

# **SOLAR IRRADIANCE VARIABILITY**

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## **EXPERIMENTAL OBSERVATIONS FROM SPACE**

- 1. TOTAL IRRADIANCE (SOLAR CONSTANT)**
- 2. SPECTRAL IRRADIANCE, UV BELOW 300 NM**

## **GROUND-BASED OBSERVATIONS:**

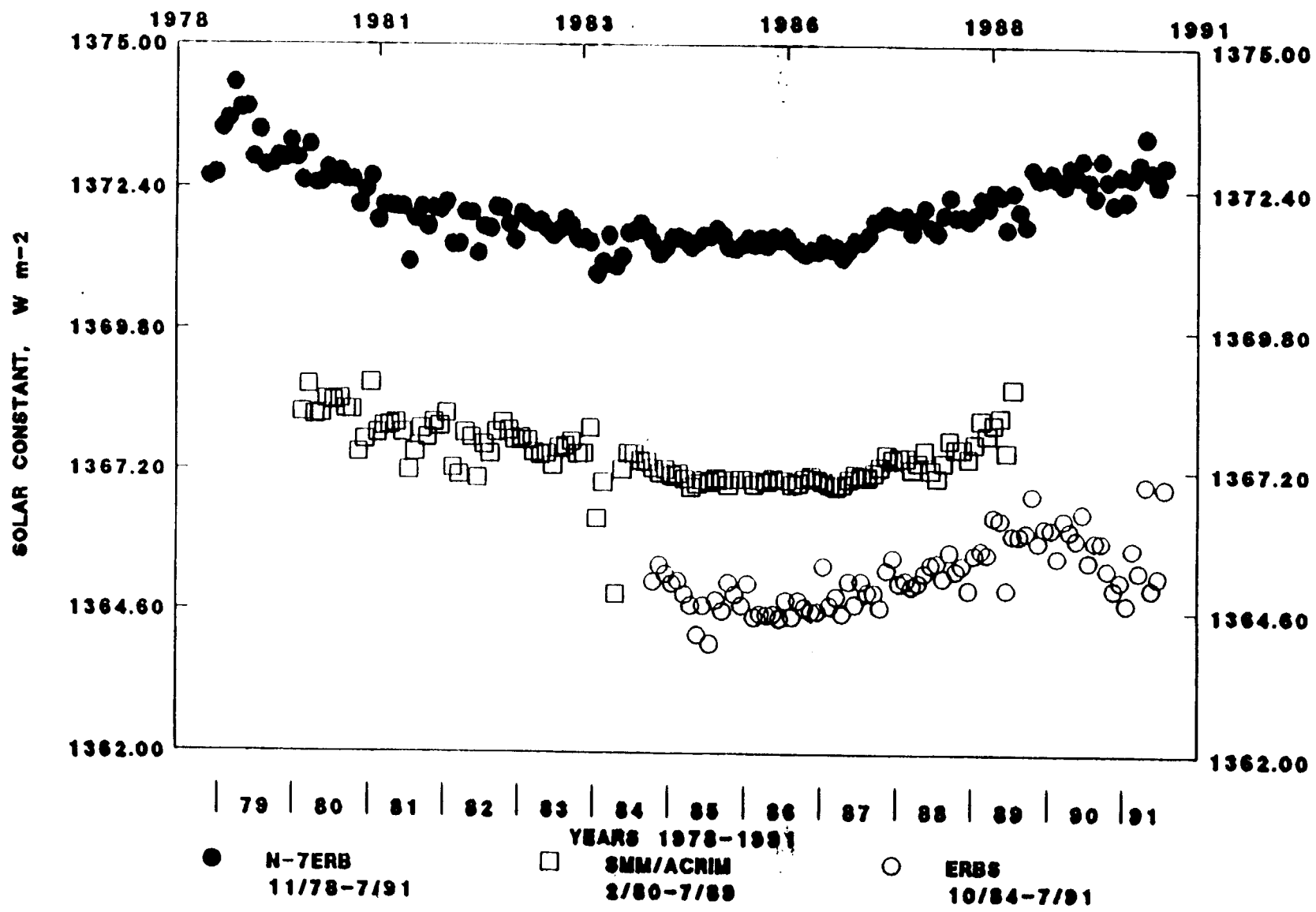
- 3. FRAUNHOFER LINE INTENSITY VARIATION -  
VISIBLE**

