TOTAL SOLAR IRRADIANCE (TSI VARIABILITY: 1978-2002

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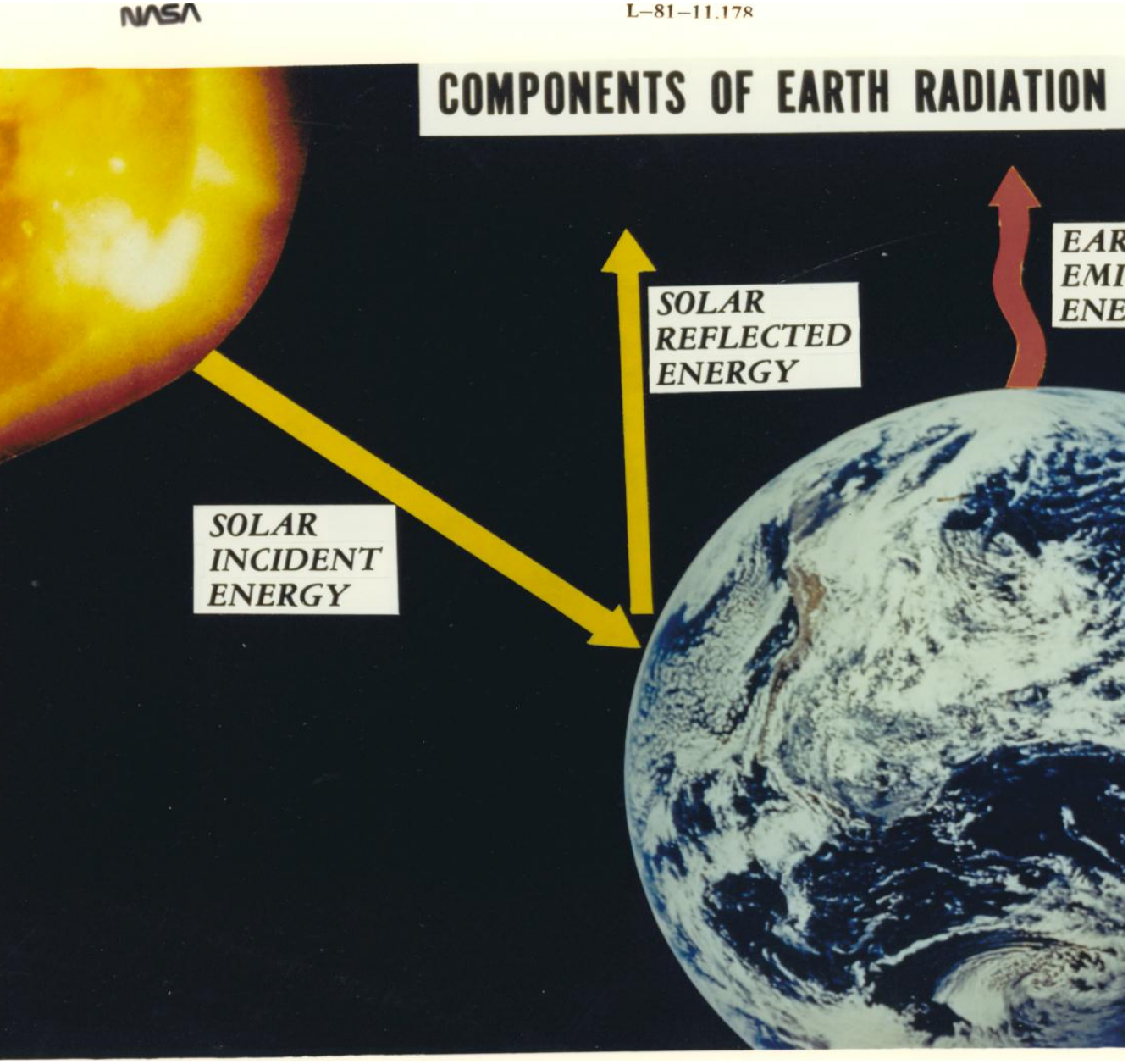

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SUMMARY

365 Wm^{-2} IS MEAN VALUE OF TSI DURING PERIODS OF MINIMUM SOLAR MAGNETIC ACTIVITIY.

.4 Wm^{-2} [0.1 %] IS THE MAGNITUDE OF THE 11-YEAR SUNSPOT CYCLE], LONG-TERM TSI VARIABILITY COMPONENT.

4-YEAR DATA BASE OF TSI MEASUREMENTS DOES NOT SUGGEST THE PRESENT OF ANY ADDITIONAL LONG-TERM TSI COMPONENTS.

1365 Wm^{-2} APPEARS TO BE THE BEST VALUE OF TSI DURING PERIODS OF MINIMUM SOLAR MAGNETIC ACTIVITIY.

1.4 Wm^{-2} [0.1 %] IS THE MAGNITUDE F THE 11-YEAR SUNSPOT CYCLE], ONG-TERM TSI VARIABILITY OMPONENT.

24-YEAR DATA BASE OF TSI EASUREMENTS DOES NOT UGGEST THE PRESENT OF ANY DDITIONAL LONG-TERM TSI OMPONENTS.

OUTLINE

ESCRIPTIONS OF MECHANISMS OF TSI VARIABILITY

SI CHARACTERIZATIONS USING SOLAR MAGNETIC INDICES.

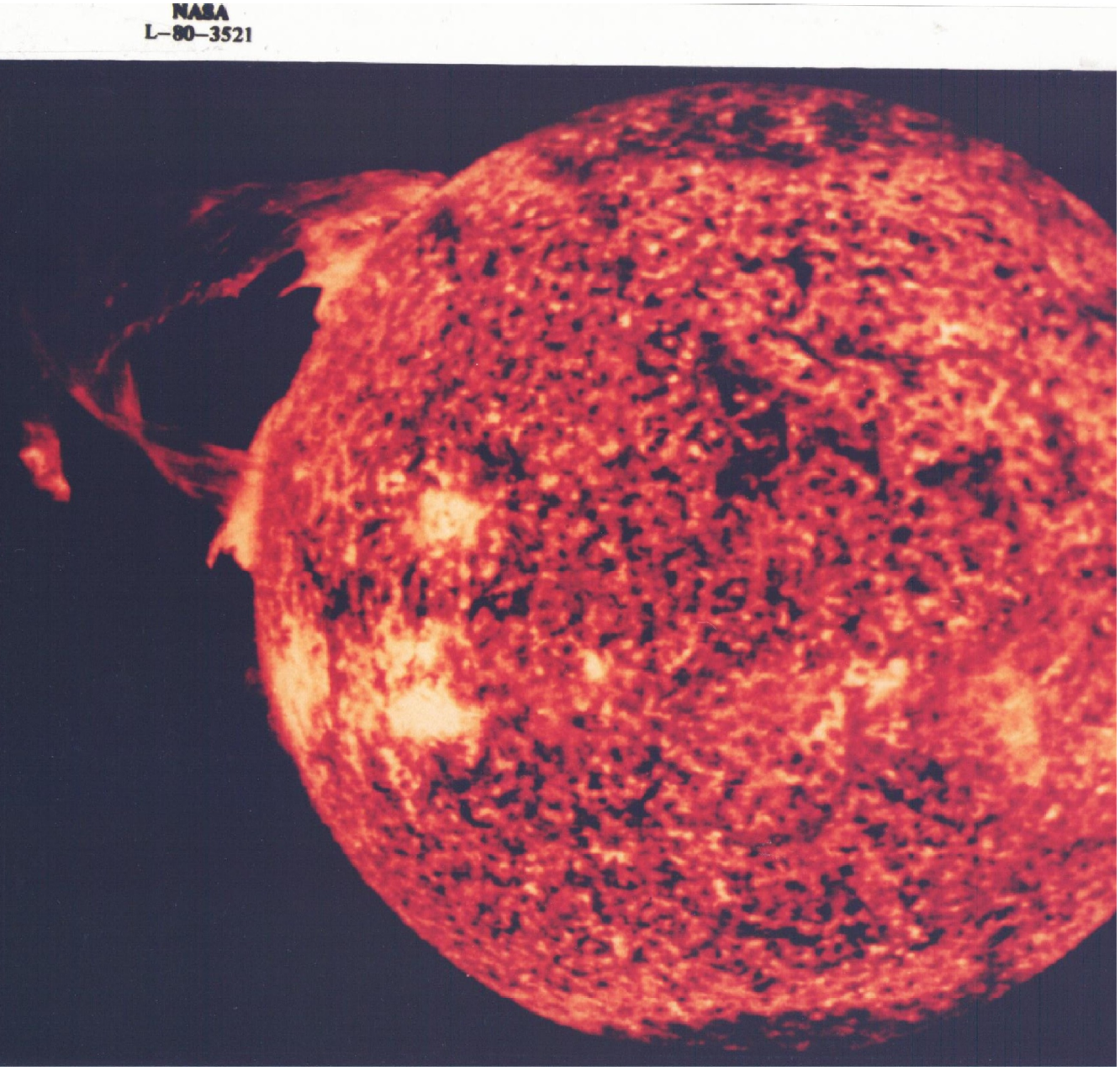
RESENTATION OF LONG-TERM SPACECRAFT TSI DATA SETS.

