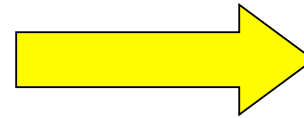
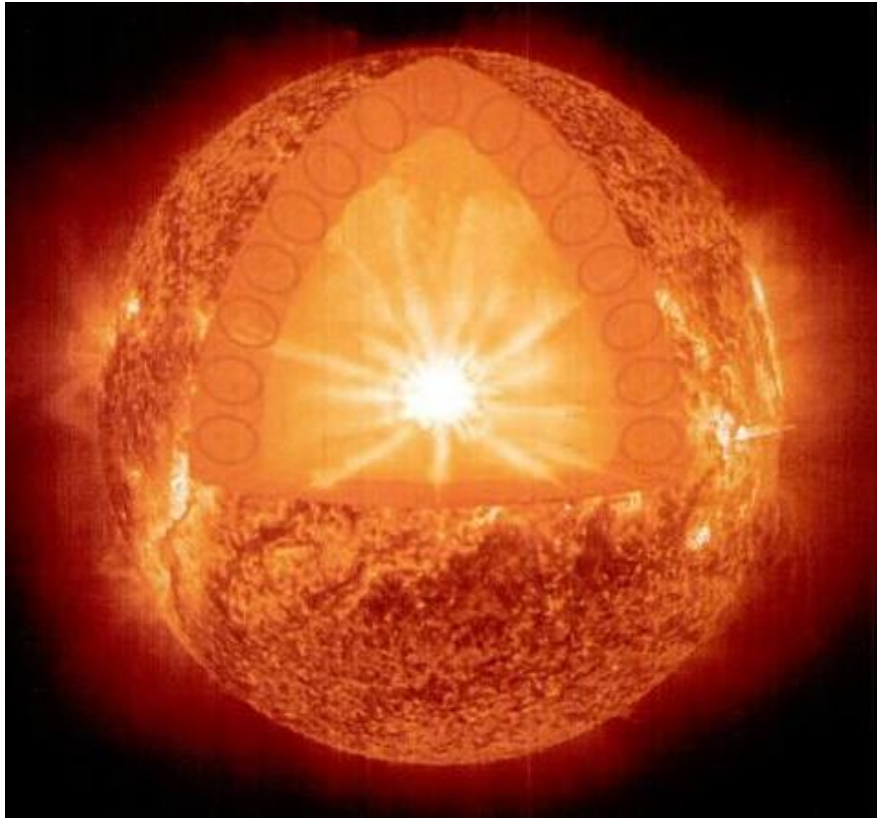


Achieving a Climate Data Record of Total Solar Irradiance

Science: Steven Dewitte, Sabri Mekaoui, Els
Janssen

Technology: André Chevalier, Christian
Conscience, Pierre Malcorps, Joel Pierrard,
Jean-Philippe Noel
STCE/RMIB

Incoming solar radiation



SOLAR
IRRADIANCE



Measurement of solar irradiance: Differential Absolute RADiometer DIARAD



- Instrument designed at RMIB by D. Crommelynck
- 11 space flights with 6 instruments for measurement Total Solar Irradiance

Space missions

RMIB

SPACELAB 1 NASA ESA	1983
ATLAS-I NASA STS-45	1992
EURECA ESA STS-46	1992
ATLAS-II NASA STS-56	1993
ATLAS-III NASA STS-66	1994
HITCHHIKER NASA STS-85	1997
HITCHHIKER NASA STS-95	1998
FREESTAR NASA STS-107	2003

now in space:

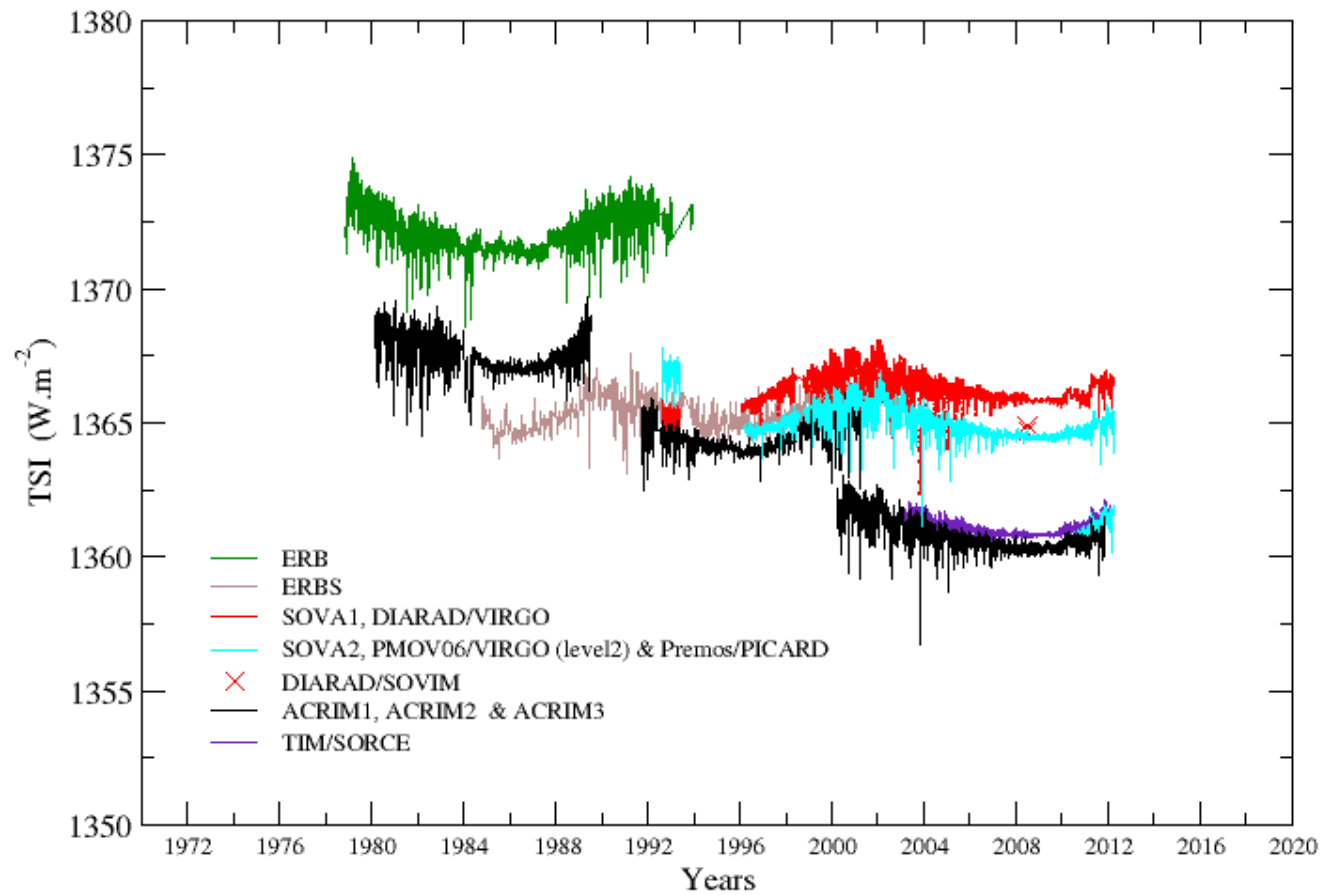
SOHO/VIRGO/DIARAD ESA Dec 1995 > 17 years

