

# Magnesium II Index: Thirty Five Years and Counting

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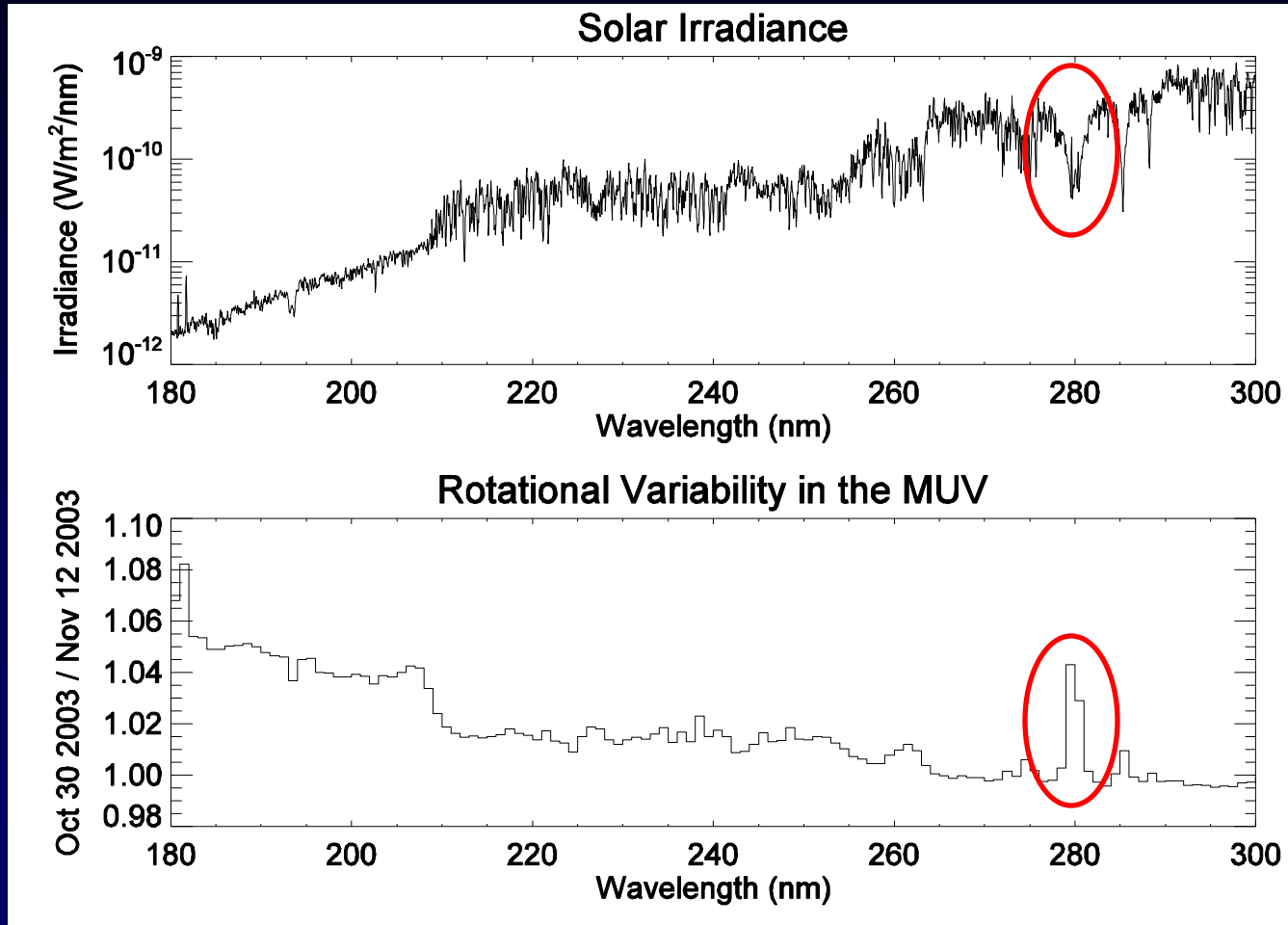
[snow@lasp.colorado.edu](mailto:snow@lasp.colorado.edu)

# Outline

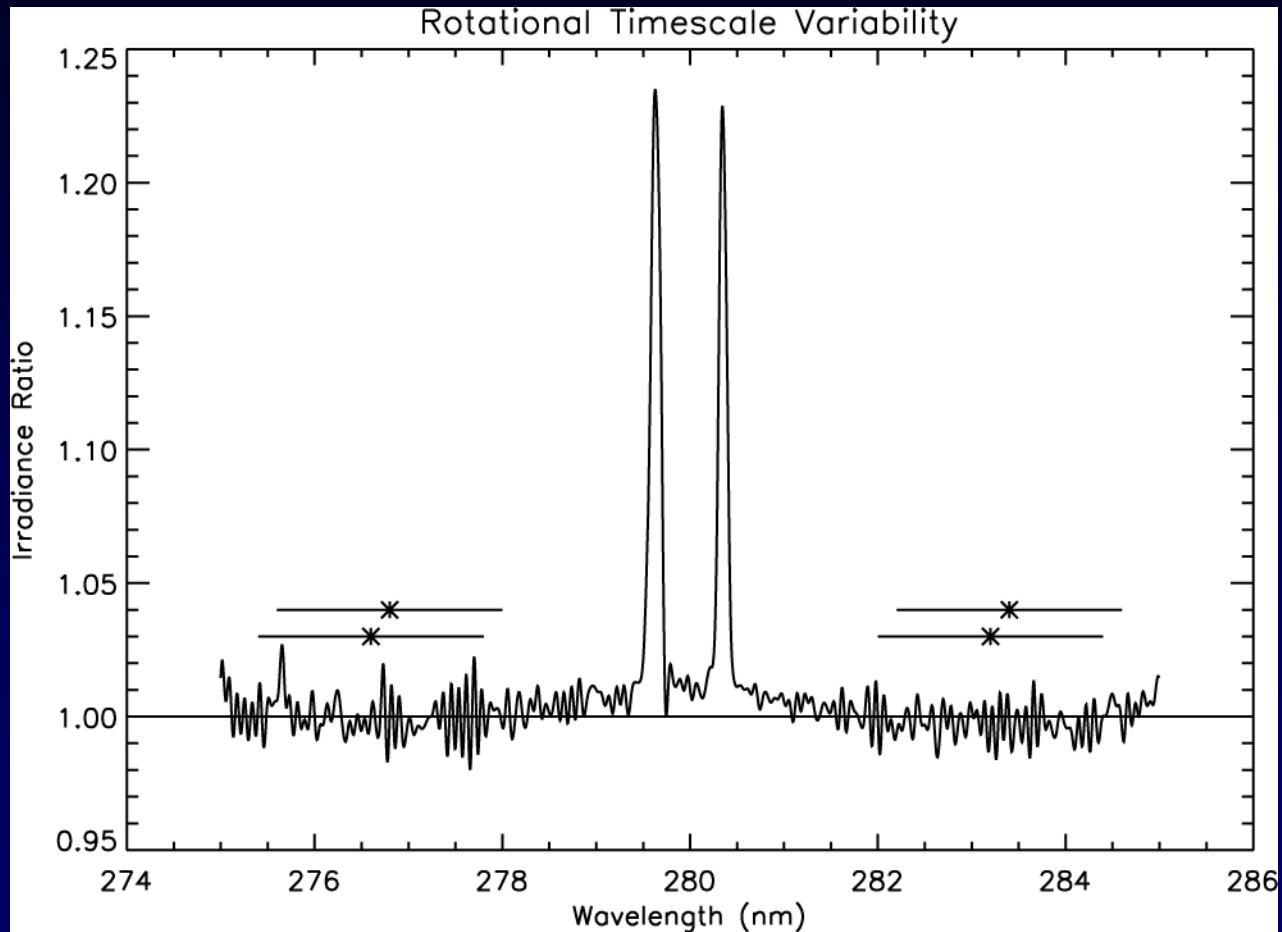
- The core to wing ratio - What
- A proxy for chromospheric activity - Why
- Observational history - When
- Composite Time Series - Work (in progress)
- Future measurements - Where "R" we going



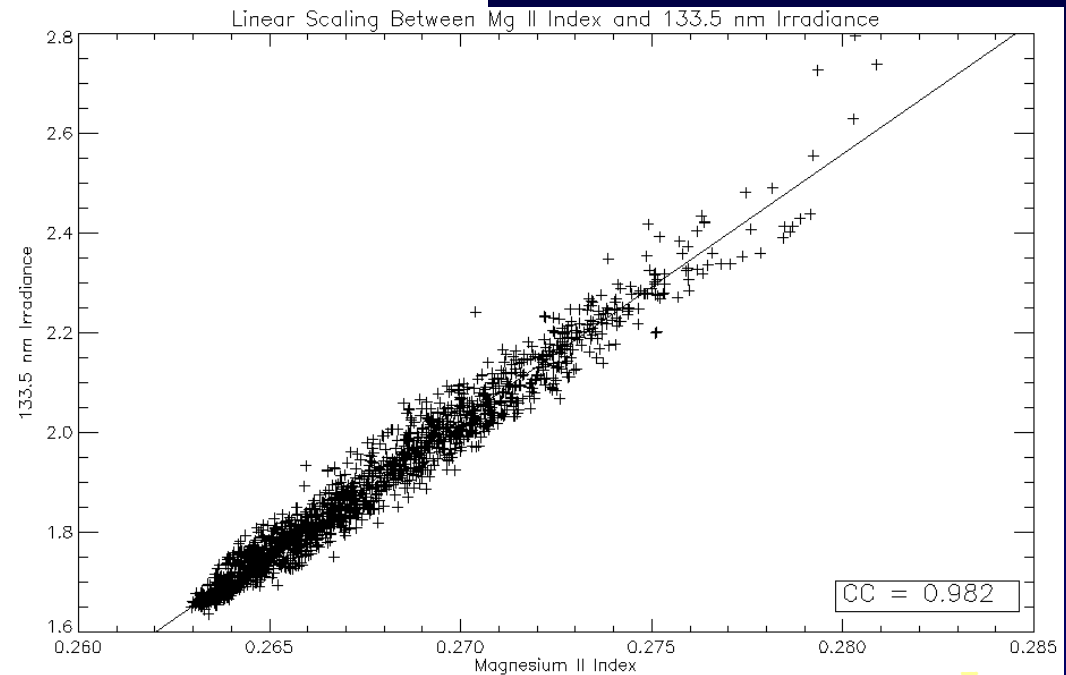
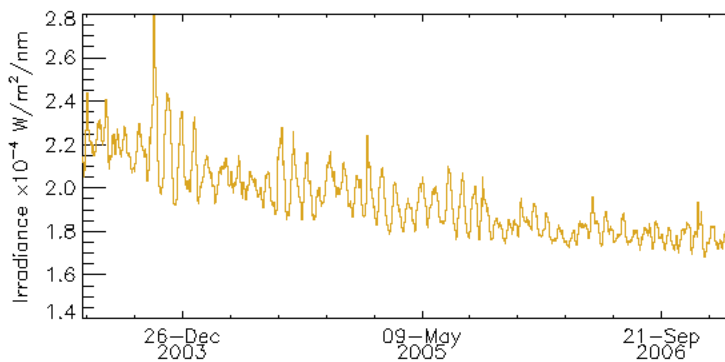
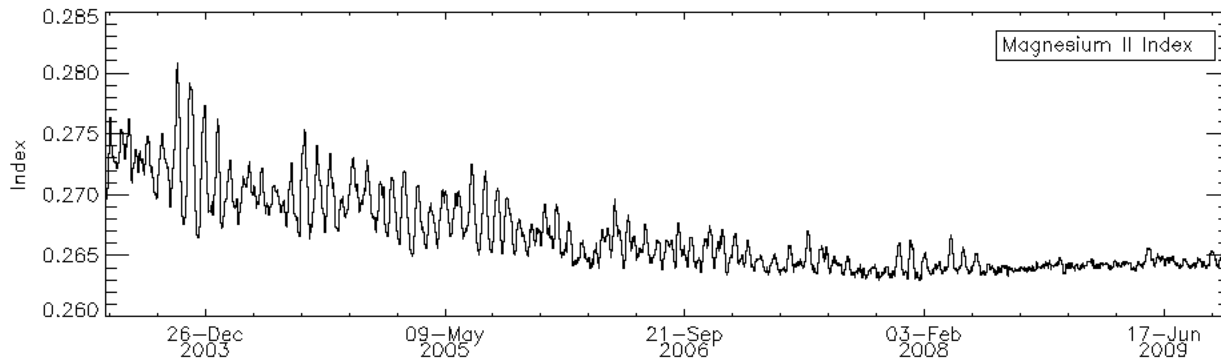
# Solar Irradiance Variability