NALYSES OF TSI DATA SETS.

DESCRIPTIONS OF MECHANISMS OF TSI VARIABILITY.

ONG-TERM, TSI BRIGHTENING
IS ATTRIBUTED TO FACULAE.

SHORT-TERM, TSI DARKENING
IS ASSOCIATED WITH
SUNSPOTS.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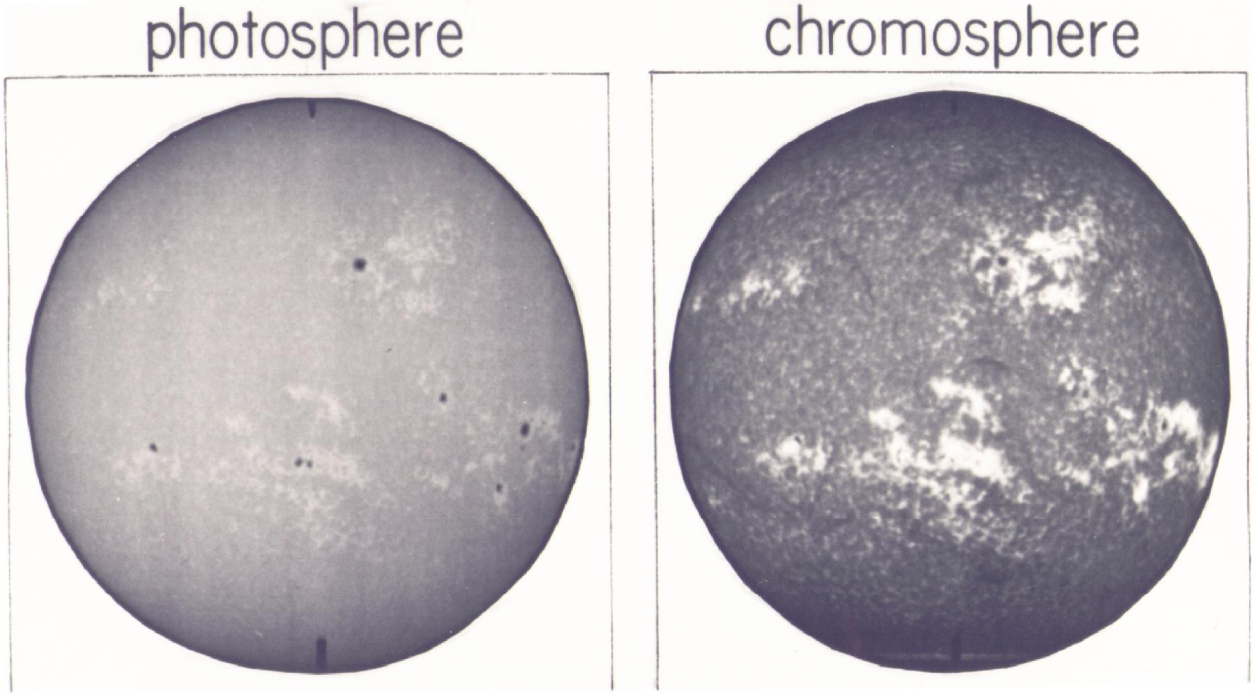
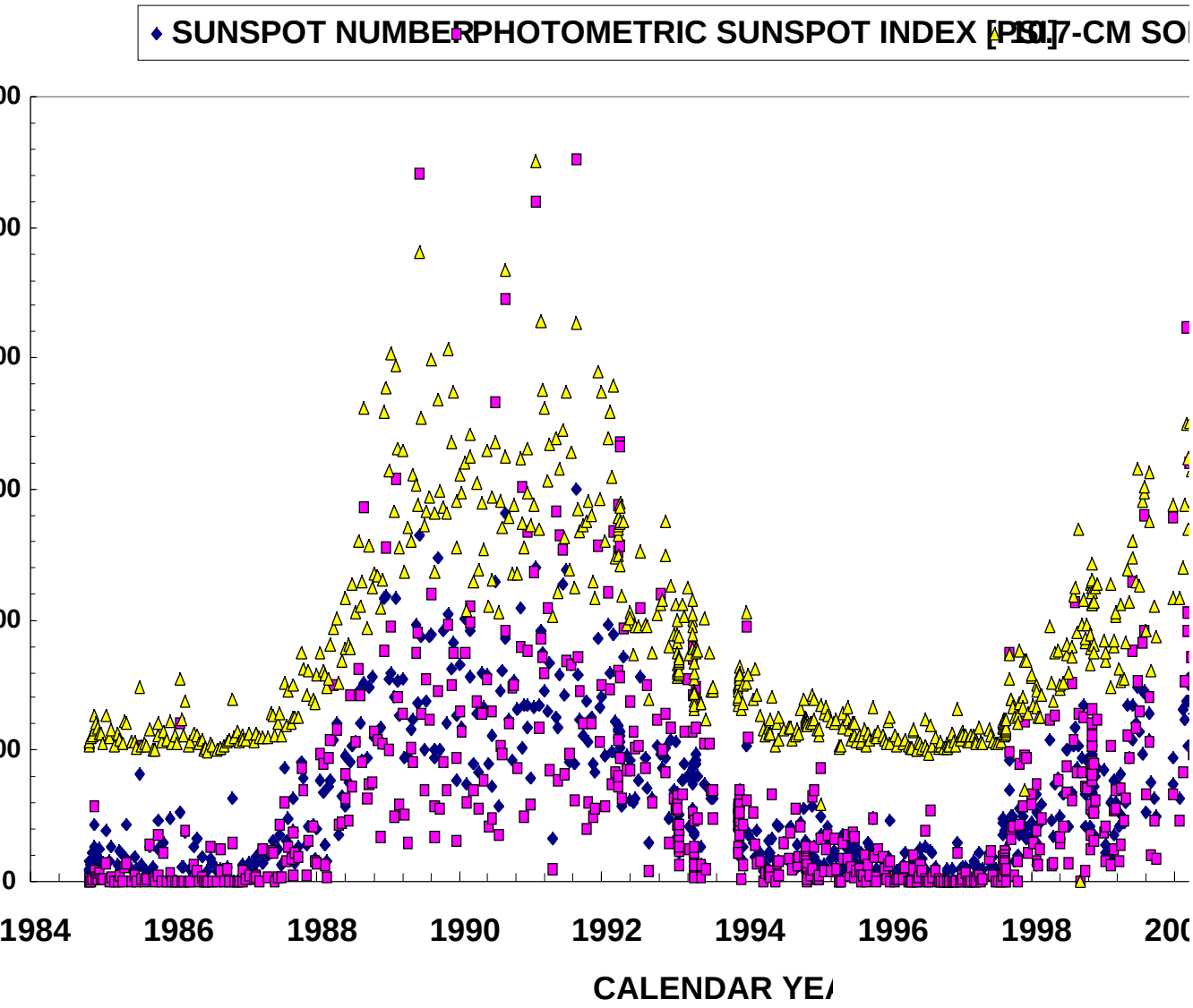
SUNSPOTS



SOLAR MAGNETIC ACTIVITY INDICES



TSI CHARACTERIZATIONS USING SOLAR MAGNETIC INDICES.