ISS/SOVIM/DIARAD ESA Feb. 2008 > 1 year

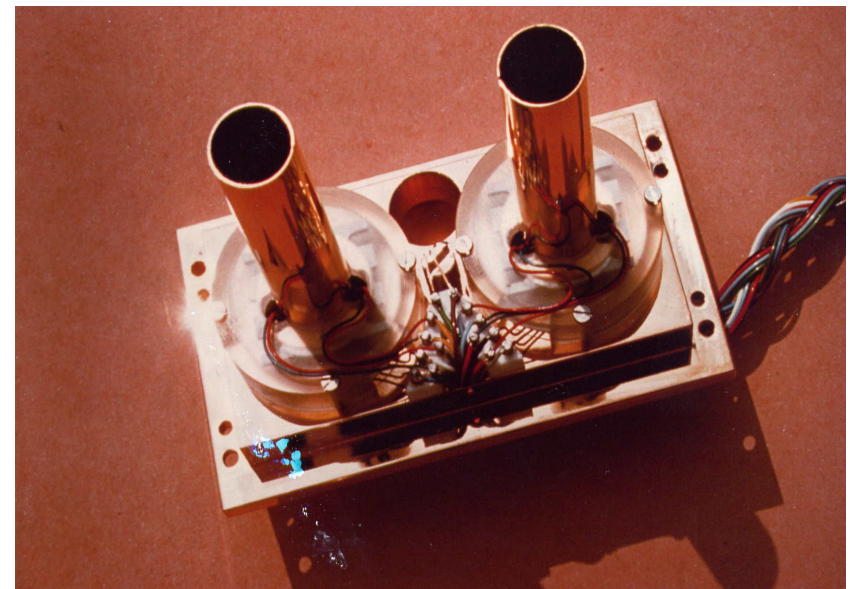
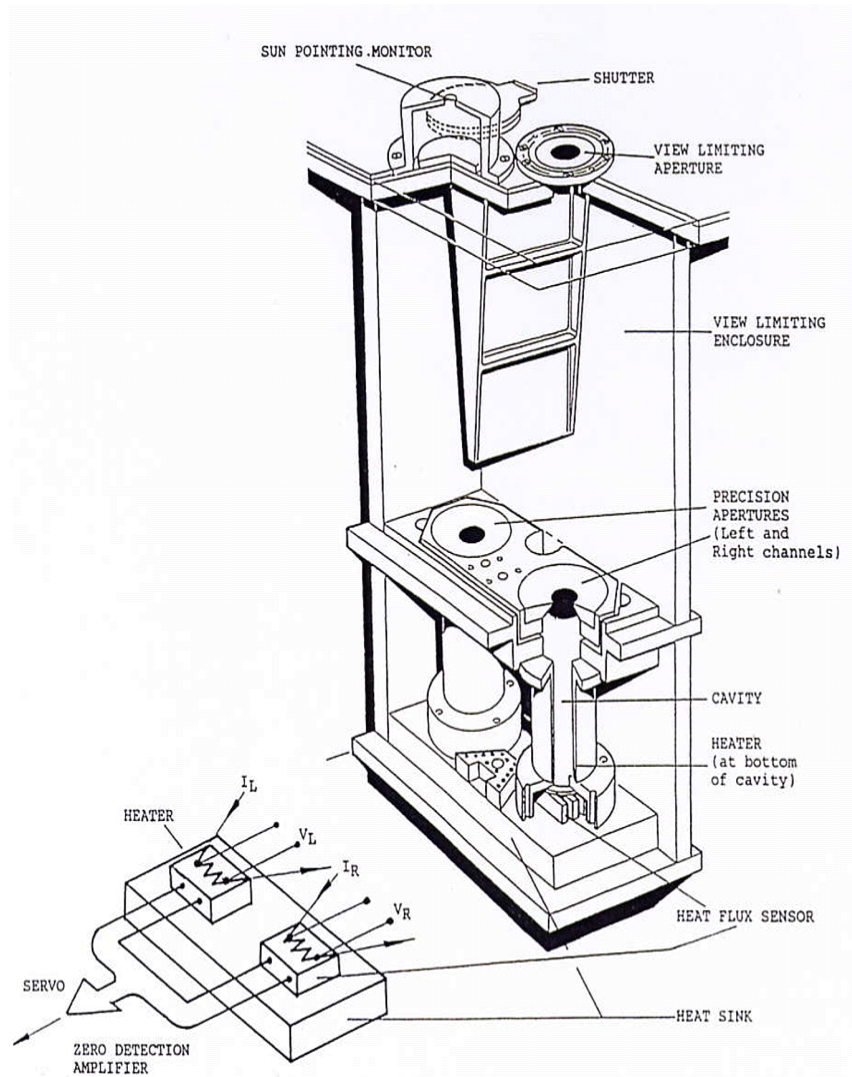
PICARD/SOVAP CNES July 2010 > 3 years



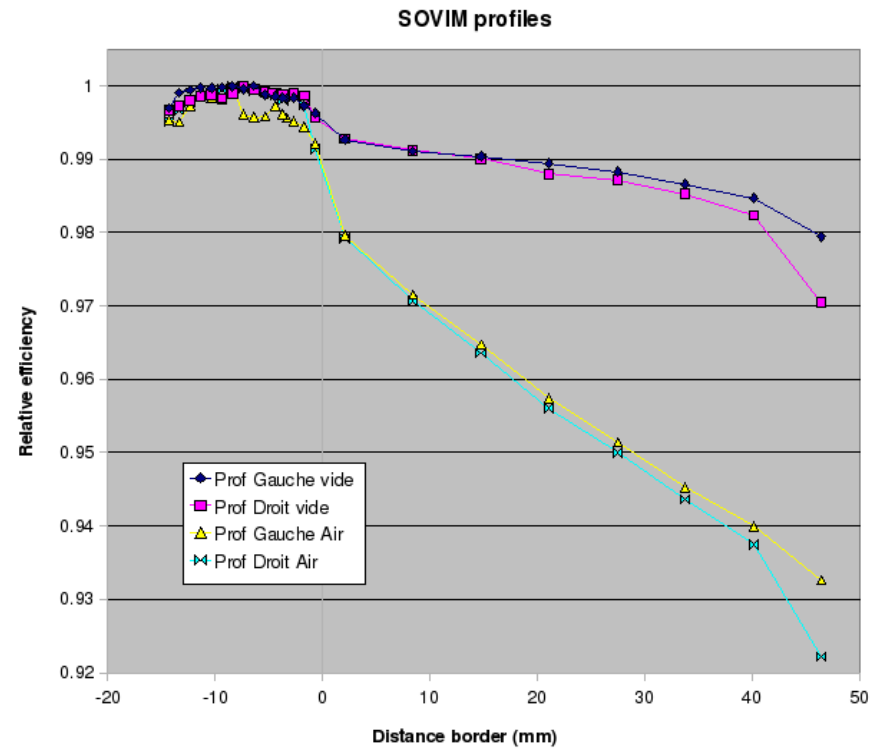
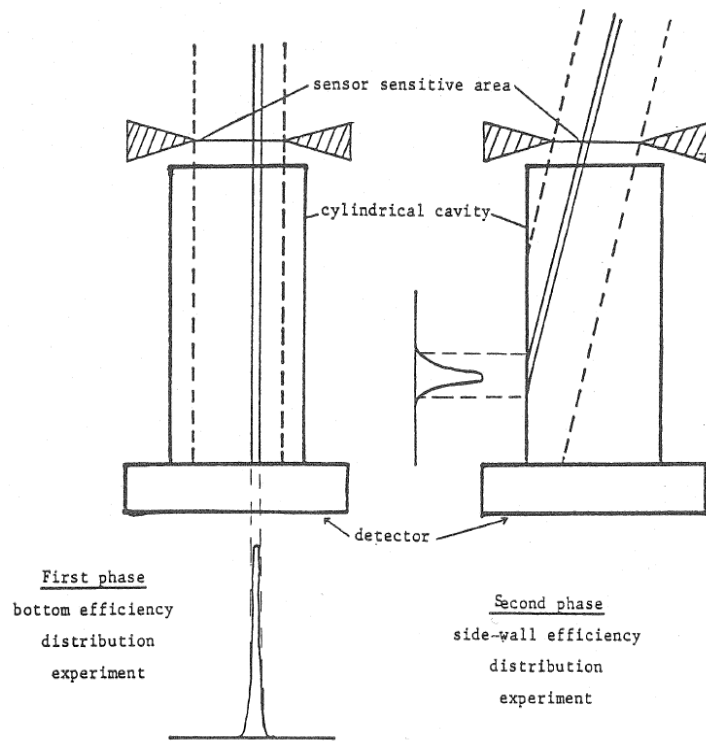
TSI absolute value is under debate.



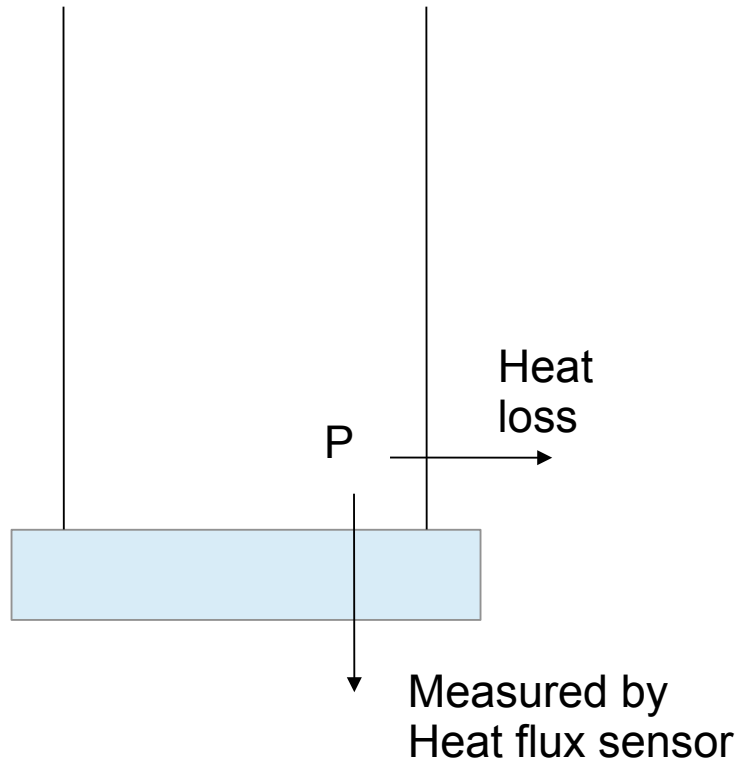
DIARAD principle



CHARACTERISATION MEASUREMENTS FOR DIARAD/ SOVIM



Revision DIARAD absolute level



Old assumption:

