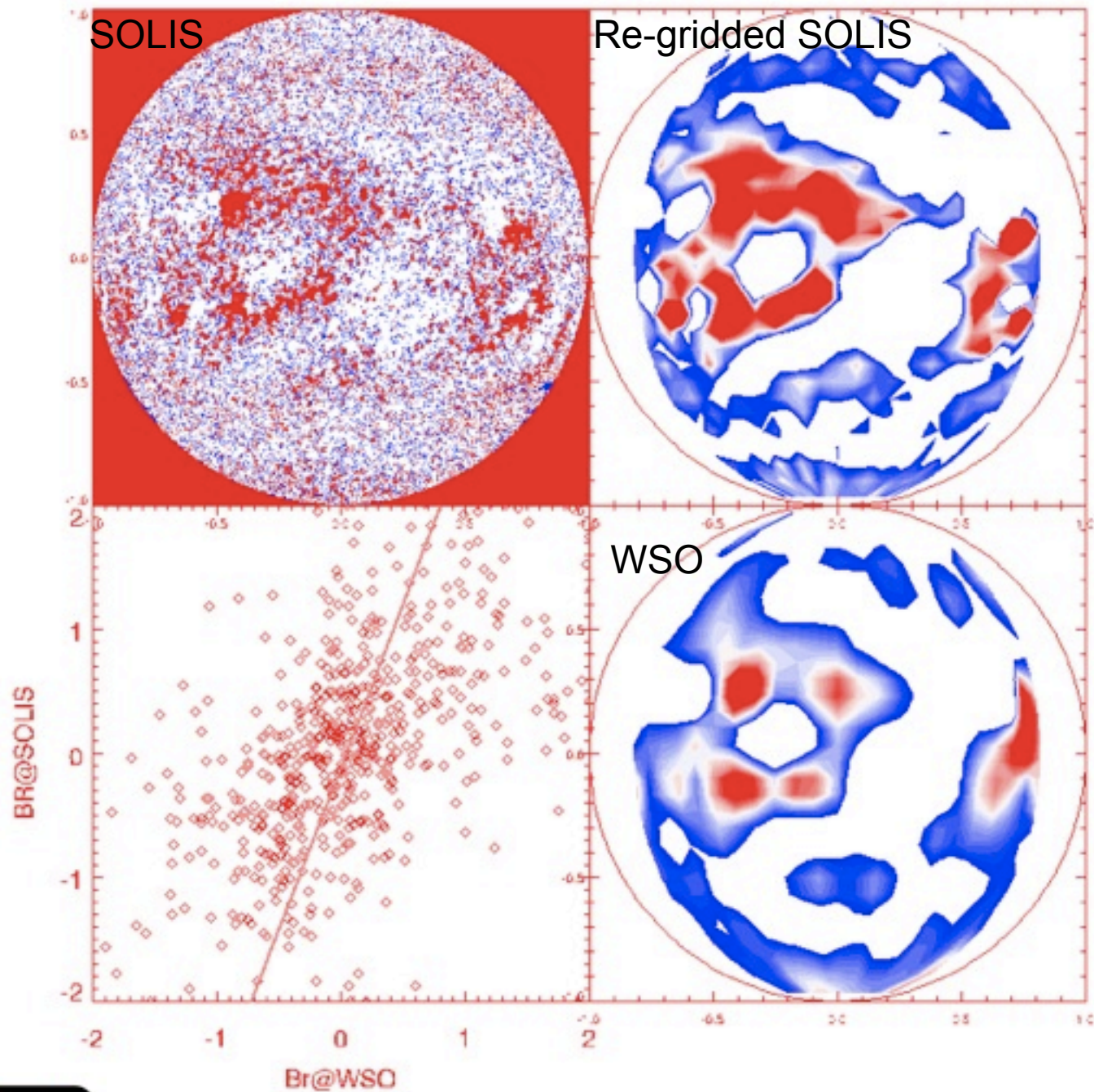


SOLIS/WSO correlation analysis for CR2047 does not show any evidence for a $\sin^2(\text{lat})$ dependence in the correction factor.



Inferred correction factors for CR 2047 show that MWO and GONG match very well (corr. coeff ~ 0.93). Correlation coefficients > 0.75 for others, except MDI.

	WSO	SOLIS	GONG	MWO	MDI
WSO	1	0.21	0.36	0.38	-
SOLIS	4.8	1	1.94	2.1	-
GONG	2.8	0.52	1	1.0	-
MWO	2.6	0.48	1.0	1	-
MDI	-	-	-	-	1



Disk comparisons from team members do not converge!