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0.7-CM SOLAR RADIO FLUX IS A PROXY FOR LONG-TERM, TSI BRIGHTENING - ATTRIBUTED TO FACULAE.

HOTOMETRIC SUNSPOT INDEX [PSI] IS THE BEST PROXY FOR SHORT-TERM, TSI DARKENING - ASSOCIATED WITH SUNSPOTS.

REGRESSION FIT MODEL

THE MODEL IS DERIVED FROM MULTI-REGRESSION ANALYSIS OF THE MARCH 1985 TO AUGUST 1989 ERBS IRRADIANCE MEASUREMENTS, THE CORRESPONDING PHOTOMETRIC SUNSPOT INDEX (PSI, SUNSPOT DARKENING), AND THE 10.7-CM SOLAR RADIO FLUX (F10,FACULAE BRIGHTENING) VALUES. THE RESULTING IRRADIANCE REGRESSION FIT I*, ARE

$$I_{ERBS} = 1362.9 - (7053 \times PPSI) + [0.02953 \times 10^{22} (F10)] - [0.00005 \times 10^{44}(F10)^2]$$

AND

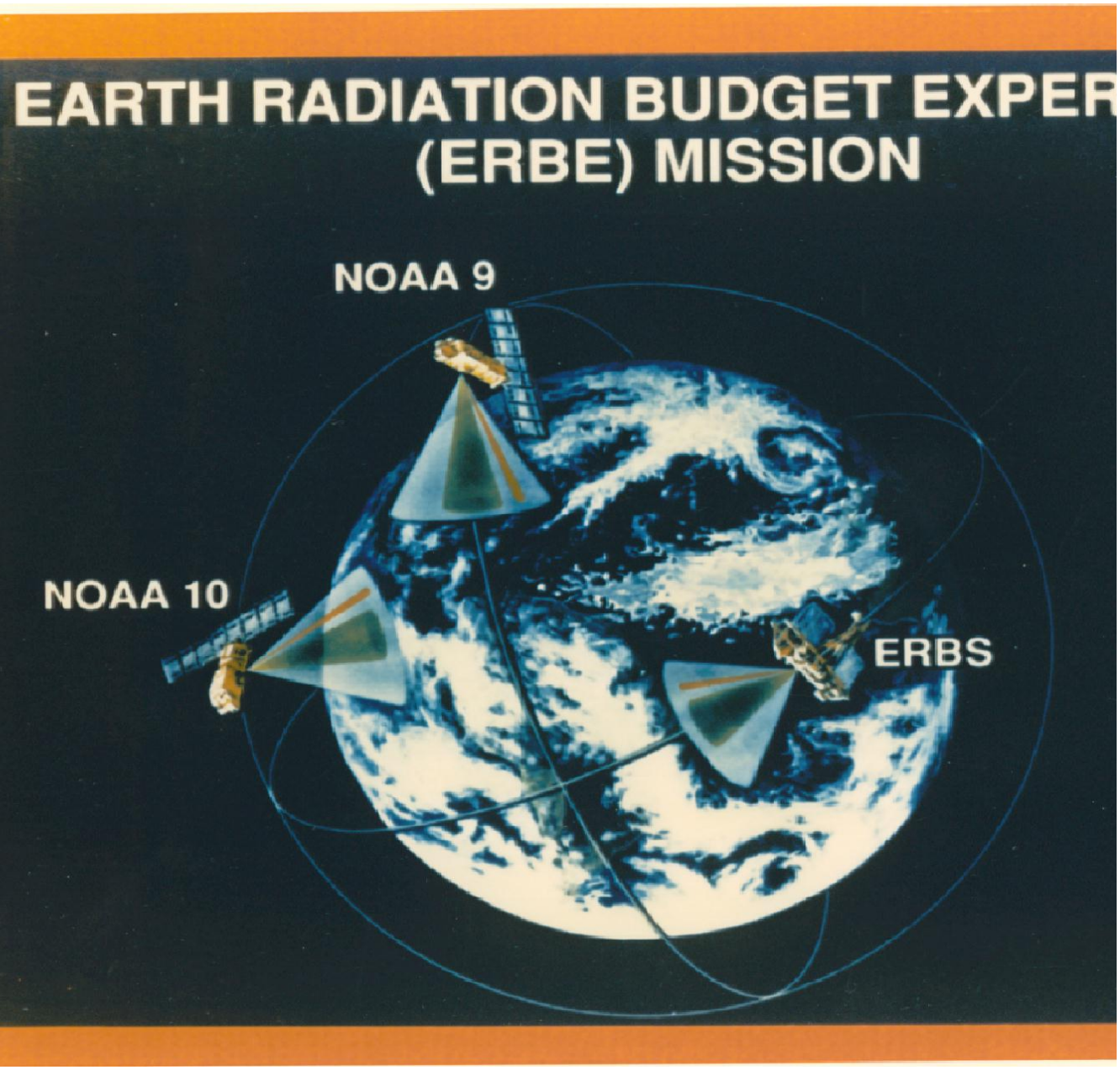
$$I_{N7} = 1369.9 - (592 \times PPSI) + [0.02561 \times 10^{22} (F10)] - [0.00005 \times 10^{44}(F10)^2]$$

WHERE F10 IS EXPRESSED IN SOLAR FLUX UNITS (1 sfu=10^{-22} Wm^{-2} Hz^{-1}) AND PPSI IS EXPRESSED IN UNITS OF 10^{-5} Wm^{-2}.

