PREMOS TSI:
comparison to other instruments and climate implications

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Thanks also to Greg Kopp

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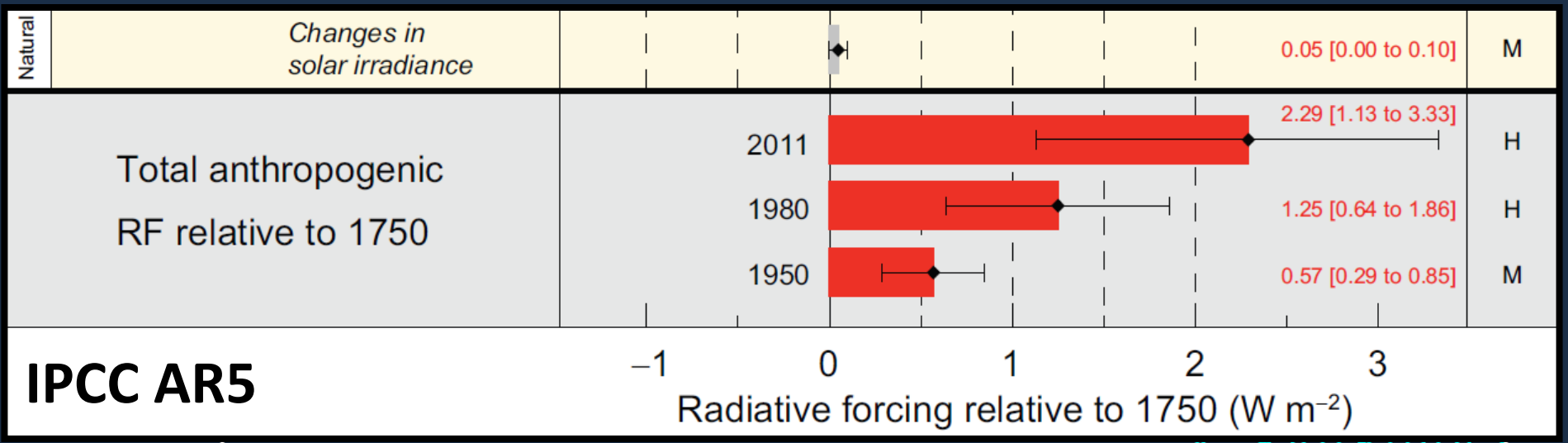
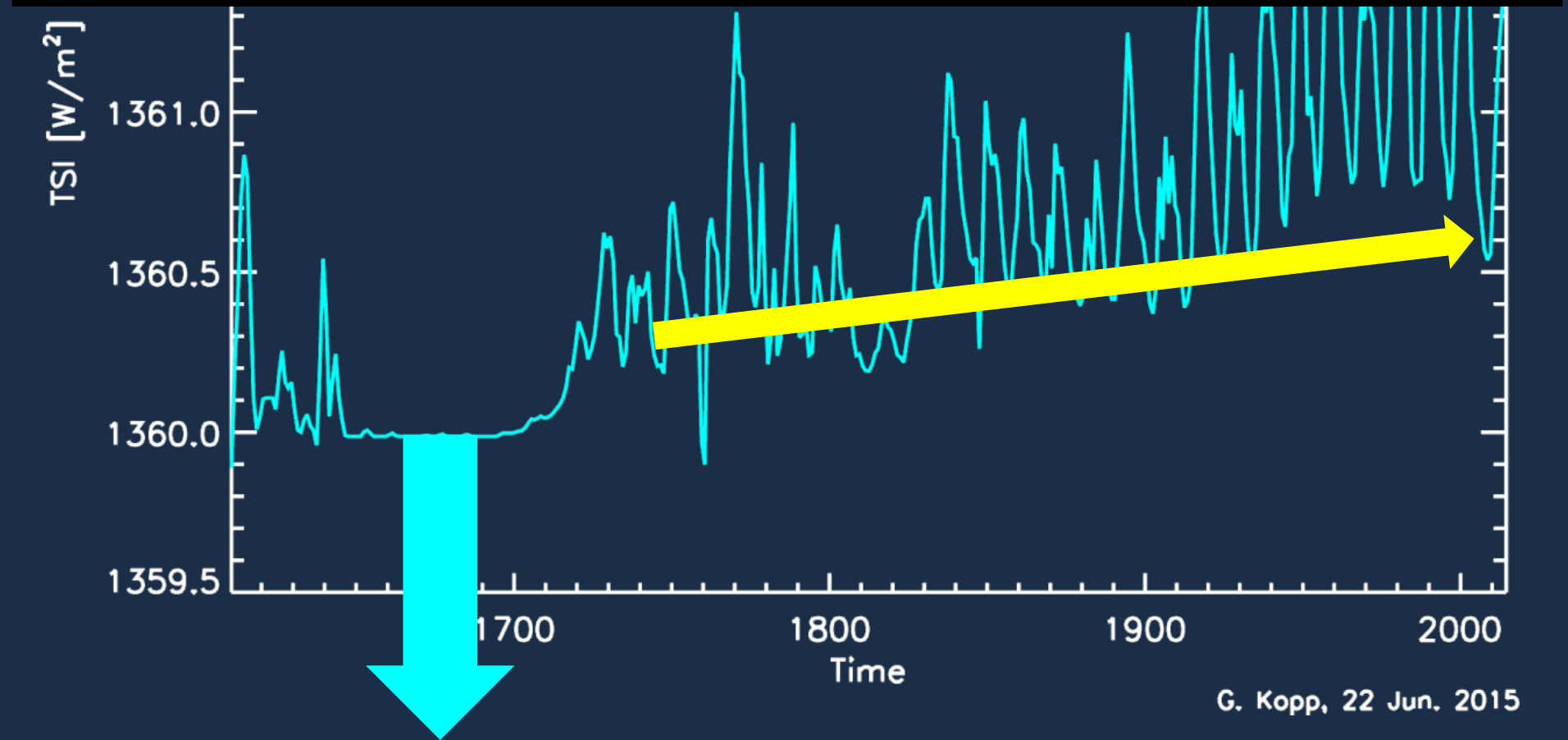
Take away points:

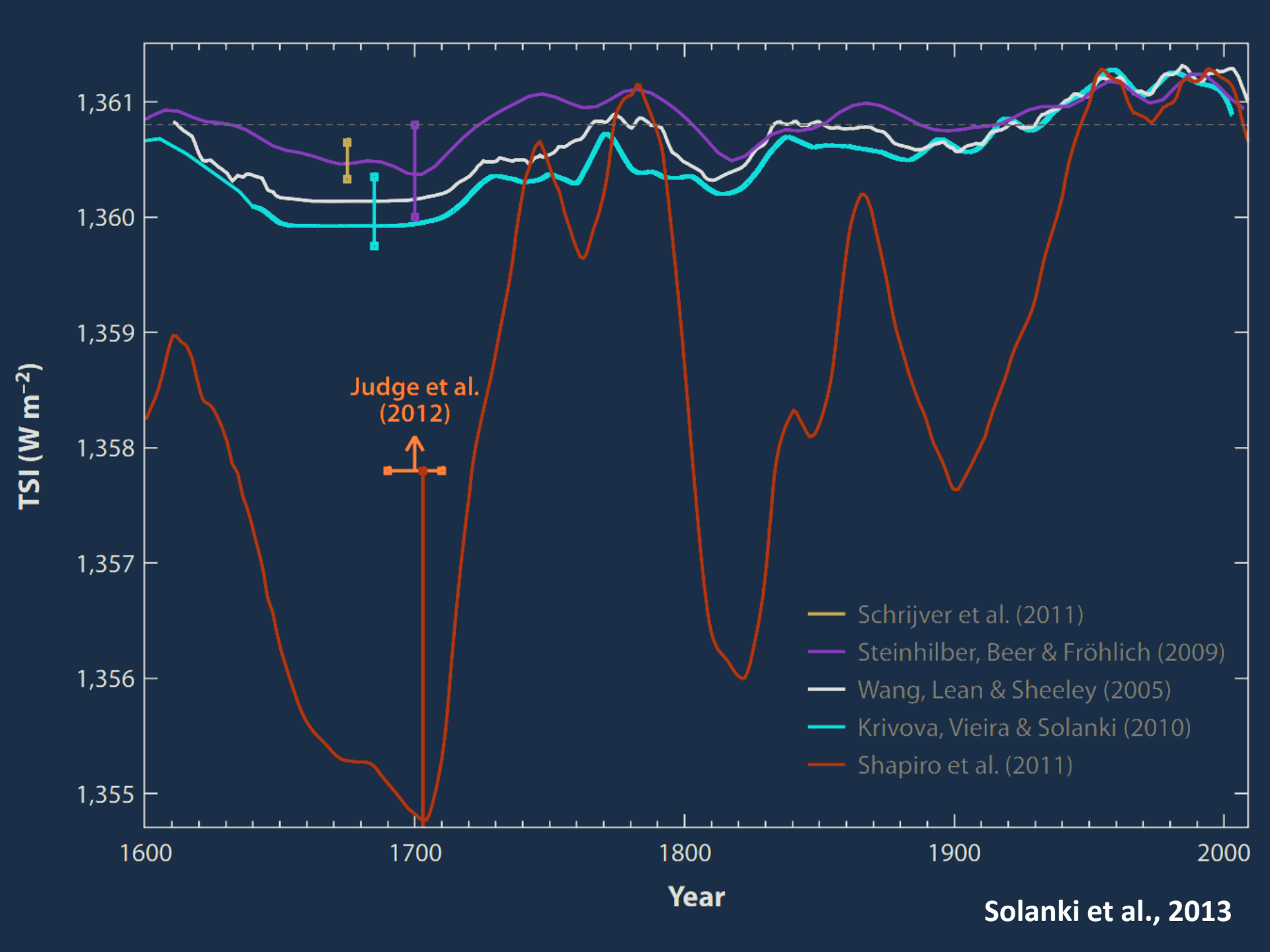
(i) PREMOS confirms 1361 Wm^{-2}
(ii) 2013/14 TSI composite issue
(iii) Currently assessing relative calibration… work in progress
(iv) SI continuity is imperative

pmod wrc


Natural
Changes in solar irradiance
0.05 [0.00 to 0.10]
M
Total anthropogenic RF relative to 1750
2011
2.29 [1.13 to 3.33]
H
1980
1.25 [0.64 to 1.86]
H
1950
0.57 [0.29 to 0.85]
M
–1
0
1
2
3
Radiative forcing relative to 1750 (W m⁻²)

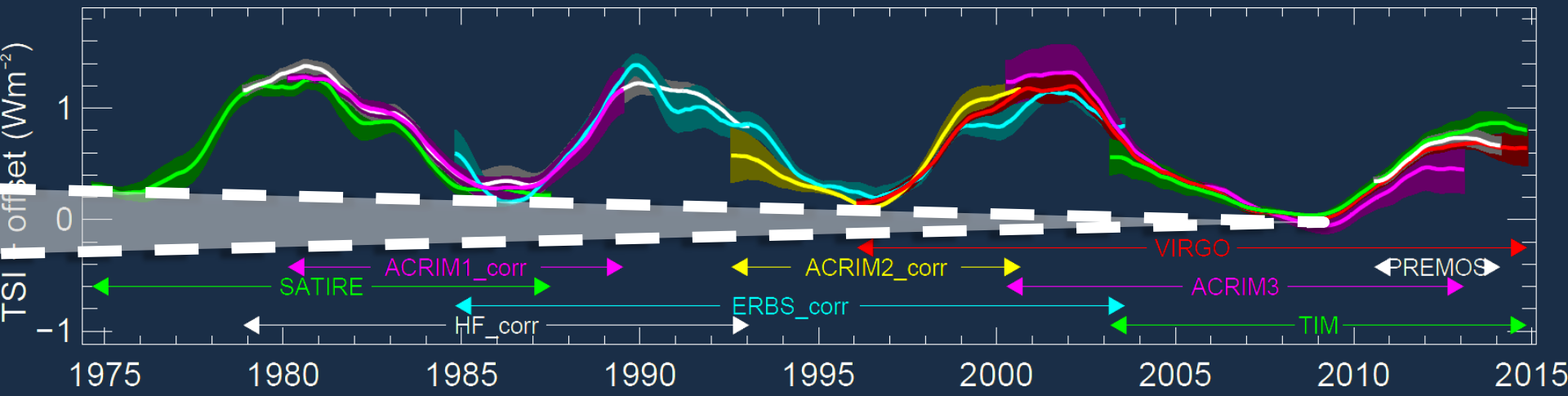
IPCC AR5


TSI [W/m²]
1361.0
1360.5
1360.0
1359.5
1700
1800
1900
2000
Time
G. Kopp, 22 Jun. 2015

