

GONG Status

SOLARNET 3 / HELAS 7

Aug. 31, 2015

GONG continues to click along

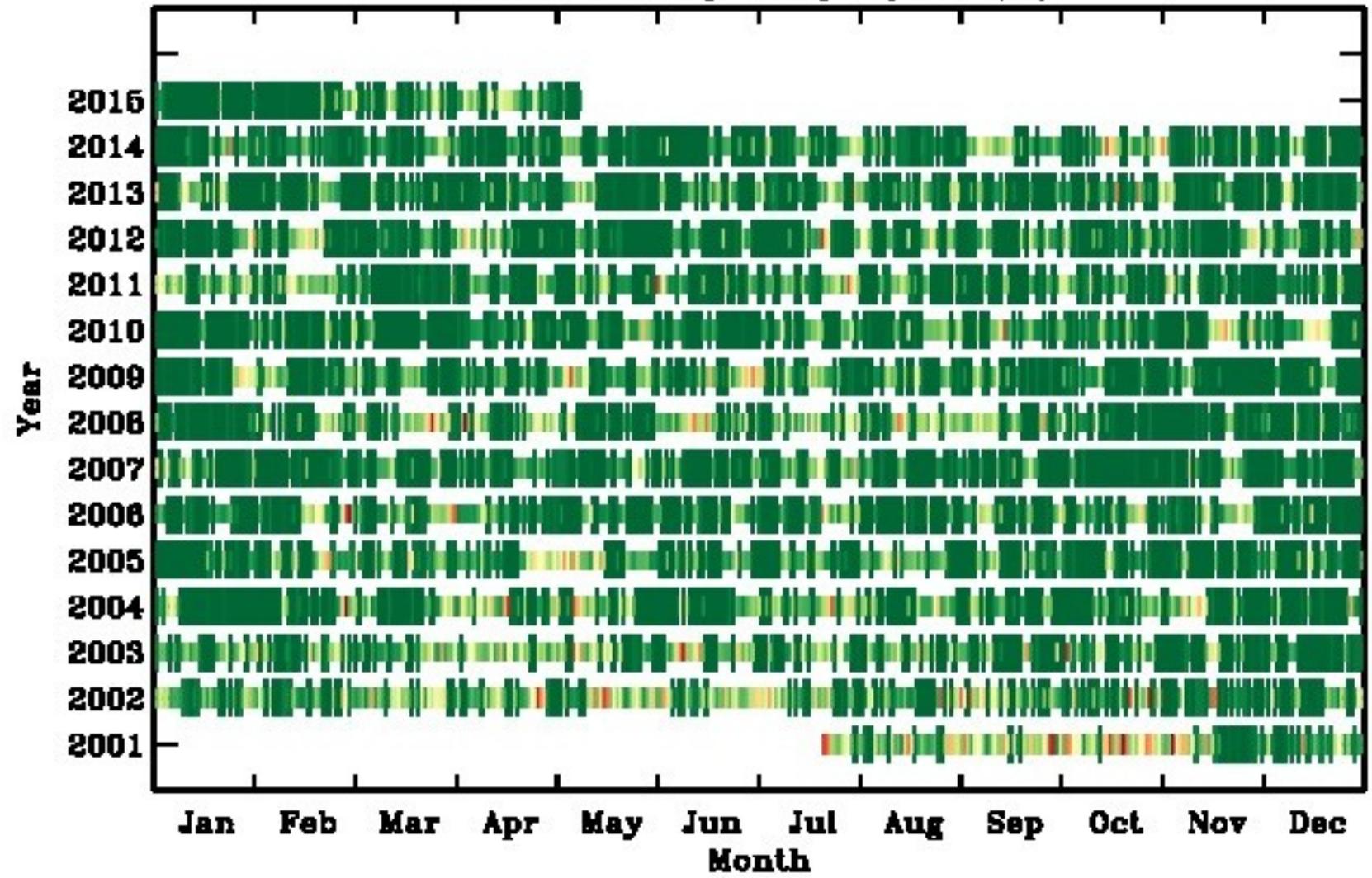
- 20th Anniversary session in Indianapolis
- Space weather strategy has worked:
 - Office of Management & Budget (OMB) attention
 - Space Weather Prediction Center (SWPC) “operationalization”
 - NSF refurbishment plan
 - NASA Infrastructure support
- “Stability” for 5-15 years
- But still facing challenges

Challenges

- Still facing NSF base support reduction in FY16
- Possible US budget continuing resolution or total shutdown
- Relocation to Boulder
- Aging instrumentation
- Juggling GONG and SOLIS priorities
- Site-to-site variations in angular position and magnetic field zero-point