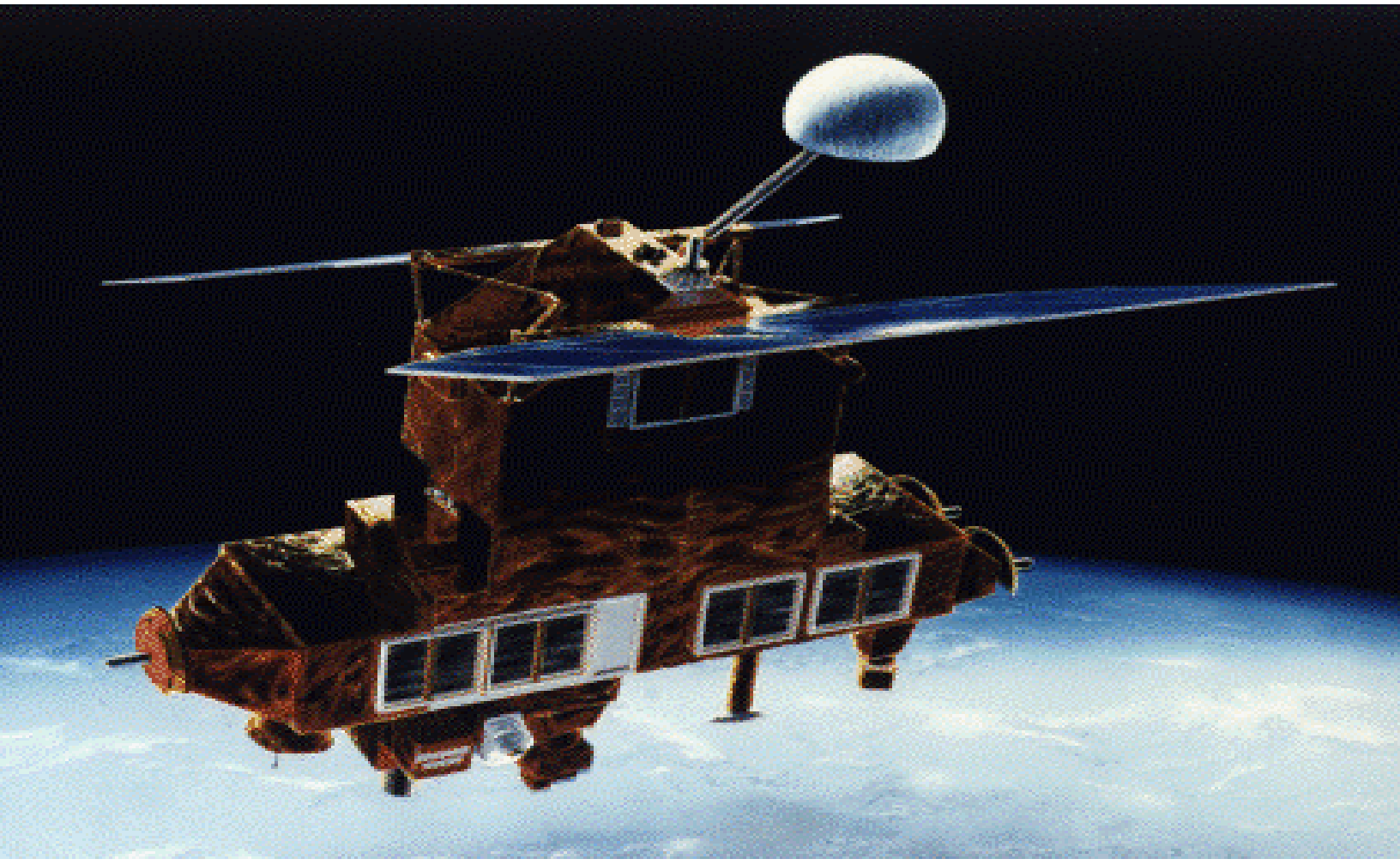
OVERVIEWS

- ACTIVE CAVITY RADIOMETER DESIGN

- DATA REDUCTION EQUATIONS


EARTH RADIATION BUDGET EXPER
(ERBE) MISSION
NOAA 9
NOAA 10
ERBS

EARTH RADIATION BUDGET SATELLITE (ERBS) CARRYING EARTH RADIATION BUDGET EXPERIMENT (ERBE) NONSCANNING AND SCANNING INSTRUMENT PACKAGES



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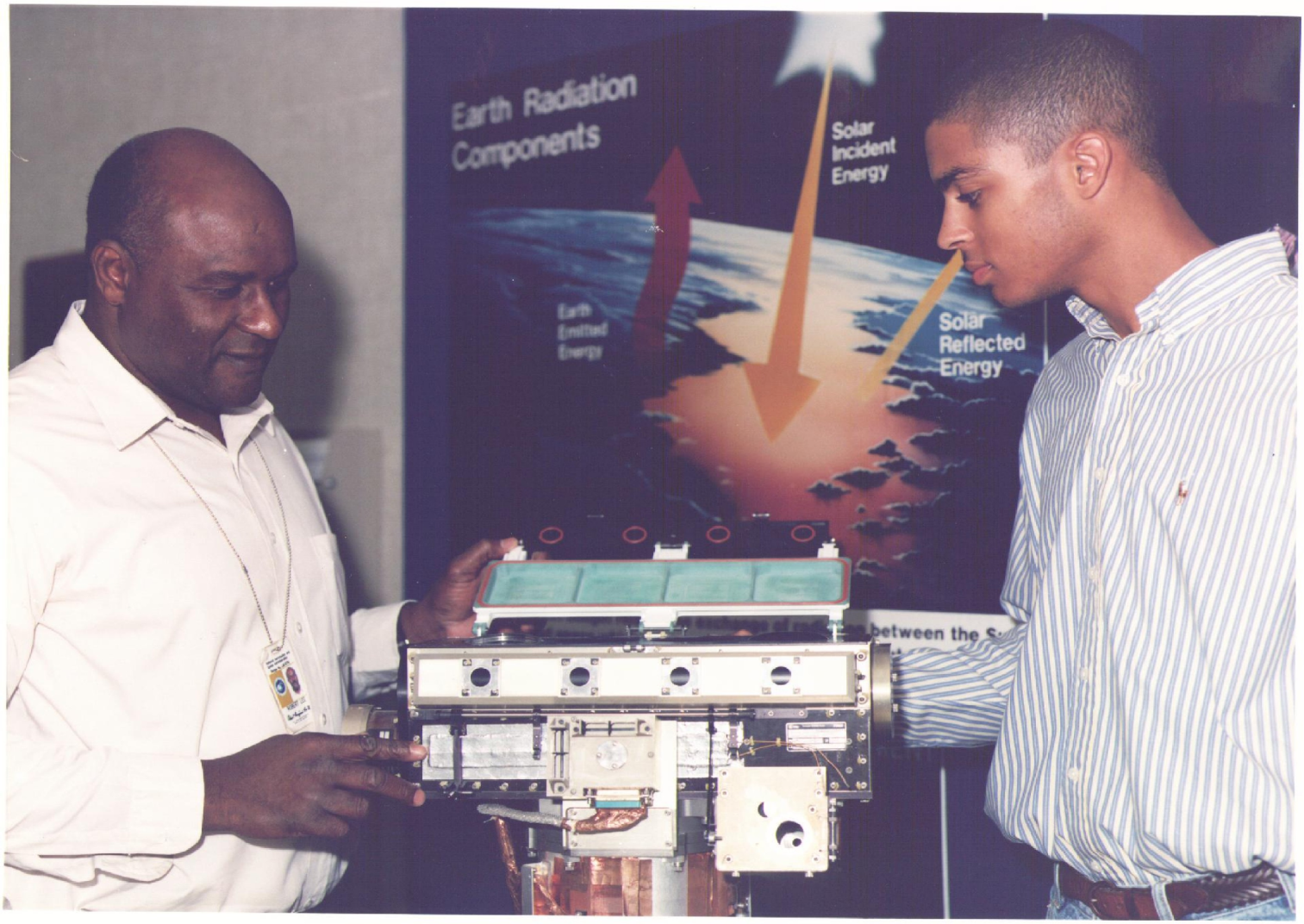
ERBE SOLAR MONITOR/NONSCANNER