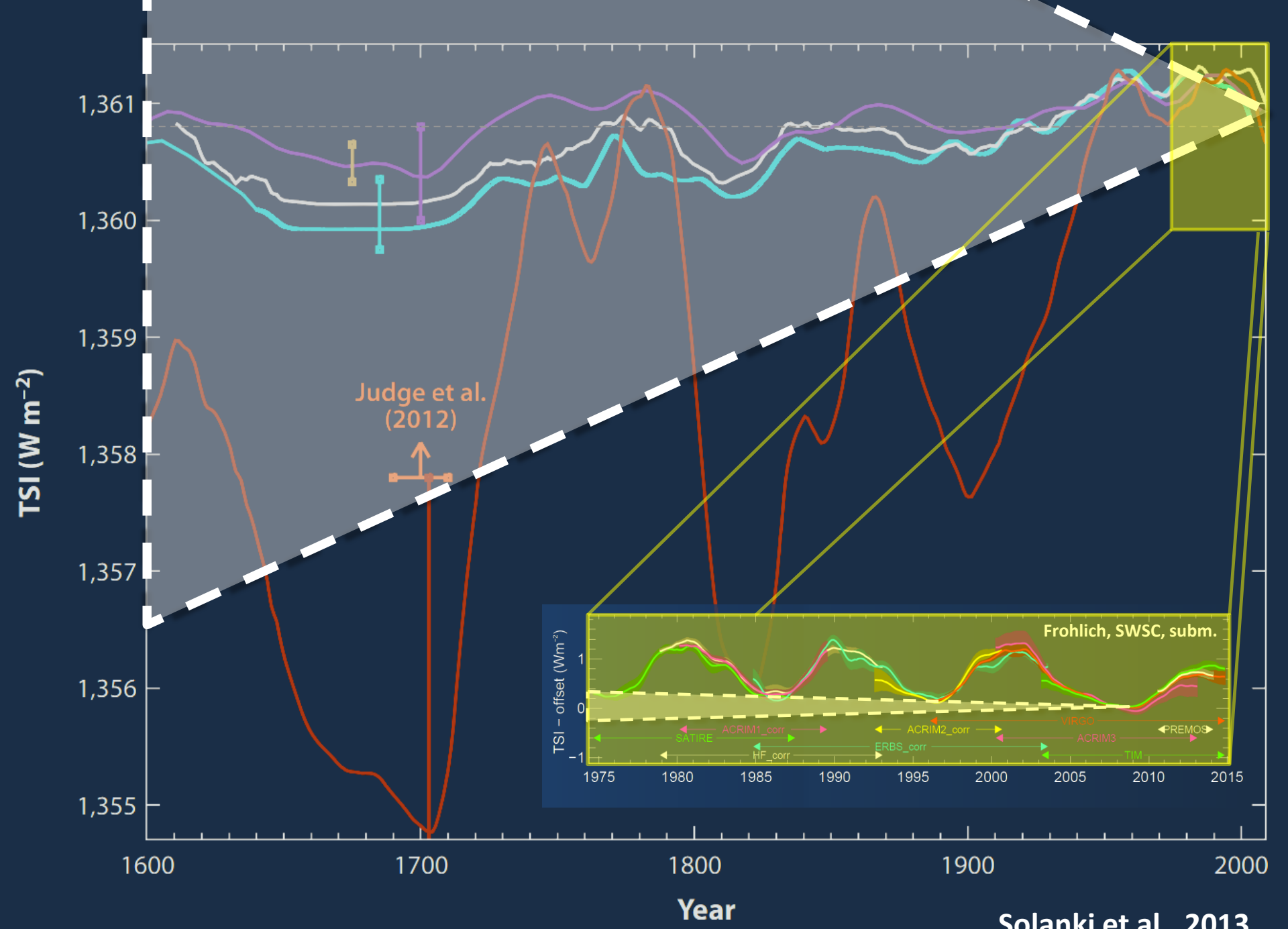


Solanki et al., 2013

Relative TSI (stability)