# Variability near 280 nm

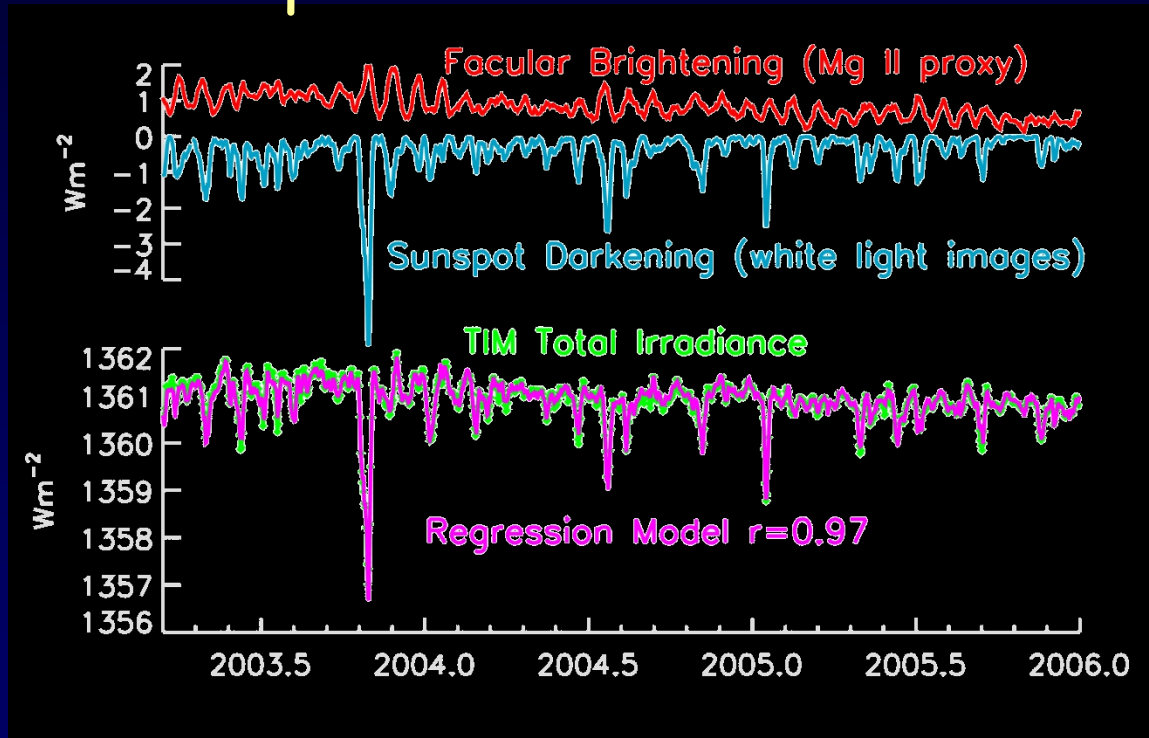


# Correlation to FUV Emission



# Component of TSI Model

- Scaled Mg II index used as proxy for facular brightening.
- Sunspot area determines darkening contribution.

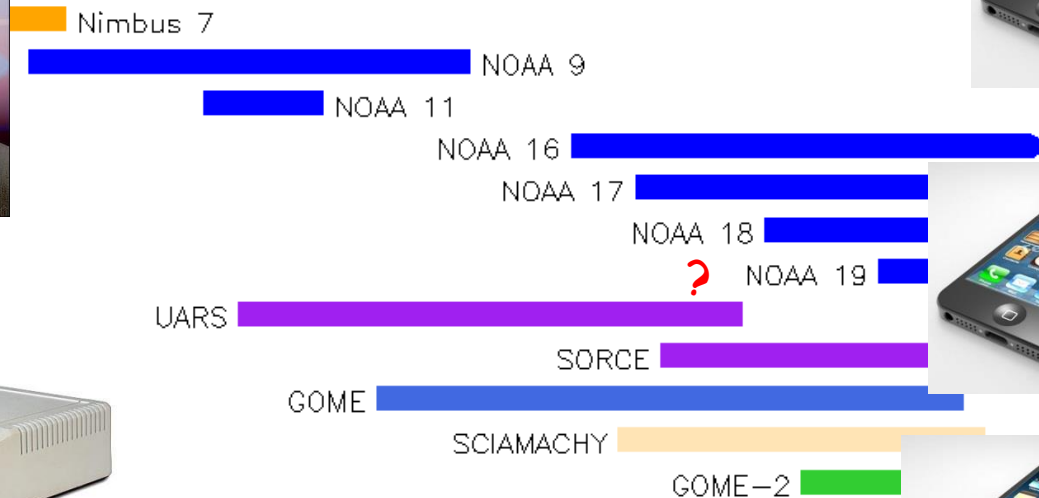


(Courtesy of Judith Lean)

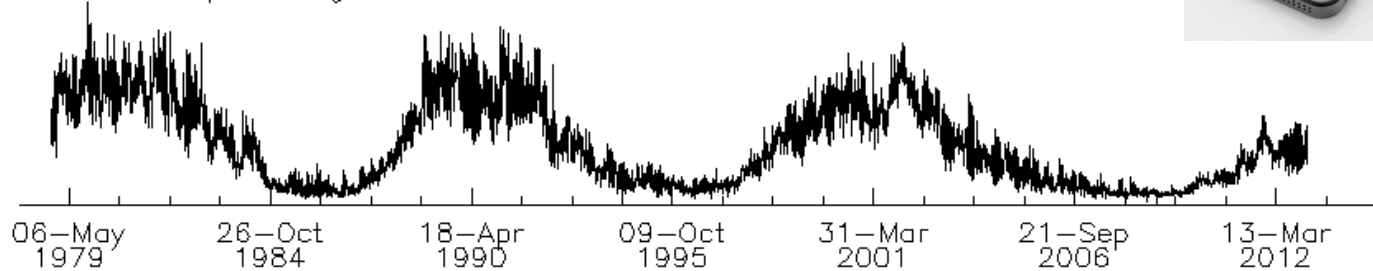
# Catalog of Datasets



Instruments Measuring Mg II Index



Bremen Composite MgII



# Resolution & Sampling

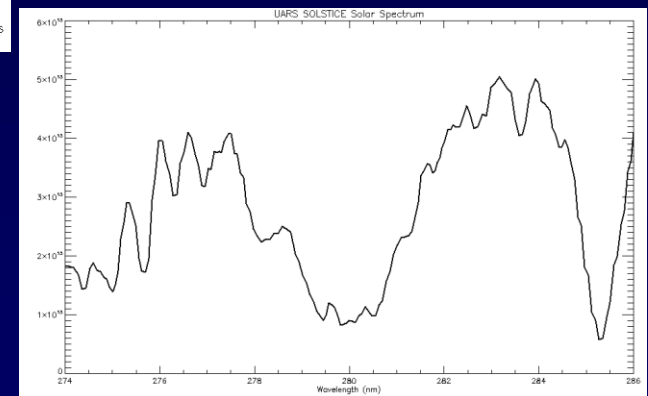
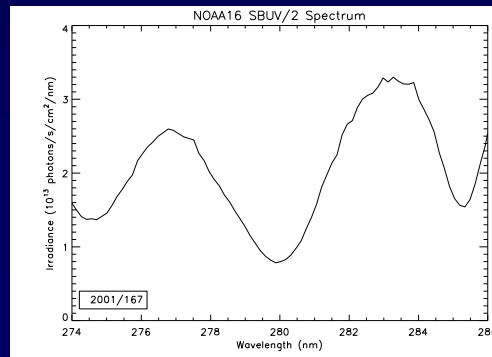
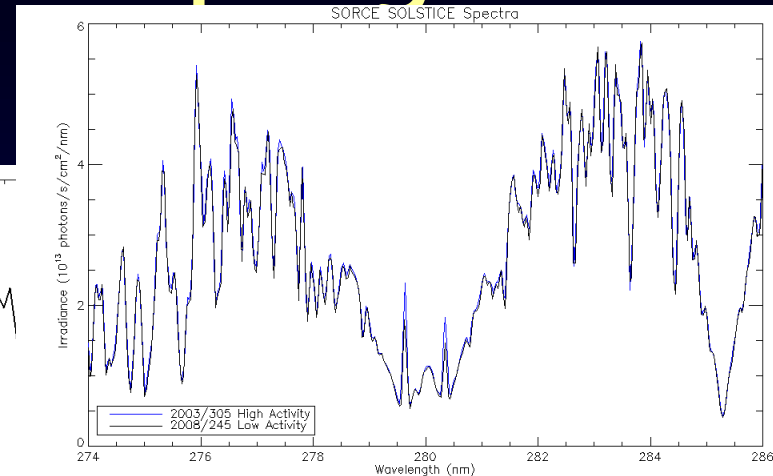
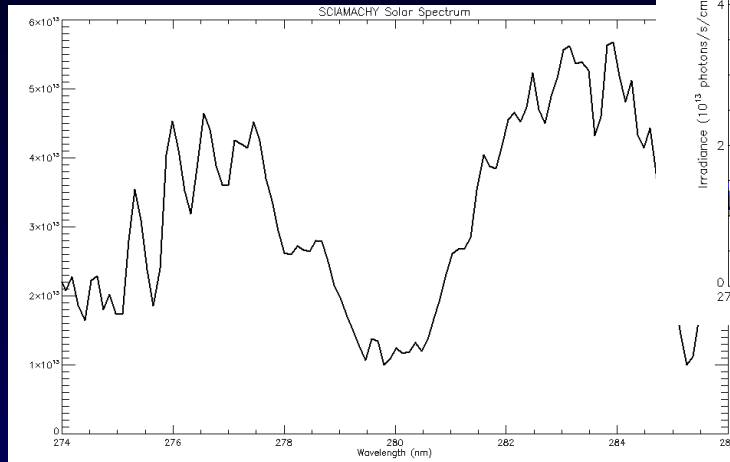
SOLSTICE-II 2003-present  
 $\Delta\lambda=0.10\text{nm}$  (3 samples)

SCIAMACHY 2002-2012  
 $\Delta\lambda=0.21\text{nm}$  (2 samples)  
 GOME 1995-2011  
 $\Delta\lambda=0.17\text{nm}$  (2 samples)  
 GOME-2 2007-present

SOLSTICE-I 1991-2005  
 $\Delta\lambda=0.2\text{nm}$  (3 samples)

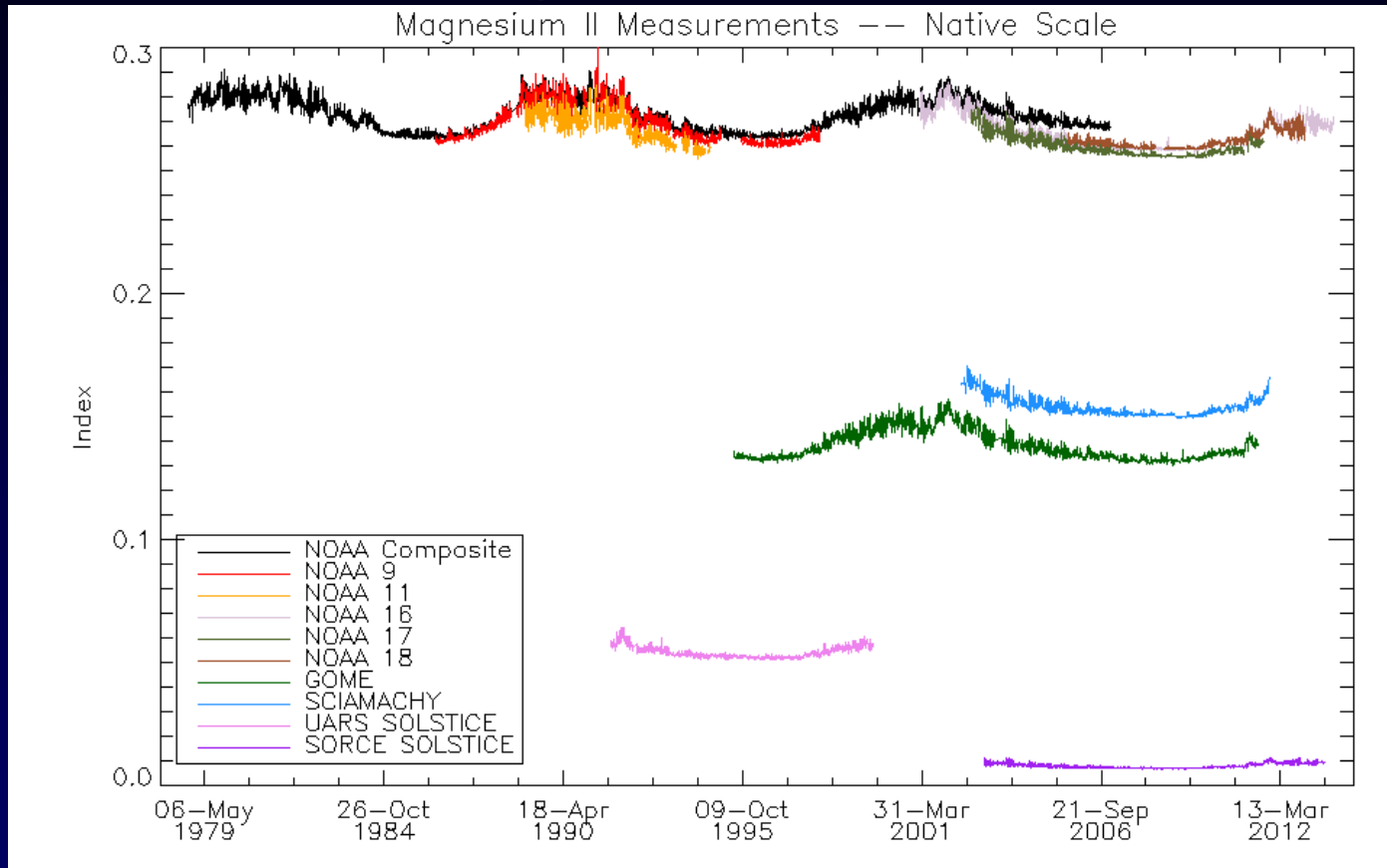
SBUV Solar Backscatter Ultraviolet  
 $\Delta\lambda=1.1\text{nm}$  (approximate)