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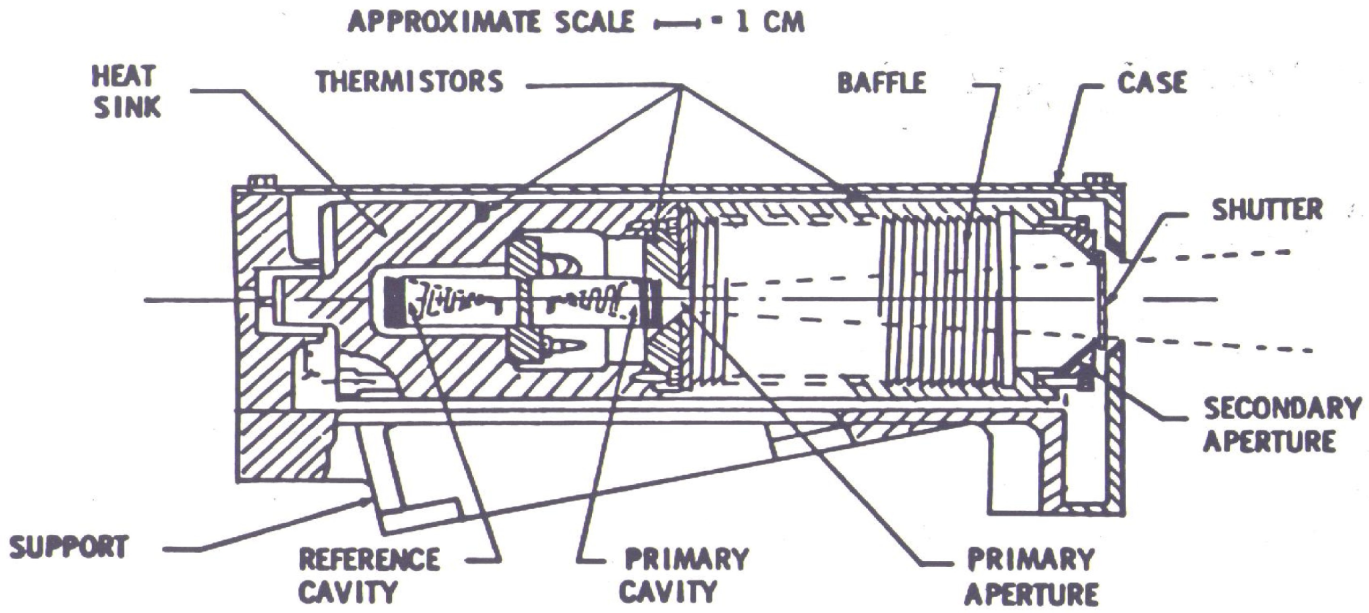
ERBE SOLAR MONITOR



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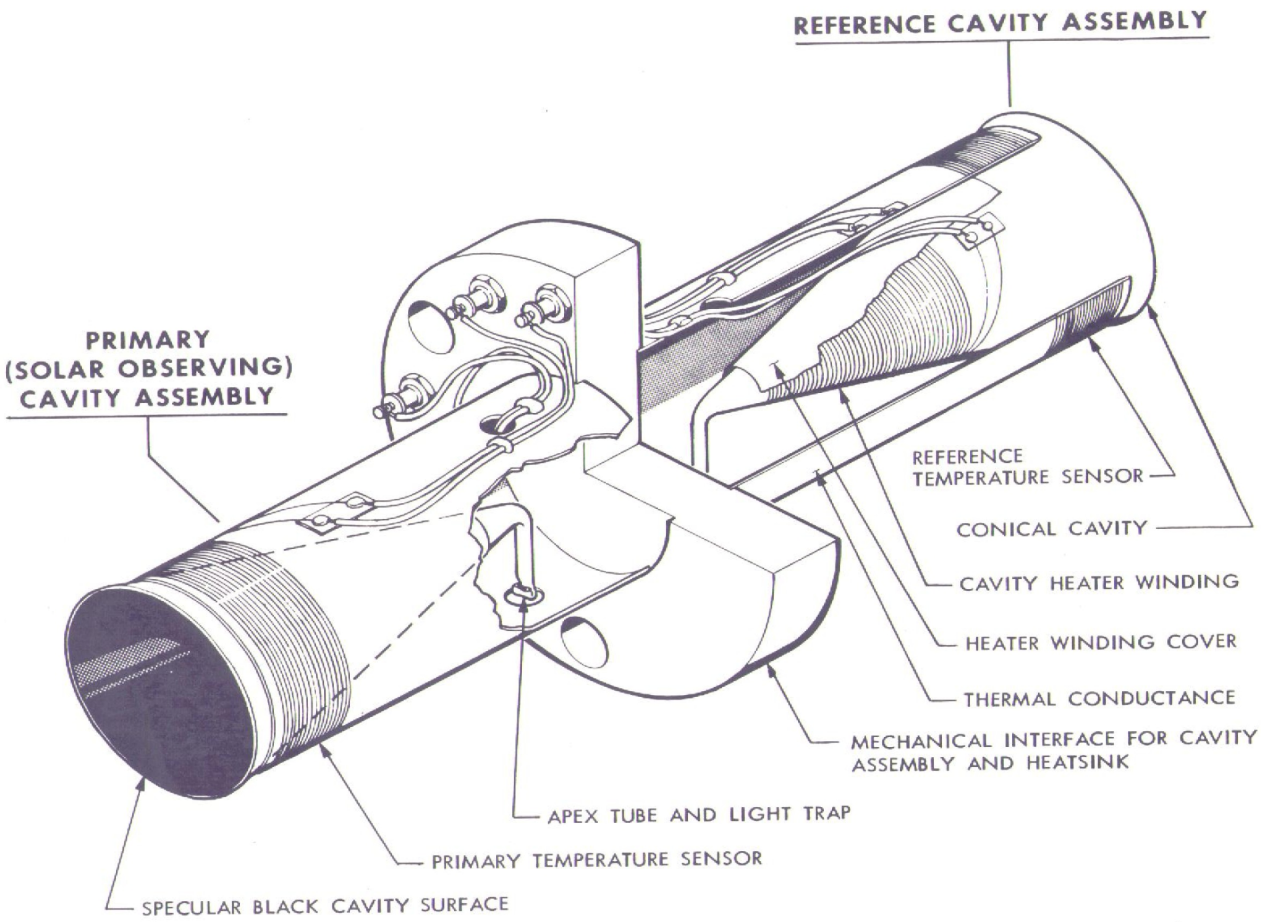
ACTIVE CAVITY RADIOMETER [ACR] GEOMETRY



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SENSOR-LEVEL, ACTIVE CAVITY RADIOMETER DATA REDUCTION EQUATION

$$SI_{ins} = (r_{E\text{-}S})^2\{(R)(\alpha)(A_{PA})\}^{-1} \times \{(V_C^2 - V_O^2) + \sigma(CF)(T_C^4 - T_O^4) + \Sigma P_i\}$$

ERE:

= EARTH-SUN DISTANCE, AU

= ACTIVE CAVITY HEATER RESISTANCE, OHMS

= ACTIVE CAVITY ABSORPTANCE

= PRIMARY APERTURE (PA) AREA

$_C$ = ACTIVE CAVITY HEATER VOLTAGE, CLOSED SHUTTER

$_O$ = ACTIVE CAVITY HEATER VOLTAGE, OPENED SHUTTER

$\sigma = 5.6697 \times 10^{-8}\ Wm^{-2}K^{-1}$

F = PA TO SECONDARY APERTURE CONFIG. FACTOR

$_C$ = PRIMARY CAVITY TEMPERATURE, CLOSED SHUTTER

$_O$ = PRIMARY CAVITY TEMPERATURE, OPENED SHUTTER

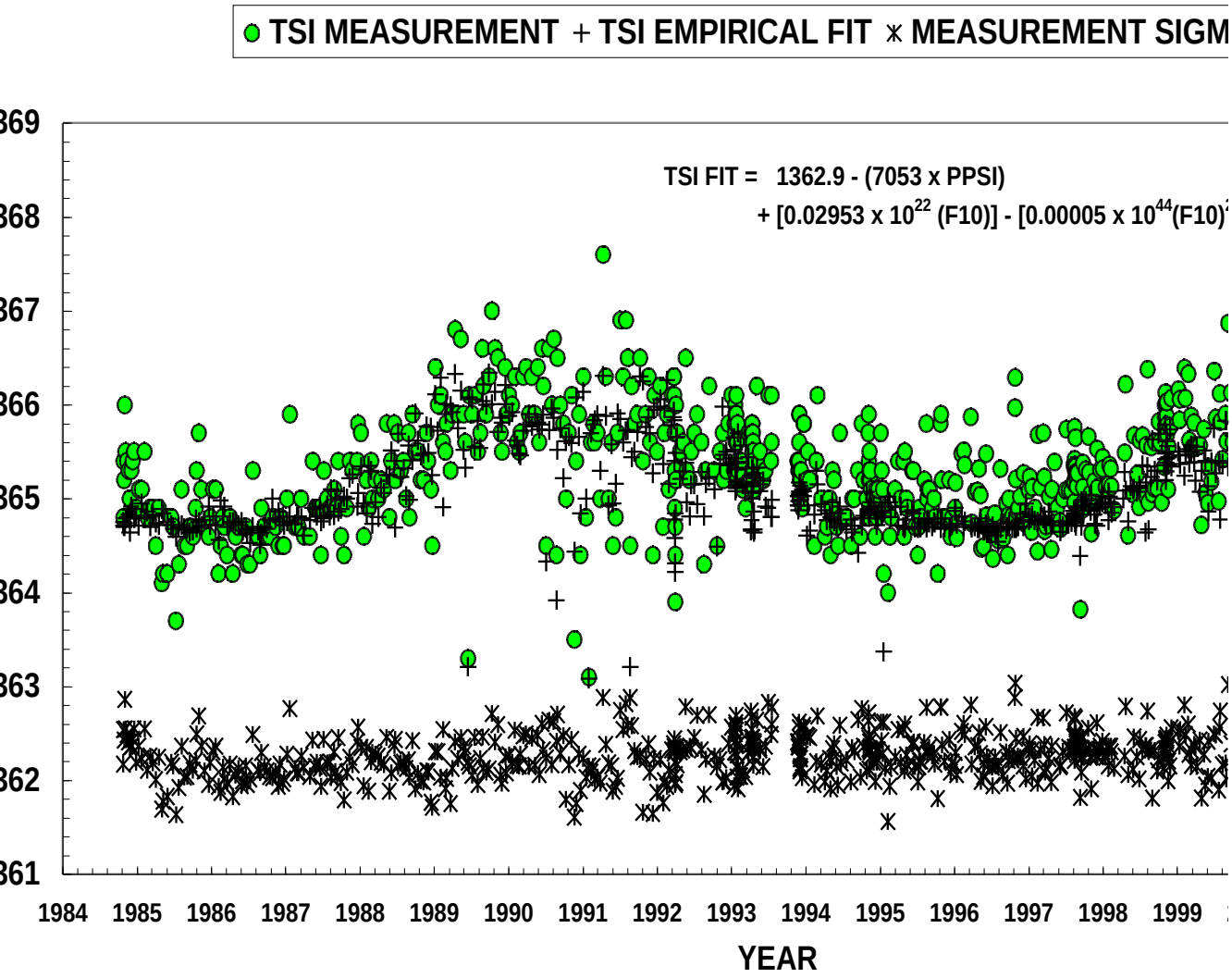
P_i = POWER EXCHANGES OF CAVITY WITH SURROUNDINGS

PRIMARY TSI CORRECTIONS

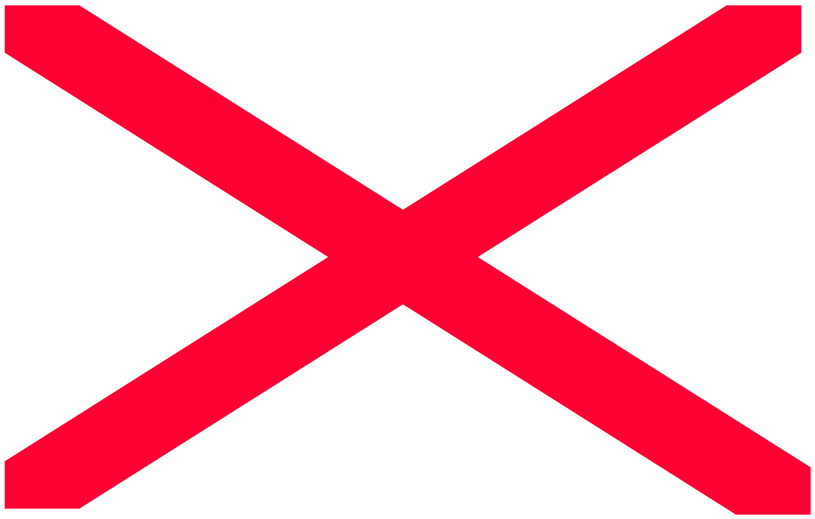
- NOMALIZATION TO MEAN EARTH-
- SUN DISTANCE [1AU], $\pm$3.3%.
- LW FLUX LOSSES OUT OF
- SECONDARY APERTURE WHEN
- SHUTTER IS OPENED, 0.40%.

-- ΣP_i ; ; $\pm$0.02%.

ERBS SOLAR MONITOR TOTAL SOLAR IRRADIANCE (TSI) MEASUREMENTS, NORMALIZED TO MEAN EARTH-SUN DISTANCE



ERBE SOLAR MONITOR MEASUREMENT OF TSI DECREASES DUE SUNSPOT DARKENING: MARCH 23 THRU APRIL 3, 1992



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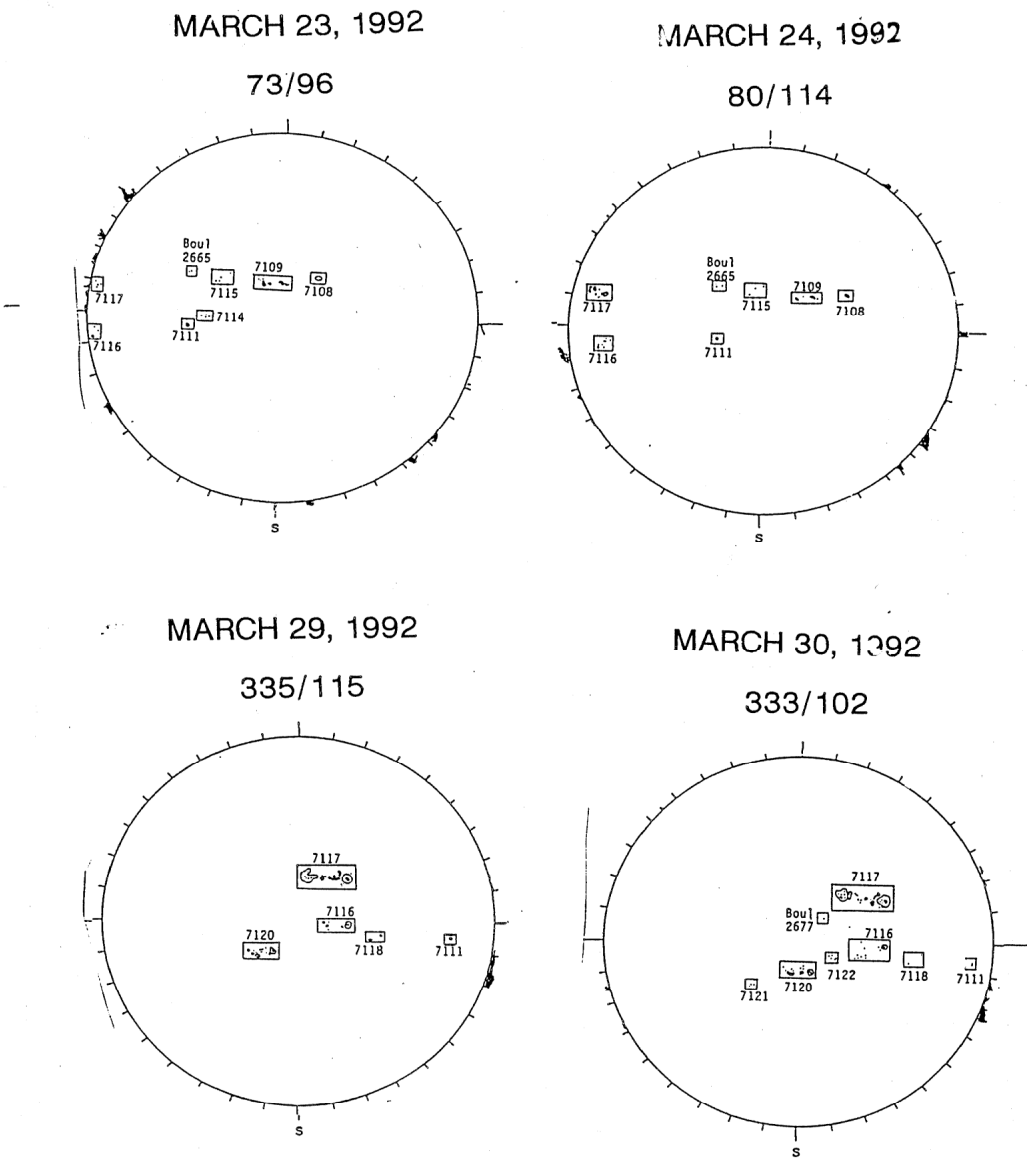
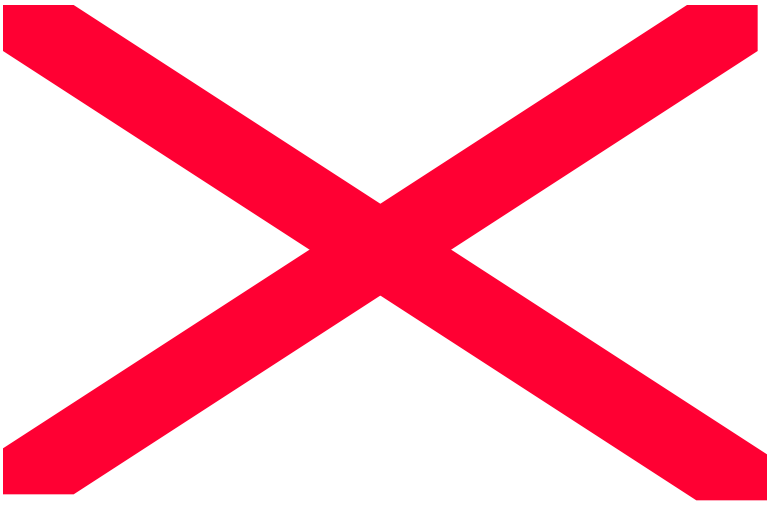
SUNSPOT DIAGRAM: MARCH 1992