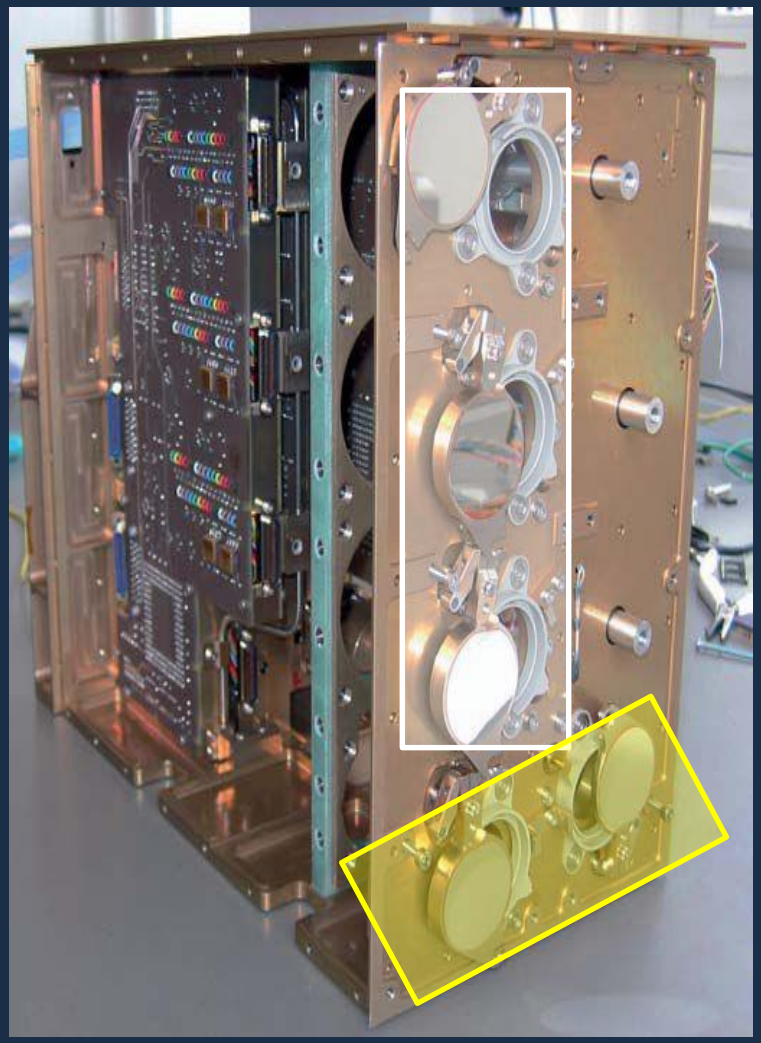


Frohlich, SWSC, submitted



Solanki et al., 2013

PREMOS
PREcision MOnitor Sensor



27 July 2010 – 4 March 2014

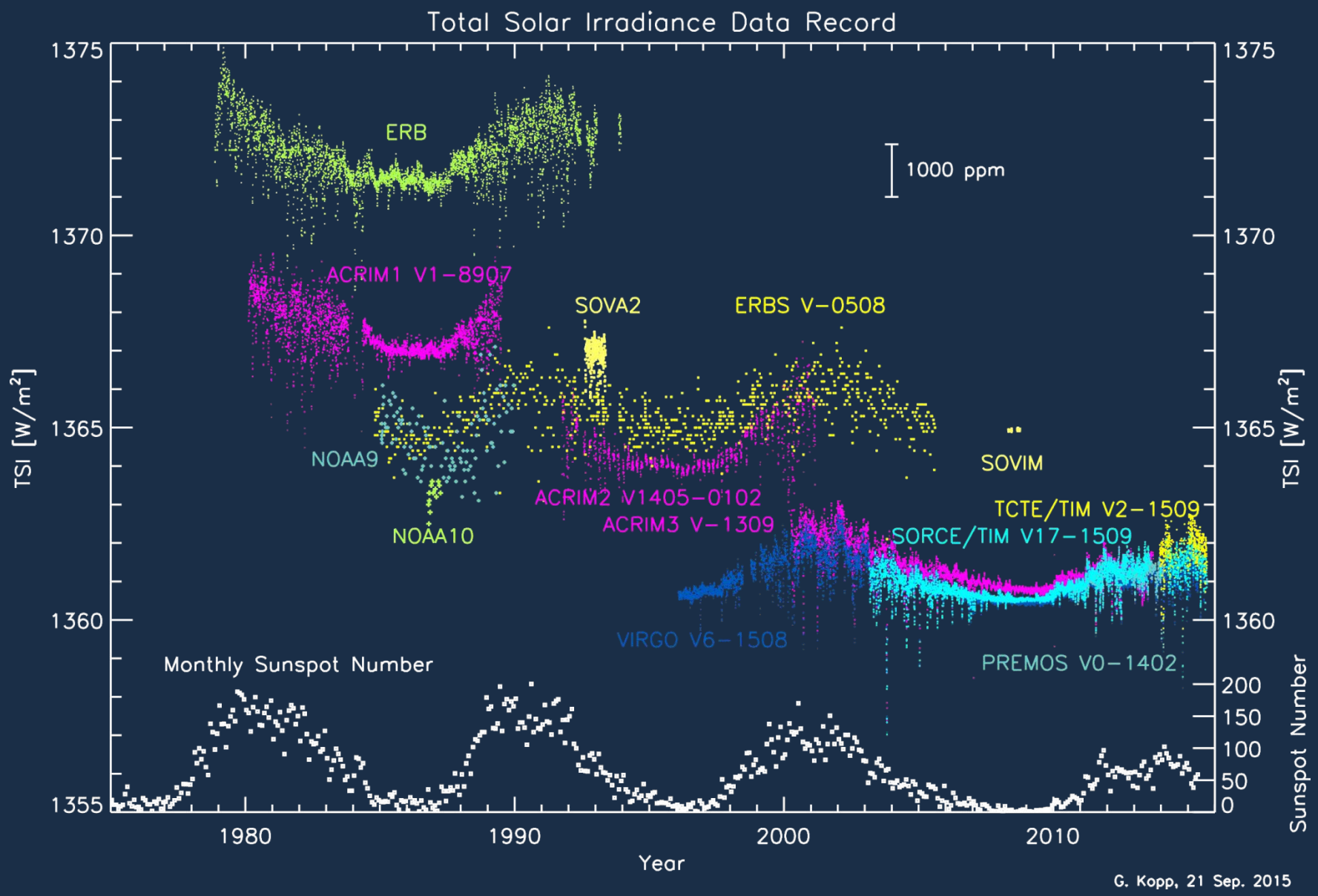
Filter radiometers

210, 215, 268, 535, 607, 782 nm

TSI **2 PMO6-type absolute radiometers**

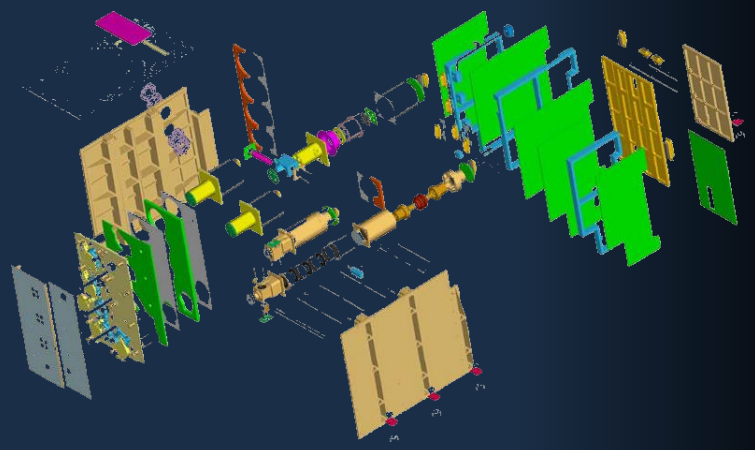
pmod wrc

Absolute TSI



Greg Kopp's webpage

Absolute TSI



Characterisation

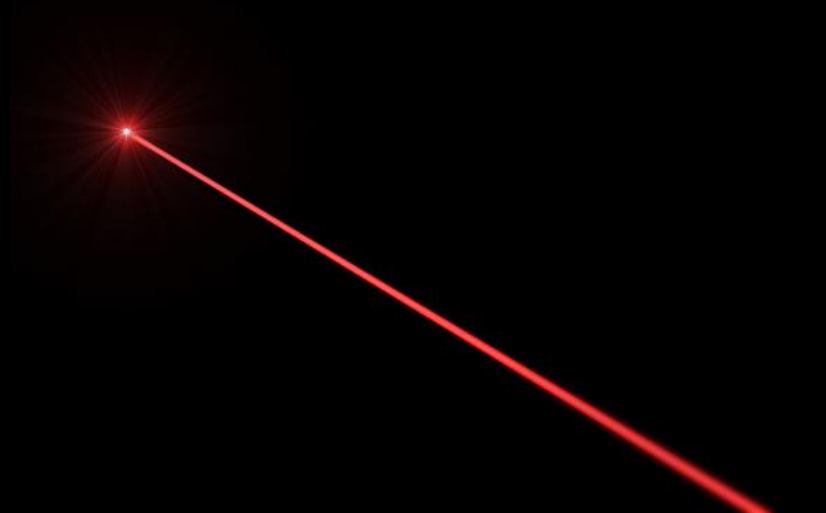
(e.g. SORCE/TIM)

effect may not be taken into account correctly

Calibration

(e.g. PREMOS, TCTE)