Nimbus-7 1978-1990  
 NOAA-9 1985-1998  
 NOAA-11 1989-1994, 1998-2001  
 NOAA-14 1996-2004  
 NOAA-16 2000-present  
 NOAA-17 2002-2011  
 NOAA-18 2005-2012  
 NOAA-19 2010-present (once per week)



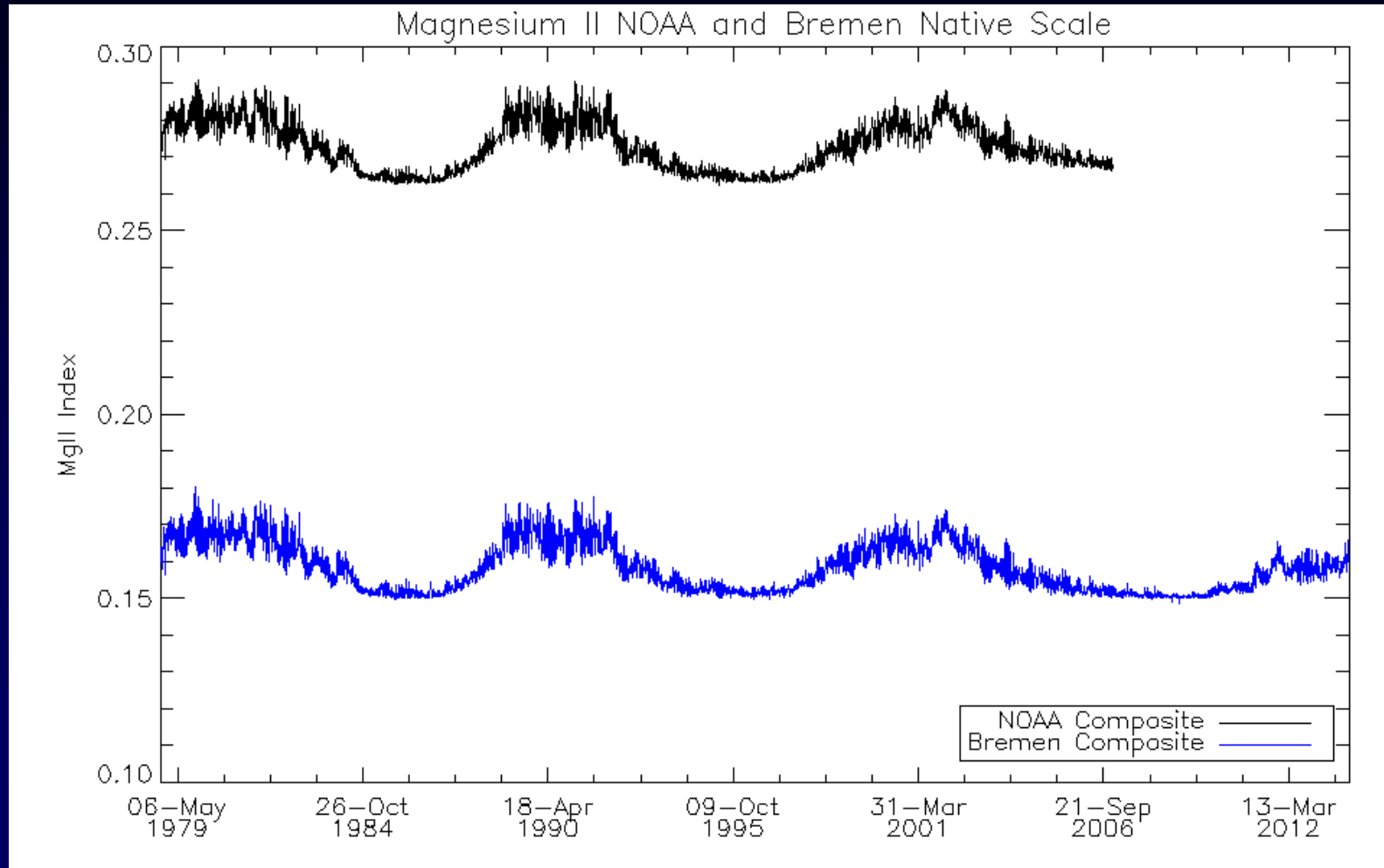


# Combining Data Records

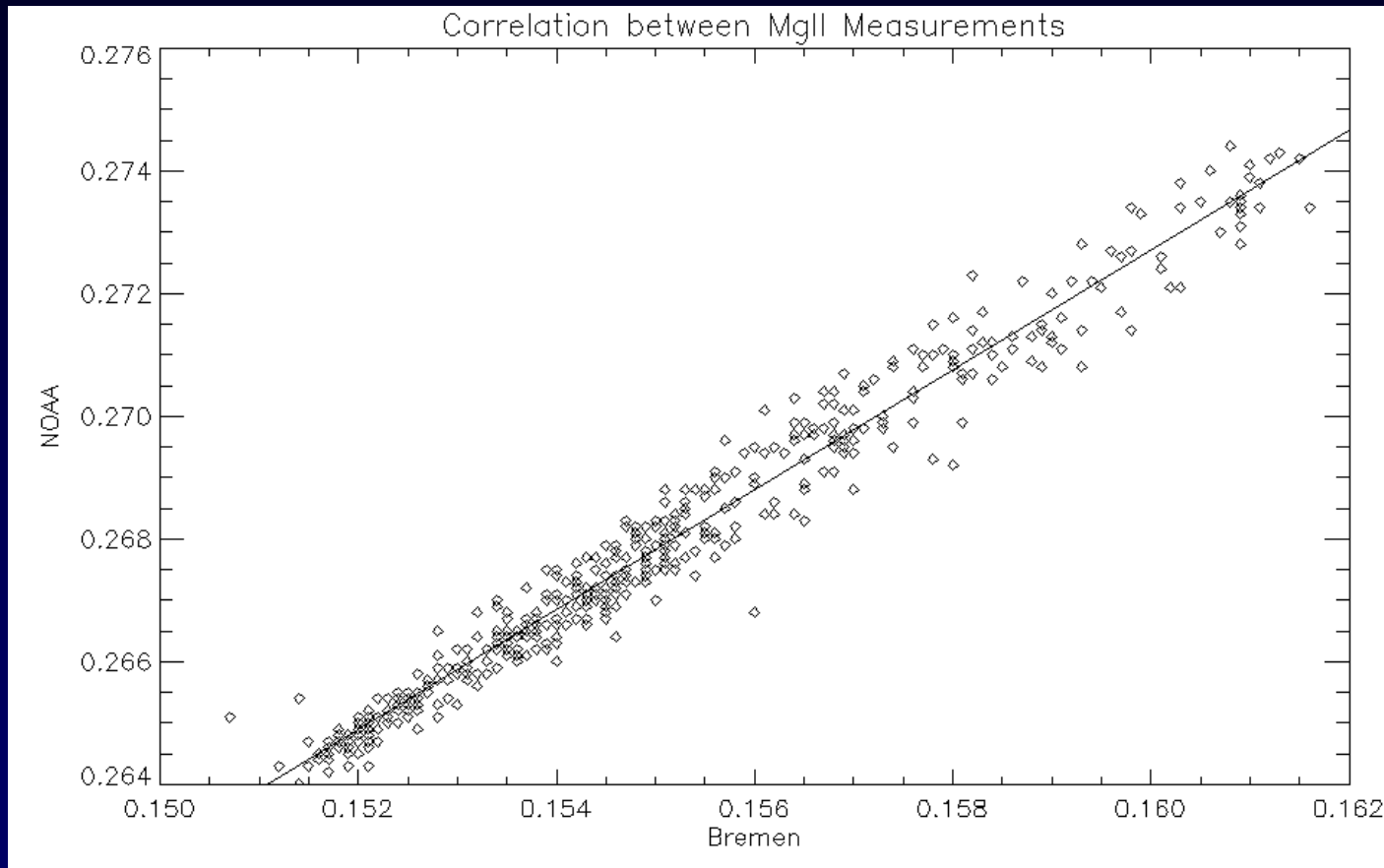


Difference in absolute scale is due to different spectral resolution in raw measurement and how wing irradiance is determined.