MARCH 1992, SOLAR MAGNETIC ACTIVITY INDICES



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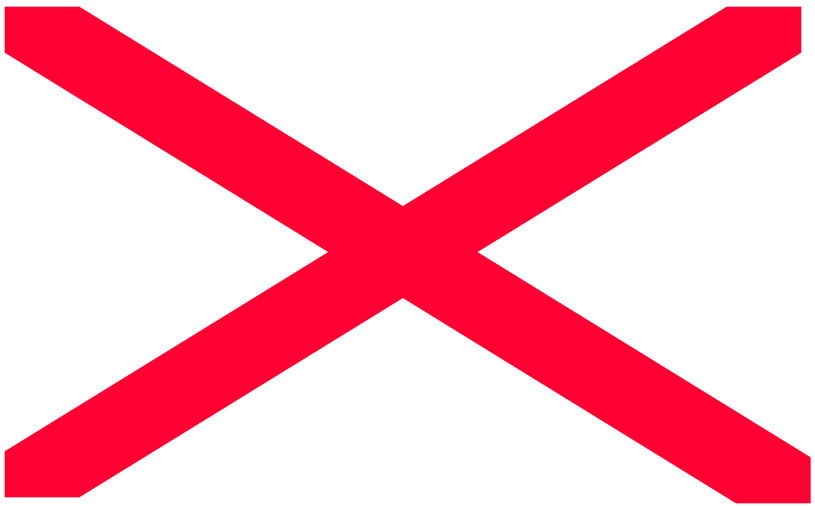
PRESENTATIONS OF LONG-TERM SPACECRAFT TSI DATA SETS.

TABLE 1
TOTAL SOLAR IRRADIANCE [TSI] SPACECRAFT MEASUREMENT

PACECRAFT	TSI (Wm
969 MARINER VI	1352.5±???
969 MARINER VII	1354.5±???
975-1977, NIMBUS-6	1392±???
978-1993, NIMBUS-7	1371.94±0.7
978-1993, SOLAR MAXIMUM MISSION (SMM)/ACRIM I	1367.51±0.6
984-2002, EARTH RADIATION BUDGET SATELLITE (ERBS)	1365.40+0.(
991-2001, UPPER ATMOSPHERE RESEARCH SATELLITE (UARS)/ACRIM II	1365.44±0.4
992,1993,1994,1996,1997,1998, ATLAS / SOLAR CONSTANT (SOLCON)	1366.4
992-1993,EURECA / SOLAR VARIATIONS (SOVA-1)	1365.1
996-2002, SOHO / VARIATIONS OF SOLAR IRRADIANCE AND GRAVITY OSCILLATIONS (VIRGO)	1365.97±0.5
00-2002, ACRIMSAT/ACRIM III	1366.76±0.5(