reference may have an offset

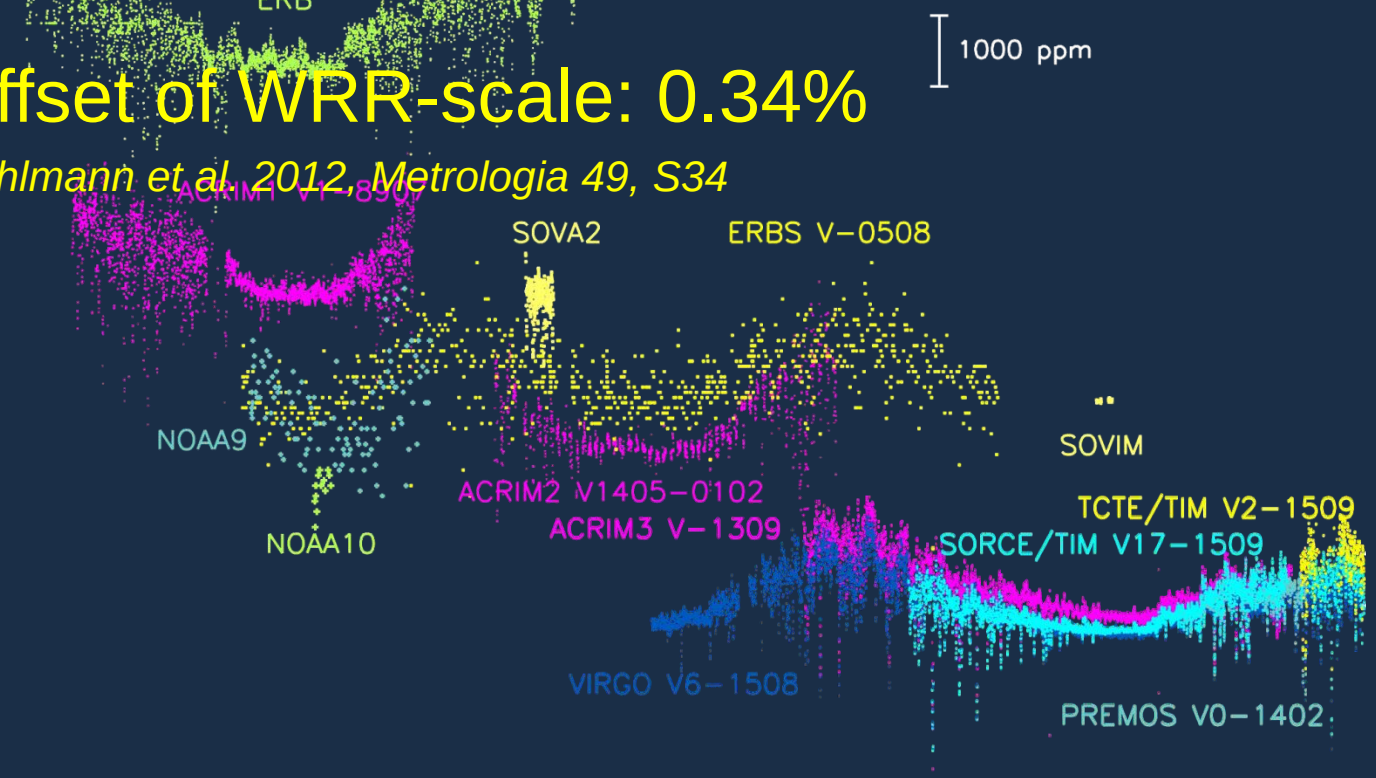


Absolute TSI

VIRGO/SOHO (WRR-calib.) 1365.4 W/m²
PREMOS(WRR-calib.) 1365.5 W/m²

Offset of WRR-scale: 0.34%

Fehlmann et al. 2012, Metrologia 49, S34



PREMOS(TRF)/PICARD **1360.9 +- 0.4 W/m²**
TIM/SORCE 1361.3 W/m²

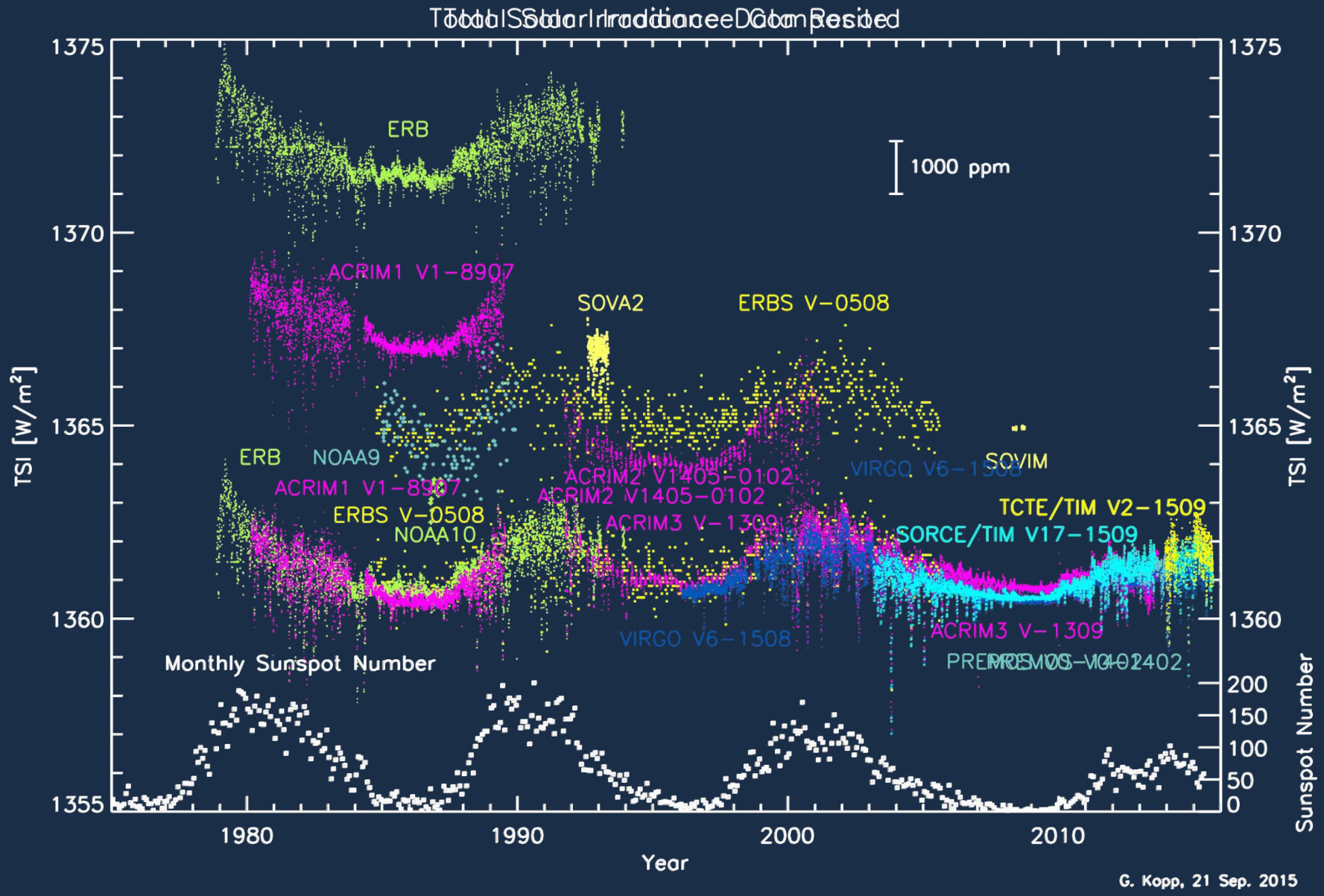
TIM and PREMOS are consistent *!*

Schmutz et al. 2013, AIP 1531, 624, doi: 10.1063/1.4804847

G. Kopp, 21 Sep. 2015

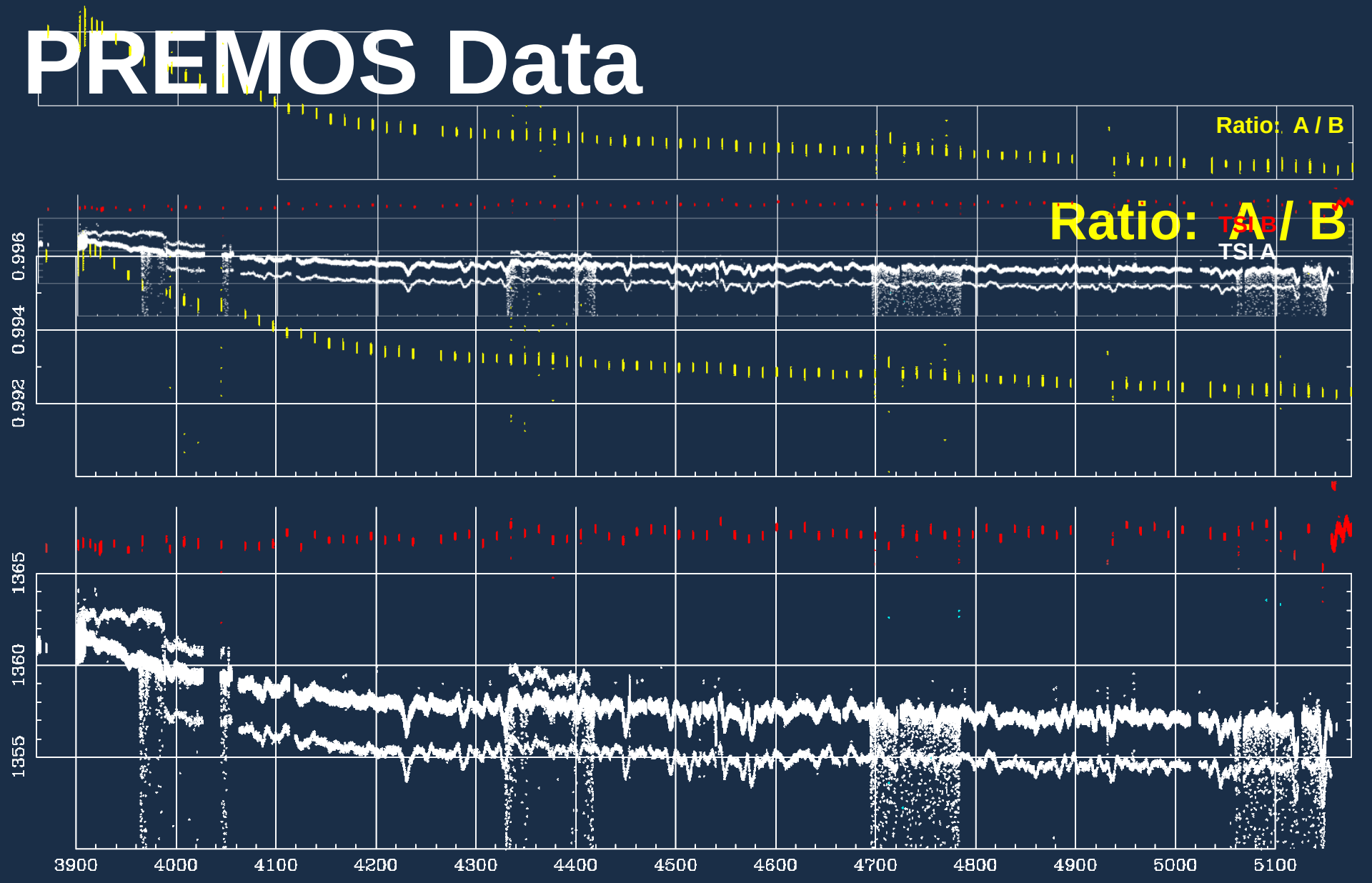
Greg Kopp's webpage

Relative TSI (stability)



Greg Kopp's webpage

PREMOS Data



Absolute: Head A

Head B

A

operational exposure

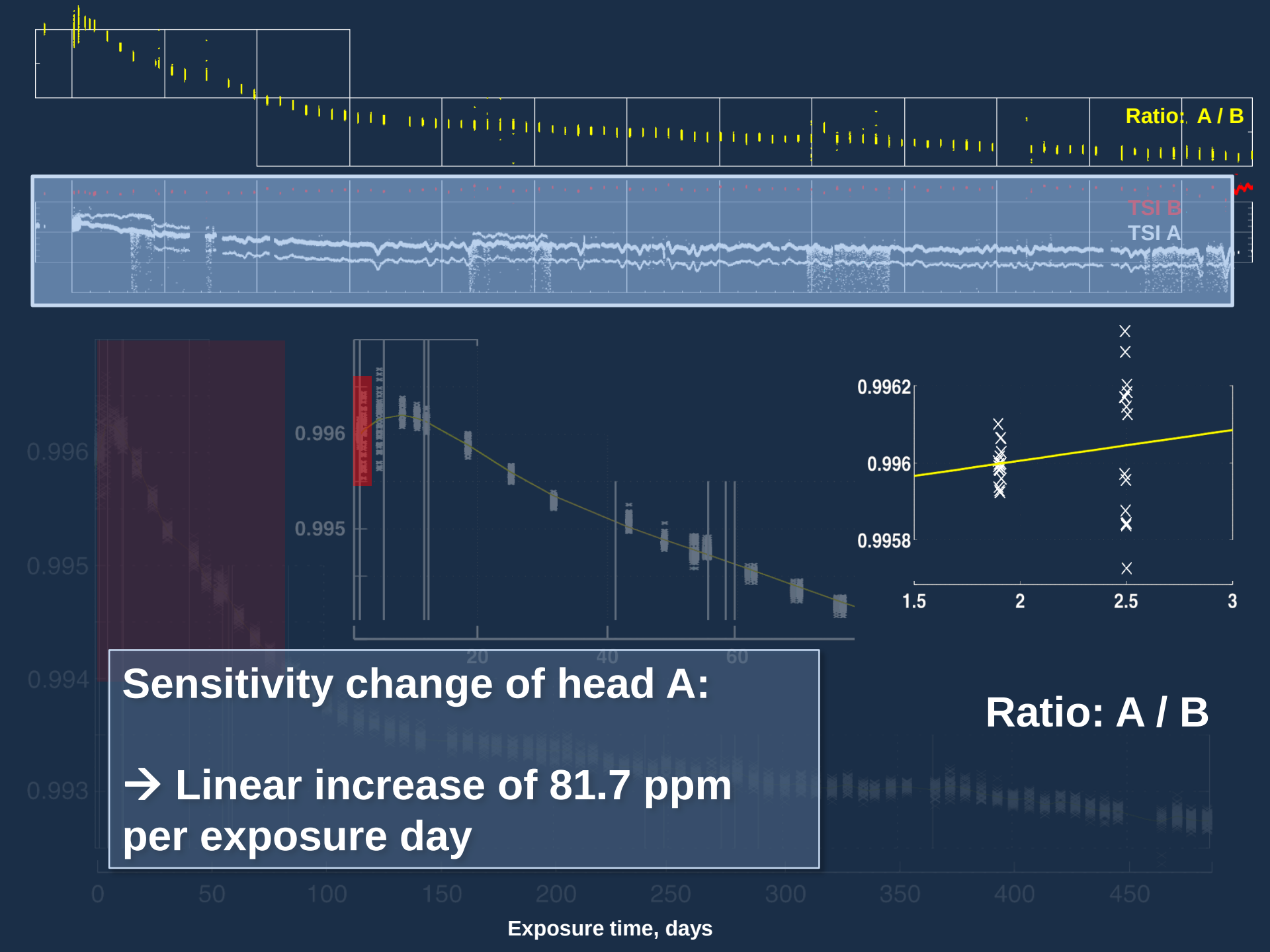
600 days

B

calibration exposure

3.74 days

Hypothesis: **B** has the *same* sensitivity change as **A** *as a function of the exposure time*

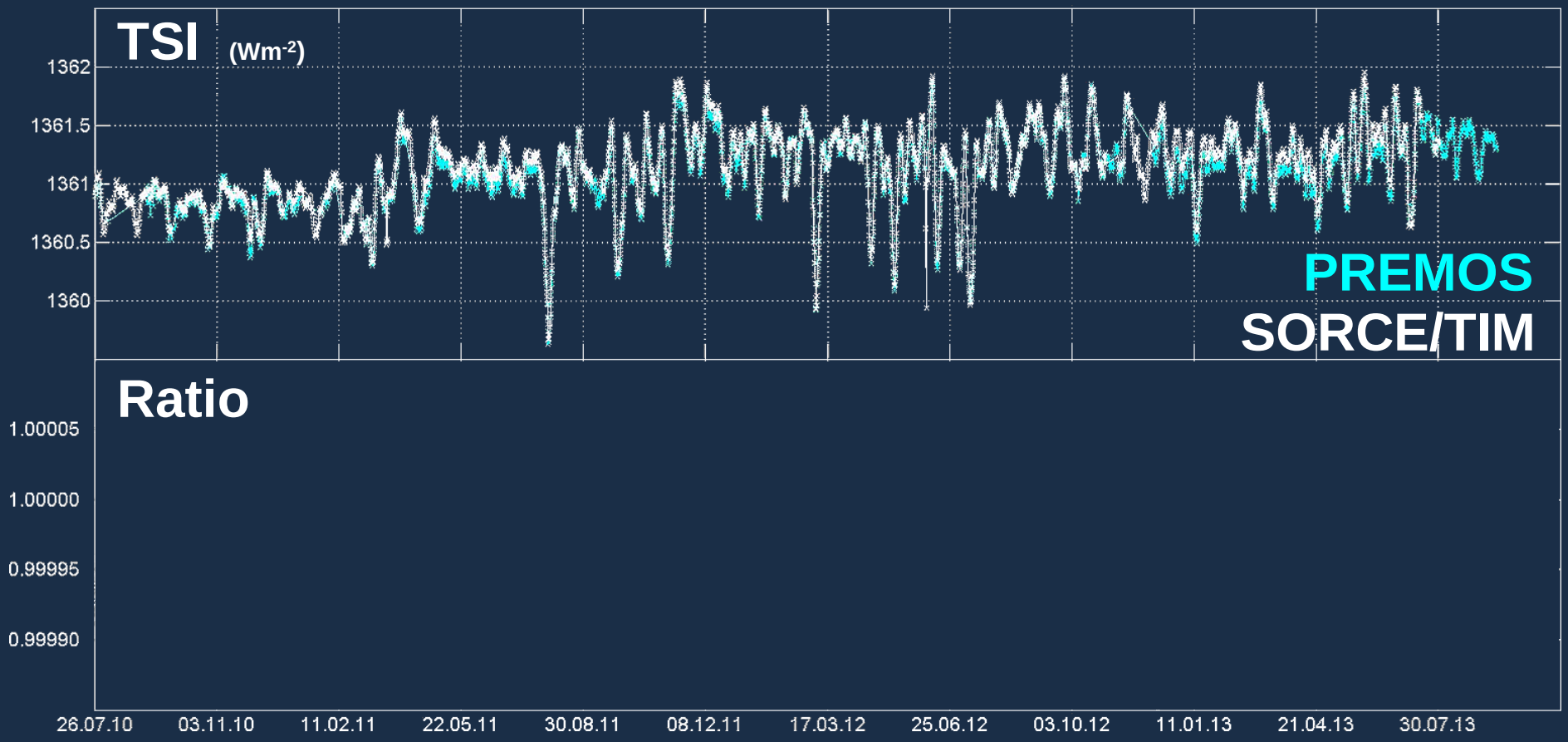


Sensitivity change of head A:

→ Linear increase of 81.7 ppm per exposure day

Ratio: A / B

PREMOS & TIM


TSI (Wm-2)
1362
1361.5
1361
1360.5
1360
PREMOS
SORCE/TIM
Ratio
1.00005
1.00000
0.99995
0.99990
26.07.10
03.11.10
11.02.11
22.05.11
30.08.11
08.12.11
17.03.12
25.06.12
03.10.12
11.01.13
21.04.13
30.07.13