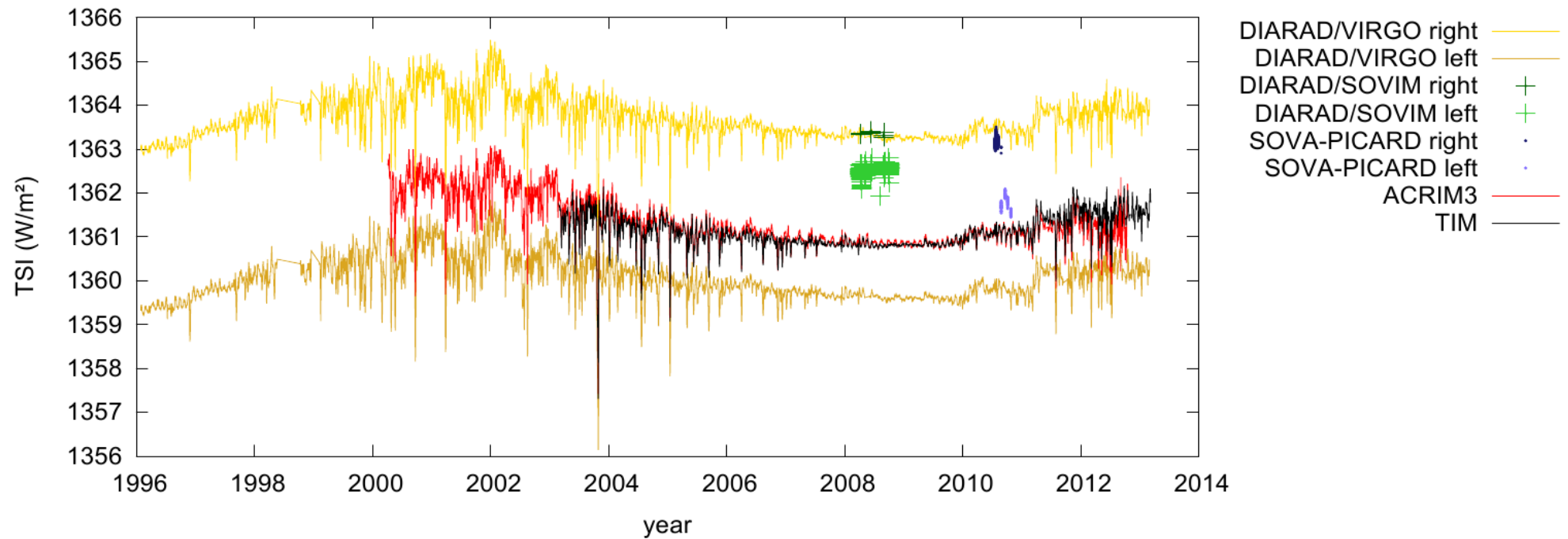
$$P_{el} = \alpha_{th,opt} P_{opt}$$

New assumption:

$$\alpha_{th,el} P_{el} = \alpha_{th,opt} P_{opt}$$

$\alpha_{th,el}$ and $\alpha_{th,opt}$
determined from same
characterisation
measurements

Revised DIARAD TSI measurements



Revised DIARAD TSI level

Values reported to solar minimum at end cycle 23, 1 sigma uncertainties

DIARAD/SOVIM:

1362.89 +/- 0.37 W/m²

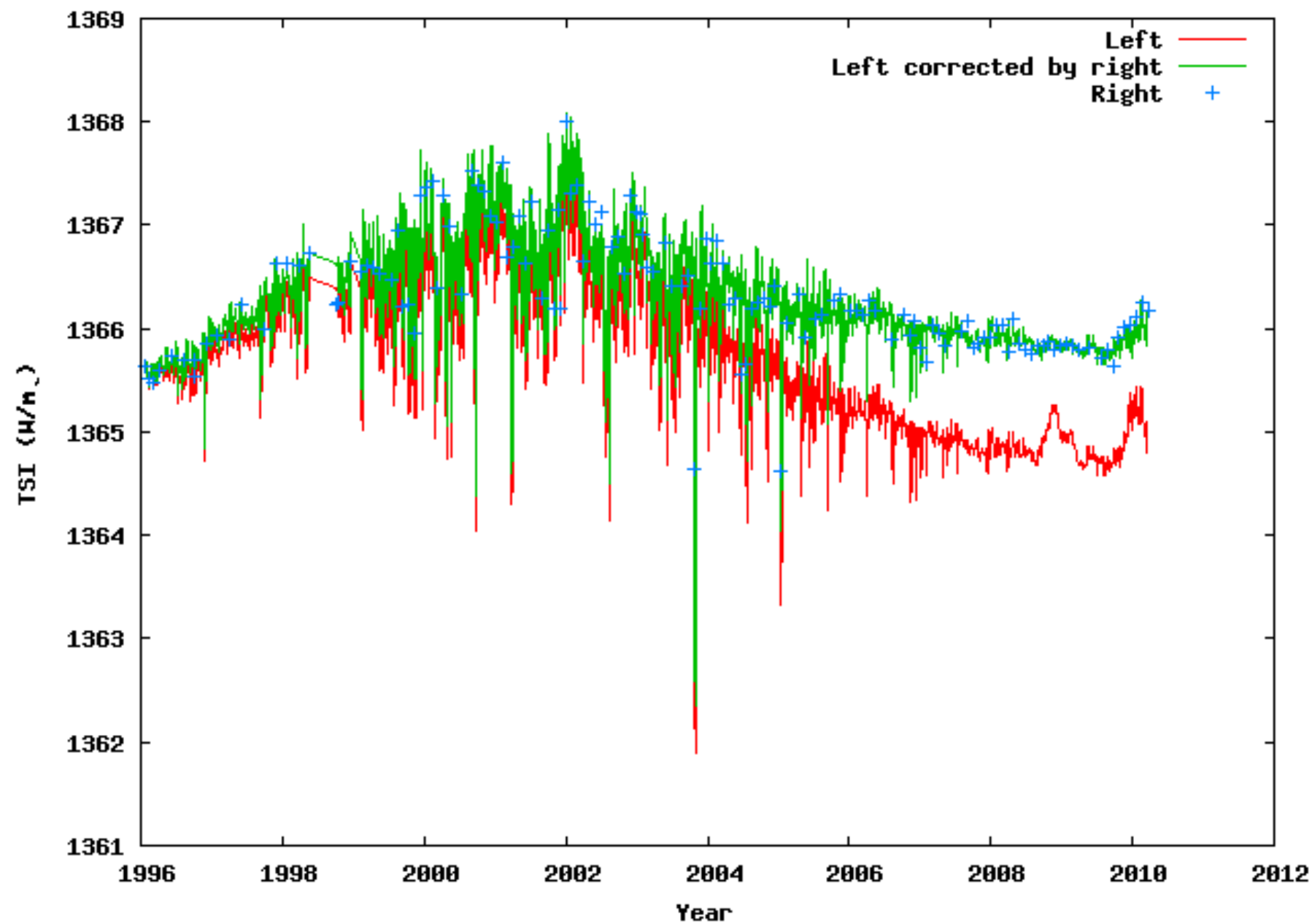
Mean DIARAD/SOVIM, SOVA-PICARD:

1362.61 +/- 0.36 W/m²

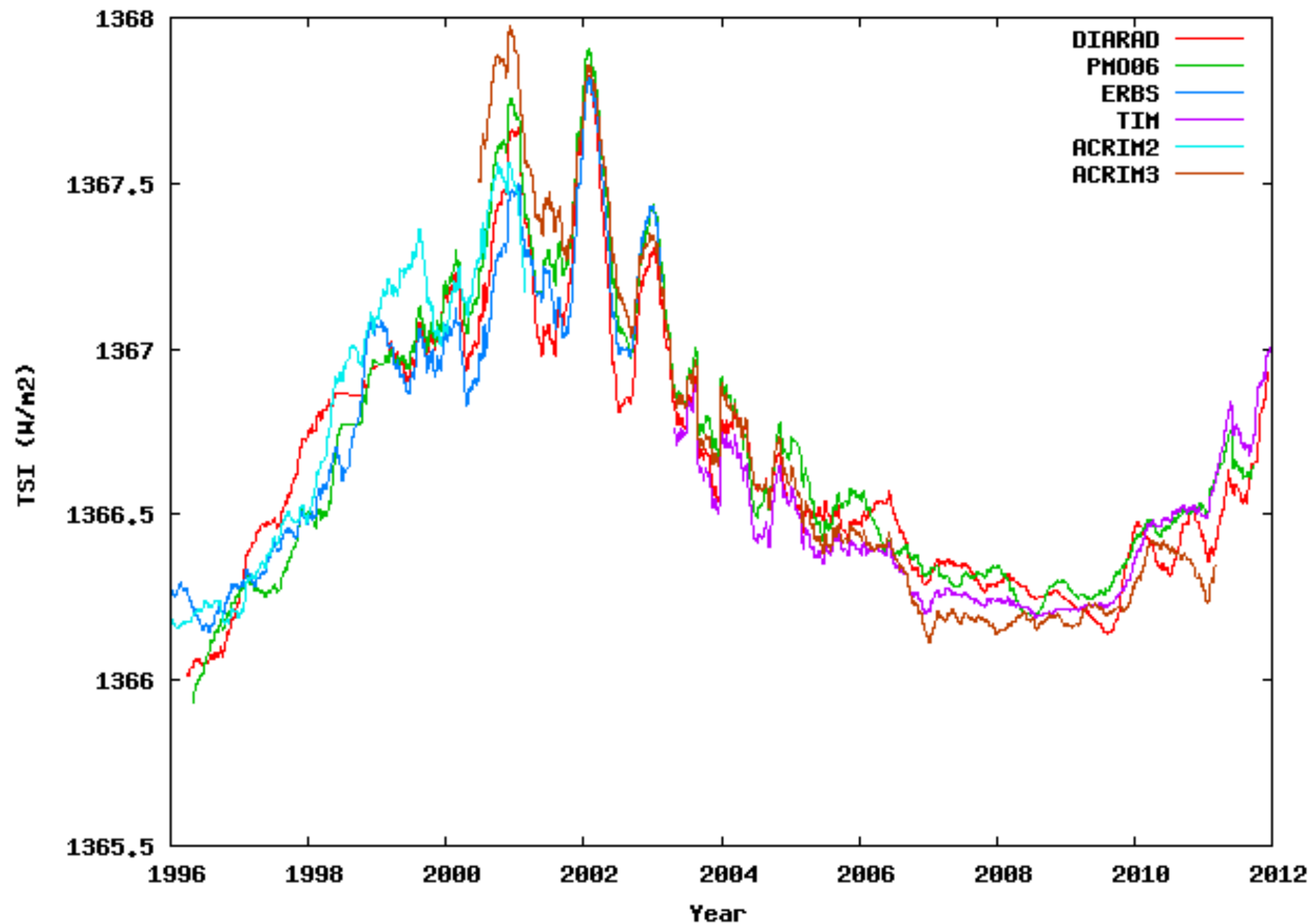
Mean DIARAD/SOVIM, SOVA-PICARD,
DIARAD/VIRGO:

1362.20 +/- 0.65 W/m²

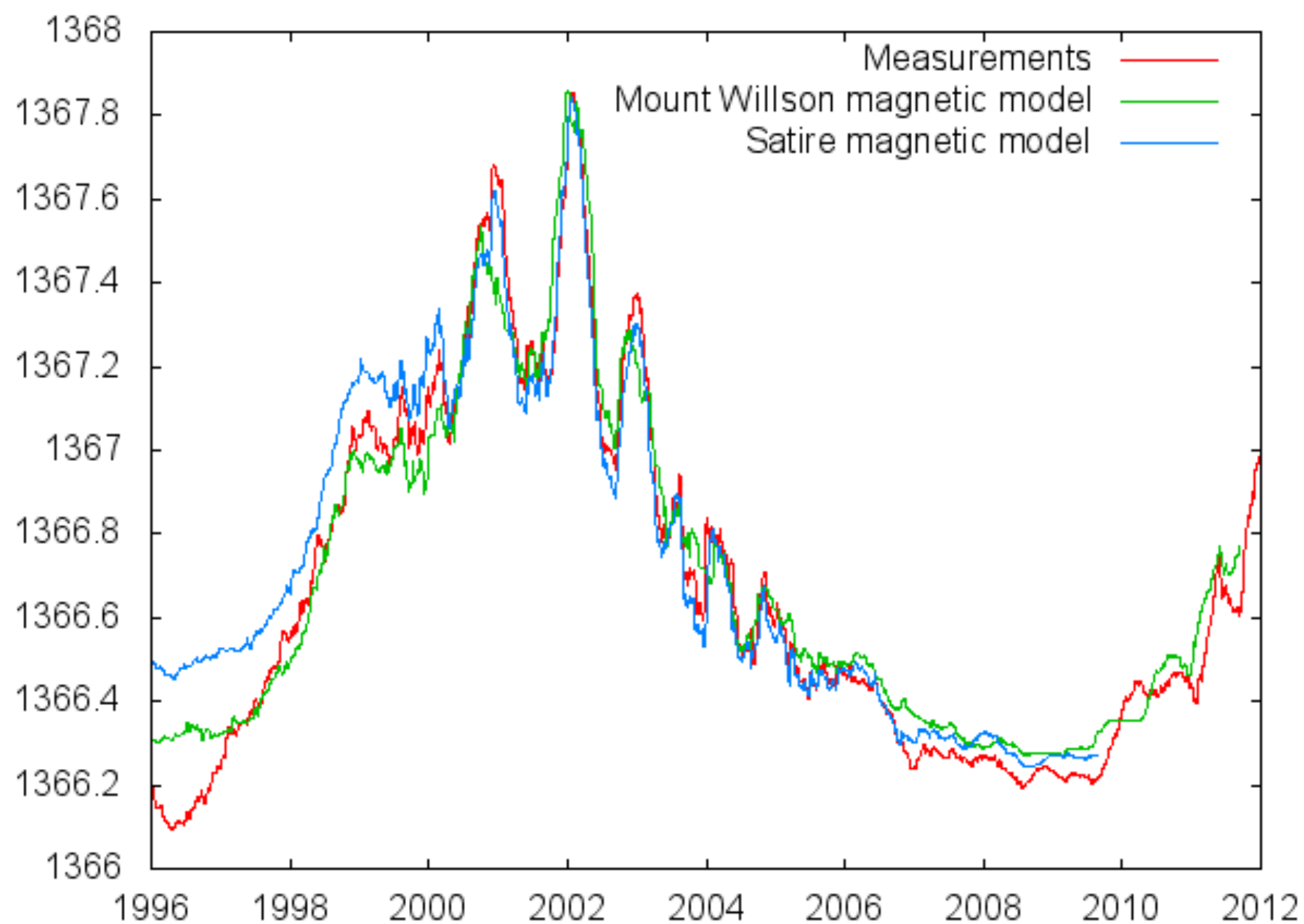
DIARAD/VIRGO Total Solar Irradiance



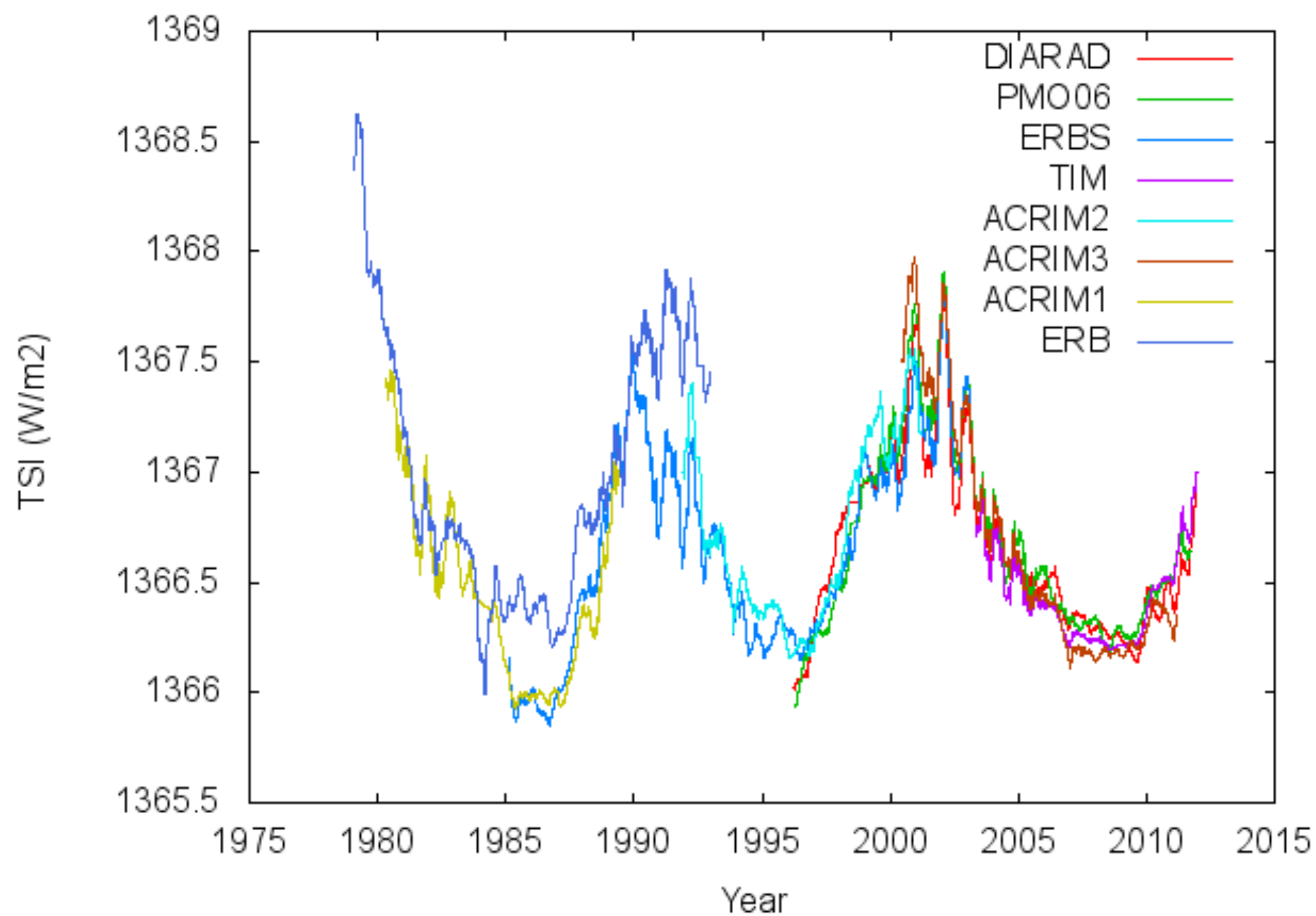
TSI instruments: 121 day running mean