# **MULTIYEAR SOLAR CONSTANT DATA**

- **ERBE, NIMBUS-7ERB, SMM/ACRIM**
- **TIME SERIES**
- **INTERCOMPARISON OF THE DATA SETS**
- **INTERANNUAL VARIABILITY OBSERVED**
- **ANNUAL CYCLE**
- **COMPARISON WITH SUNSPOT NO, 2800 MHZ SOLAR FLUX**

# SOLAR SENSOR STABILITY IN SPACE

1. SMM -REDUNDANT RADIOMETERS  
DEGRADATION 600PPM IN 9.75Y
2. ERB & ERBE -NO REDUNDANCY  
-EXPOSURE-TIME FEW MINUTES
3. LDEF (LONG DURATION EXPOSURE FACILITY) FOR 6 YEARS  
-NO CHANGE IN ELECTRICAL PROPERTIES  
-SLIGHT CHANGES FOR CAVITY PAINT



## SOLAR CONSTANT DATA-COMPARISON

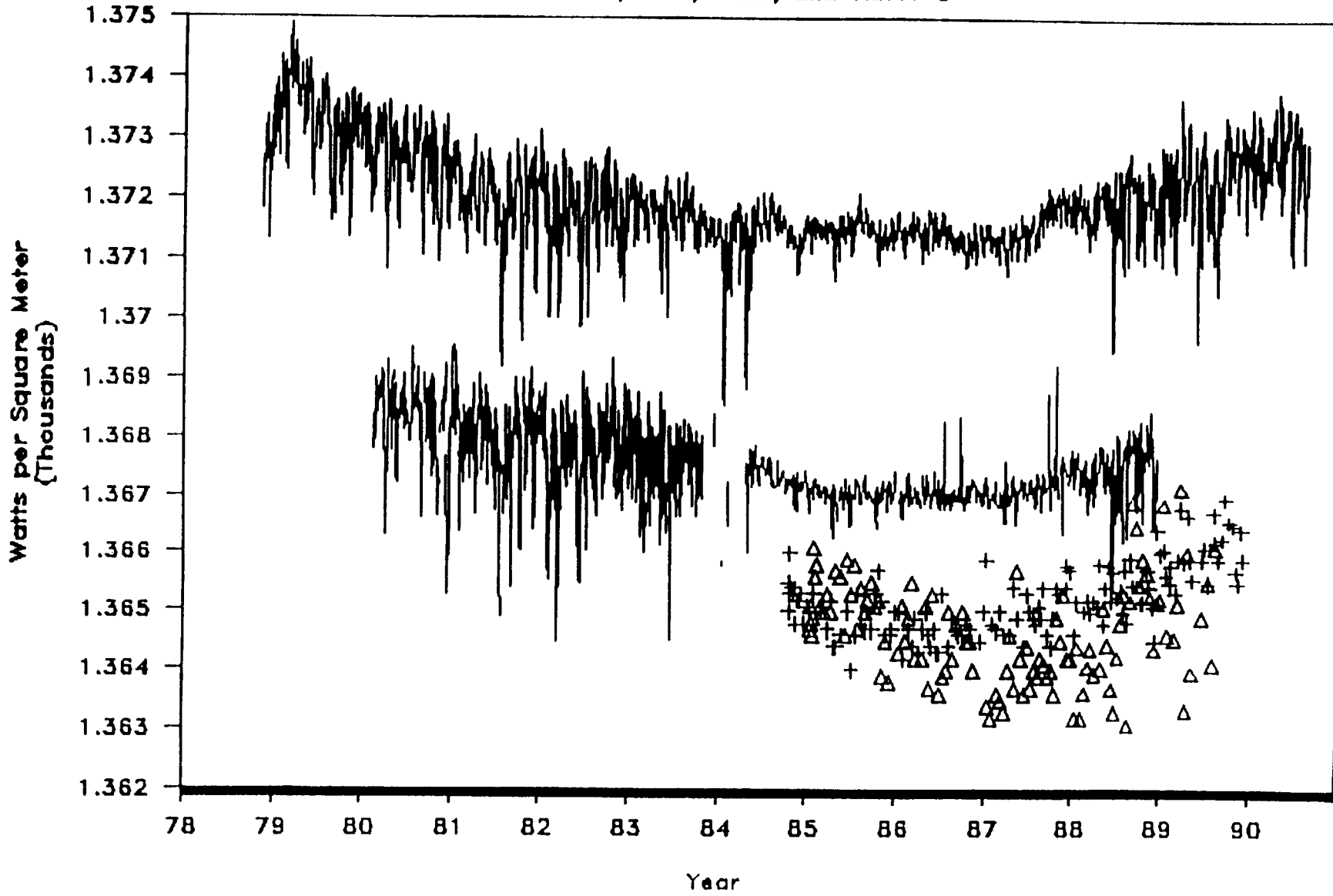
SATELLITE	<u>MEAN</u>	MAX.	MIN.	<u>STD DEV.</u>
ERBS	1365.28	1366.9	1364	0.6264
NOAA 9	1364.8	1366.1	1363.7	0.6152
NOAA-10	1363.0	1365.4	1359.5	1.4898
N-7ERB	1372.03	1374.3	1370.85	0.65737
SMM	1367.48	1368.8	1364.9	0.55078