Pete Riley:

From 2004/07/06

$$\text{SOLIS} = -0.11 + 2.634 * \text{WSO}$$

From 2008/03/31:

$$\text{SOLIS} = -0.012 + 4.345 * \text{WSO}$$

From 2007/12/31:

$$\text{SOLIS} = -0.063 + 3.814 * \text{WSO}$$

Yang Liu:

From 07/21/04 17:00:

$$\text{SOLIS} = 0.04 + 0.699 * \text{MDI}$$

$$\text{MWO} = -0.1 + 0.944 * \text{MDI}$$

From Aug. 2006/June 2007

$$\text{WSO} = 0.045 + 0.227 * \text{MDI}$$

MDI~4.4*WSO and SOLIS~0.7*MDI.

Leading to: SOLIS~3.0*WSO

Jack Harvey:

SOLIS/WSO magnetogram comparison for Jan 13, 2008:

$$\text{SOLIS6301} = 0.11 + 2.032 * \text{WSO} \pm 0.4$$

$$\text{SOLIS6302} = 0.10 + 2.097 * \text{WSO} \pm 0.4$$

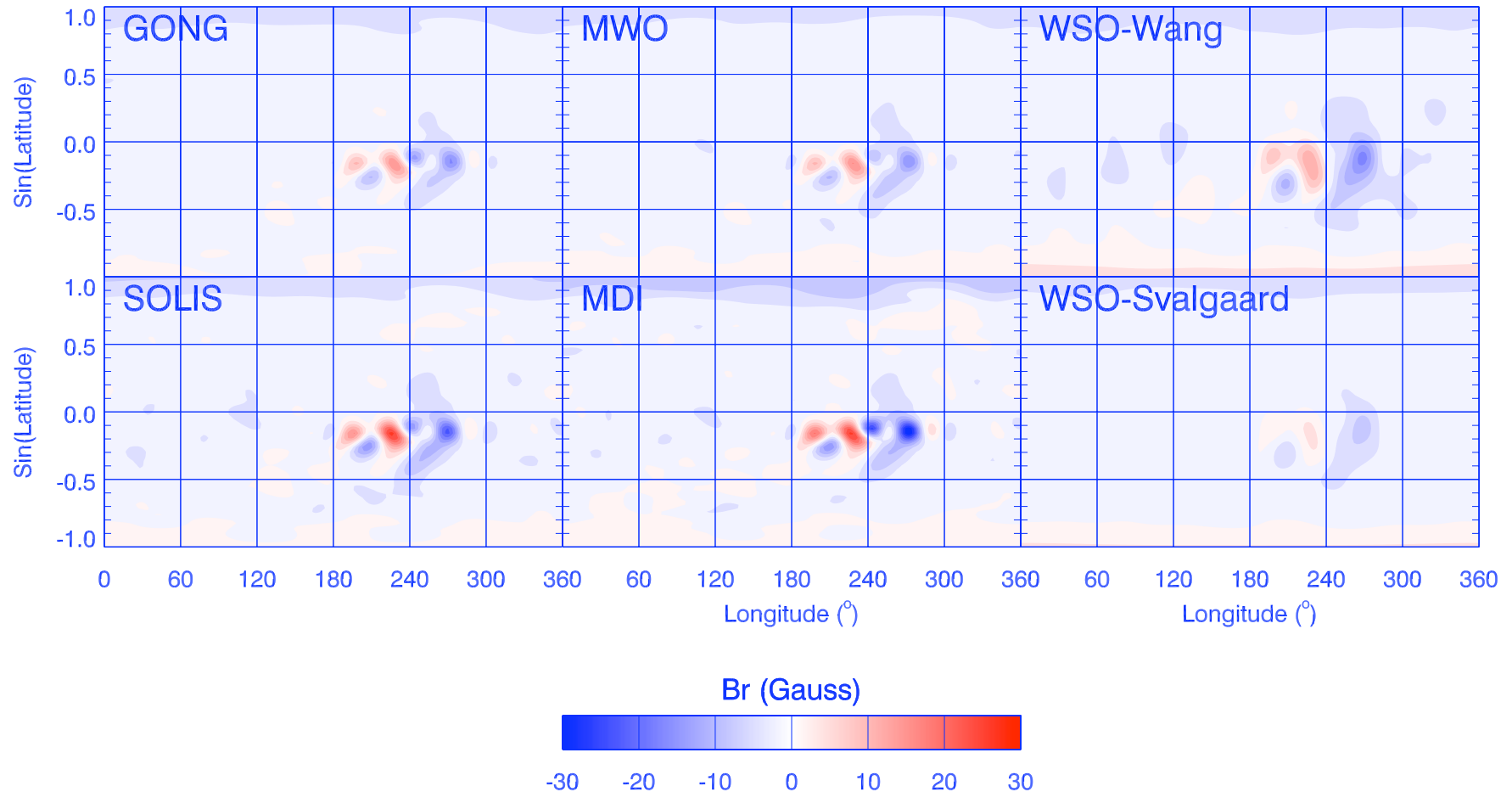
For 24 April 2008:

$$\text{SOLIS6301} = 0.14 + 1.821 * \text{WSO}$$

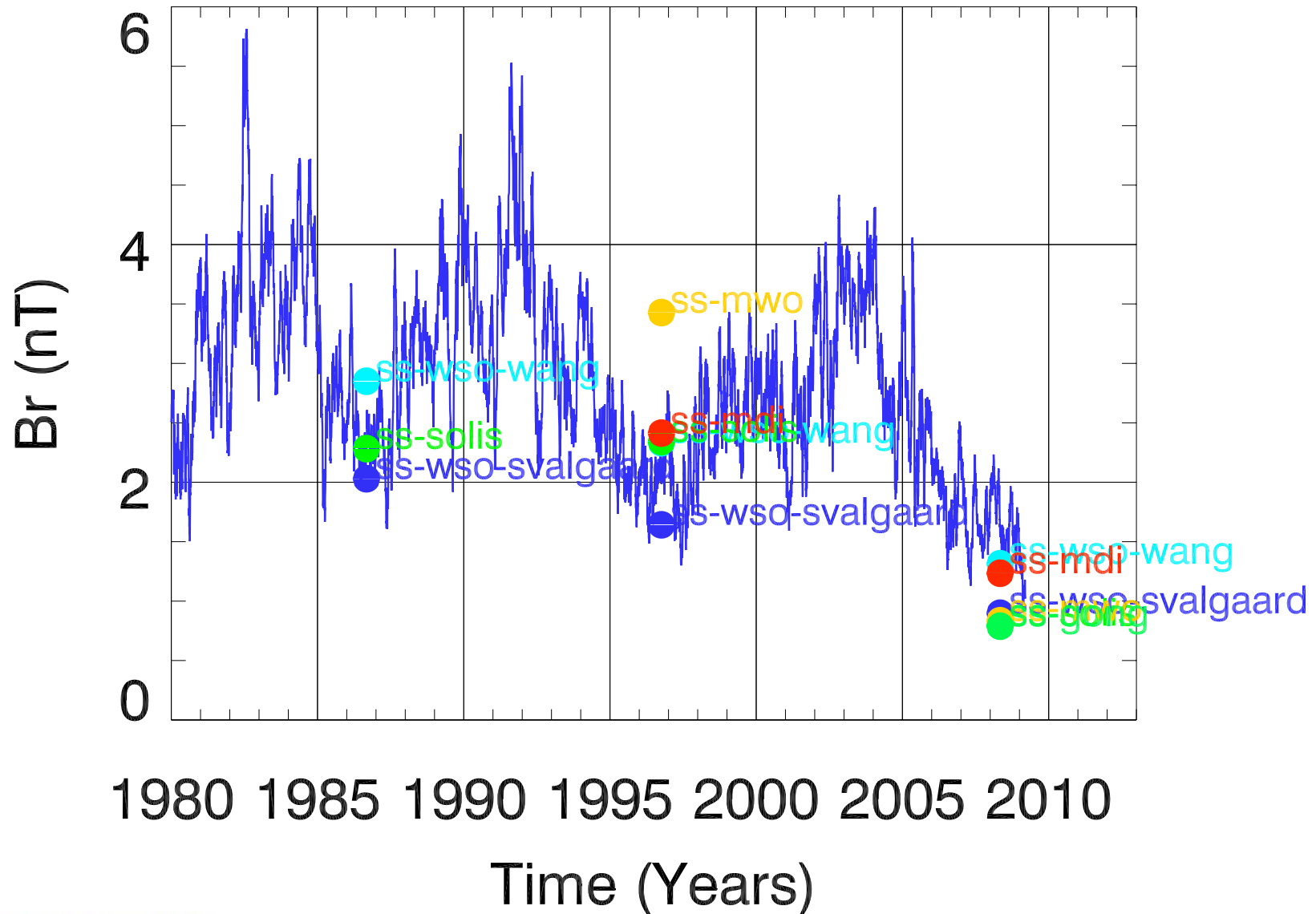
$$\text{SOLIS6302} = 0.10 + 1.669 * \text{WSO}$$

GONG/WSO comparisons show large offset, the origin of which remains unknown.