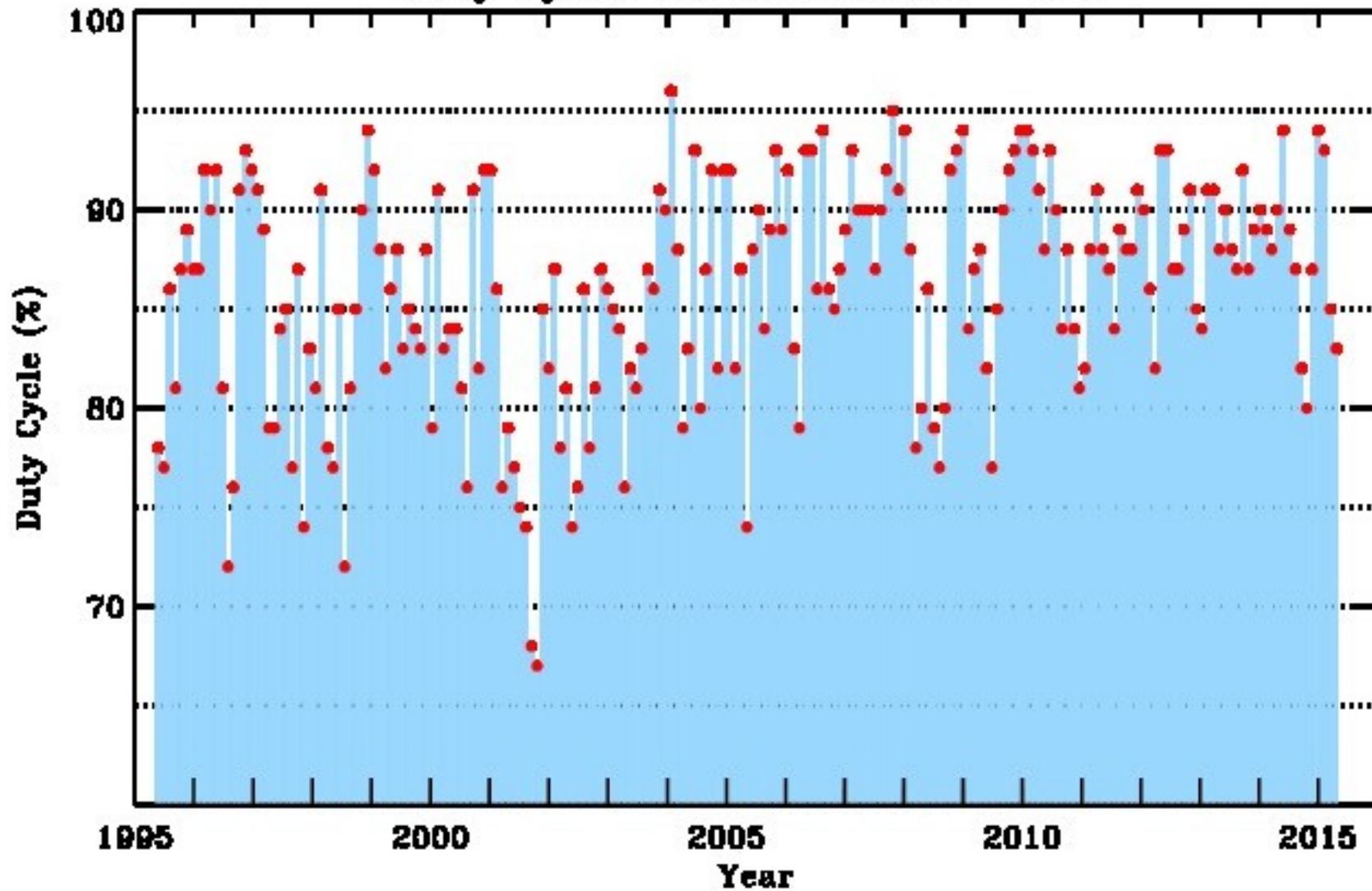


GONG+ Daily Duty Cycle (%)



MEDIAN: 0.910 MEAN: 0.874

Duty Cycle: GONG Month 1 - 203



MEDIAN: 0.870 MEAN: 0.859

SWPC – Space Weather Prediction Center

- Administered by NOAA
- Will “operationalize” GONG space weather products
- Install data processing pipelines (magnetic fields and H- α) at SWPC Boulder data center and US Weather Service forecast computing center
- Very robust systems
- Space weather data will be distributed by SWPC and placed in NGDC
- NSO will still be source for science data
- SWPC will also fund GONG operations and data processing for at least 5 years @ \$1M/yr

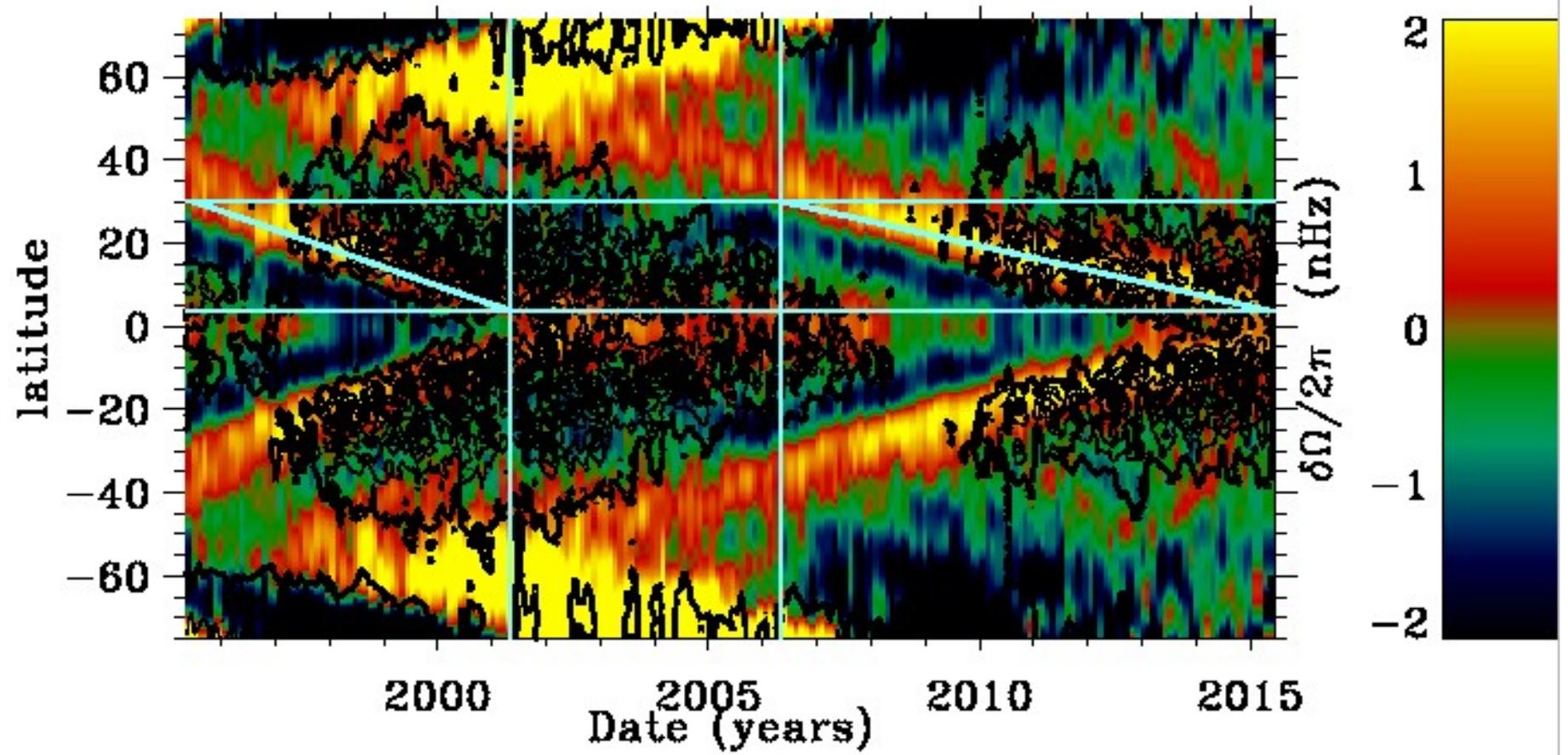
Refurbishment options

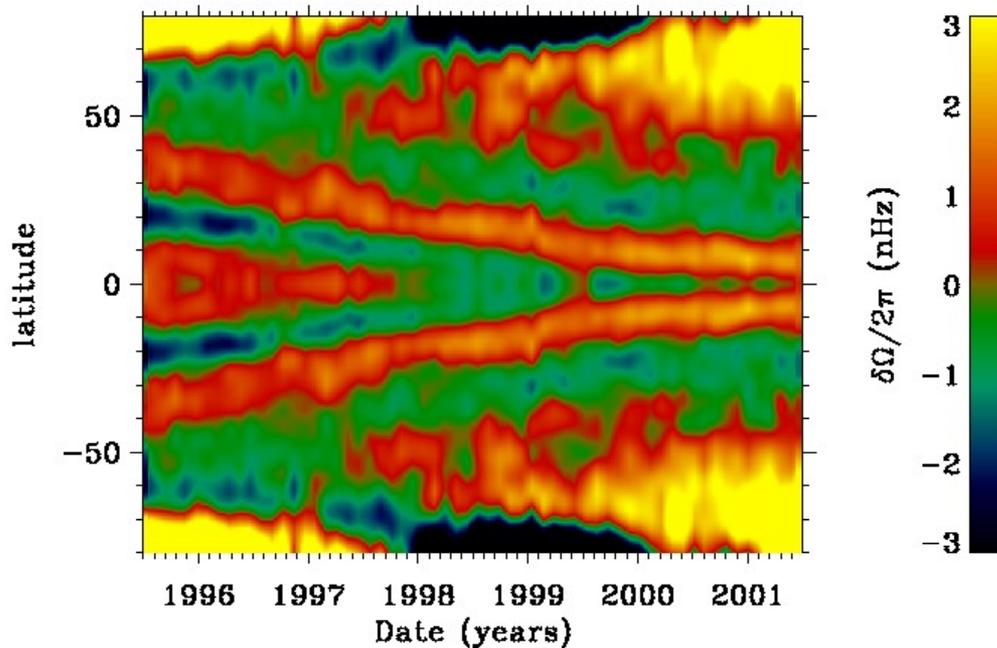
- NSF has one-shot \$2.5M for GONG refurbishment in FY16 budget, but more likely for FY17 and may be a lower amount over 2-3 years
- Ideas:
 - New cameras
 - Better H- α filters including Doppler shift
 - Move magnetic field modulator to decrease zero-point problems
 - Higher spatial resolution???
 - More intensity wavelengths?
 - Enhanced data center