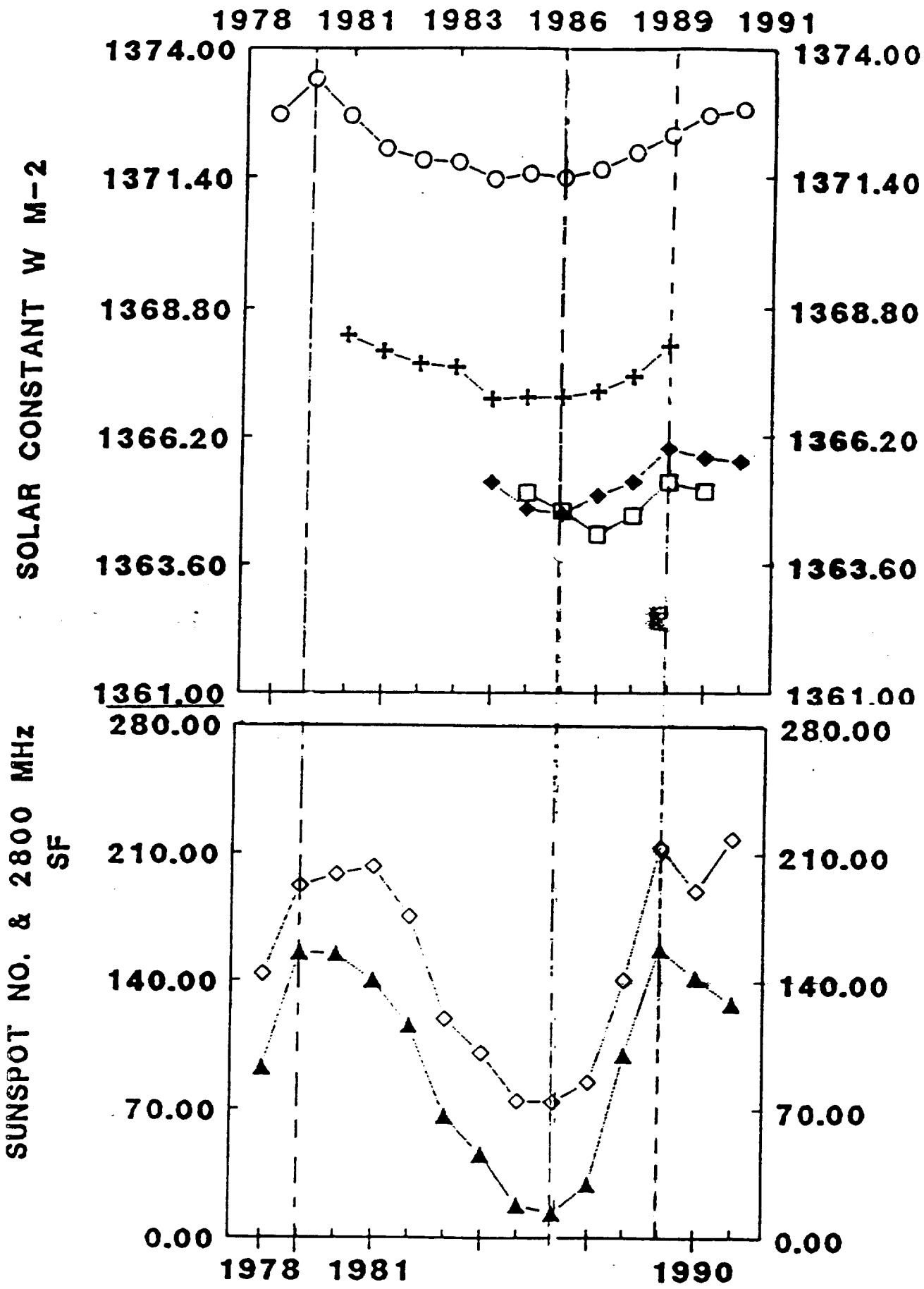
**Solar Constant Data ( $W/m^2$ ) from Nimbus-7 ERB, SMM/ACRIM, ERBS, and NOAA-9 on Common Observation Days During 1985-1990**