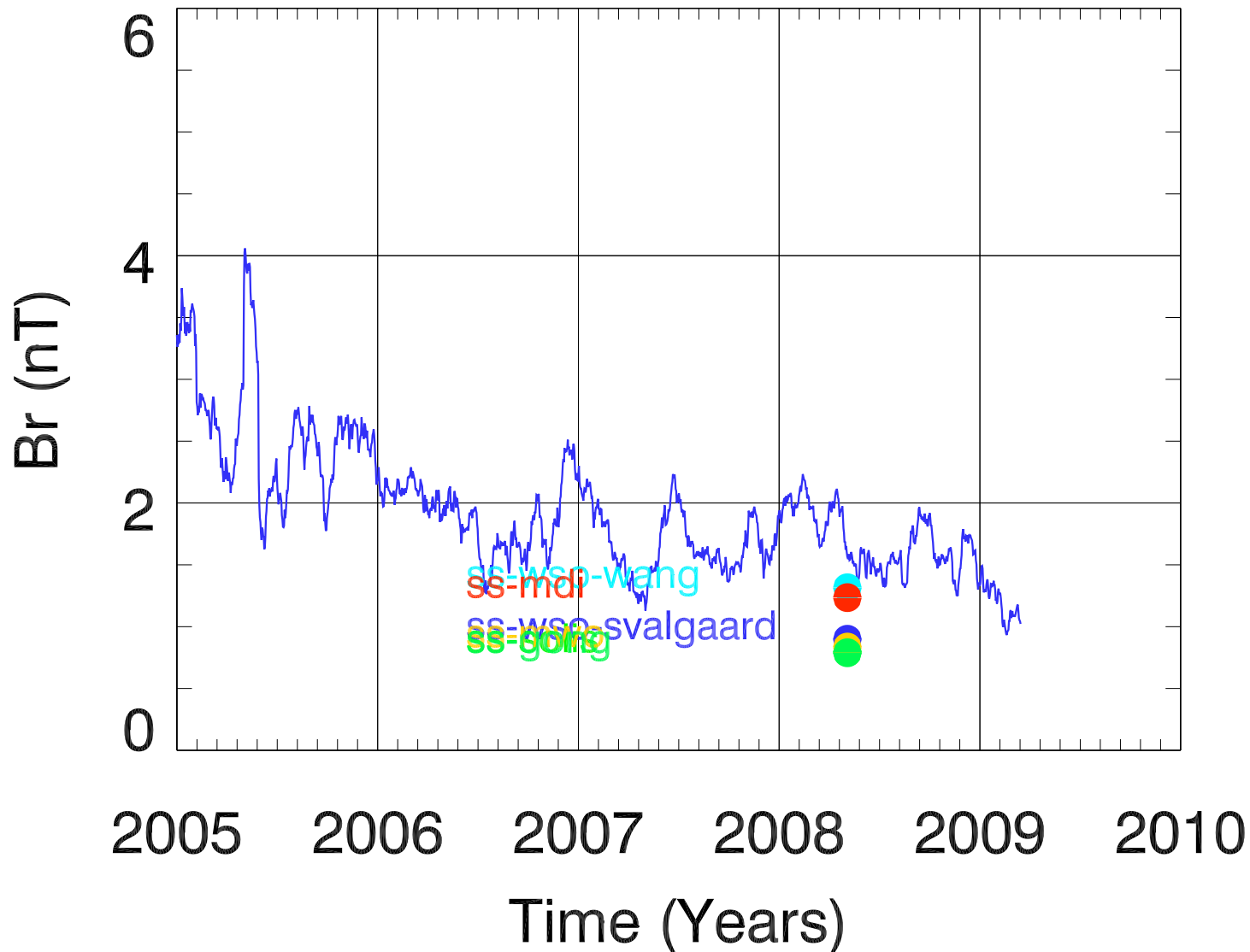
Processing all synoptic maps in the same way leads to model inputs that more closely resemble one another. Here are 6 maps for CR 2068.



Comparison of open flux computed with PFSS model and observations of open flux at 1 AU.



Comparison of open flux computed with PFSS model and observations of open flux at 1 AU.



Summary

- **Diachronic maps match to varying degrees:**
 - GONG/MWO match remarkably well
 - WSO should be multiplied by 4.4 (2.7) to match SOLIS (GONG)
 - SOLIS maps may need to be shifted by up to 2.5 Deg. longitude
- **Disk magnetogram comparisons confuse issue:**
 - $WSO = 1.6 * SOLIS$ to $4.3 * SOLIS$
- **Isolated comparisons of PFSS results at solar minimum do not resolve issue:**
 - Complete solutions over entire observatory range (1975 - present) are required
 - Limitations in PFSS model may require running MHD model on all maps
- **The most recent solar and in situ data may provide clues...**