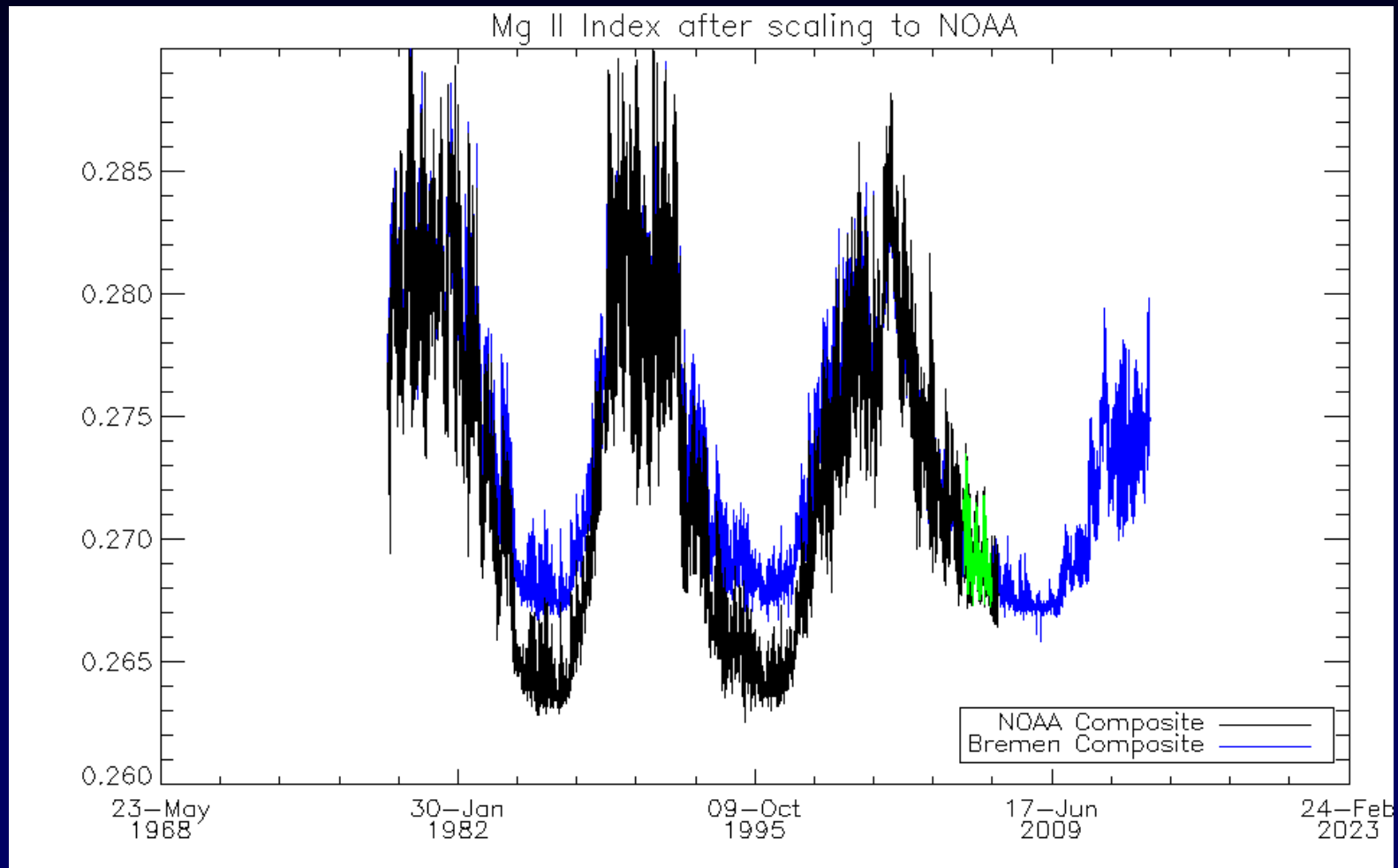
# Scaling Example



# Find Linear Scaling Function Over some time range



# ~~Now they are in agreement~~

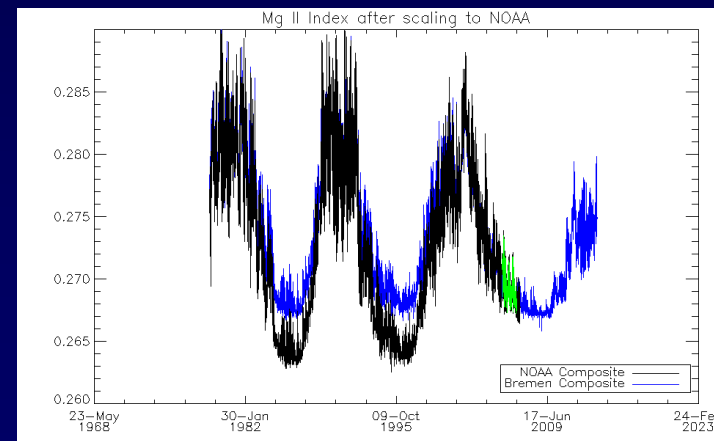


# What went wrong?

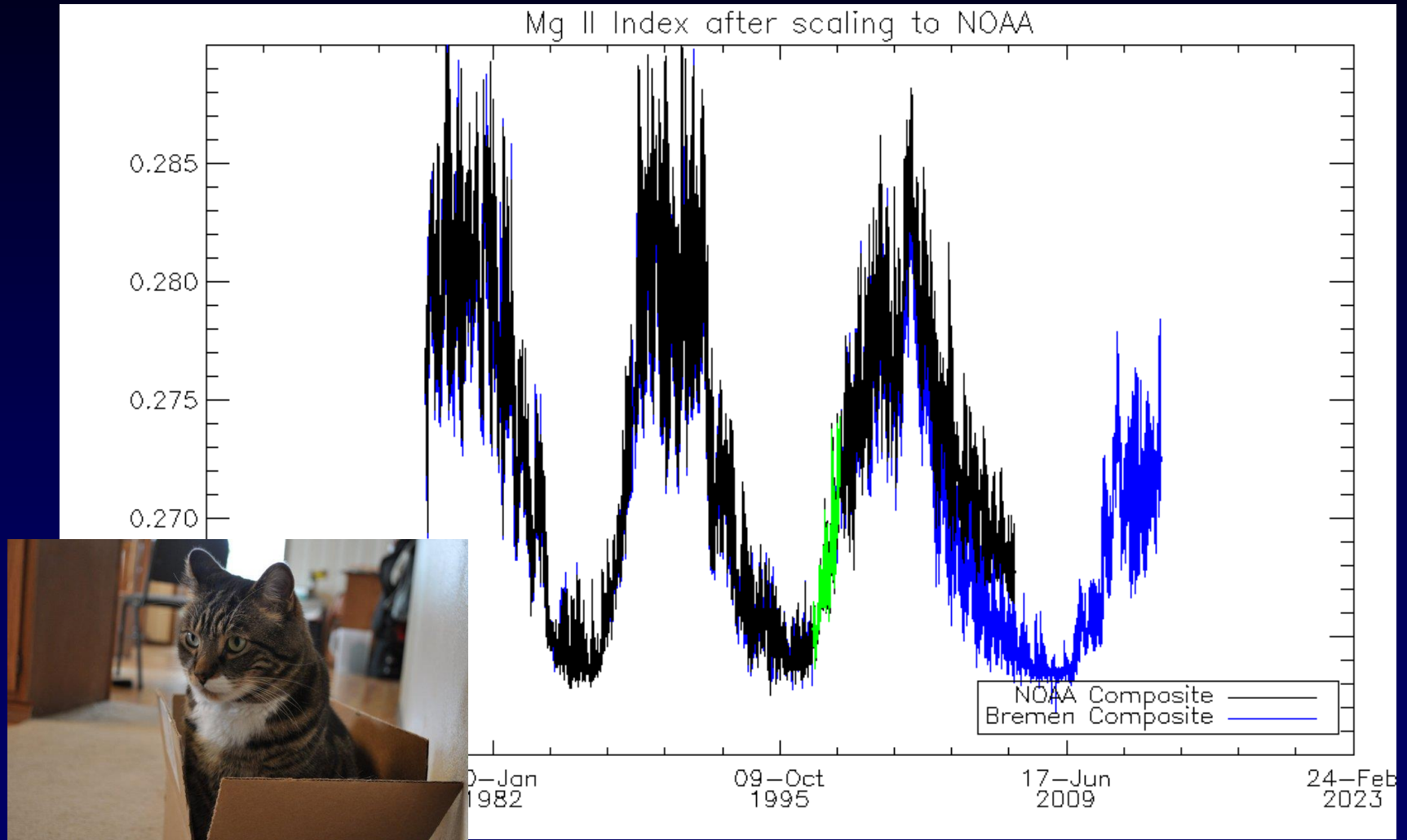
- Scaling corrected for spectral resolution difference.



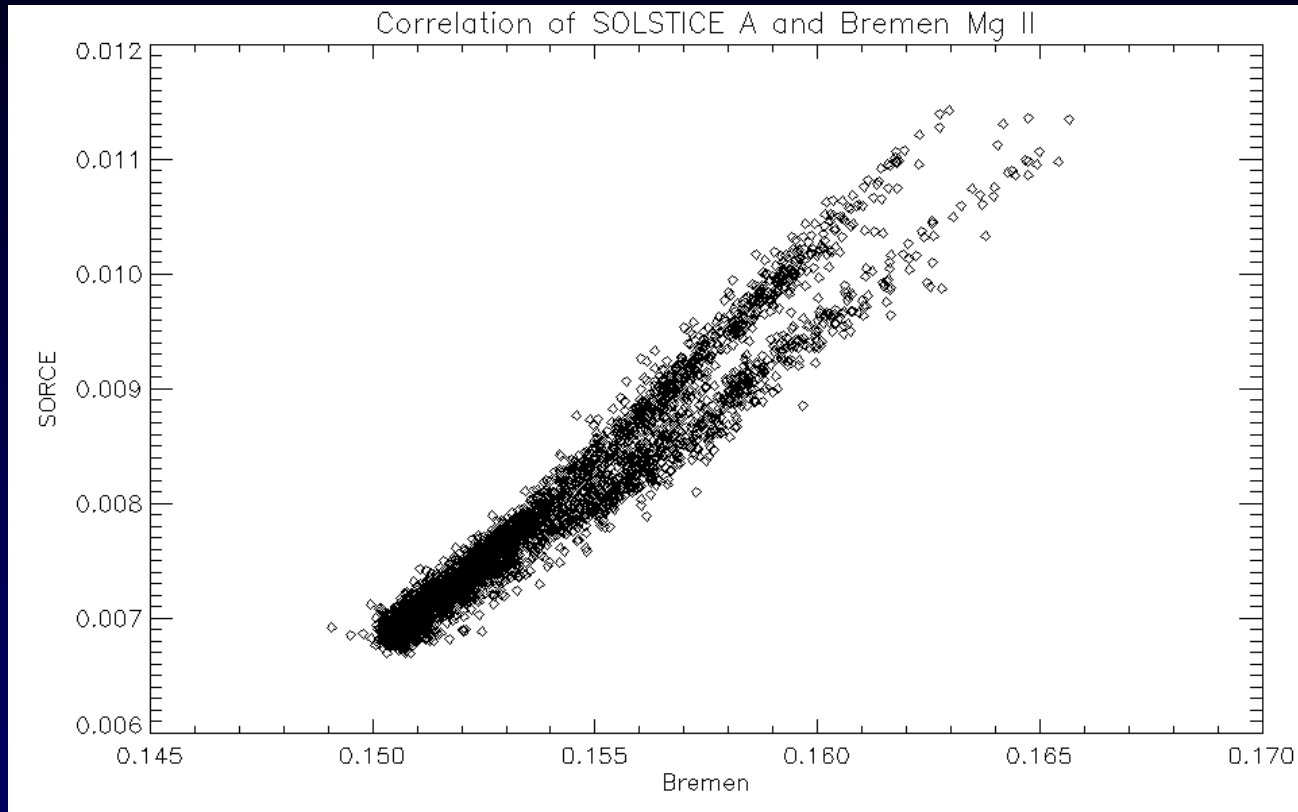
- Artifact in NOAA composite's long term trend introduced error in scaled dataset.



# Try a different interval

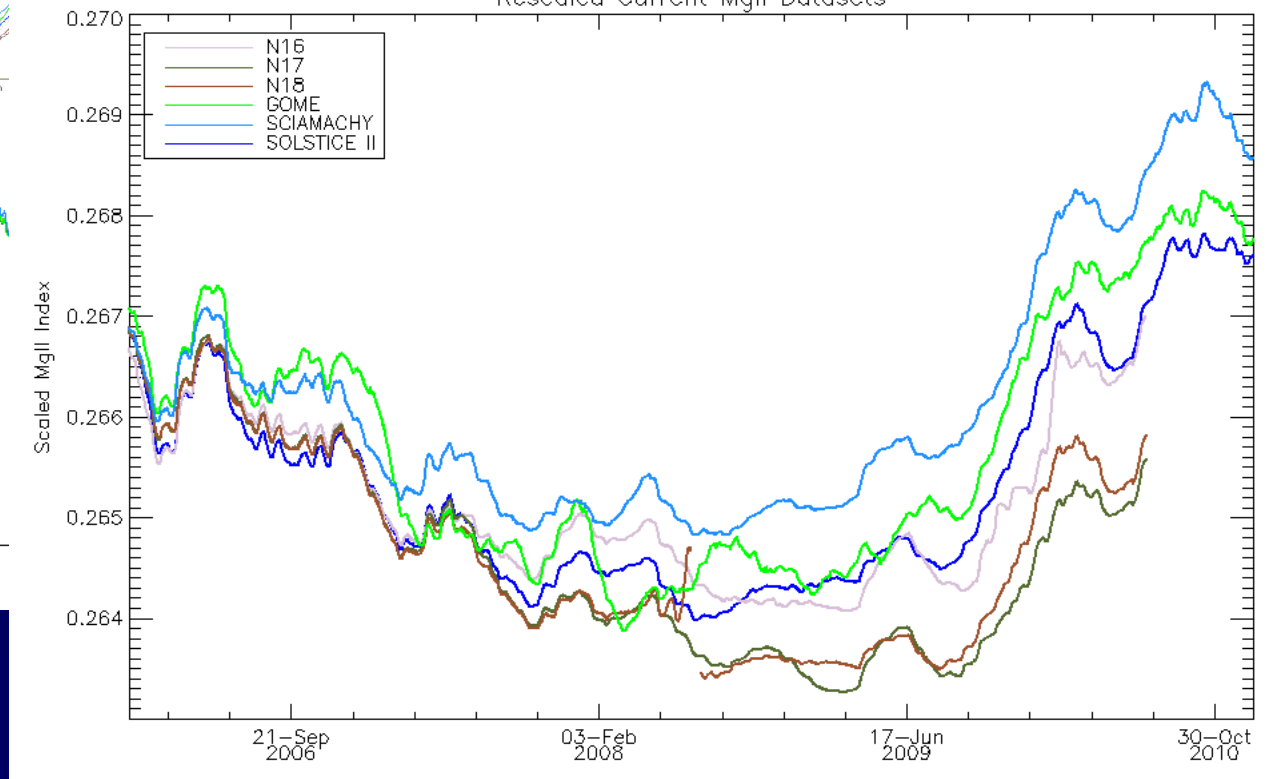
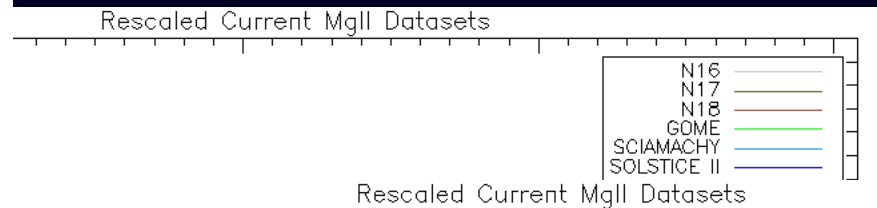
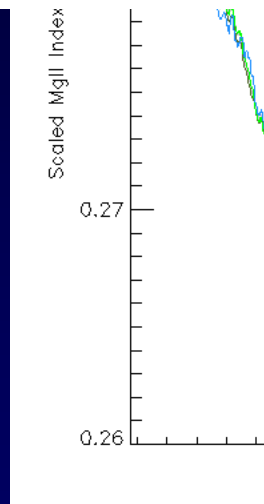
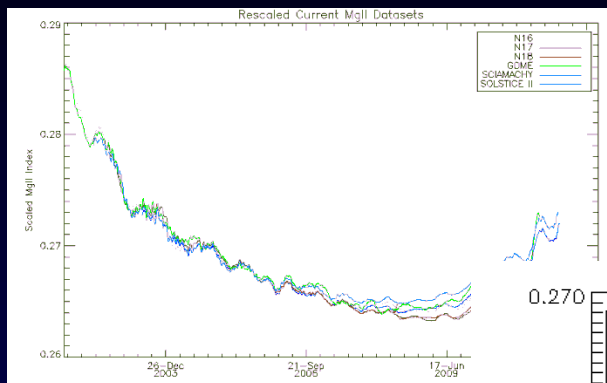