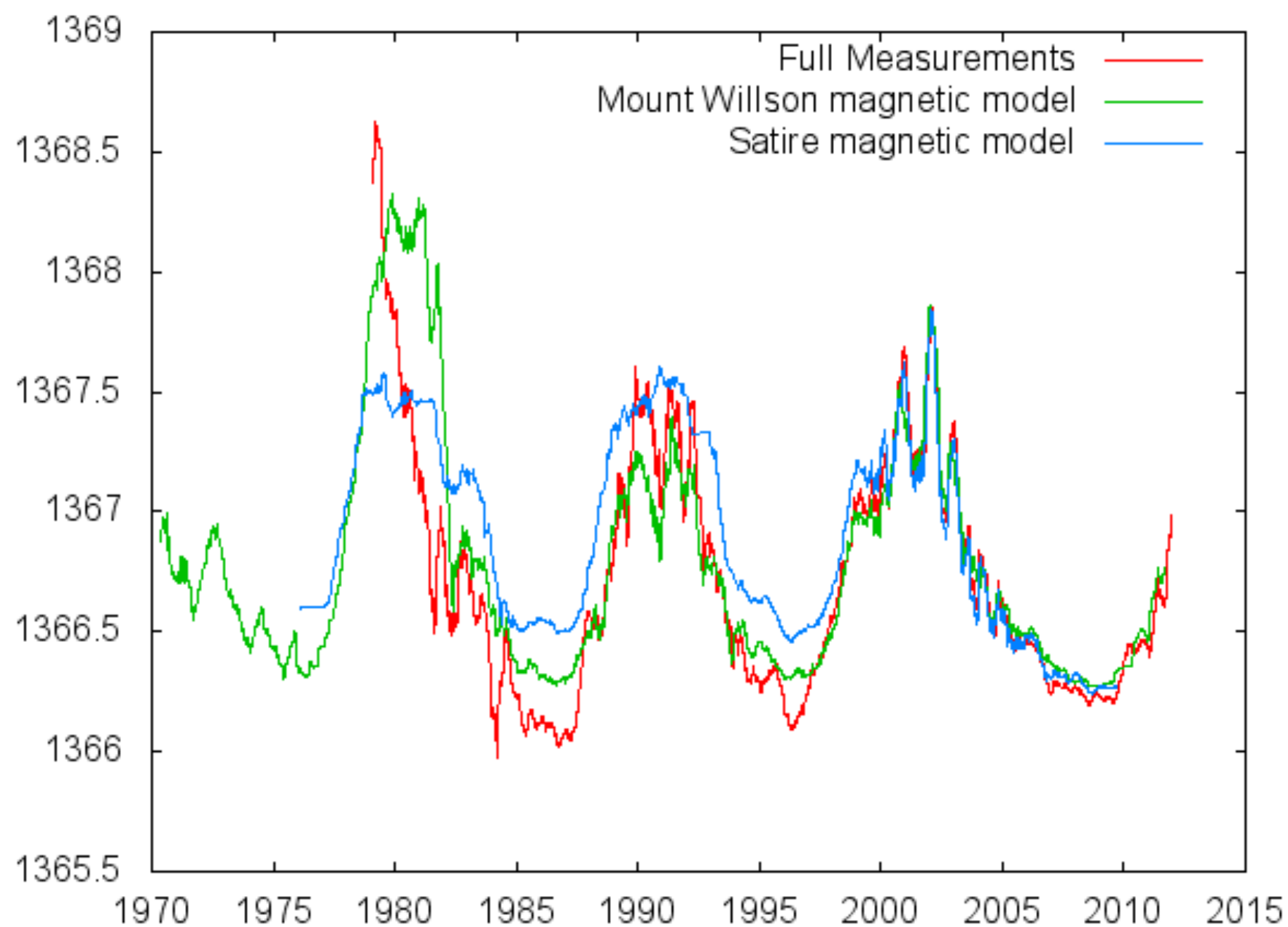
121 day running mean



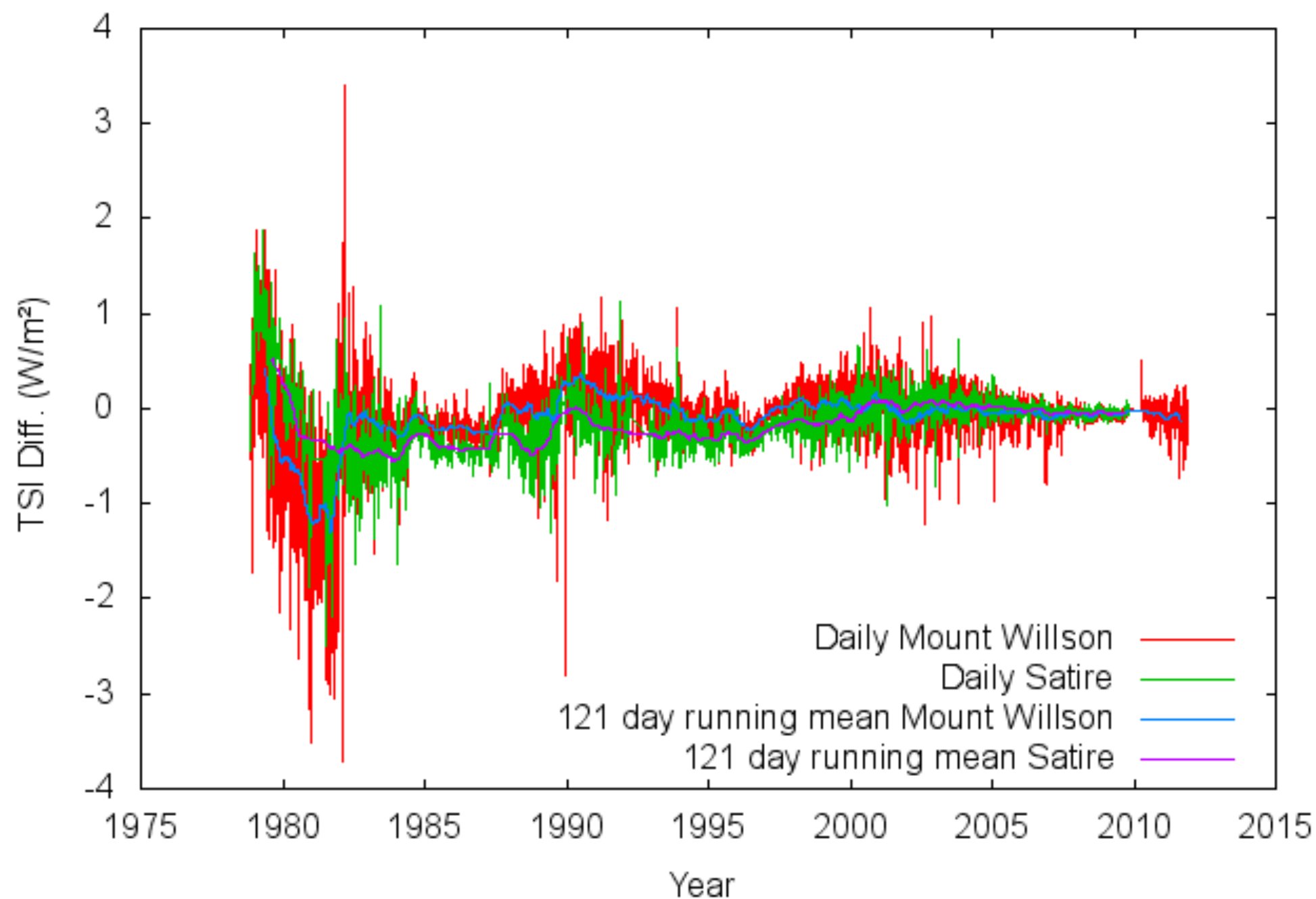
TSI instruments: 121 day running mean



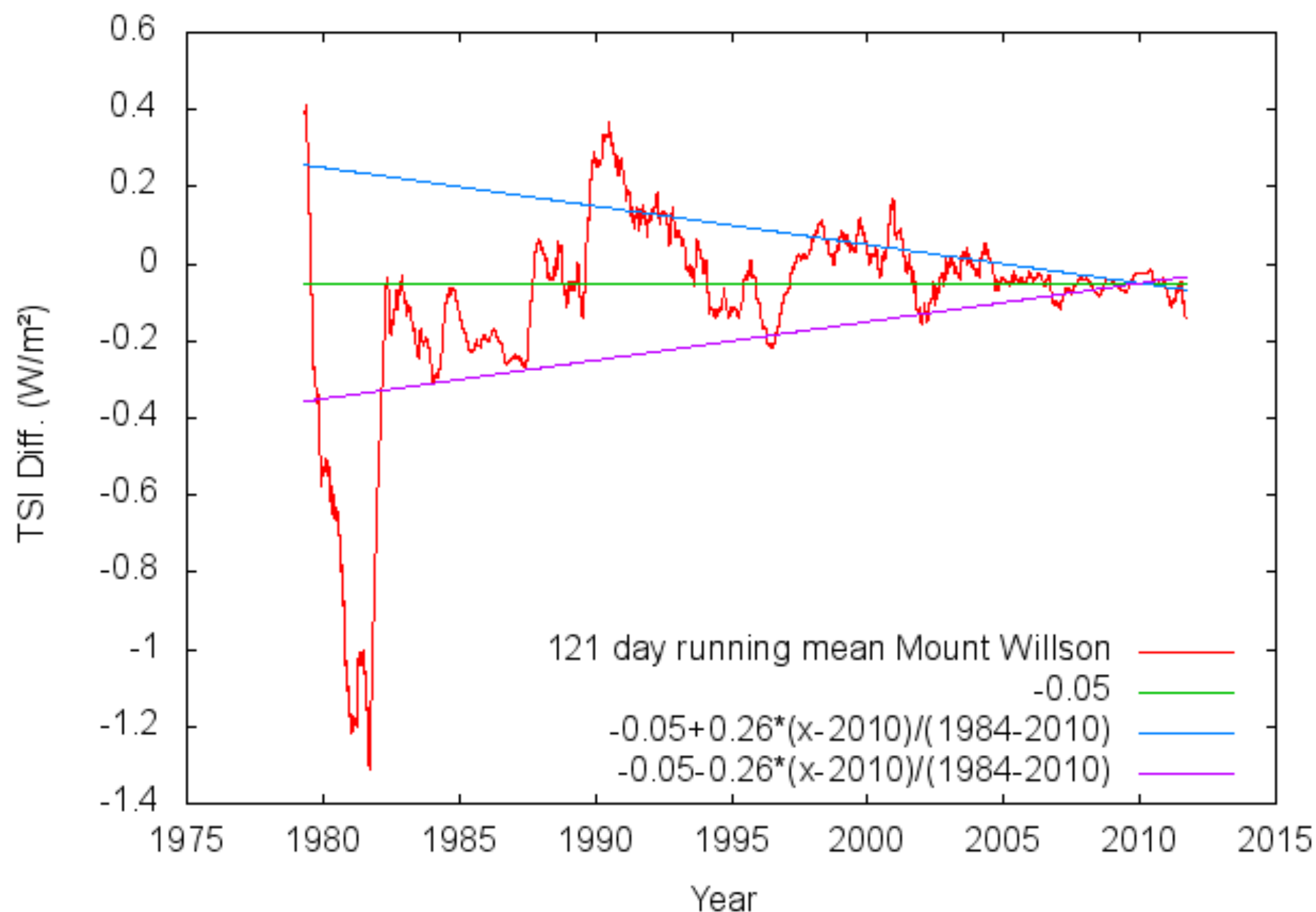