SPACECRAFT TOTAL SOLAR IRRADIANCE (TSI) MISSIONS



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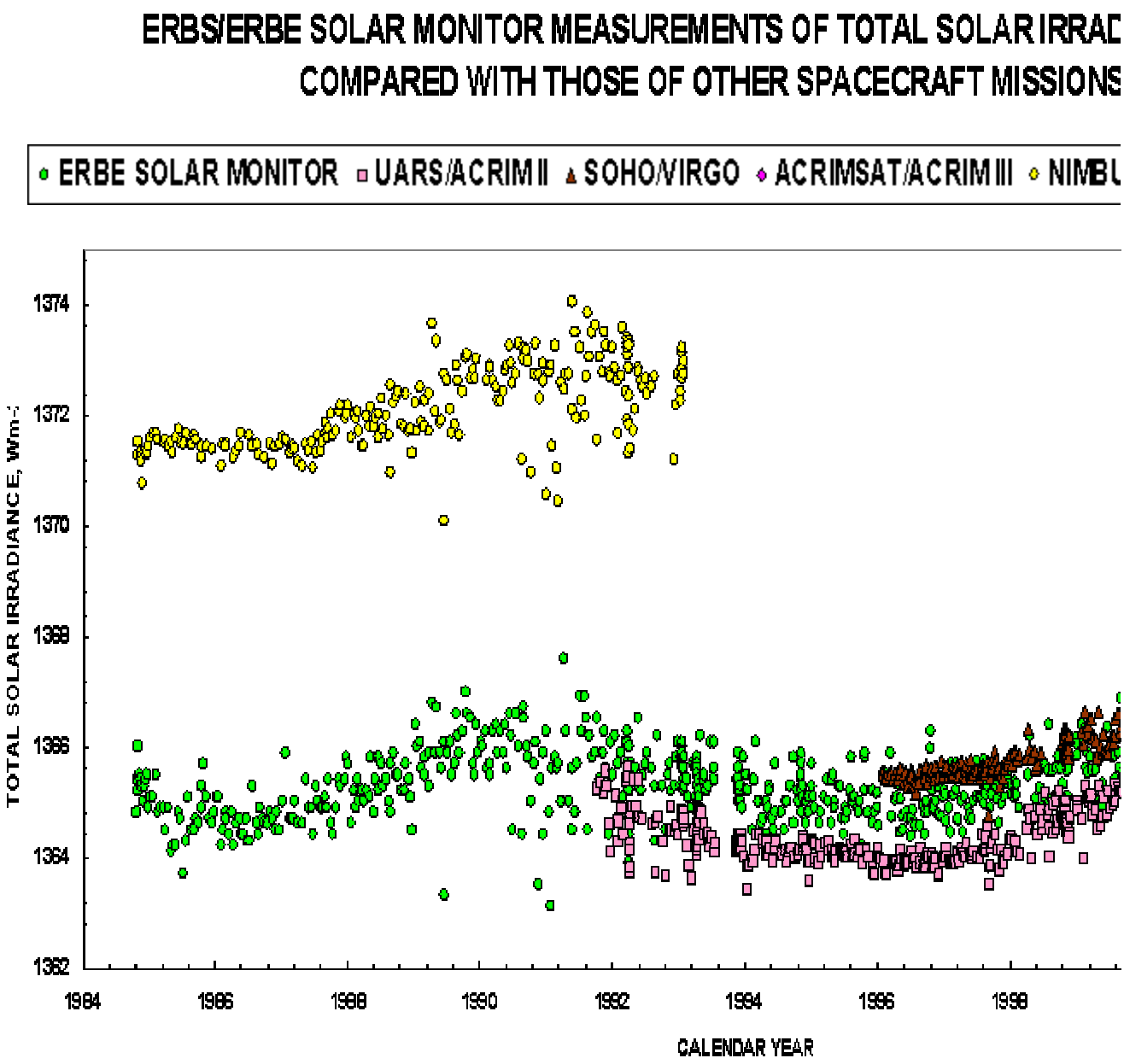
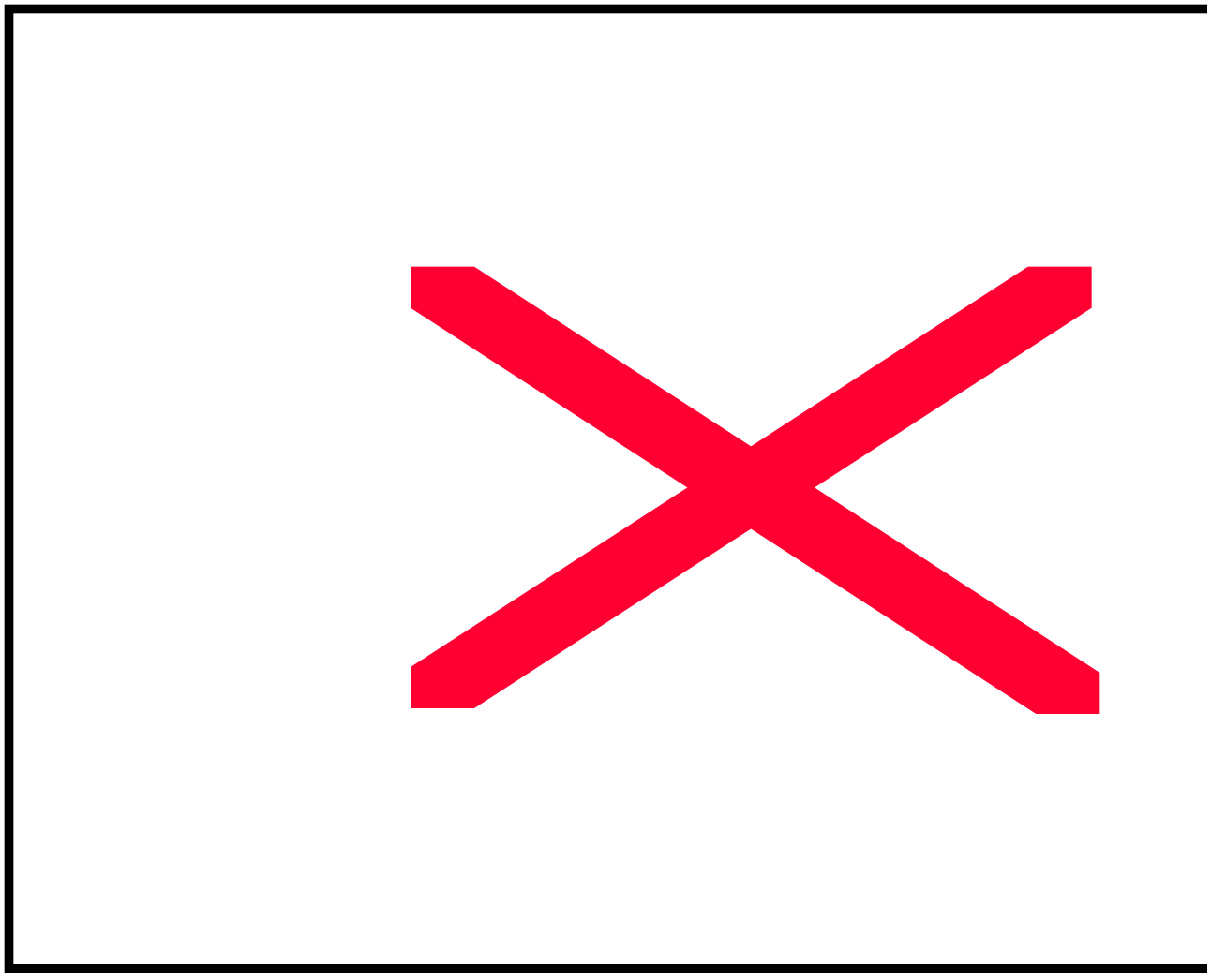

ERBS/ERBE SOLAR MONITOR MEASUREMENTS OF TOTAL SOLAR IRRAD
COMPARED WITH THOSE OF OTHER SPACECRAFT MISSIONS
ERBE SOLAR MONITOR
UARS/ACRIM II
SOHO/VIRGO
ACRIMSAT/ACRIM III
NIMBU
TOTAL SOLAR IRRADIANCE, Wm-2
1374
1372
1370
1368
1366
1364
1362
1984
1986
1988
1990
1992
1994
1996
1998
CALENDAR YEAR

1365 Wm^{-2} APPEARS TO BE THE BEST VALUE OF TSI DURING PERIODS OF MINIMUM SOLAR MAGNETIC ACTIVITIY.

ACTIVE CAVITY RADIOMETER [ACR]: LONG-TERM SPACECRAFT TOTAL SOLAR IRRADIANCE MEASUREMENTS



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ACTIVE CAVITY RADIOMETER [ACR]: DIFFERENCES BETWEEN TOTAL SOLA
IRRADIANCE [TSI] EMPIRICAL MODEL FIT AND LONG-TERM SPACECRAFTMEN

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ACTIVE CAVITY RADIOMETER [ACR]: DIFFERENCES BETWEEN TOTAL SOL
IRRADIANCE [TSI] EMPIRICAL MODEL FIT AND LONG-TERM SPACECRAFTME

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TOTAL SOLAR IRRADIANCE (TSI) VARIABILITY: 1978-2002

RESULTS

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1.4 Wm^{-2} [0.1 %] IS THE MAGNITUDE OF THE 11-YEAR SUNSPOT CYCLE], LONG-TERM TSI VARIABILITY COMPONENT.

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Data Source References

.ERBS: The 1984-1999 measurements can be obtained from the Langley Distributed Active Archive Center [DAAC] by telnet eosdis.larc.nasa.gov, ogin name: ims, password: larcims or by NCSA Mosaic using the URL ddresshttp://eosdis.larc.nasa.gov

. UARS, SMM: The 1991-1998 measurements can be obtained from the ACRMSAT web page acrim.com or the Langley Distributed Active Archive Center [DAAC] by elnet eosdis.larc.nasa.gov,login name: ims, password: larcims or by NCSA Mosa sing the URL address http://eosdis.larc.nasa.gov

. NIMBUS 7 The 1980-1993 measurements can be obtained from the Goddard Distributed Active Archive Center [DAAC] using the URL address ttp://daac.gsfc.nasa.gov

5. SOLCON/ SOVA 1/VIRGO: Dominique Crommelynck ,Royal Meteorological nstitute of Belgium Avenue Circulaire, 3,1180 Bruxelles, Phone Number: (32 2) 730600, Fax Number : (32 2) 3746788 E-Mail: dcr@radio.oma.be

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