# What else can go wrong?



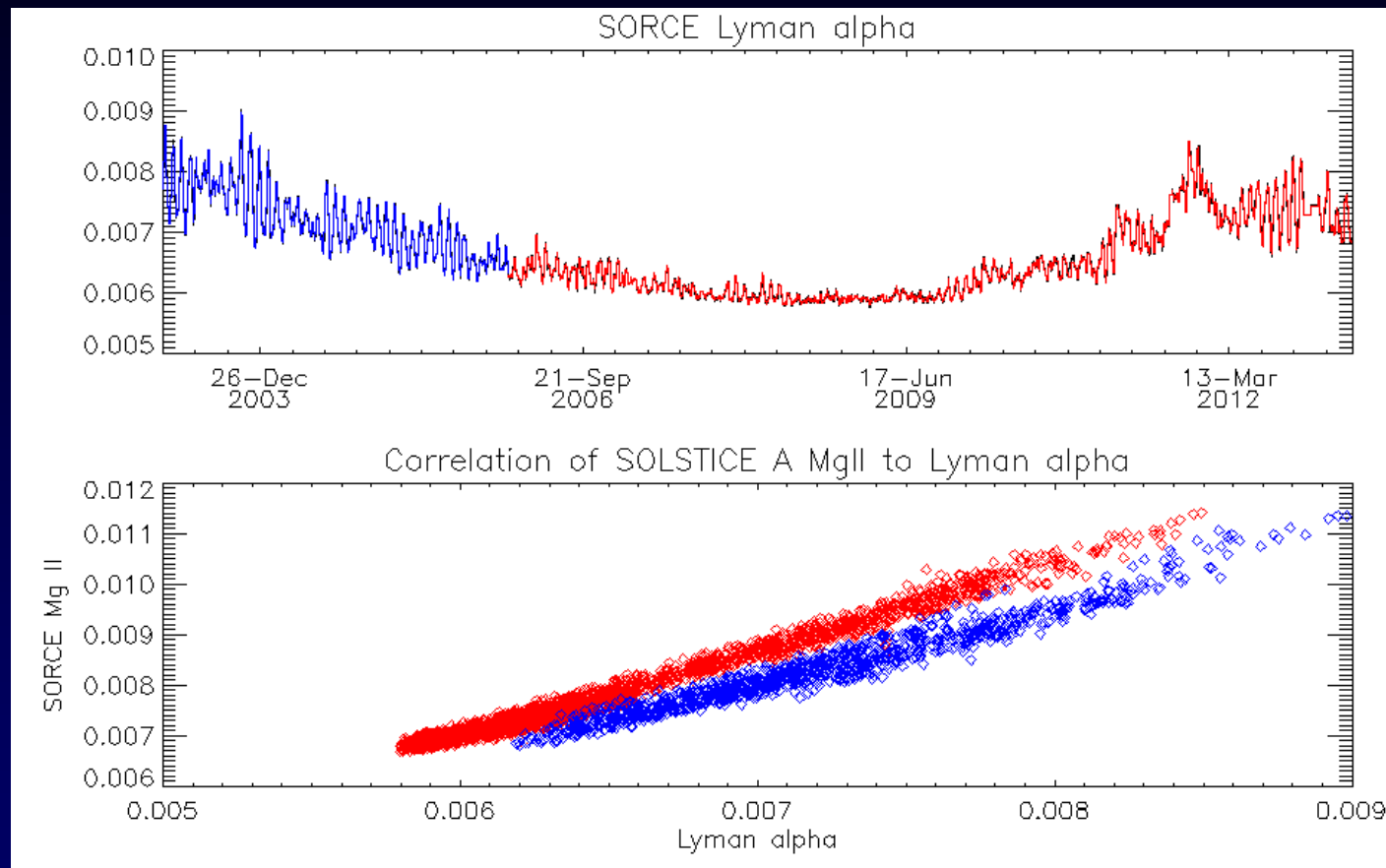
Which dataset is right?

# Recall from a few years ago

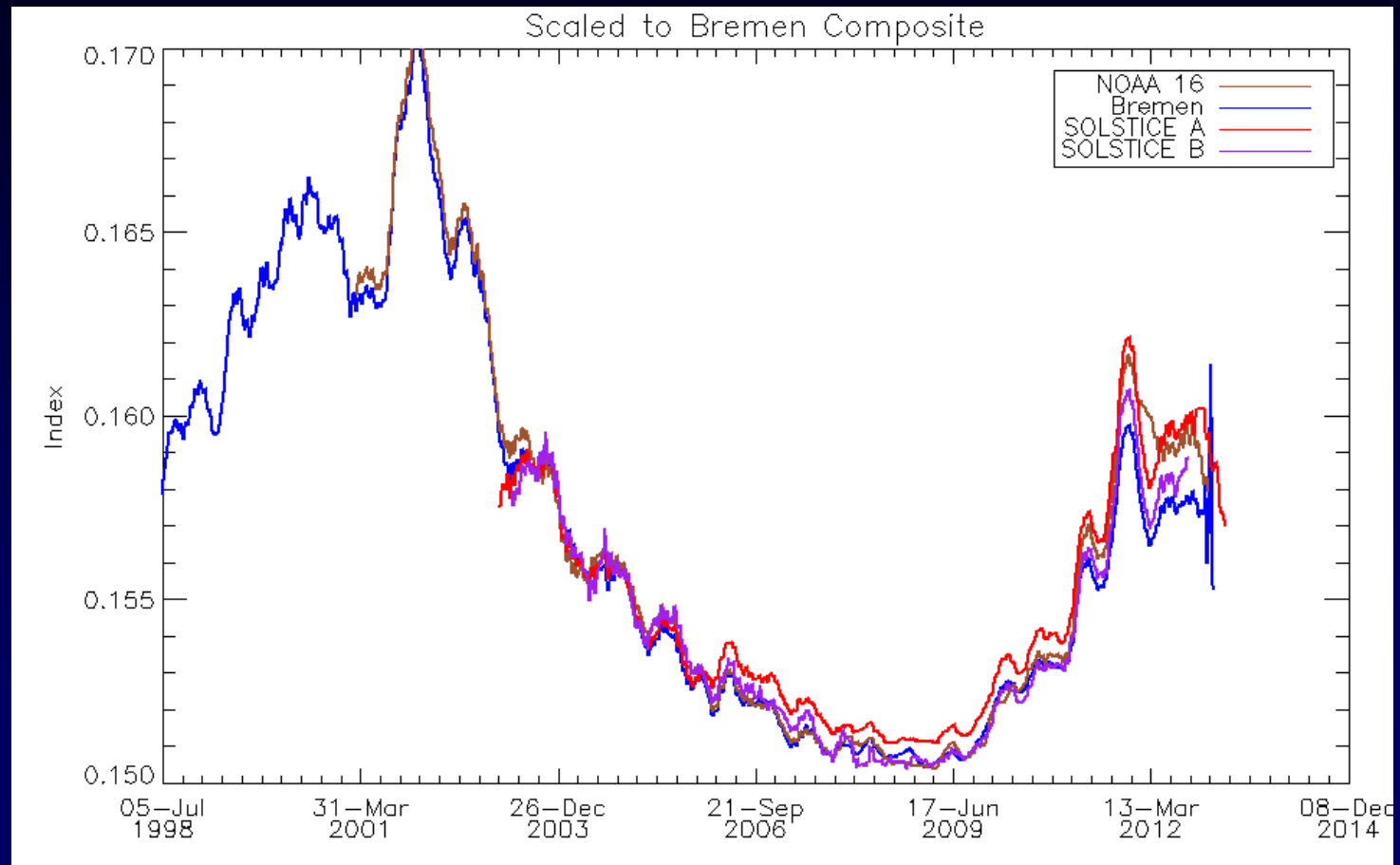




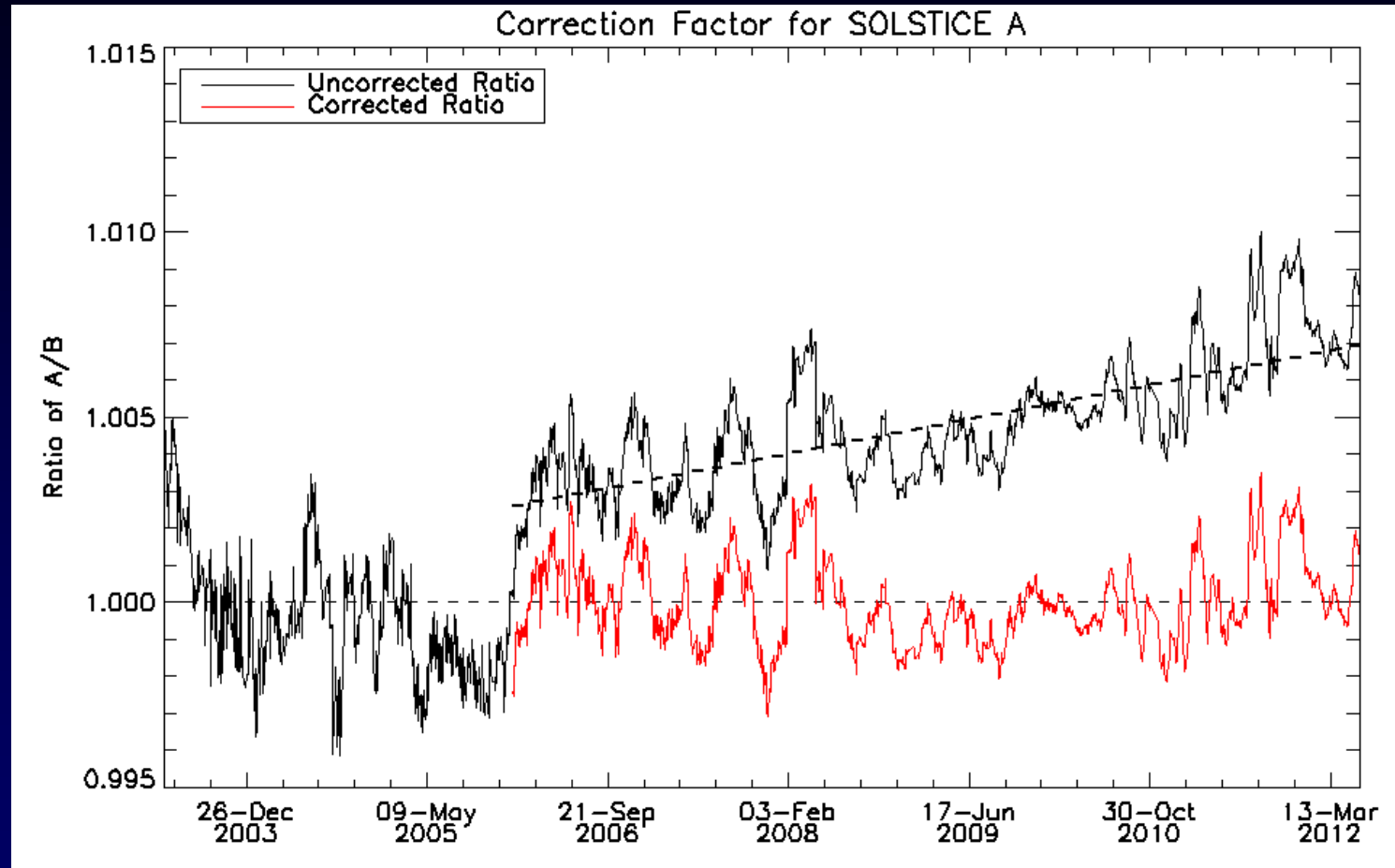
# Suspect data located!