121 day running mean



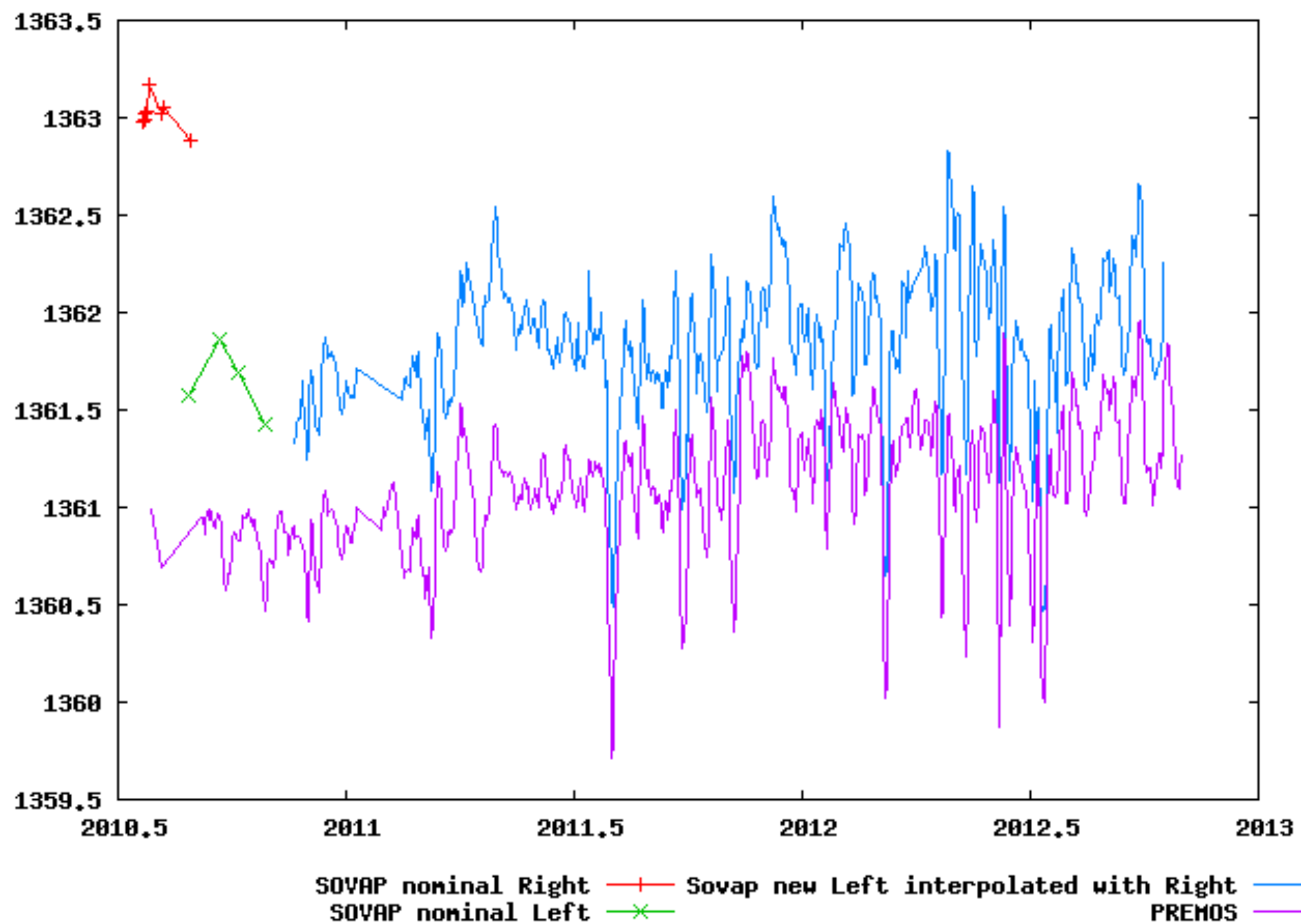
Difference TSI composite measurements to



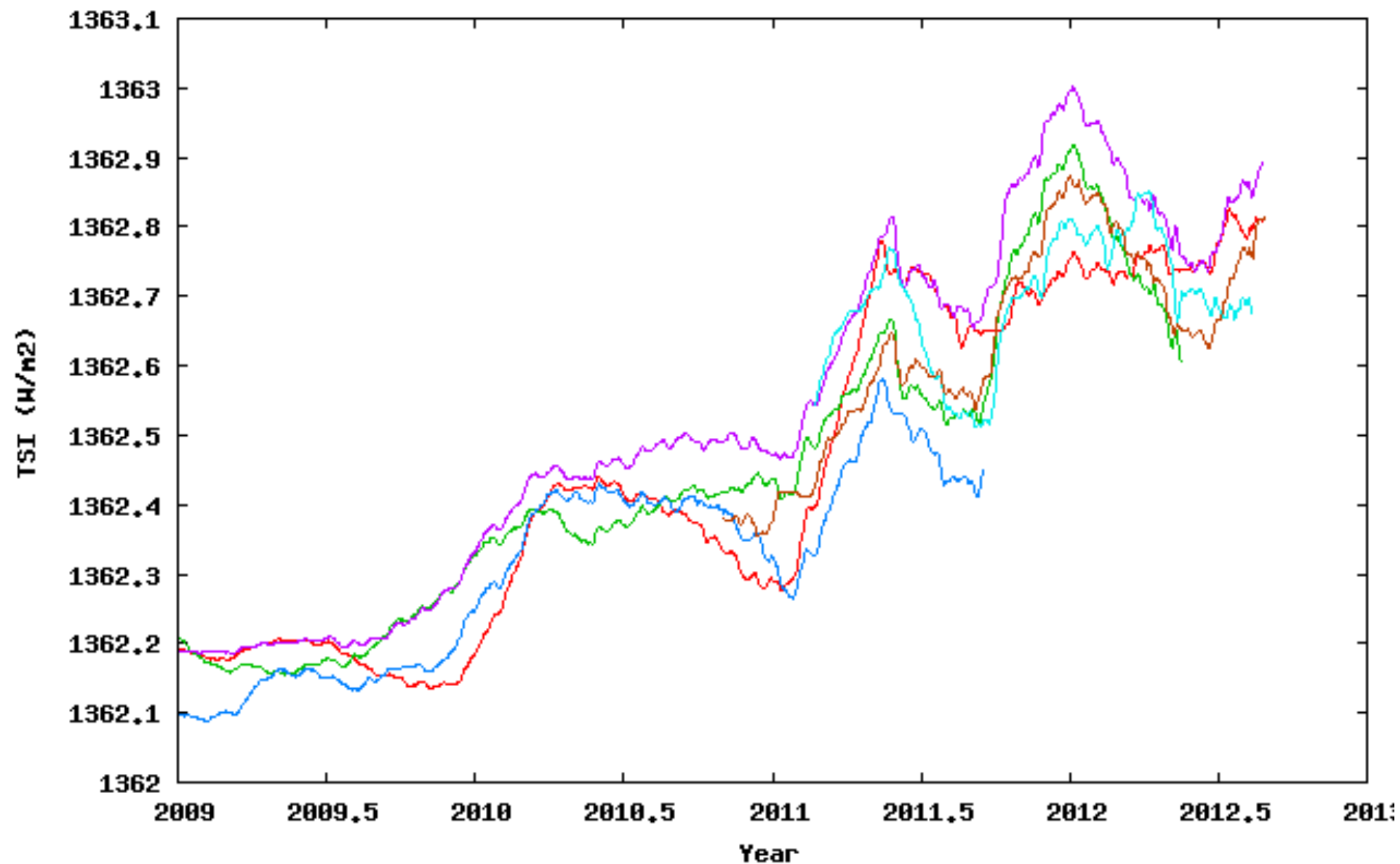
Difference TSI composite measurements to