PREMOS & TIM

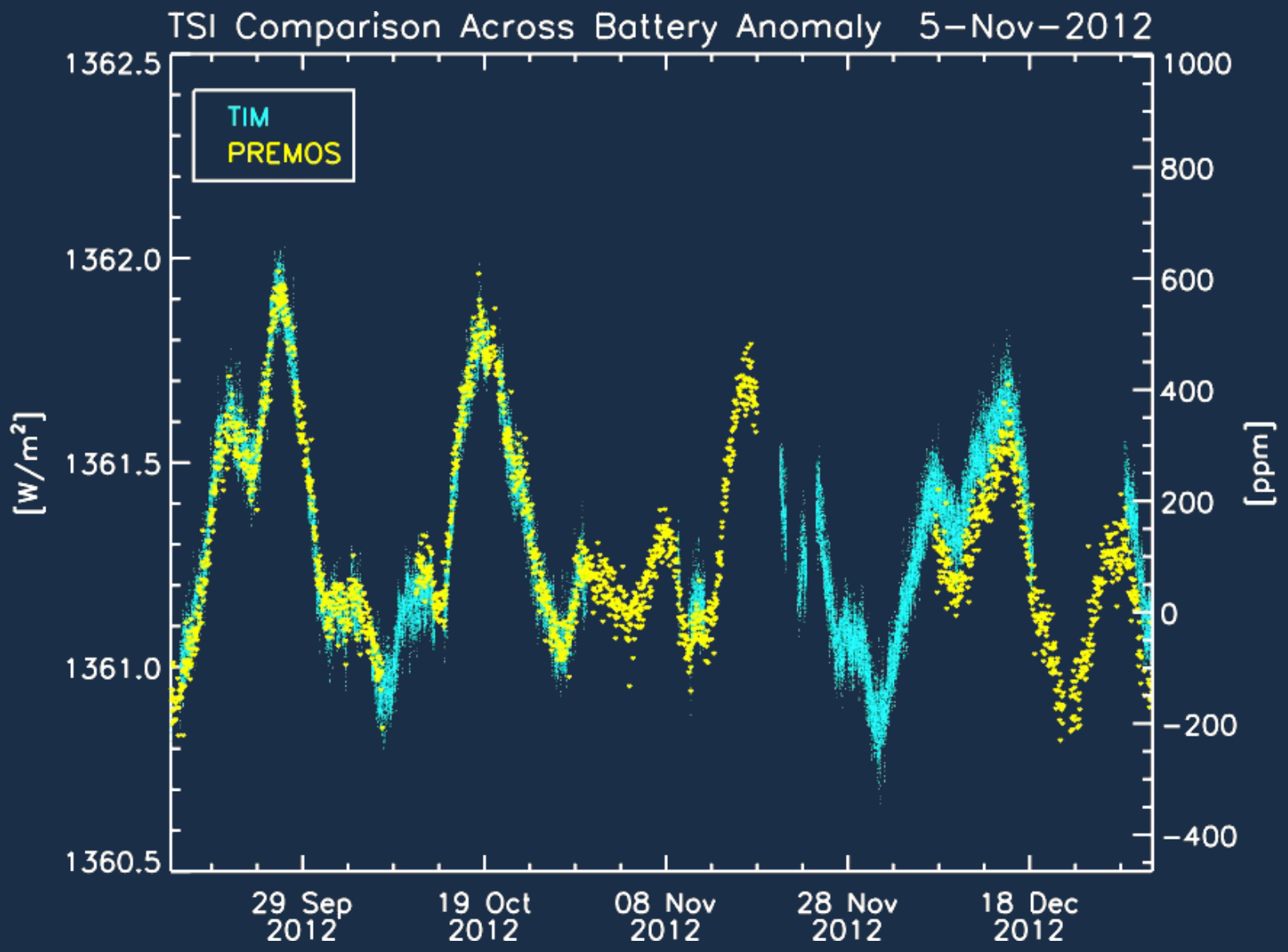
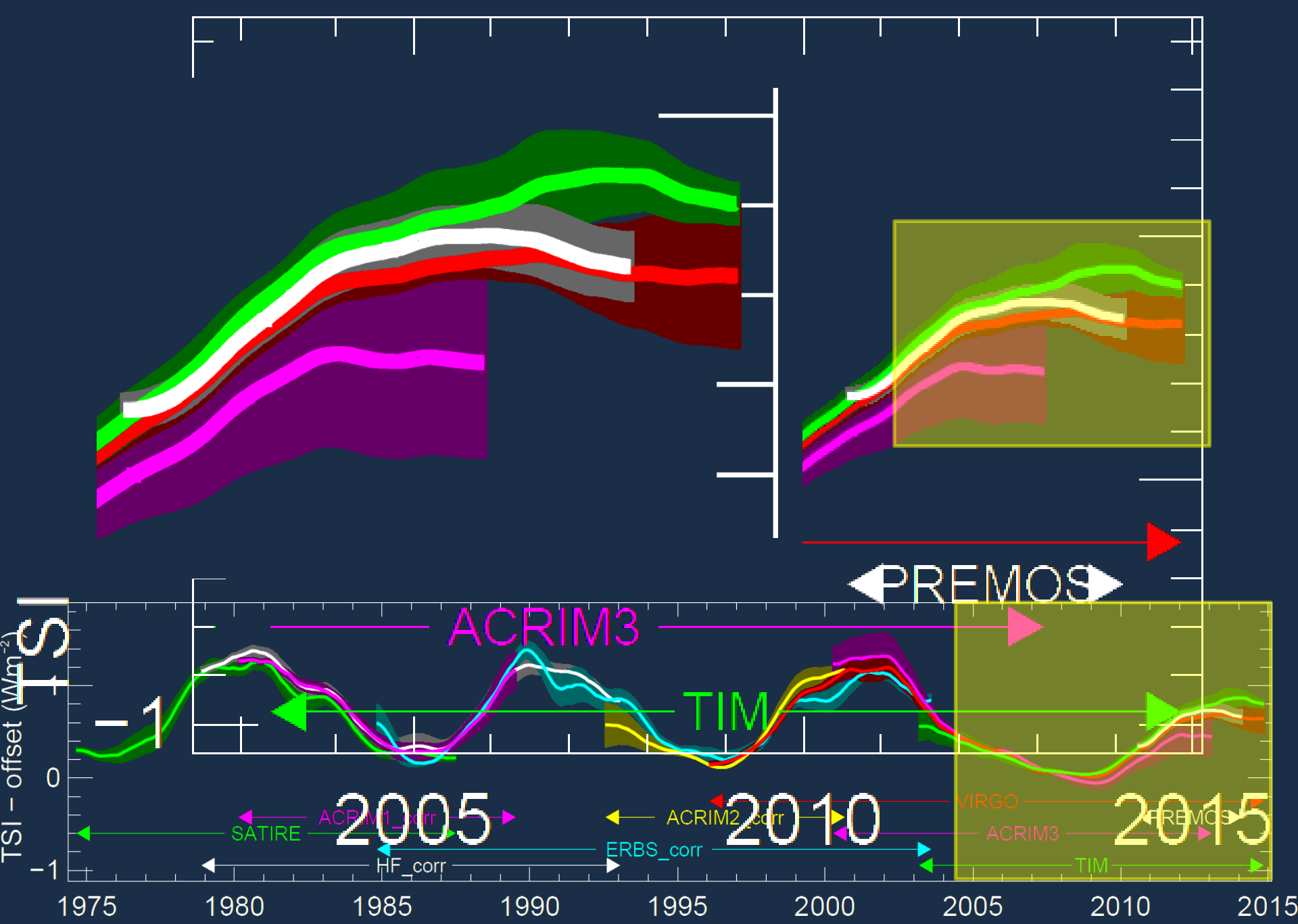
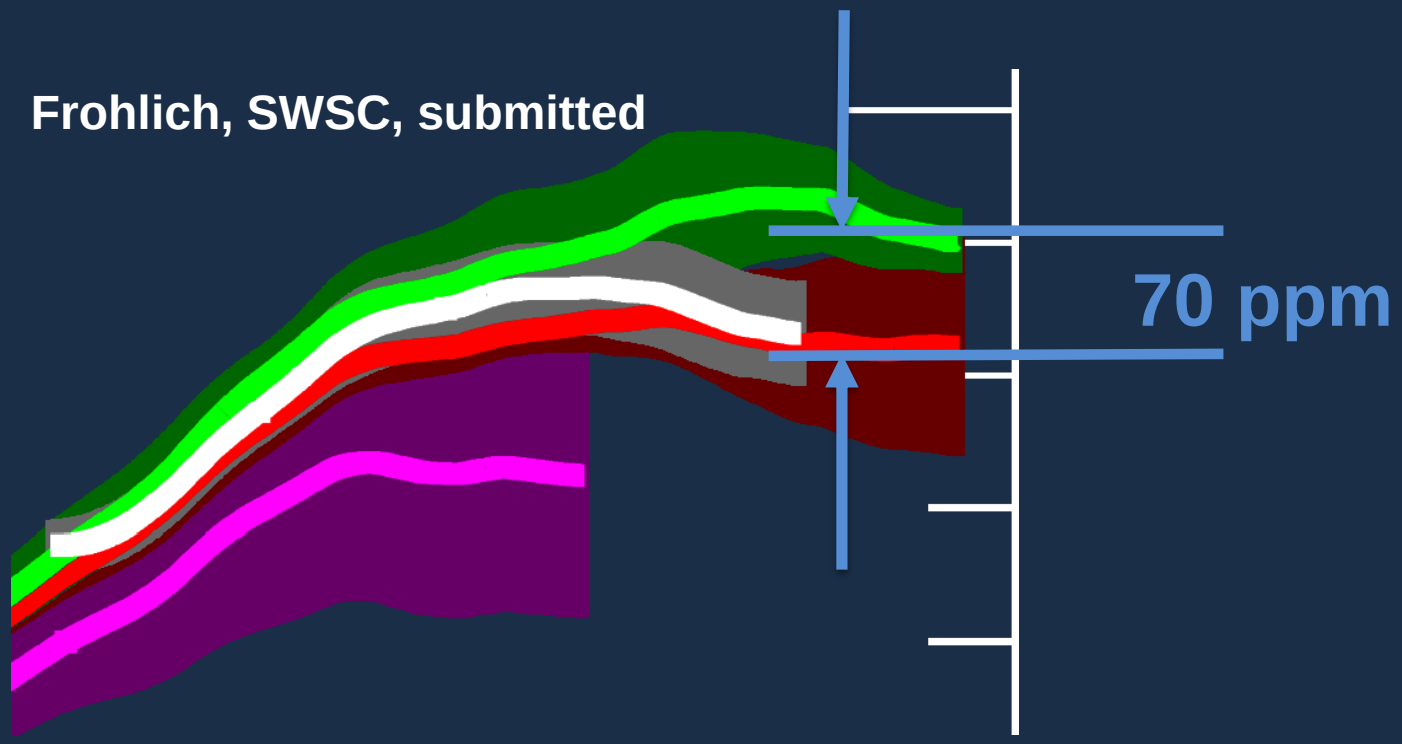


Image: Greg Kopp



Frohlich, SWSC, submitted



2012:

VIRGO (1996-present)

ACRIM-3 (2000-2013)

TIM (2003-present)

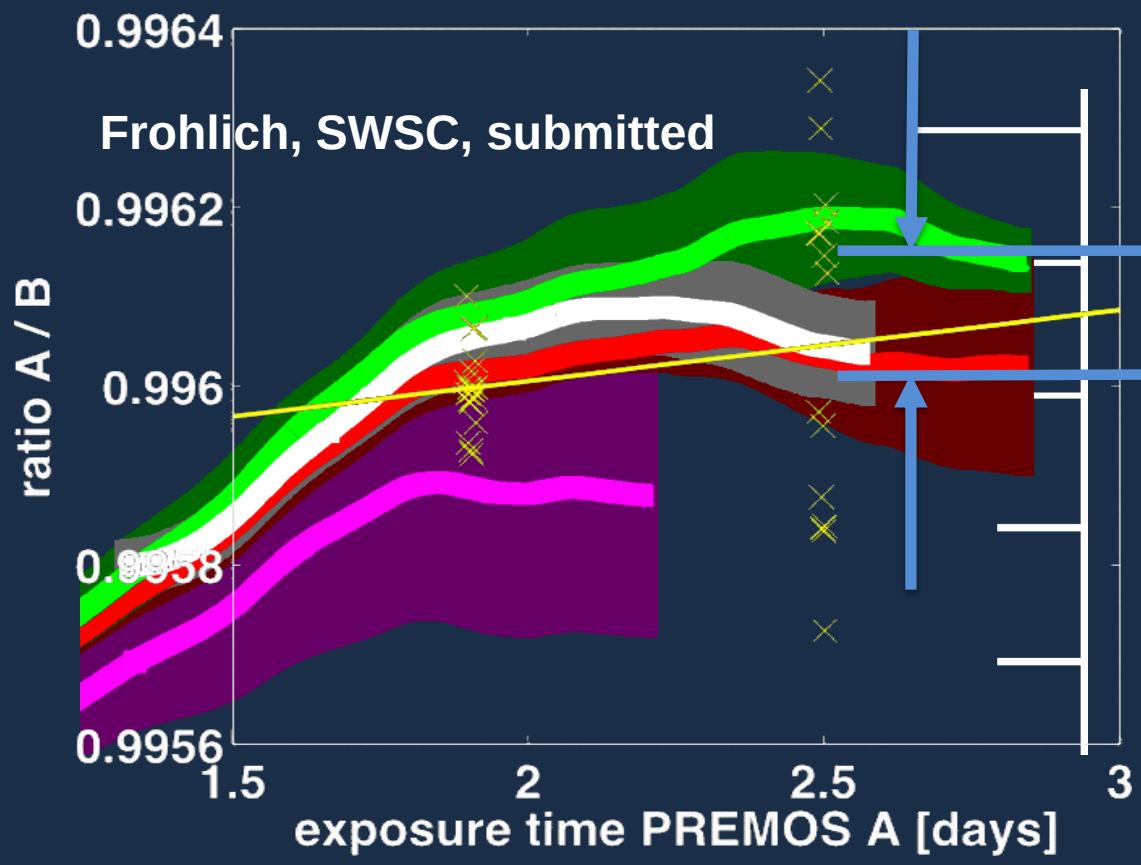
PREMOS (2010-2014)