# SOLSTICE B To the Rescue!

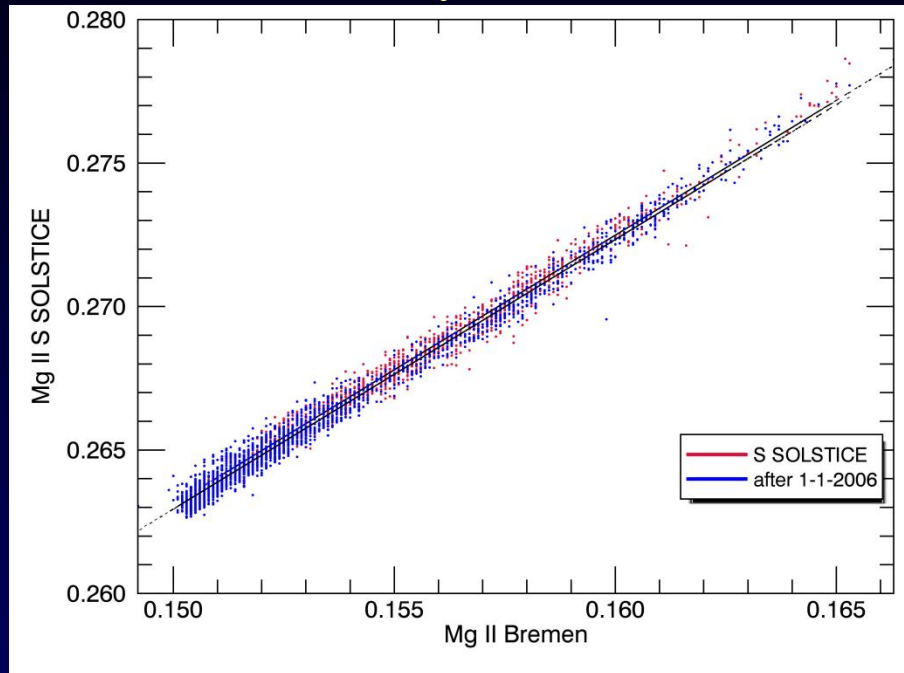


# Correction to B



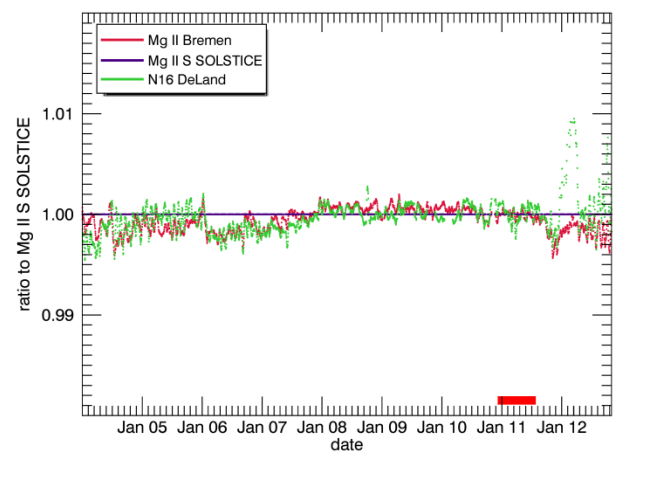
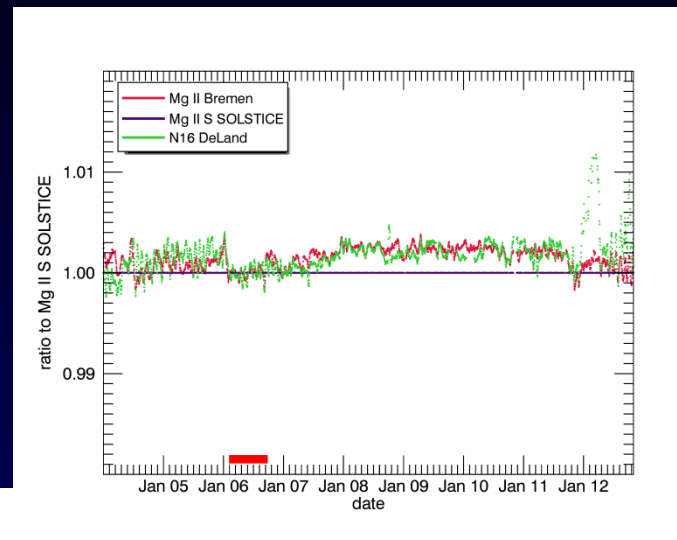
Snow et al. (2014) *Journal of Space Weather and Space Climate*, 4, A04.

# Comparisons among MgIIs



Over last 10 years, indices now agree to better than 0.3%.

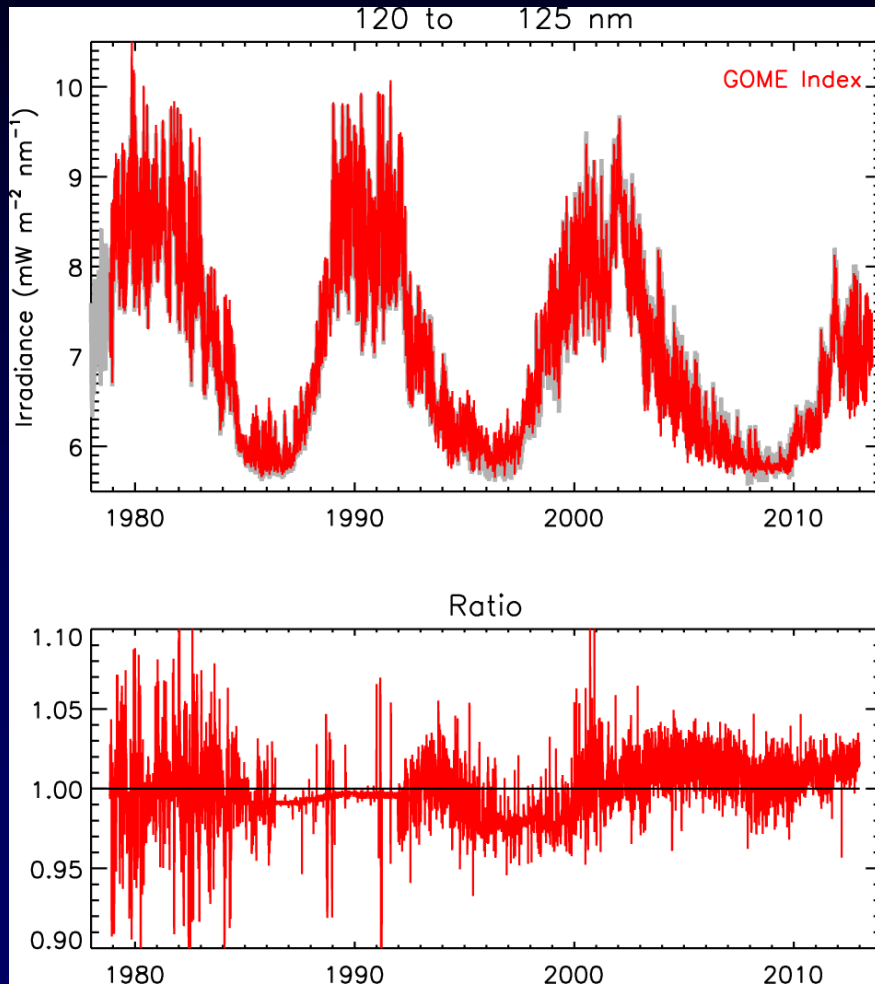
That's about 3% of the solar cycle variation!