Daily mean Picard Total Solar Irradiance

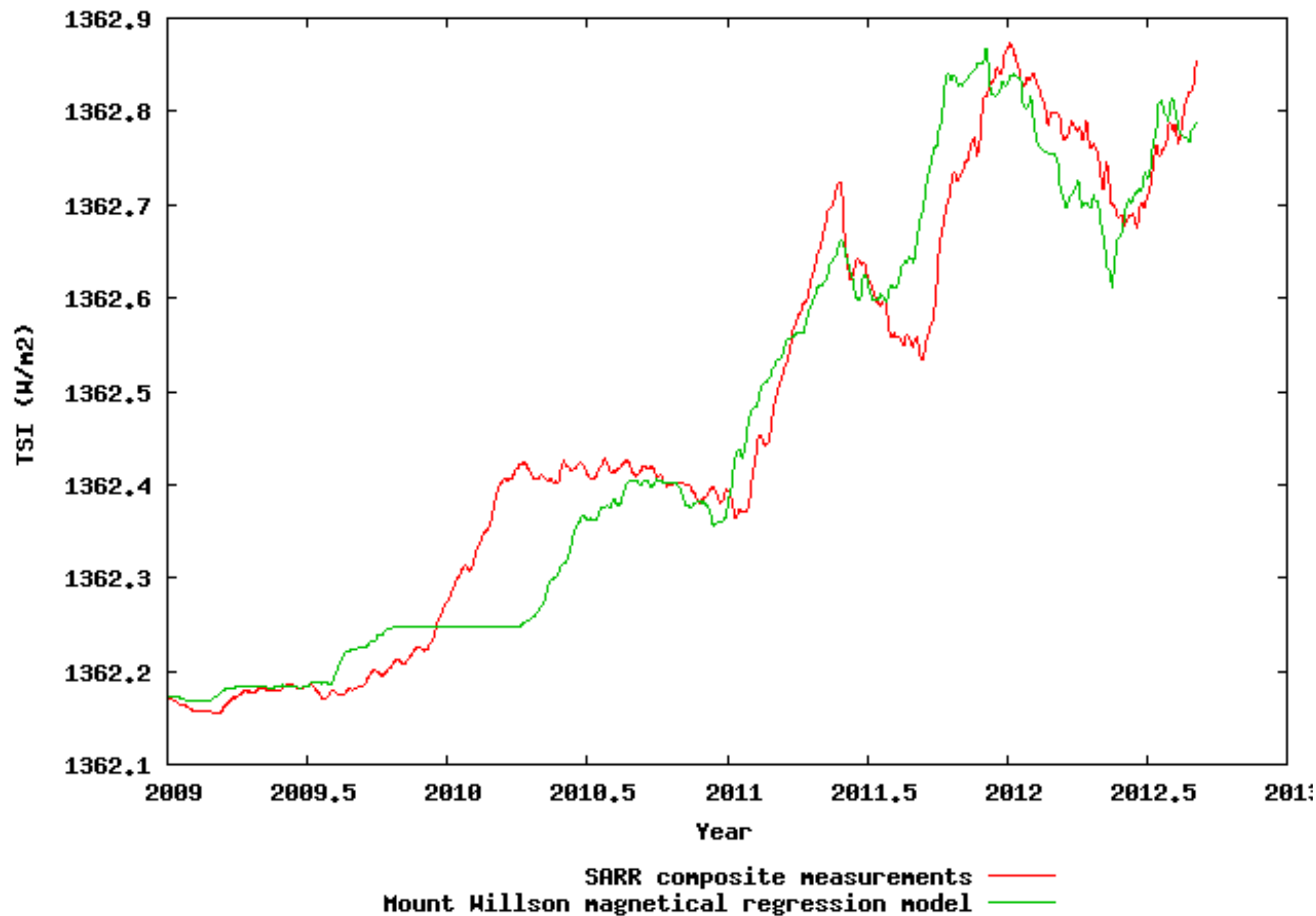


121 day running mean TSI

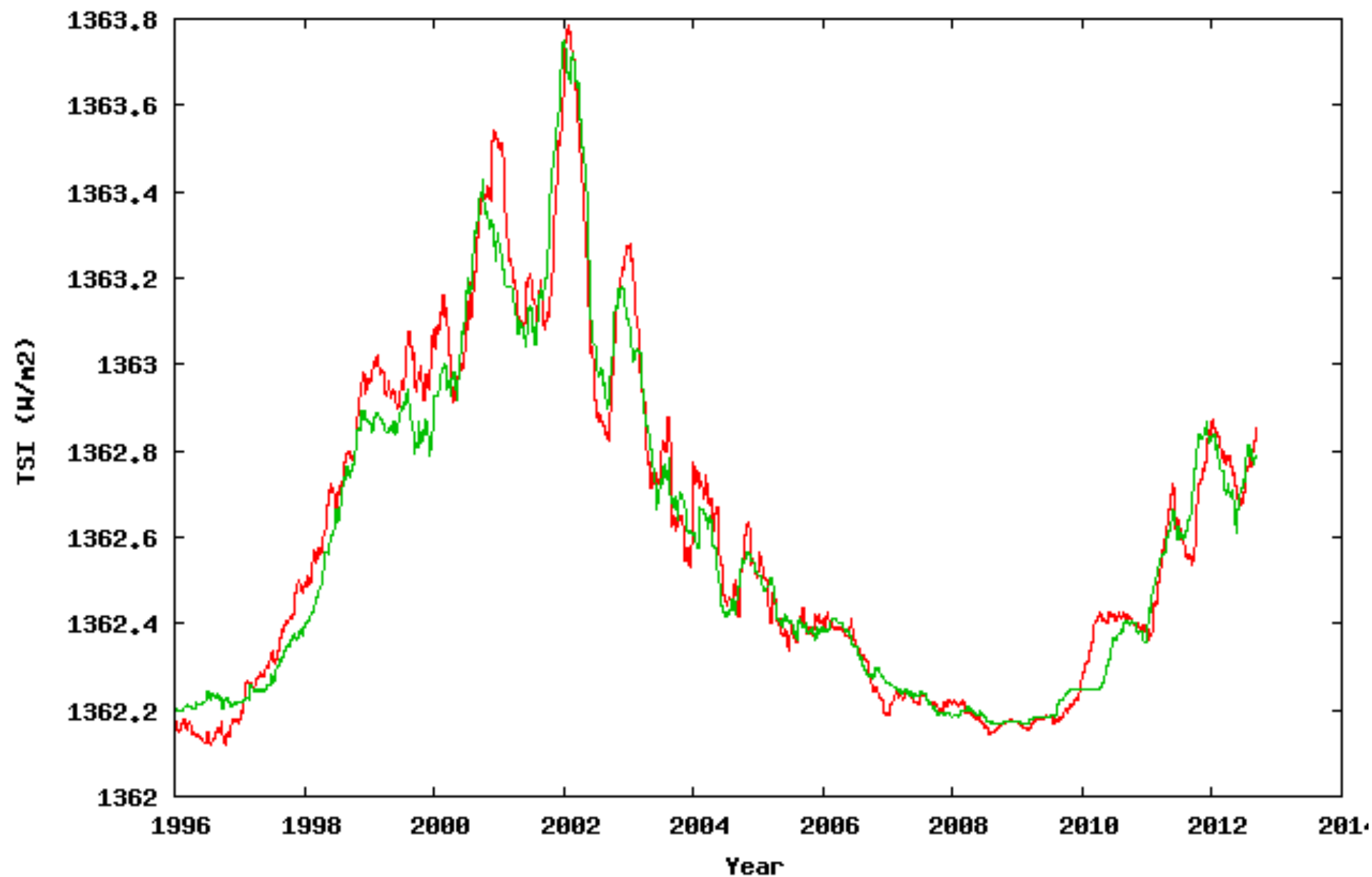


DIARAD Left +1901ppn = Right -766ppn	TIM +1009ppn
PM006B -2306ppn	SOVAP Left -480ppn = Right +480ppn
ACRIM3 +1334ppn	PREMOS +1135ppn