2015:

VIRGO (1996-present)

TIM (2003-present)

TCTE (Dec 2013)

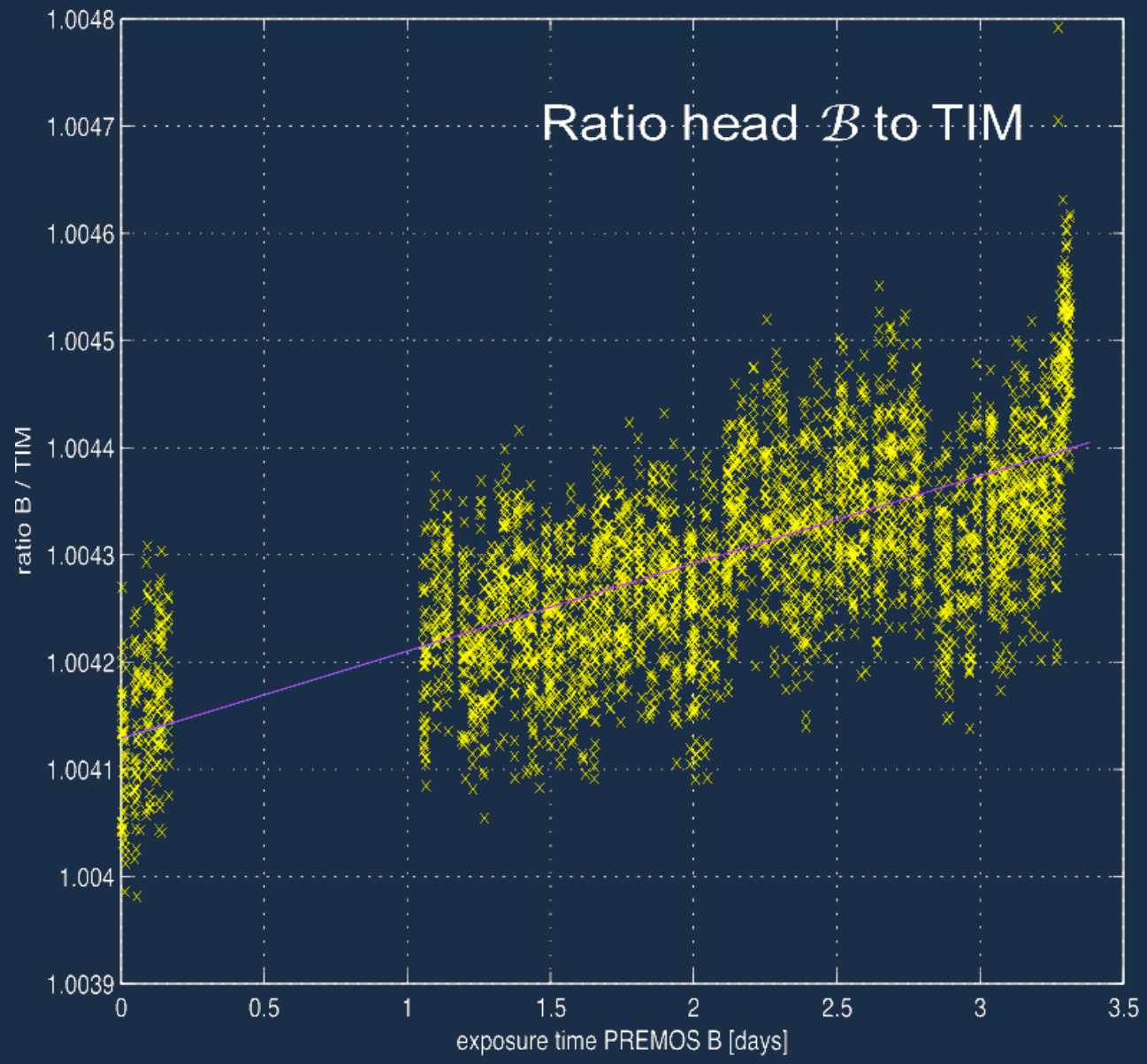


70 ppm

Measurement time-dependence depends on the sensitivity correction of head B

How good is the relative stability of PREMOS?

Is a *linear* increase of 81.7 ppm per exposure day correct?



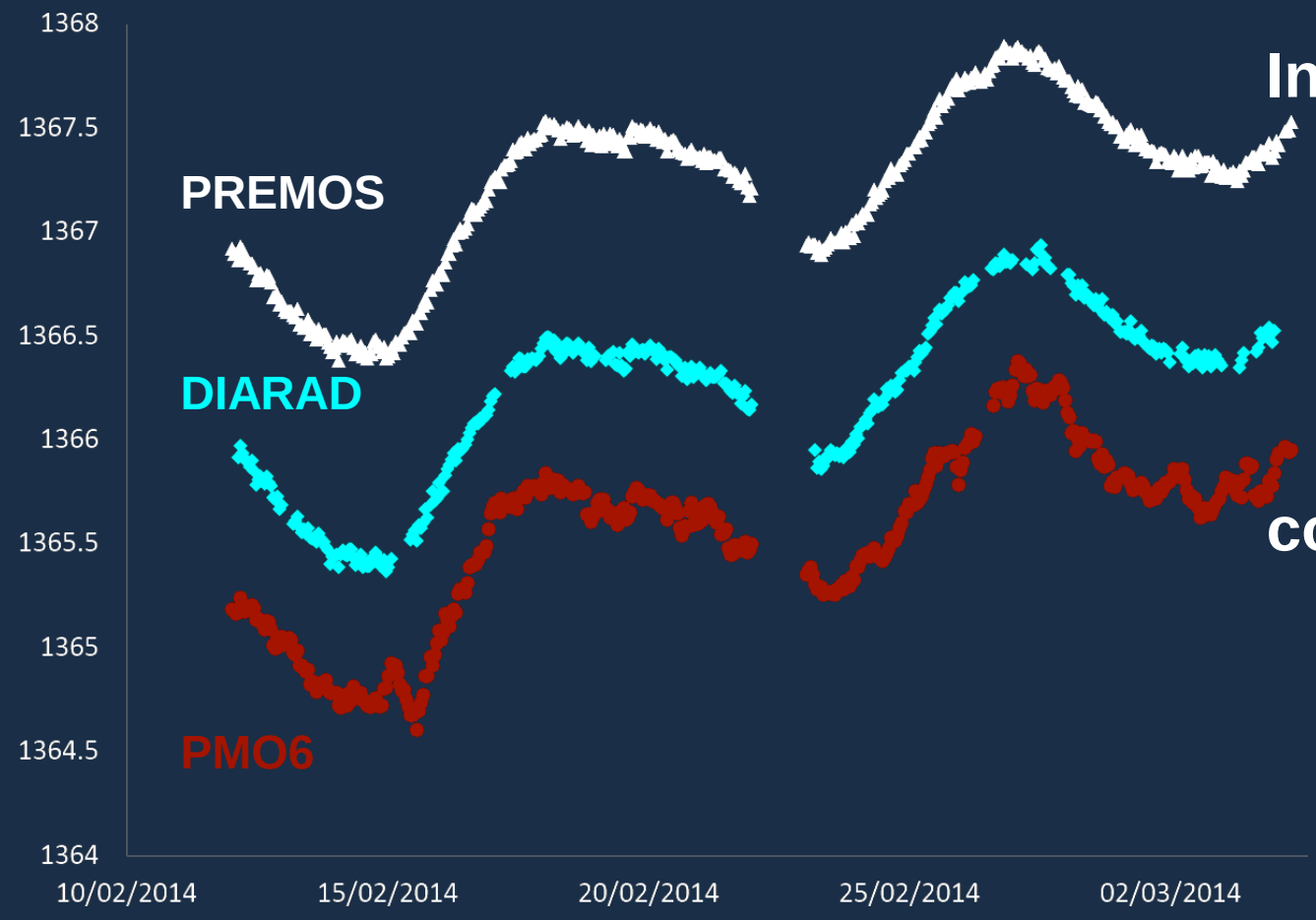
1

Compare *B* over the *whole* mission to TIM/SORCE

✓

Linearity is overall good; except for a "step" in 2012

Is a *linear* increase of 81.7 ppm per exposure day correct?



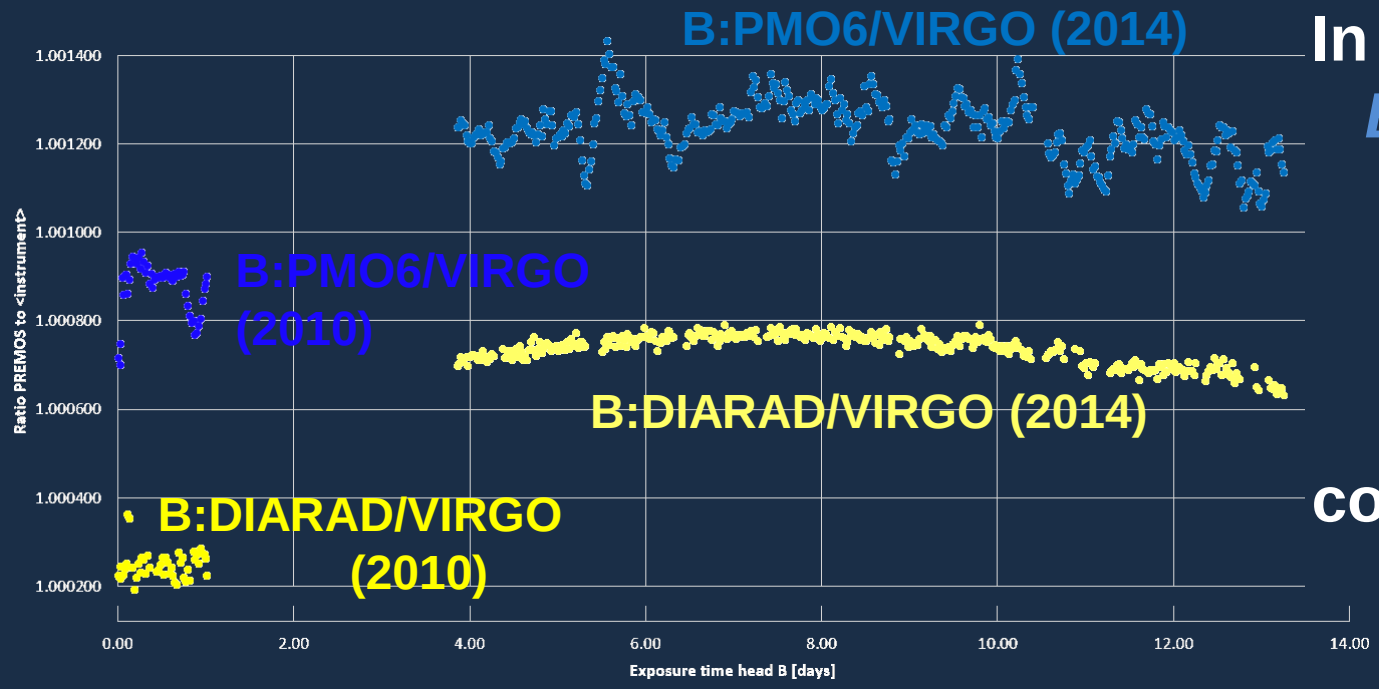
2

In last two weeks *B* became the operational instrument

…

compare to other instruments

Is a *linear* increase of 81.7 ppm per exposure day correct?