Data center

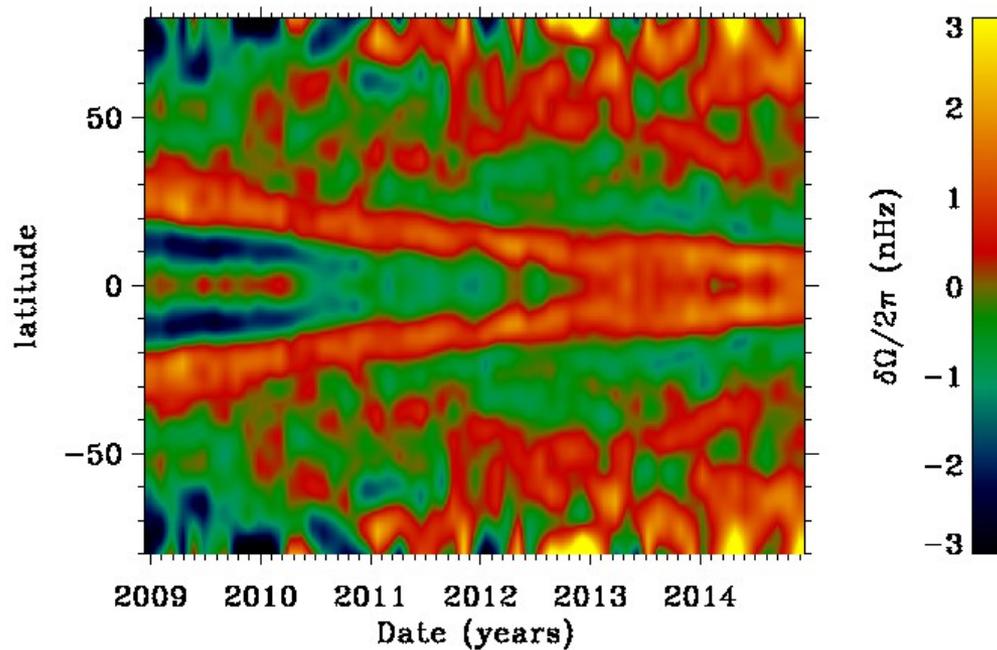
- Being revamped
- Current hardware architecture cannot cope with increasing volume
- Purchasing completely new COTS system with monolithic storage of 1 PB
- Will be installed in Boulder summer 2016

Cycle 25 starting to pick up?





DRB averaged over 6
years 1995.5 – 2001.5
and removed

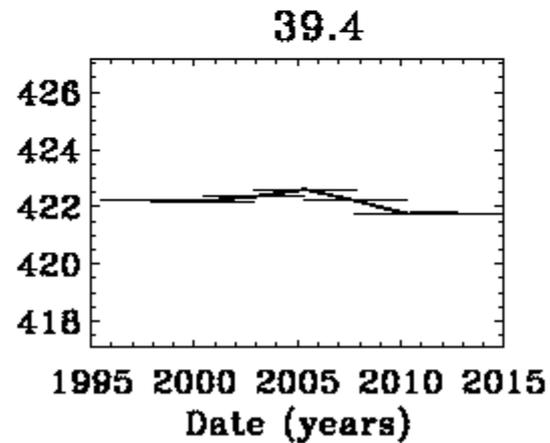
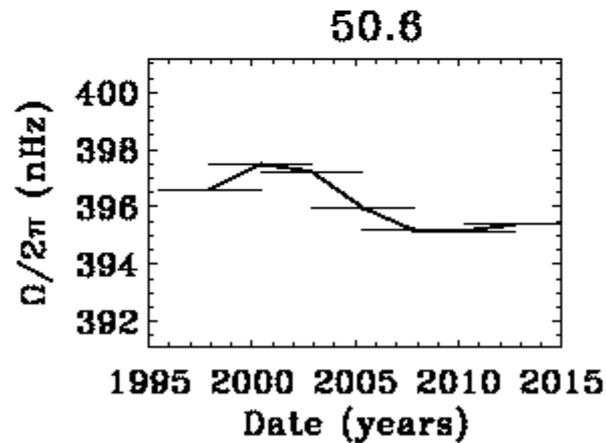
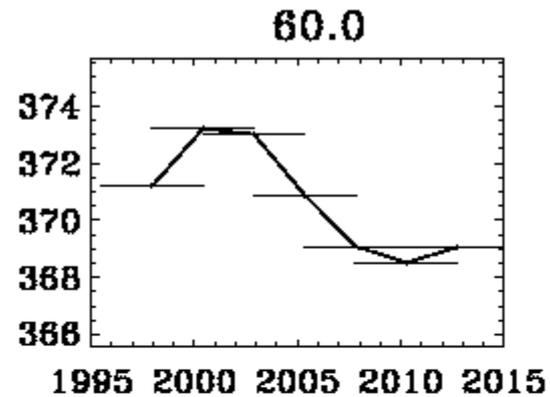
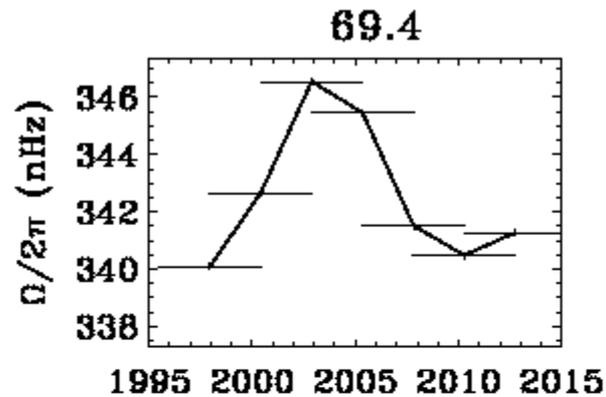