121 day running mean Total Solar Irradiance

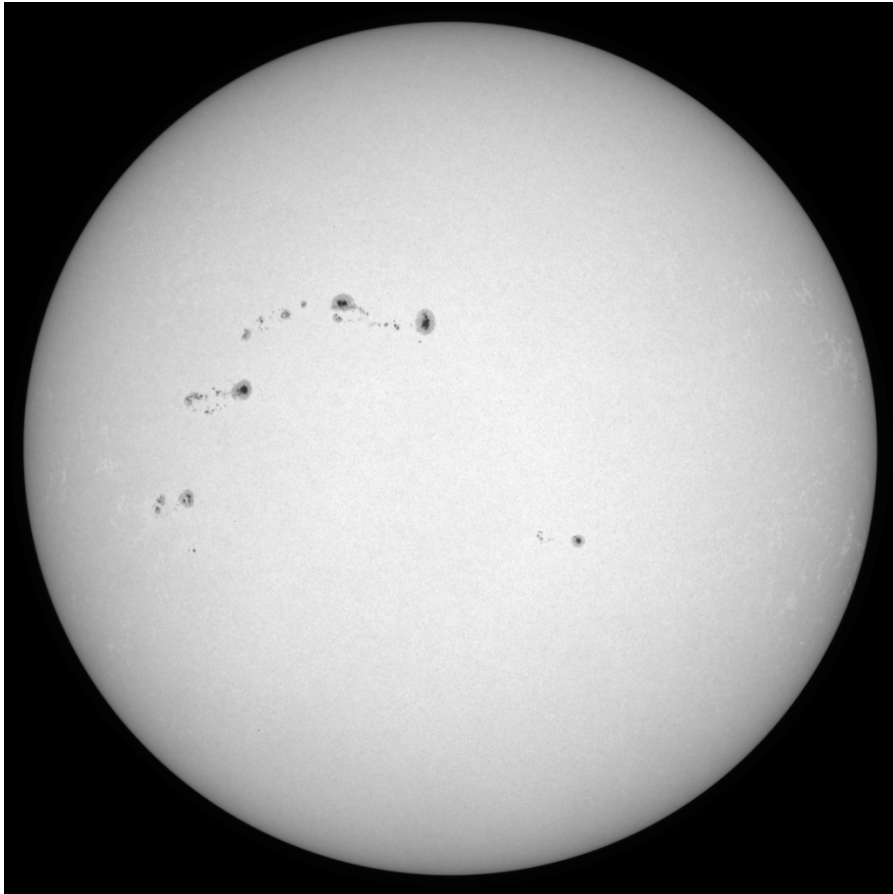


121 day running mean Total Solar Irradiance



SARR composite measurements —
Mount Willson magnetical regression model —

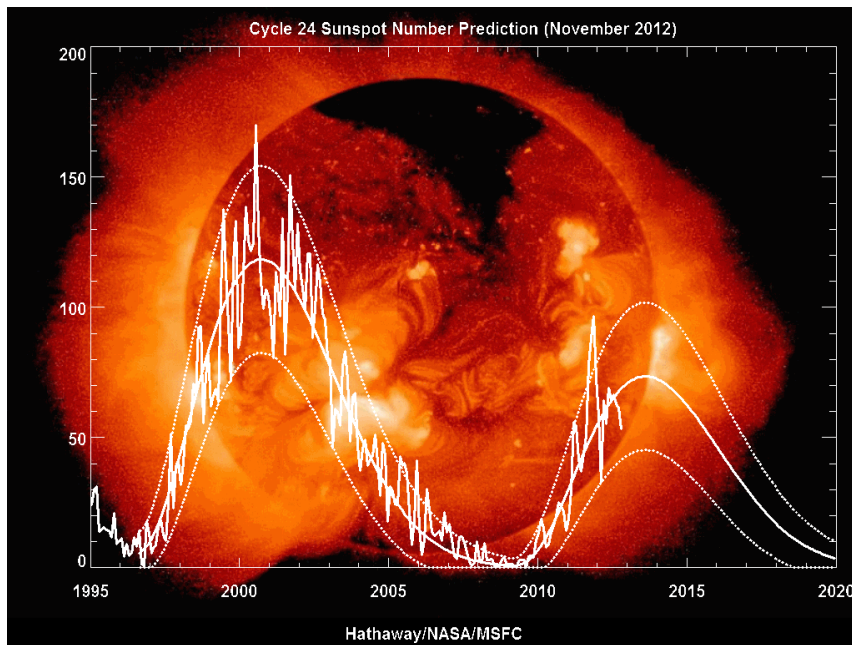
Sunspots



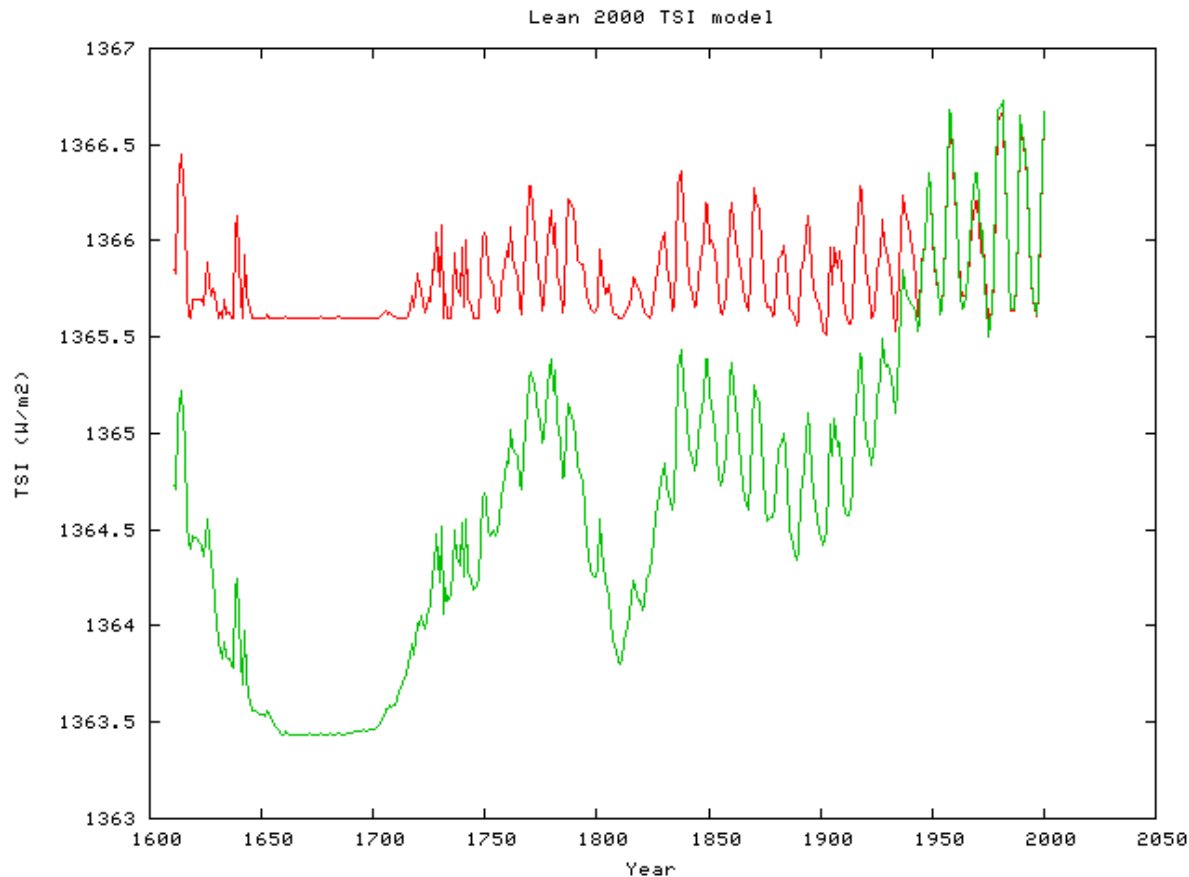
- Sunspots:
direct observation,
11 year cycle
- First observed by G.
Galilei [1564-1642]
- The sunspot
timeseries is currently
under review !

Gleissberg minimum cycle

- Lowest cycle since 1906
- Maximum in fall 2013



Classical view long term TSI reconstruction



- Red: extrapolated
- Green: + modelled long term variation
- No longer credible with sunspot review + current low cycle !

Conclusions

- Even after 30 years, the work is not finished for the construction a Total Solar Irradiance Climate Data Record ...
- DIARAD absolute level has been revised, it remains an independent absolute radiometer.
- Individual instruments need ageing correction from a backup channel with low exposure.
- A composite from overlapping independent instruments needs to be made for quantifying the long term TSI variation.
- The measured TSI variation can be explained/validated from magnetogram based regression models
- The current unusual cycle 24 will give us a direct measurement of the TSI variation at time scales beyond 11 years.