# Agreement=Righteousness!



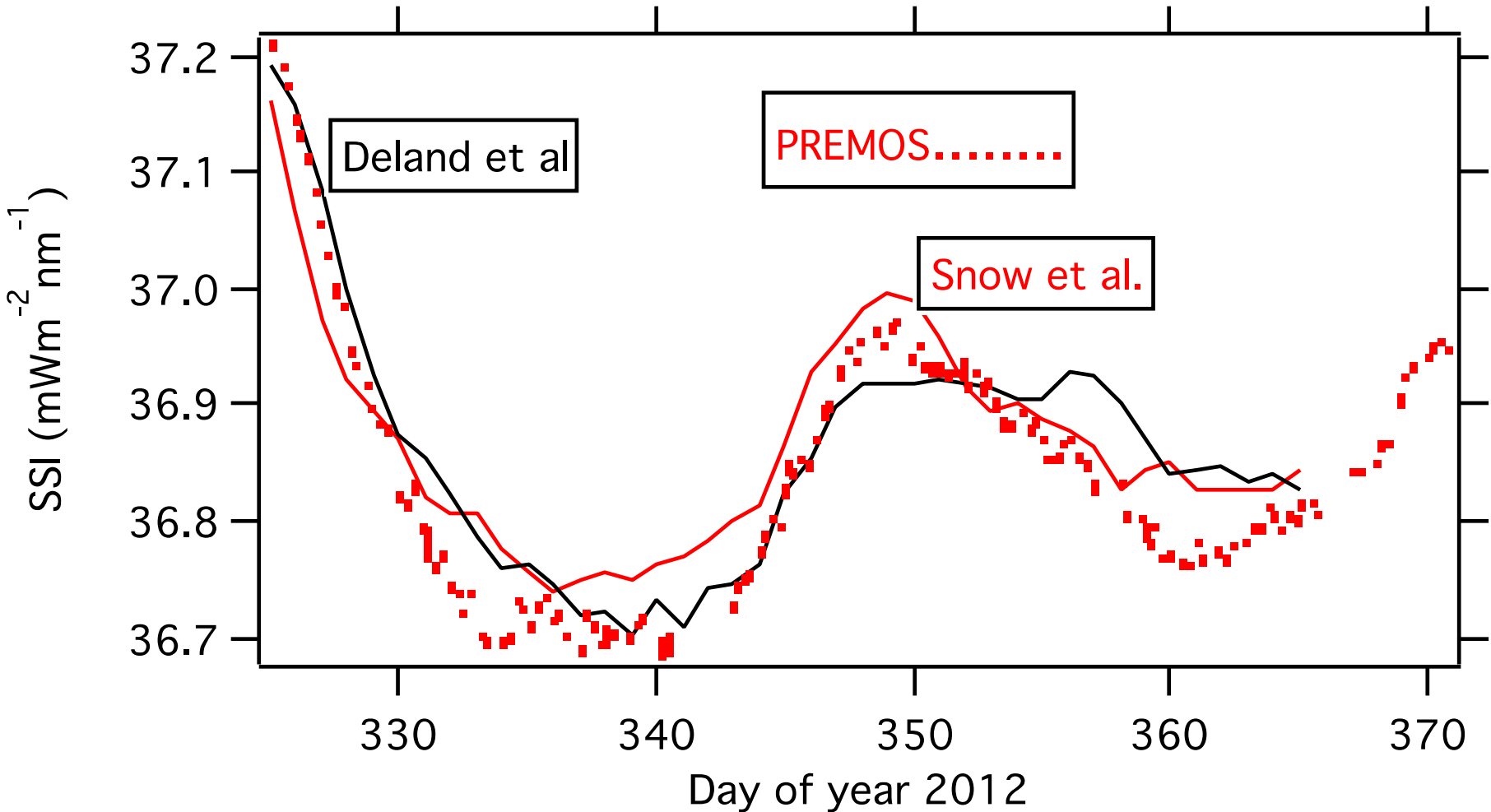
# Effect on SSI Model



J. Lean, private  
communication



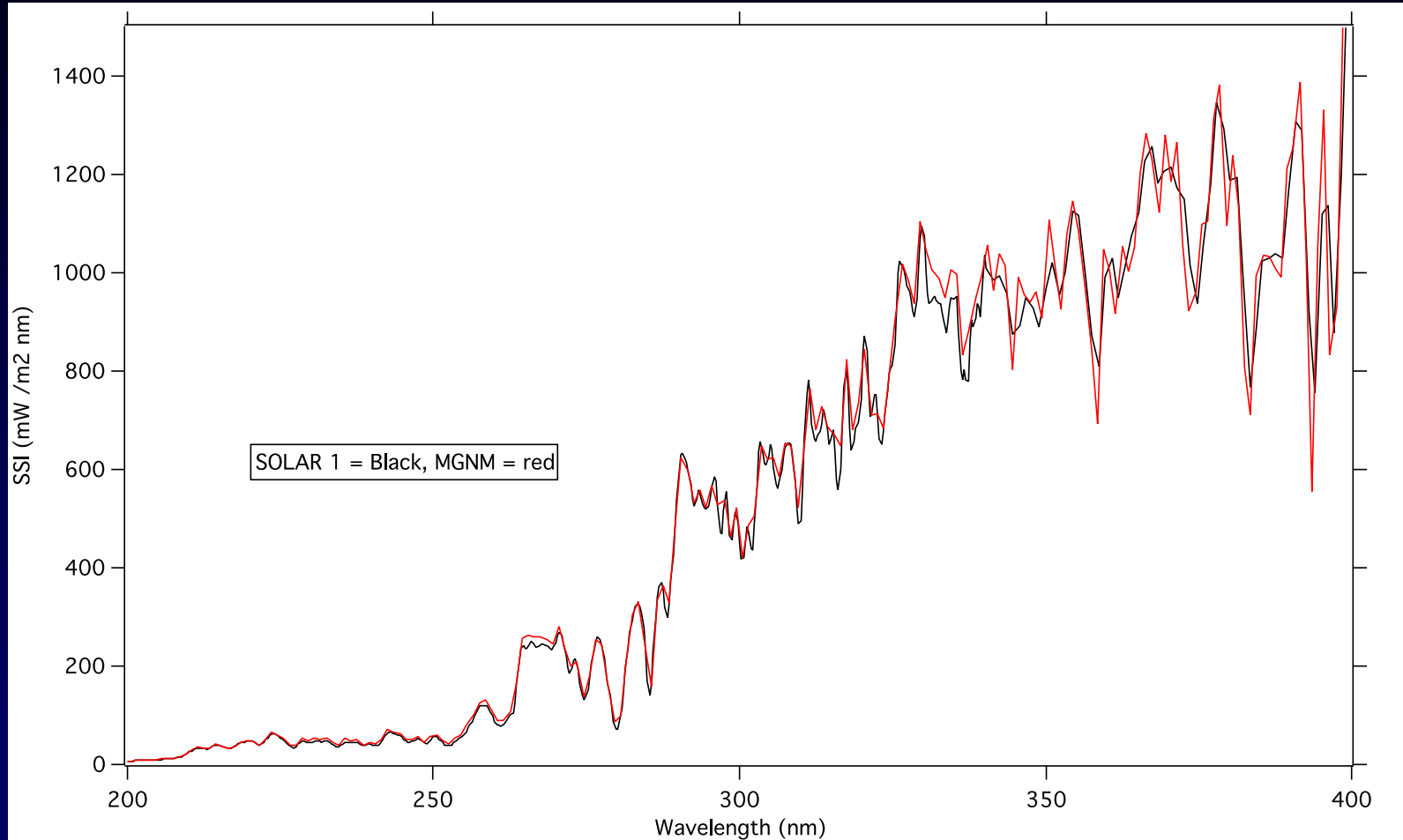
# Recent measurements



Courtesy G. Thuillier



# SOLSPEC



Courtesy G. Thuillier



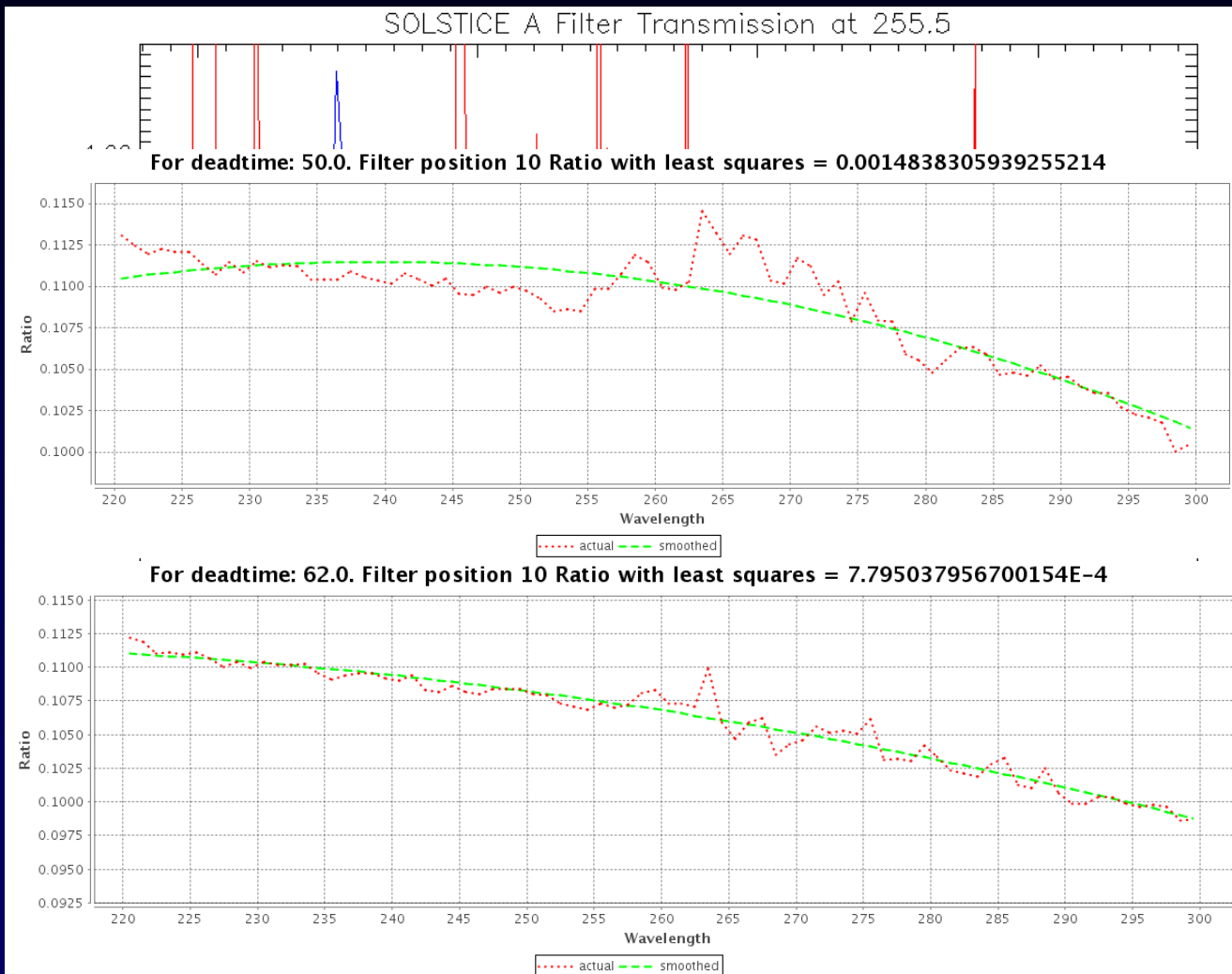


# SOLSTICE

- Degradation trend analysis is ongoing.
- Version 13 improved corrections:
  - Filter Transmission
  - Dark Rate
  - Dead Time