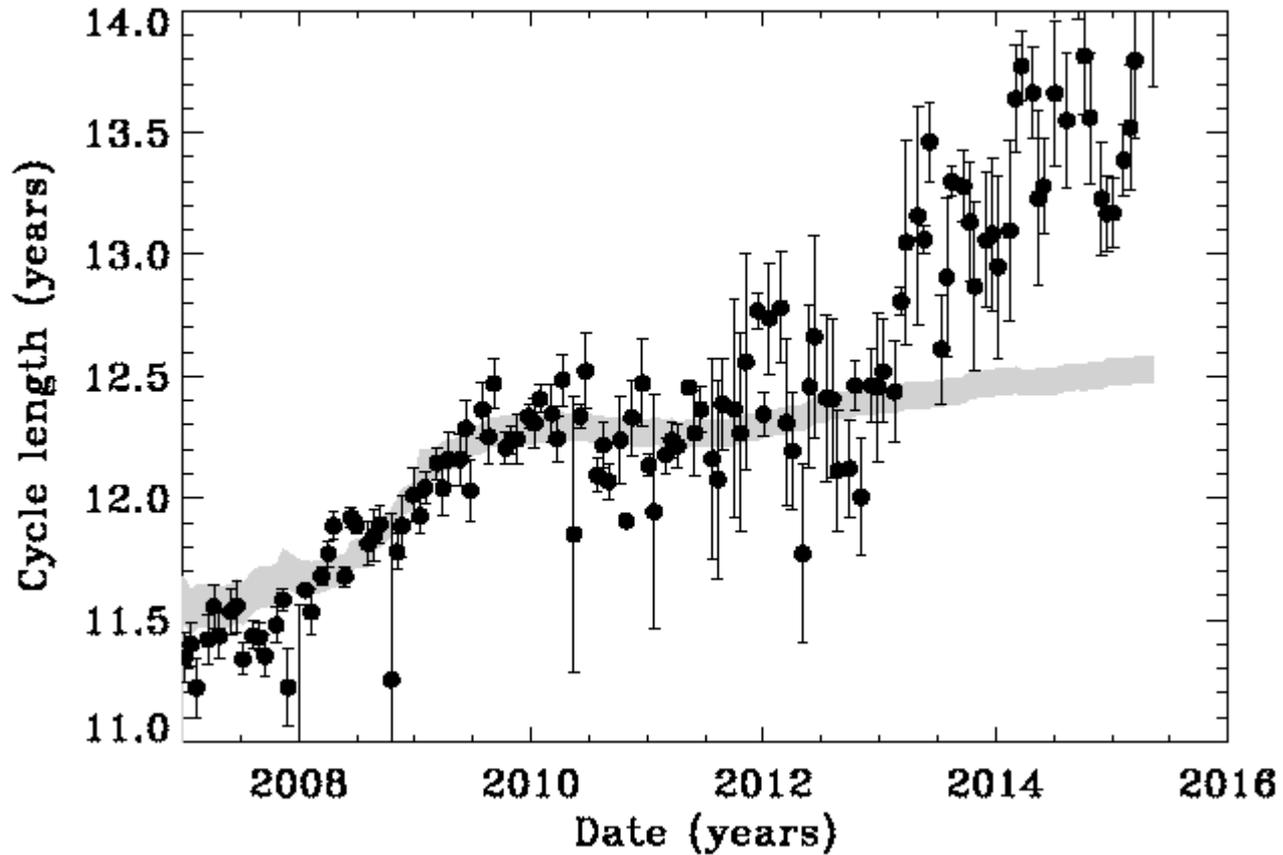
DRB averaged over 6
years 2009.0 – 2015.0
and removed

C25 poleward branch present
but weak and intermittent

Temporal evolution of rotation rate at selected latitudes

5-year average centered every 2.5 years





Estimates of cycle length

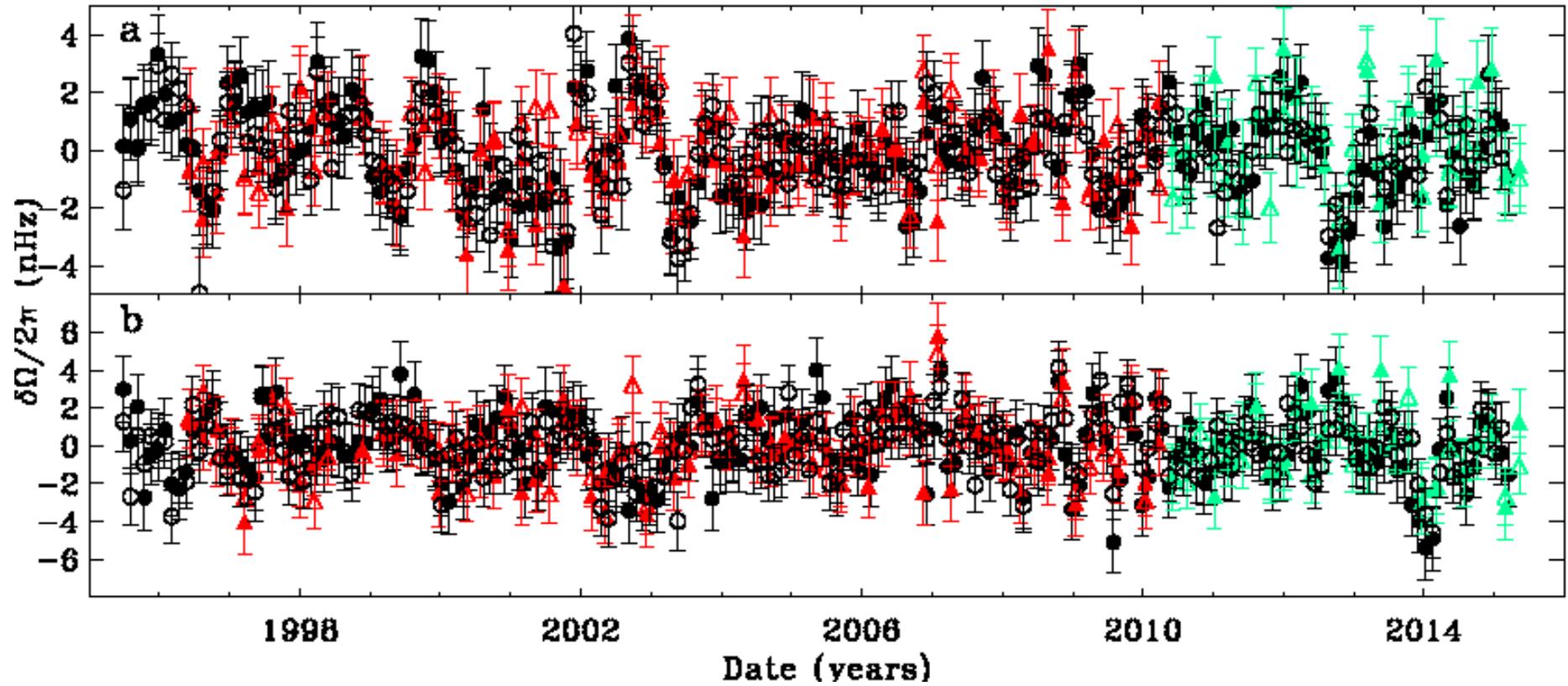
Grey line: sinusoidal fit of period + second harmonic, points:
Cross-correlation

Conclusion: Cycle is rapidly lengthening, and is no longer well-described by sinusoids