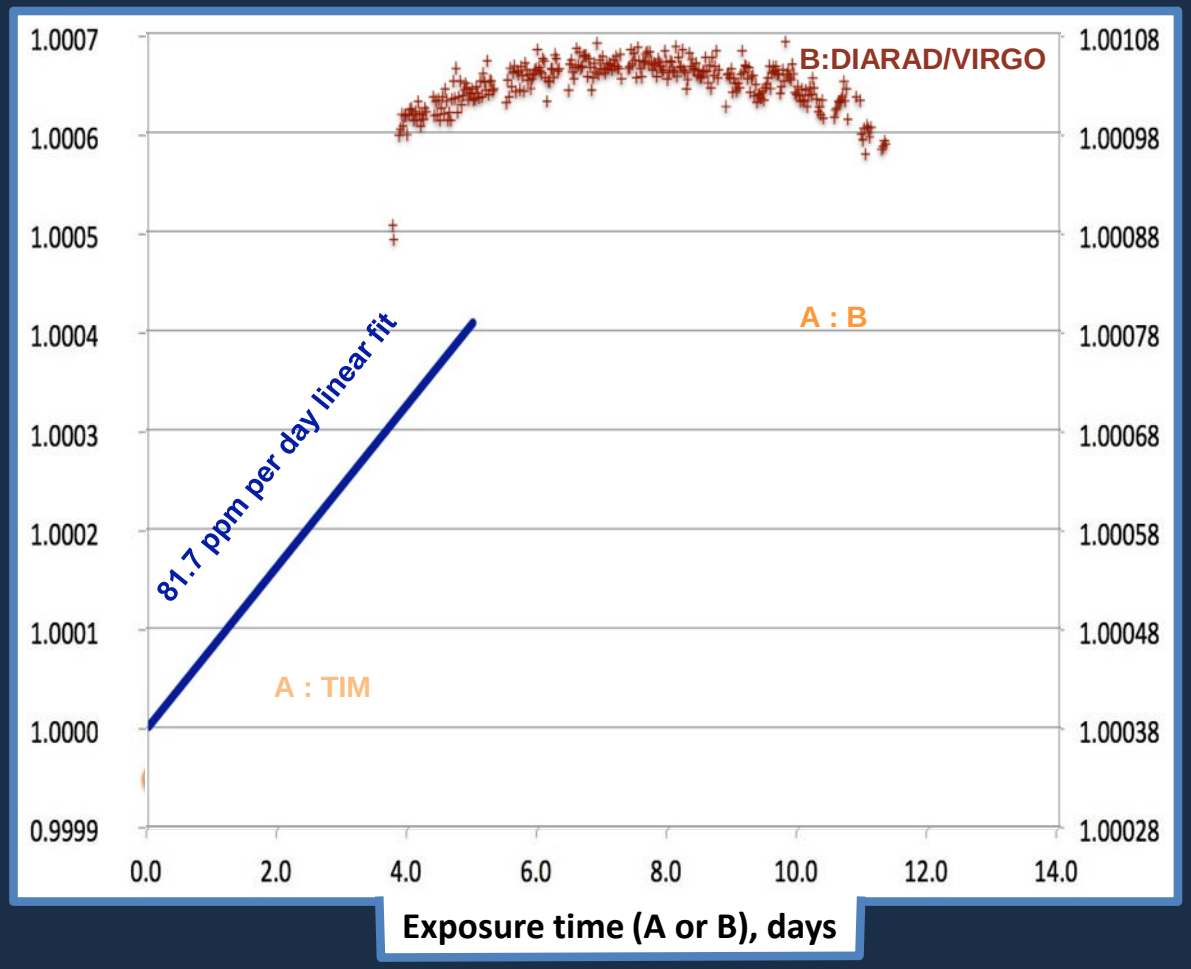
2

In last two weeks *B* became the operational instrument

…

compare to other instruments

Is a *linear* increase of 81.7 ppm per exposure day correct?



3

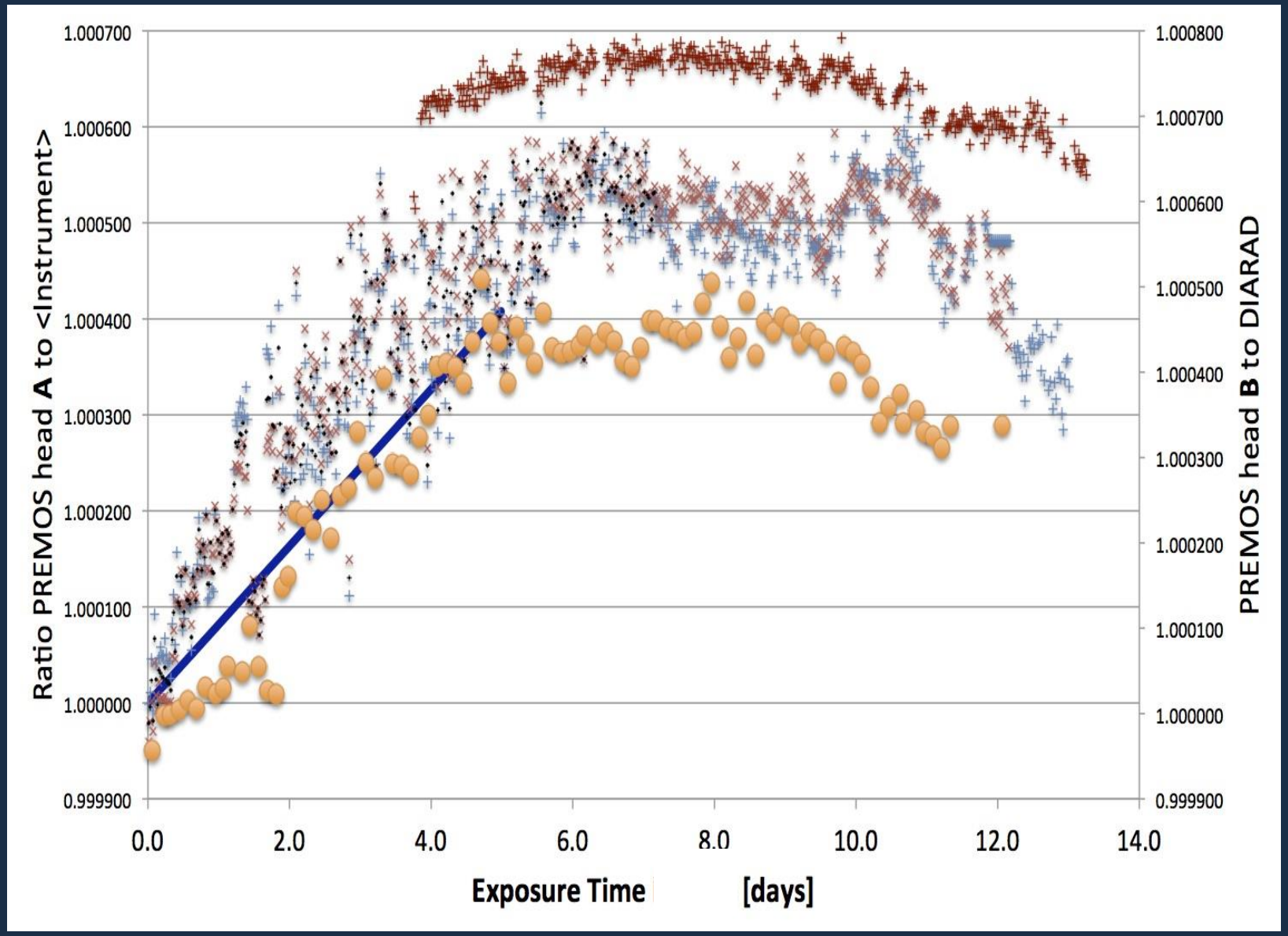
Sensitivity:
B **(2014) at same level as** ***A*** **(2010)?**

…
compare ***A*** **to** ***B*** **in first days of 2010**

?

Comparison … not yet finished

Is a *linear* increase of 81.7 ppm per exposure day correct?

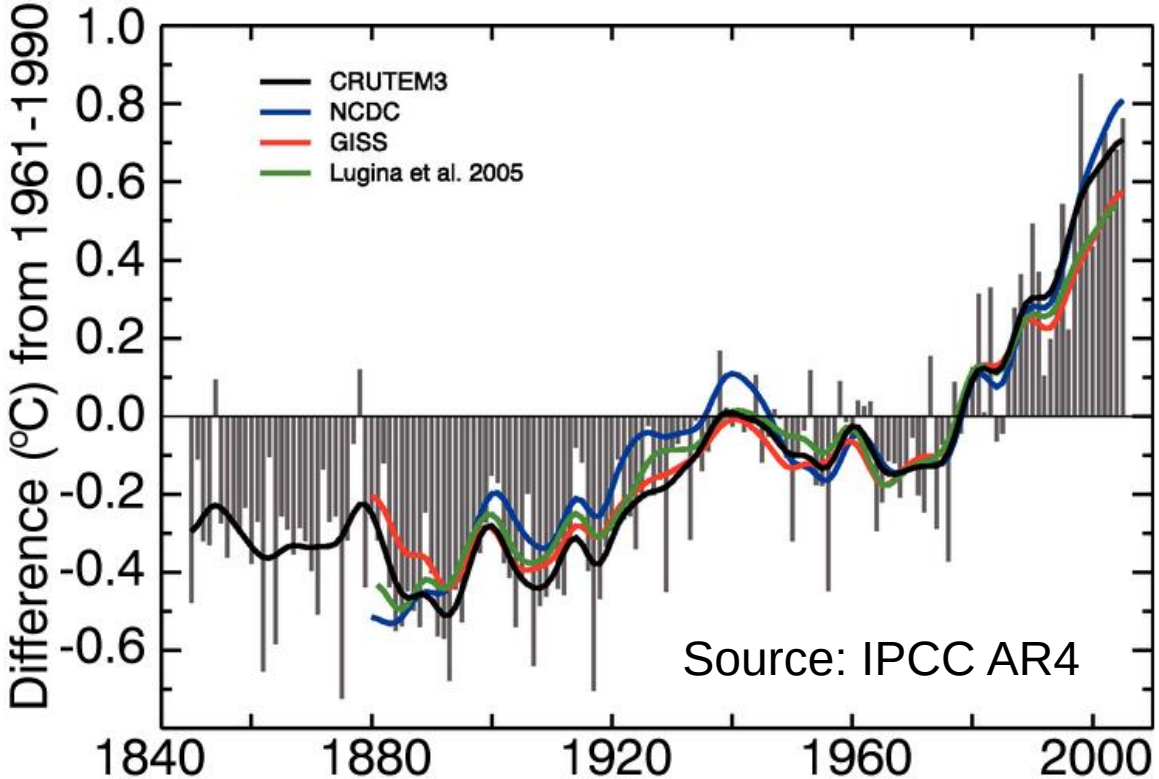

Ratio PREMOS head A to <Instrument>
PREMOS head B to DIARAD
Exposure Time [days]
1.000700
1.000600
1.000500
1.000400
1.000300
1.000200
1.000100
1.000000
0.999900
1.000800
1.000700
1.000600
1.000500
1.000400
1.000300
1.000200
1.000100
1.000000
0.999900
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0