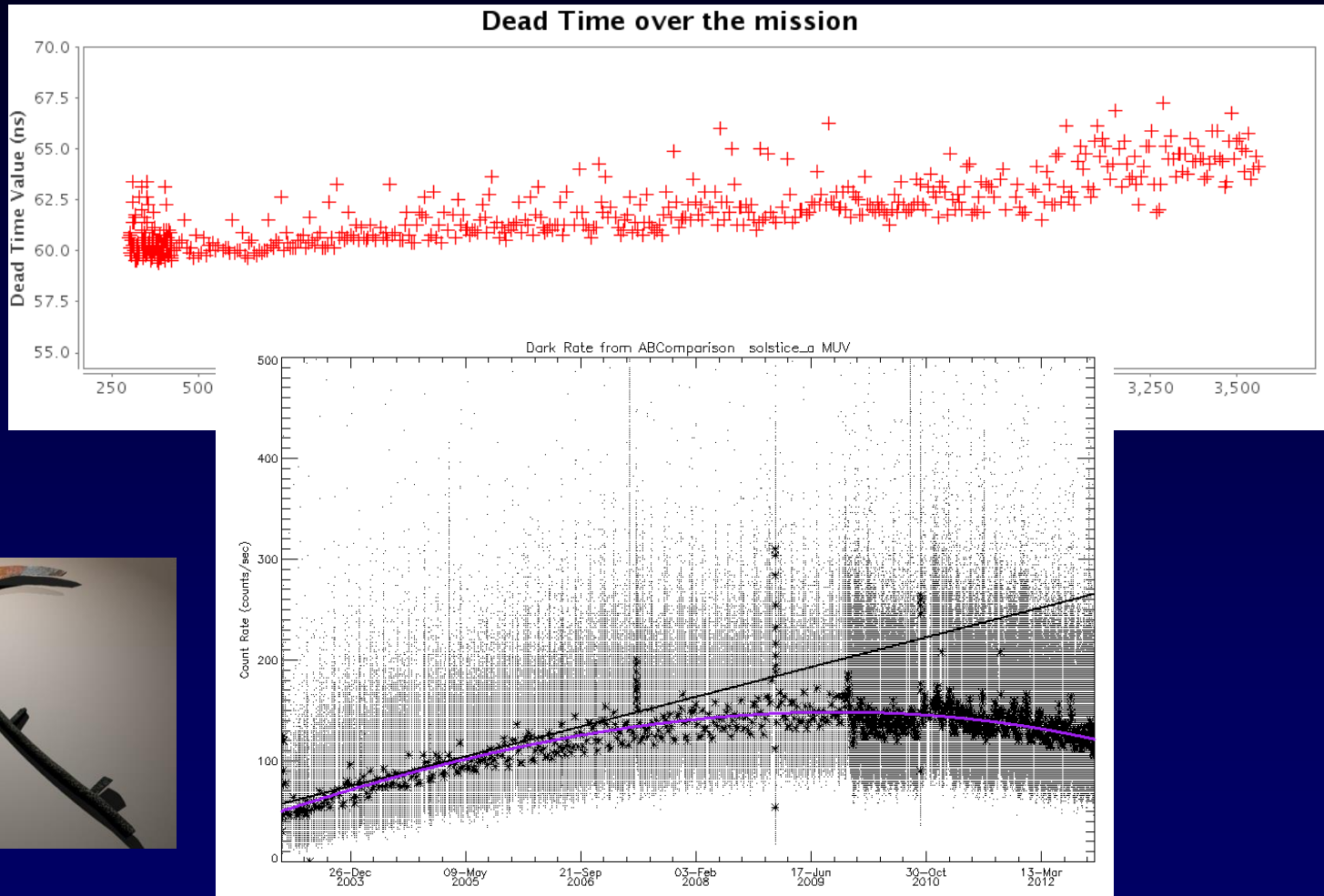


# Filter Transmission

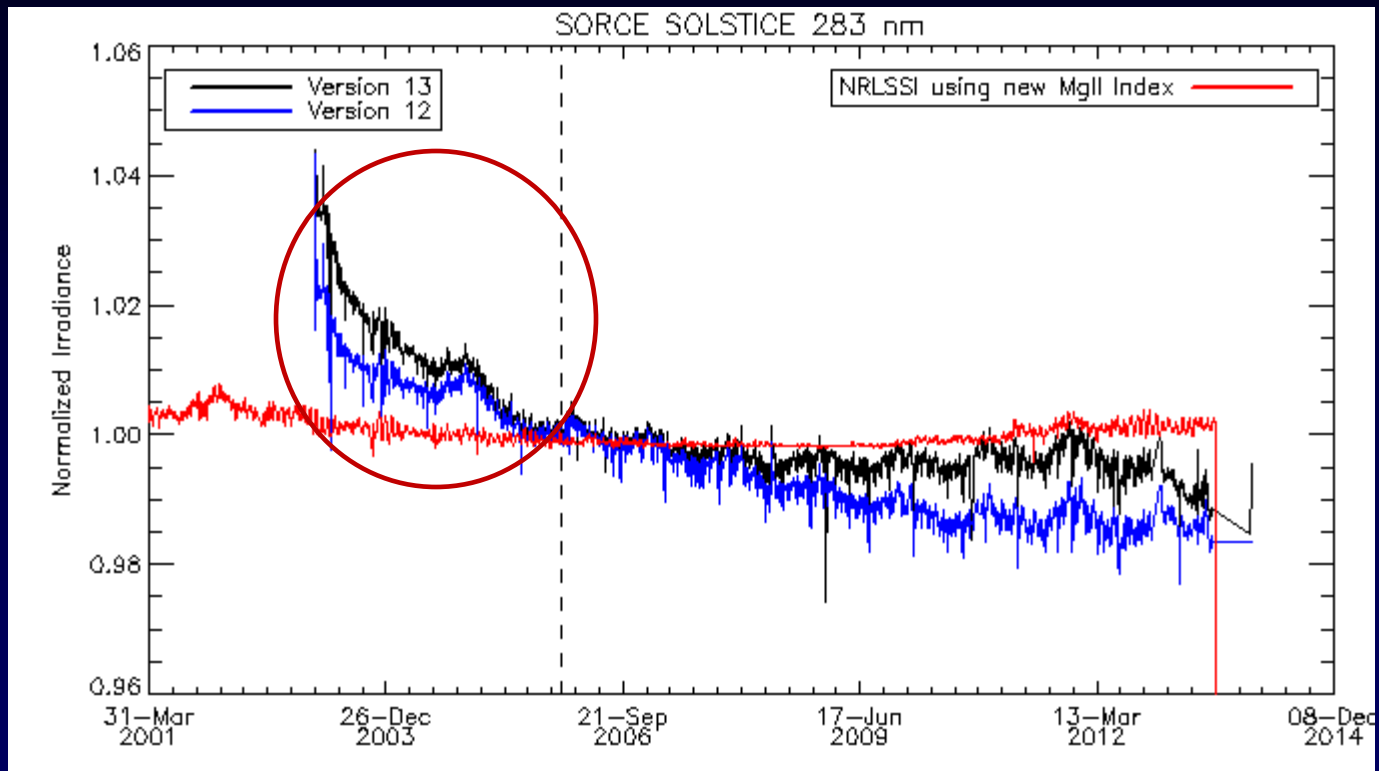




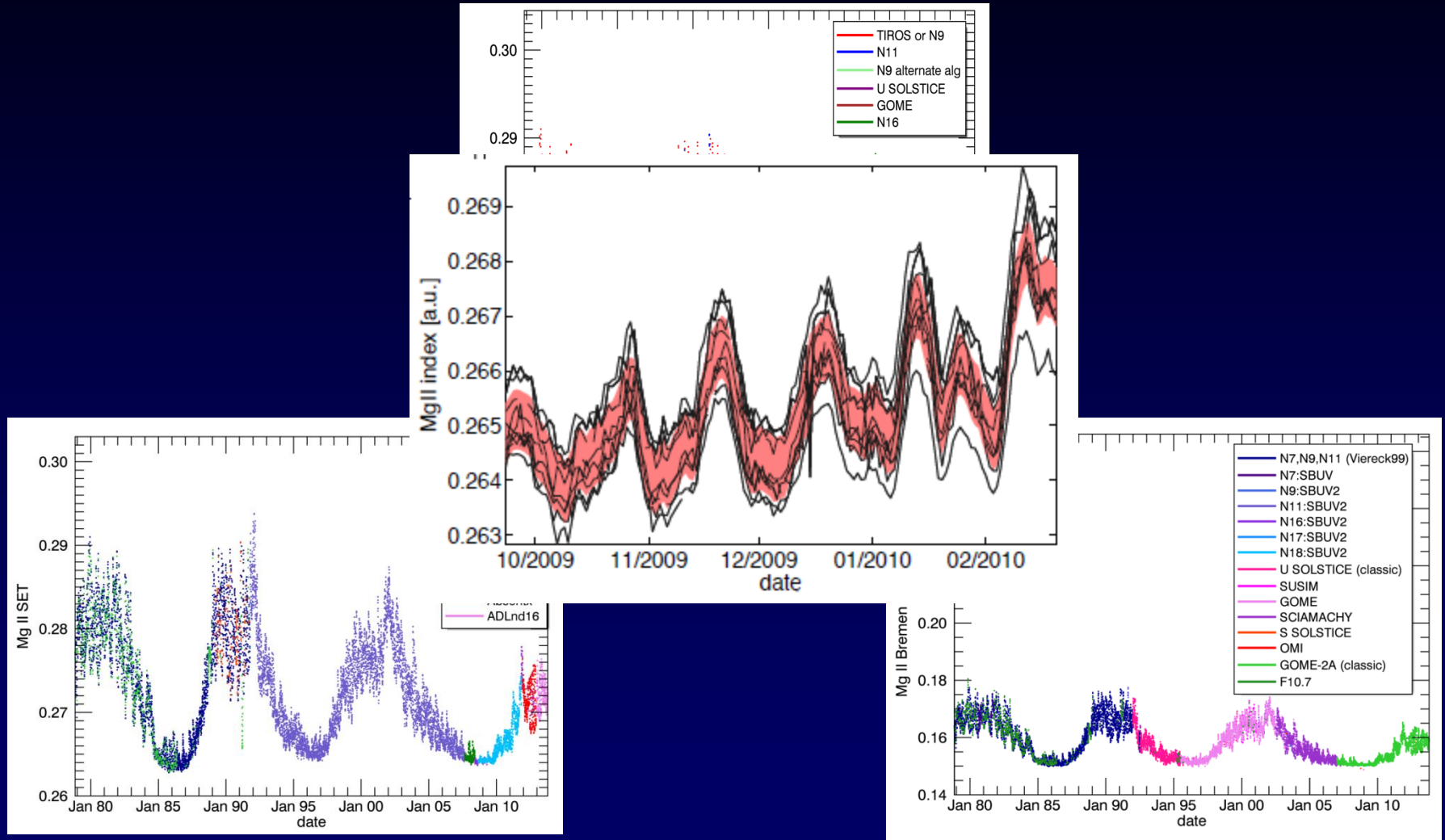
# Dark & Dead



# SOLSTICE V13



# What's Next?



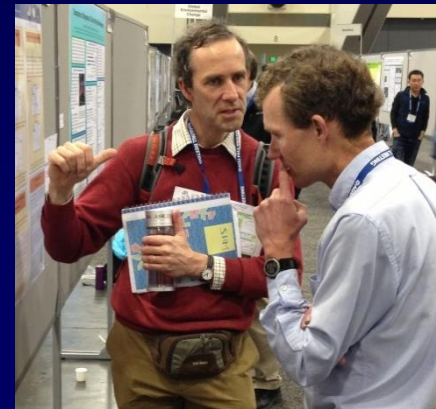
# Data selection choices

- Choose one data source per day?

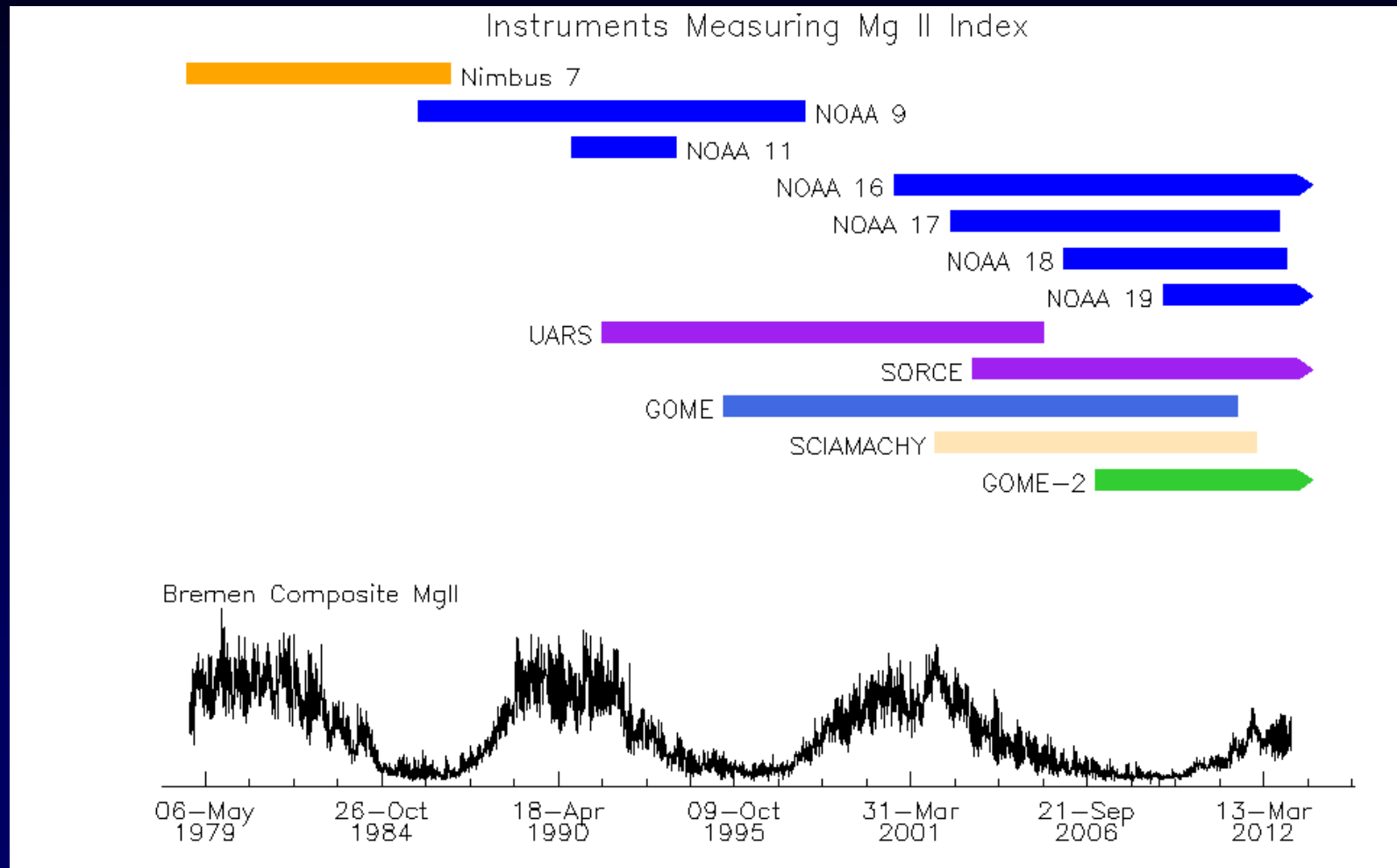


from multiple sources?

- Use Bayesian method?



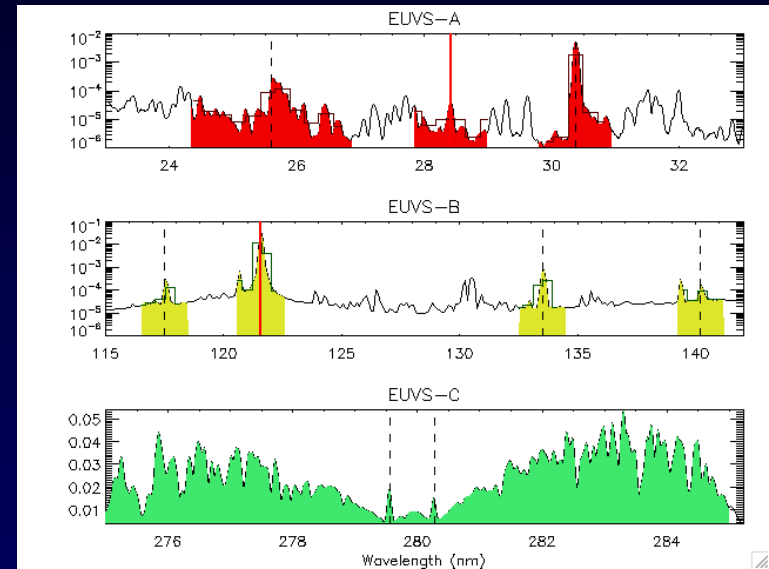
# Will the MgII record continue?





# GOES-R EXIS Overview

- EUV and X-ray Irradiance Sensors (EXIS)
  - X-ray Sensors (XRS) (0.05-0.4nm and 0.1-0.8 nm)
  - Extreme UltraViolet Sensor (EUVS)
    - Channel A: Coronal measurement (25-31 nm)
    - Channel B: Transition Region measurement (117-140 nm)
    - Channel C: Chromospheric Measurement (275-285 nm)





# EUVS C Capabilities

- Grating Spectrograph:
  - 512 element diode array (Hamamatsu 3924)
  - filter 15 nm wide bandpass,  $10^7$  out of band rejection
- Wavelength Range: 275-285 nm
- Spectral Resolution: 0.1 nm
- Sampling: 5 pixels per resolution
- Measurement Cadence: 5 seconds



# Summary

- The MgII core to wing ratio is a proxy for chromospheric activity with a long history.
- Although it is mostly free of instrument artifacts, detailed analysis is still required to produce a reliable composite.
- Luxury of multiple overlapping datasets is coming to an end.
- Future of MgII proxy will begin with GOES-R EXIS.