Cycle 25 predictions

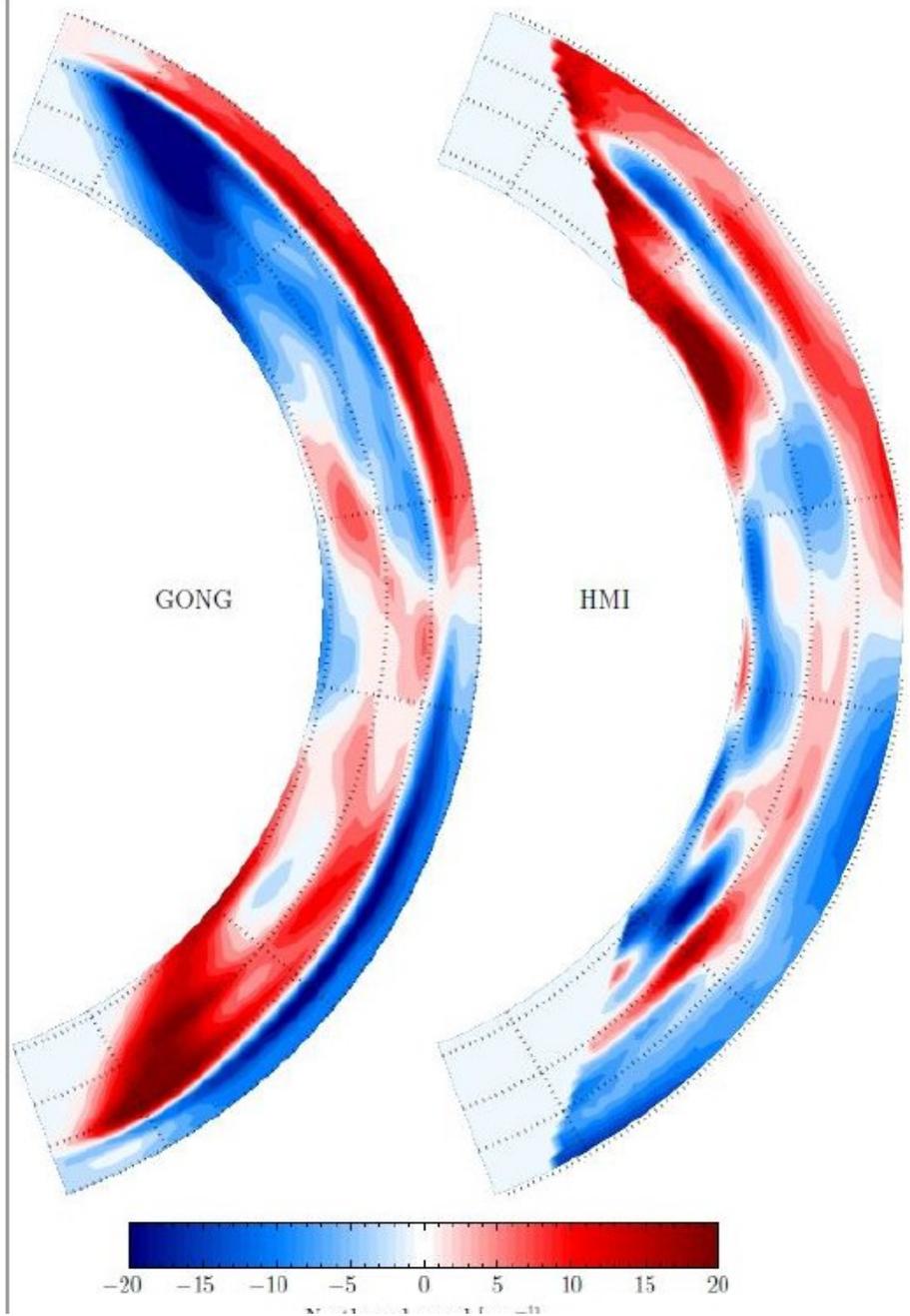
- Will be weak since poleward branch is weak
- Will be very long since period is apparently increasing
- Solar minimum between C24 and C25 will occur in 2022-2023
- But we are extrapolating based on 1.5 cycles – need more data!

Rotation rate fluctuations at the CZ base



Inversion results as a function of depth and latitude. In GONG case in most latitudes one cell meridional flow can be seen. Some weak deep poleward flow at low latitudes may be due to endpoint configurations during cross-correlation computations. General flow speed magnitude (poleward and return components) between GONG and HMI are in good agreement but the depth and latitude variations not so much.

Jackiewicz, J., Serebryanskiy, A., Kholikov, S.
2015, *ApJ*, **805**, article id. 133