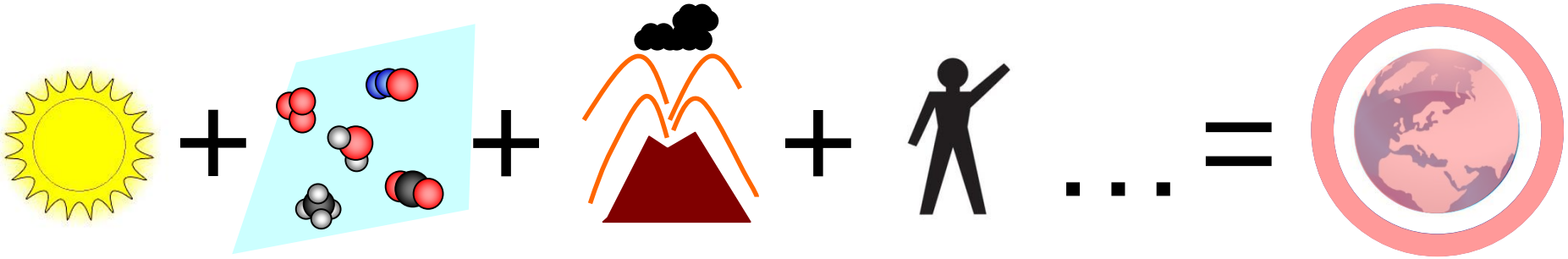
Take away points:

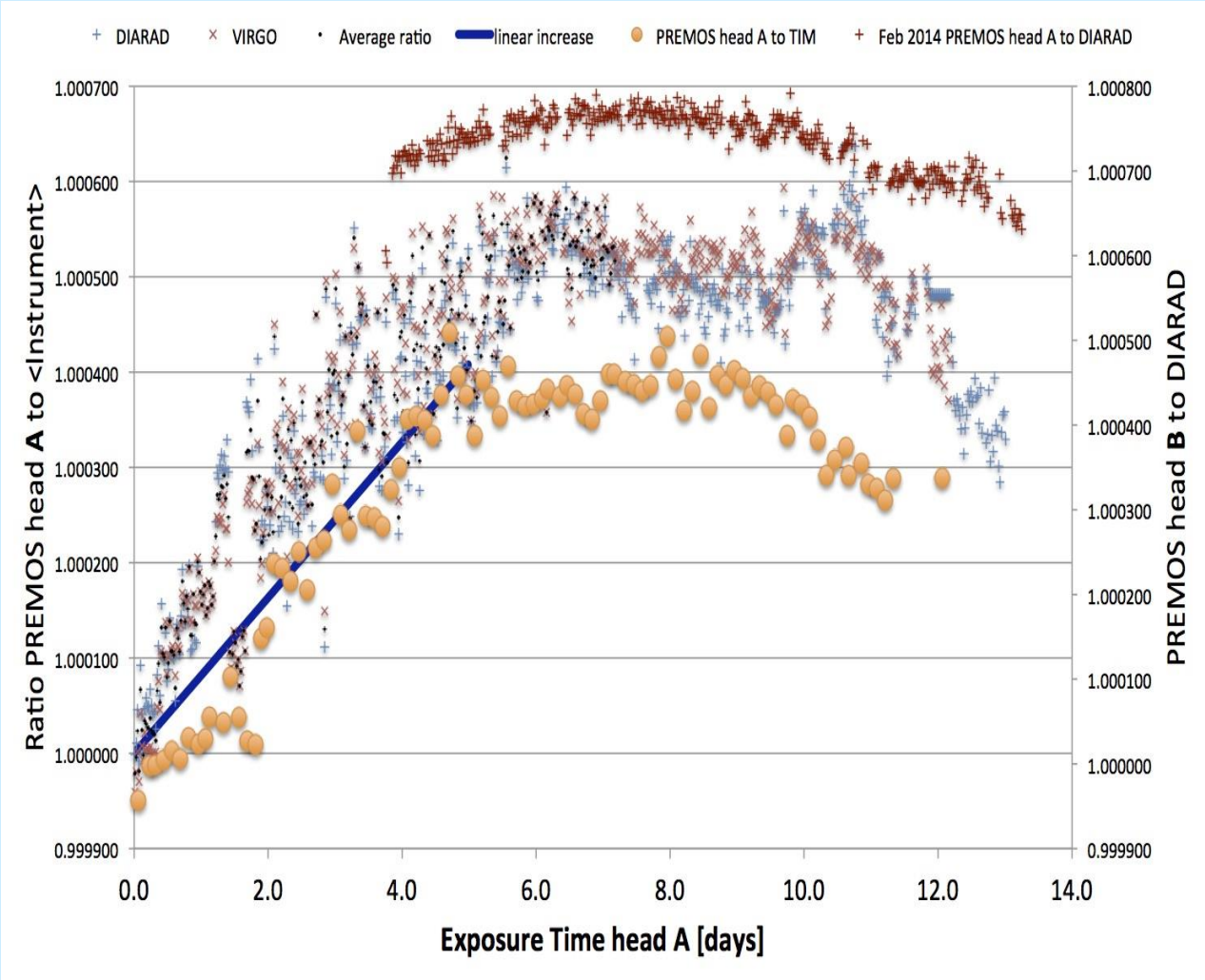
(i) PREMOS confirms 1361 Wm^{-2}
(ii) 2013/14 TSI composite issue
(iii) Currently assessing relative calibration… work in progress
(iv) SI continuity is imperative

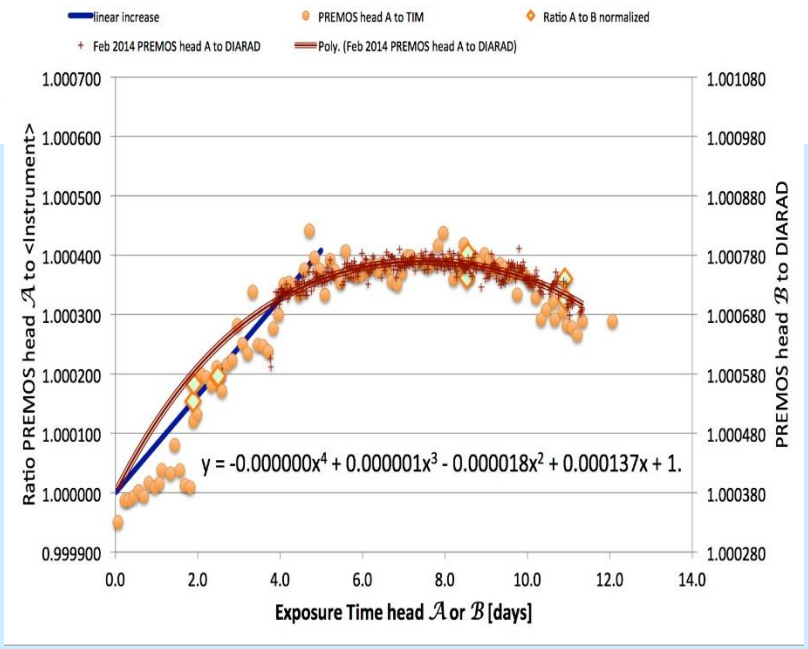
pmod wrc

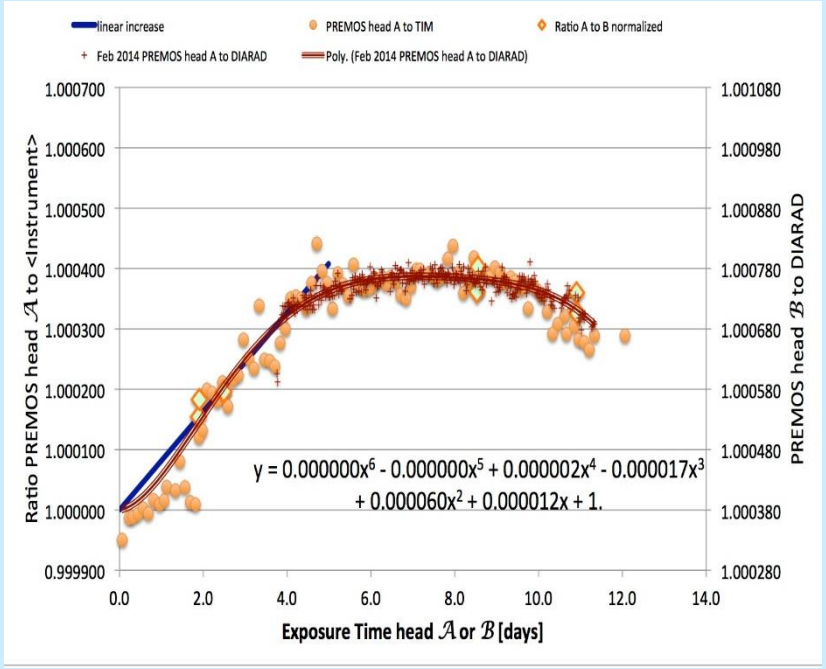
What is the Sun's role in global temperature change?

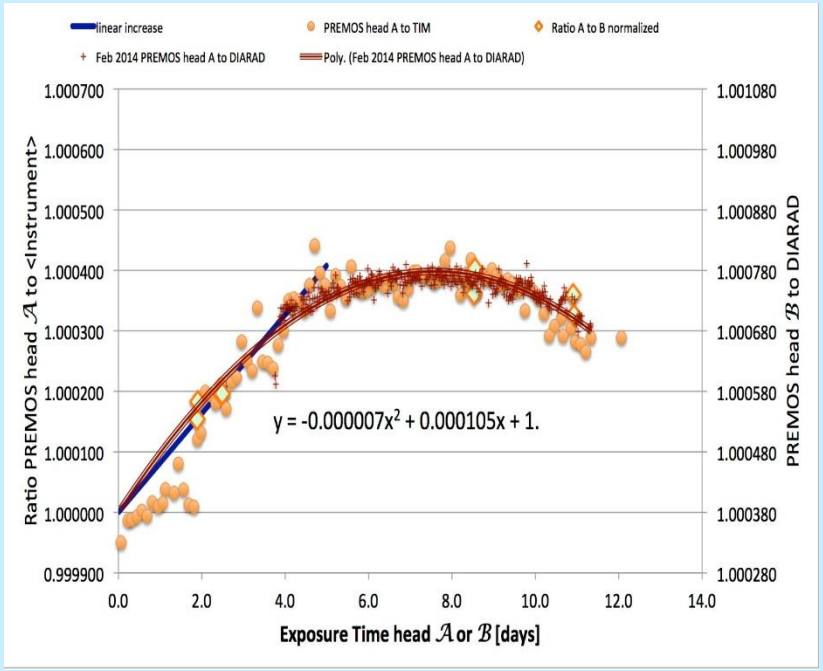





DIARAD
VIRGO
Average ratio
linear increase
PREMOS head A to TIM
Feb 2014 PREMOS head A to DIARAD
Ratio PREMOS head A to <Instrument>
PREMOS head B to DIARAD
Exposure Time head A [days]
1.000700
1.000600
1.000500
1.000400
1.000300
1.000200
1.000100
1.000000
0.999900
1.000800
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0


linear increase
PREMOS head A to TIM
Ratio A to B normalized
Feb 2014 PREMOS head A to DIARAD
Poly. (Feb 2014 PREMOS head A to DIARAD)
Ratio PREMOS head 𝒜 to <Instrument>
PREMOS head ℬ to DIARAD
Exposure Time head 𝒜 or ℬ [days]
y = -0.000000x^4 + 0.000001x^3 - 0.000018x^2 + 0.000137x + 1.


linear increase
PREMOS head A to TIM
Ratio A to B normalized
Feb 2014 PREMOS head A to DIARAD
Poly. (Feb 2014 PREMOS head A to DIARAD)
Ratio PREMOS head 𝒜 to <Instrument>
PREMOS head ℬ to DIARAD
Exposure Time head 𝒜 or ℬ [days]
y = 0.000000x^6 - 0.000000x^5 + 0.000002x^4 - 0.000017x^3
+ 0.000060x^2 + 0.000012x + 1.


linear increase
PREMOS head A to TIM
Ratio A to B normalized
Feb 2014 PREMOS head A to DIARAD
Poly. (Feb 2014 PREMOS head A to DIARAD)
Ratio PREMOS head 𝒜 to <Instrument>
PREMOS head ℬ to DIARAD
Exposure Time head 𝒜 or ℬ [days]
y = -0.000007x^2 + 0.000105x + 1.