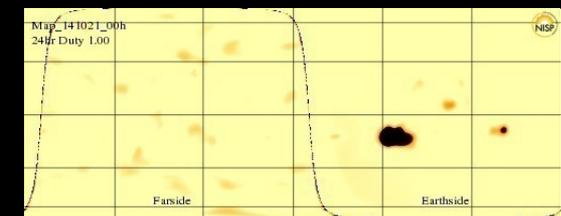
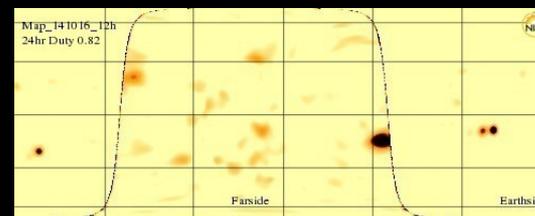
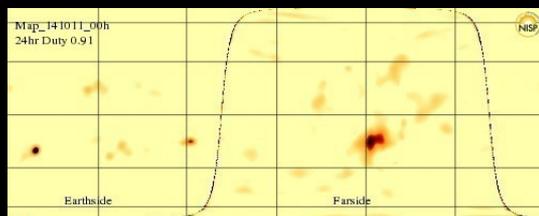
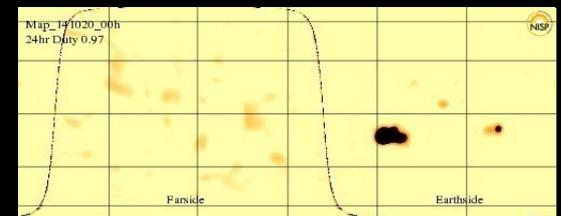
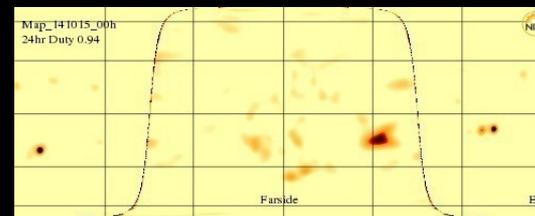
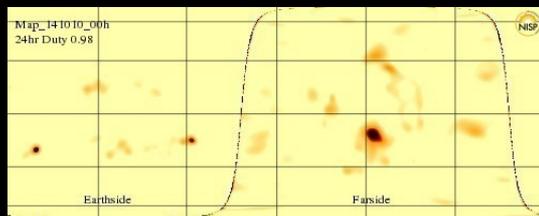
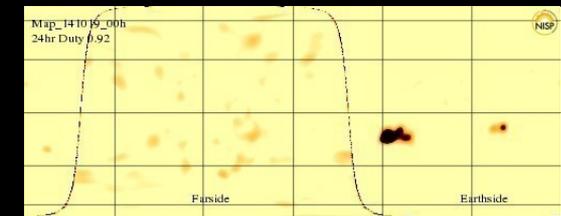
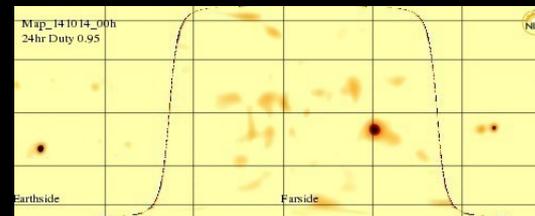
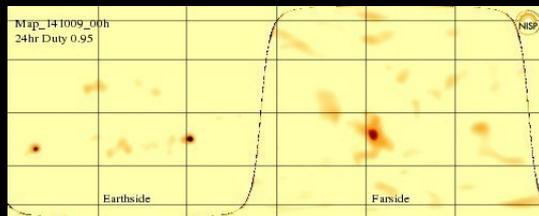
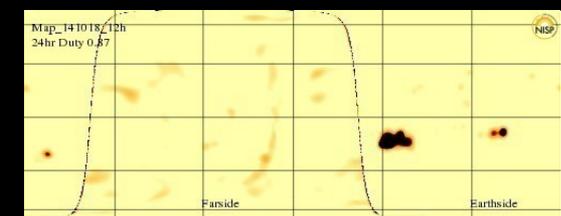
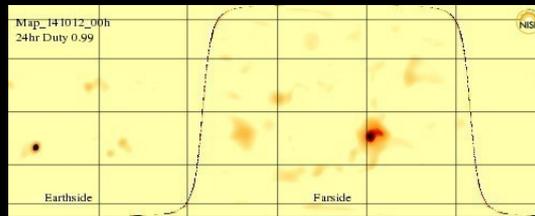
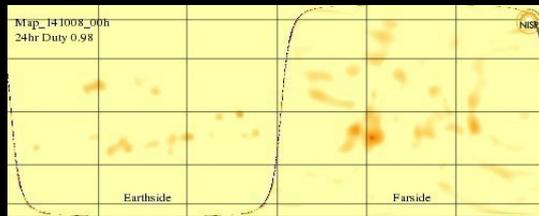
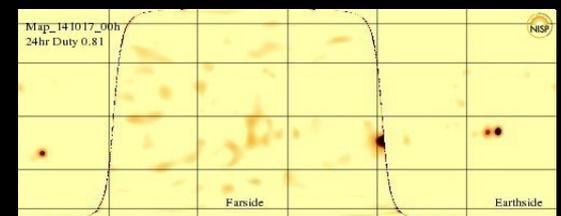
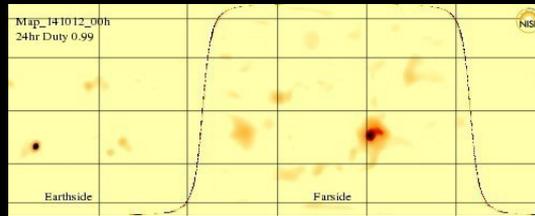
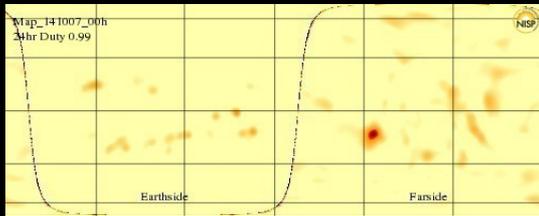


Long-term p-mode amplitude & width variations

- René Keifer visit for 3 months April-June
- Analyzed 20 years of GONG global mode data to study variations of width, amplitude, area (width x amplitude), and background
- Found widths correlated with solar magnetic activity, amplitudes and areas are anti-correlated
- Fractional change in mode widths is largest for $2400 \leq \nu \leq 3300 \mu\text{Hz}$, with an amplitude of $\sim 10\%$ between minimum and maximum
- The fractional change in mode amplitude exhibits a peak-to-peak amplitude of $\sim 30\%$ over solar cycle 23
- Mode energy supply rate decreased by $\sim 20\%$ over last 20 years.
- Will p modes vanish in 100 years???

GONG Far-side Maps (October 7 – 21, 2014)

Front-side AR 2192 is clearly visible in these maps.



Far-side data comparisons

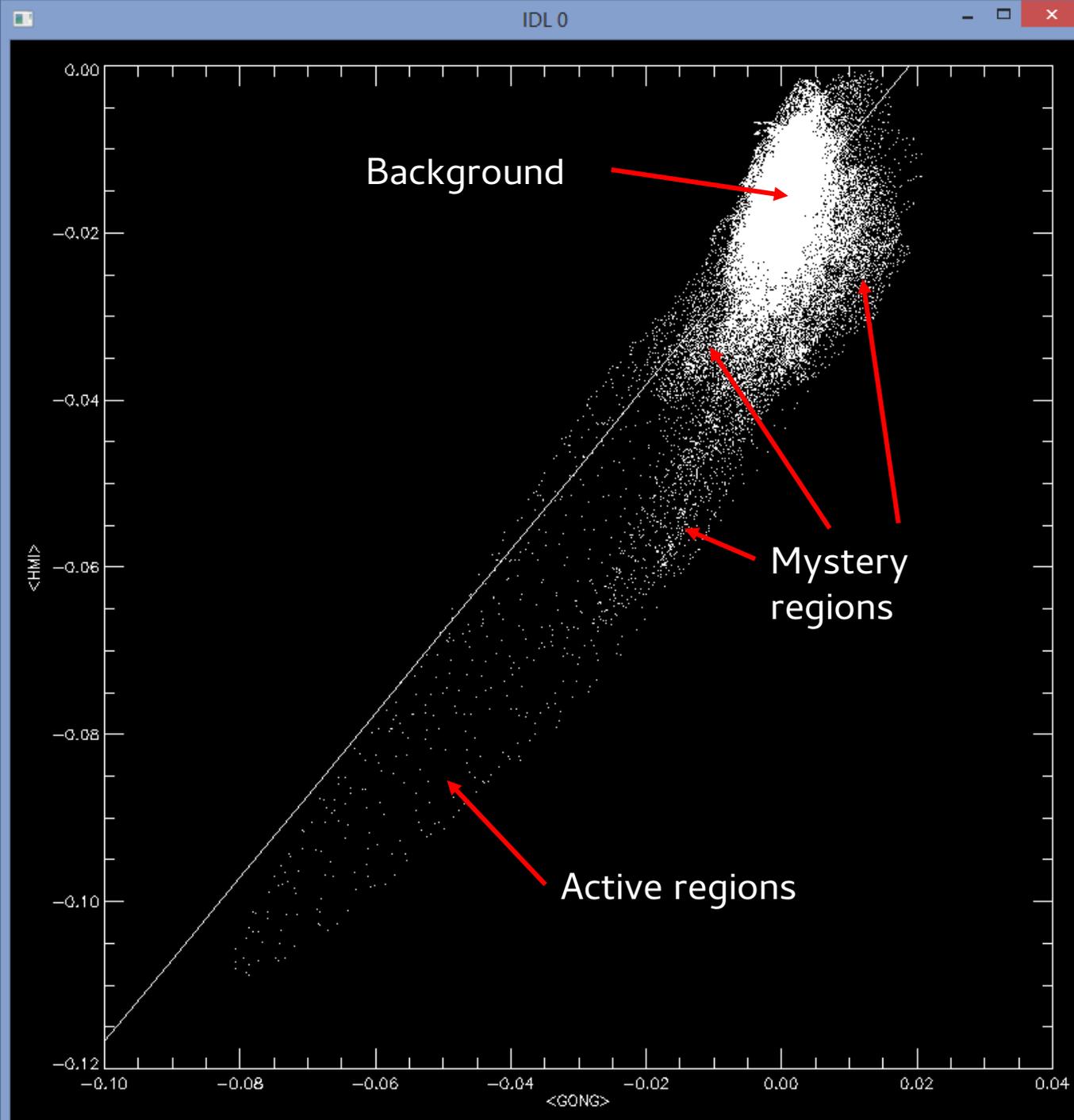
X-axis: Average
GONG

Y-axis: Average HMI

Correlation: 0.65

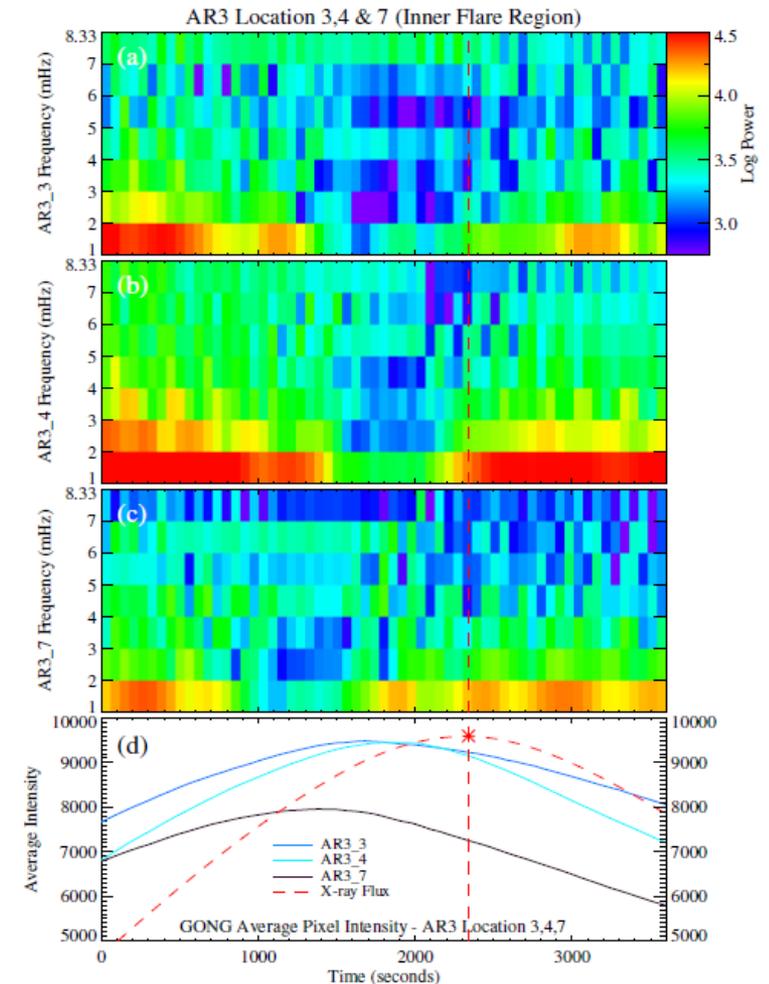
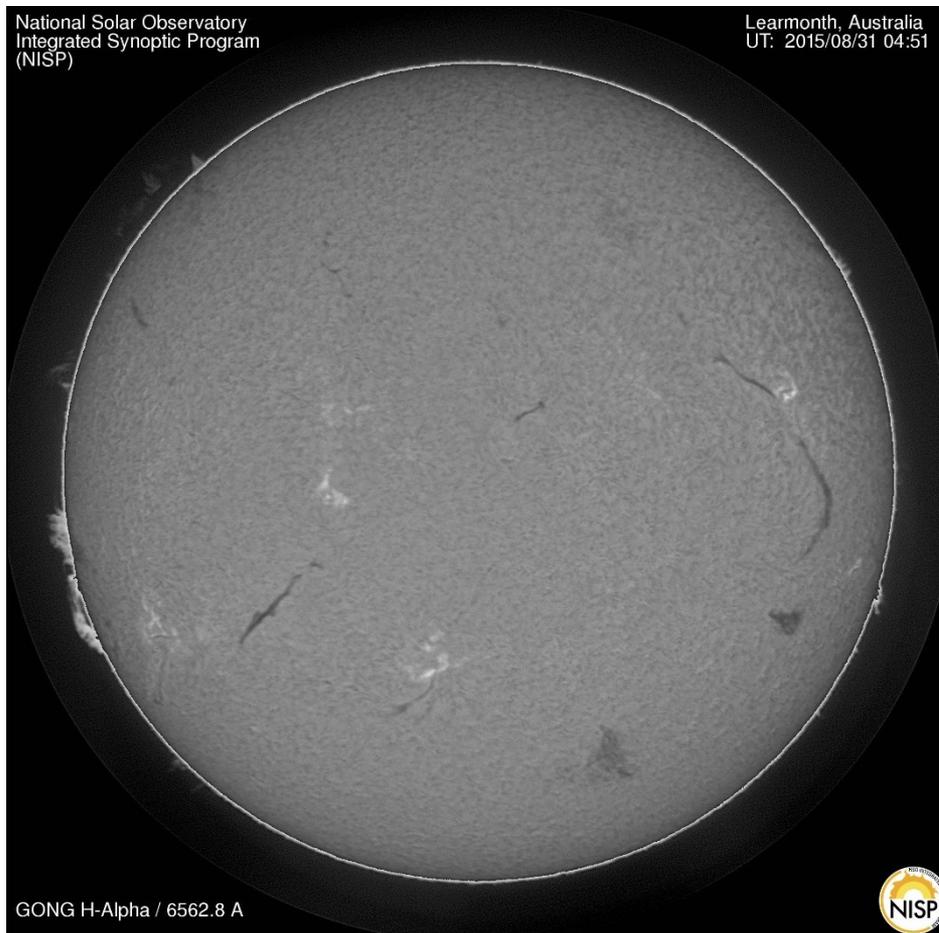
Linear fit:
 $HMI = 0.982 * GONG - 0.019$

Estimate noise as the
width of the features
in this type of plot



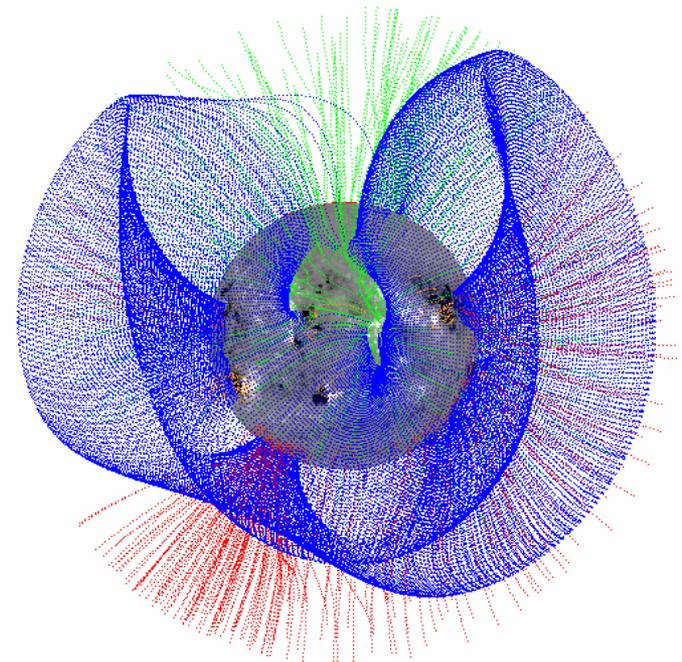
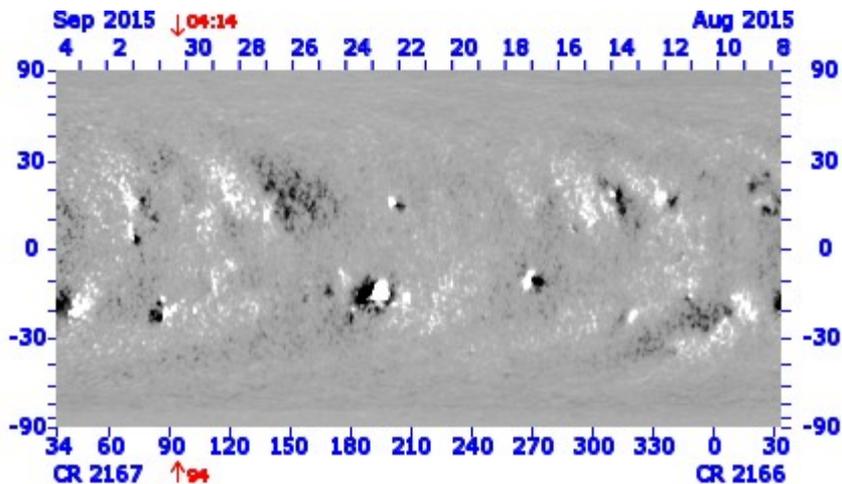
H- α data

- Has become very popular for science with $\sim 1/2$ of recent publications



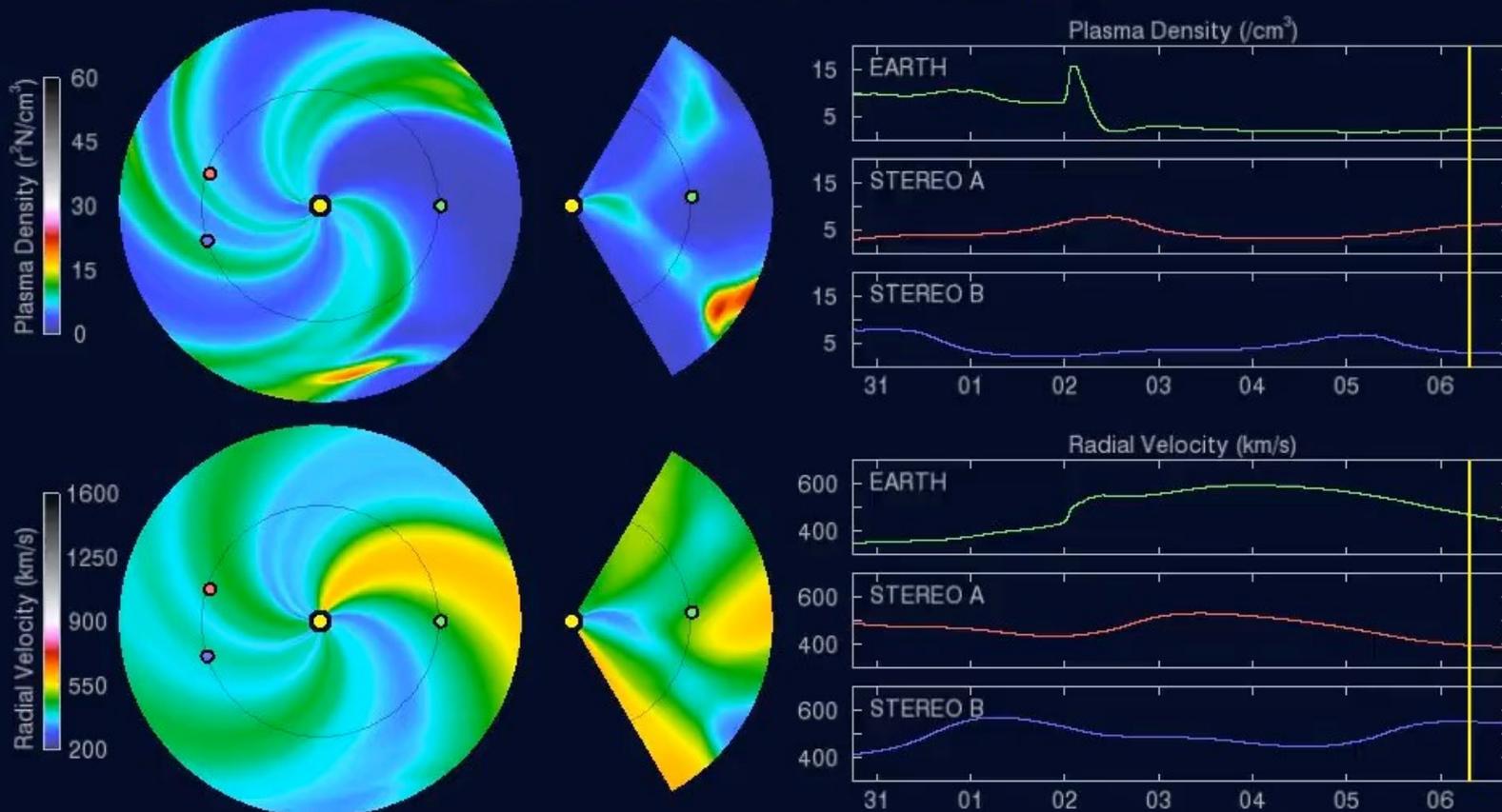
Magnetic fields

- Prime space weather data set
- SWPC: WSA+Enlil geomagnetic storm forecasts
- AFRL: ADAPT EUV and F10.7-cm flux forecasts



SWPC geomagnetic storm prediction

2014-08-06 07:00:00



Space Weather Prediction Center

Run Time: 2014-08-01 18:00 UT Mode: CME

Image Created: 2014-08-01 19:22 UT

Frame Time: 2014-08-06T07:00:00

The future

- SPRING – Solar Physics Research Integrated Network Group
- Led by KIS
- Multi-wavelength, multi-height
- Helioseismology, vector **B**, intensity
- Flexible platform, specialized instruments
- Half-way through concept study by Roth & Gosain plus community

A potentially catastrophic space weather event

2012-07-17T00:00

2012-07-17T00 + 0.00 day