<b>Satellite Observation (Days)</b>	<b>Mean Value (<math>W/m^2</math>)</b>	<b>Standard Deviation</b>	<b>Maximum</b>	<b>Minimum</b>
<b>Nimbus-7 (92)</b>	<b>1371.88</b>	<b>0.568</b>	<b>1373.66</b>	<b>1370.99</b>
<b>ERBS (92)</b>	<b>1365.23</b>	<b>0.677</b>	<b>1366.96</b>	<b>1363.7</b>
<b>NOAA-9 (92)</b>	<b>1364.87</b>	<b>0.863</b>	<b>1367.1</b>	<b>1363.1</b>
<b>SMM (68)</b>	<b>1367.17</b>	<b>0.420</b>	<b>1369.21</b>	<b>1366.2</b>

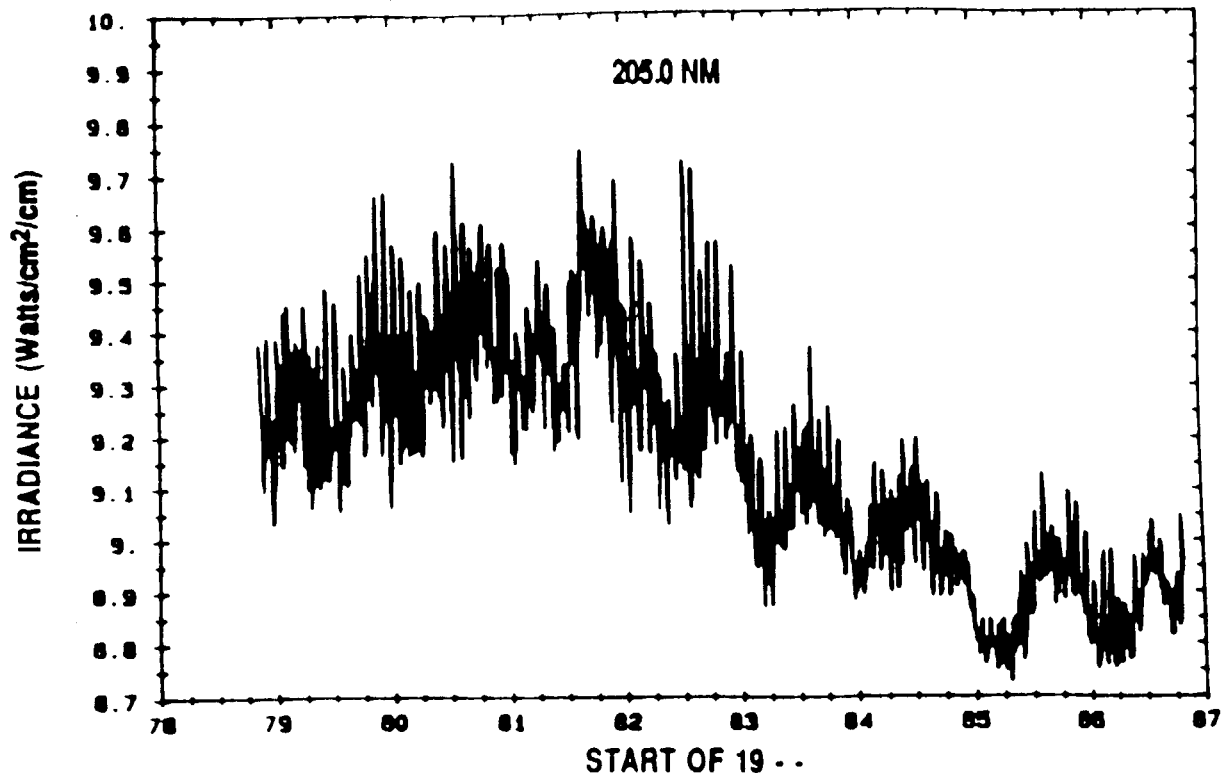
# Solar Irradiance from Four Satellites

Nimbus-7, SMM, ERBS, and NOAA-9









Hertz and  
Schroeder - '90

# SOLAR CYCLE RELATED SOLAR IRRADIANCE VARIATIONS:

## SOLAR CONSTANT

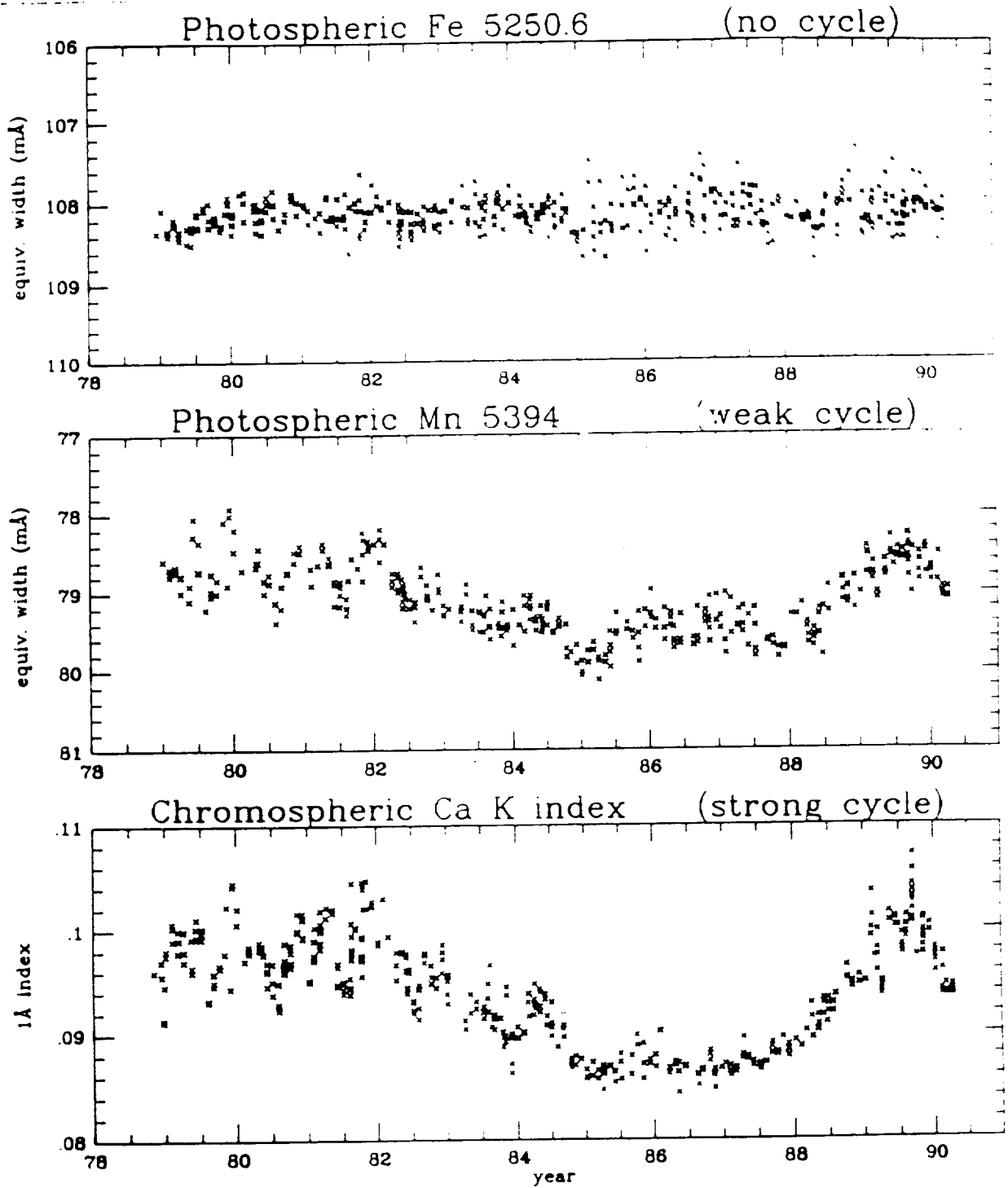
0.15% 1979-1986 N-7 ERB

0.1% 1980-1986 SMM/ACRIM

SOLAR UV VARIATION (WAVELENGTH BELOW  
300 NM)

CONTRIBUTE 19-30 % OF SOLAR CYCLE  
RELATED VARIATION

SOLAR RADIATION ABOVE 300NM -  
CONTRIBUTE 81-67% ??

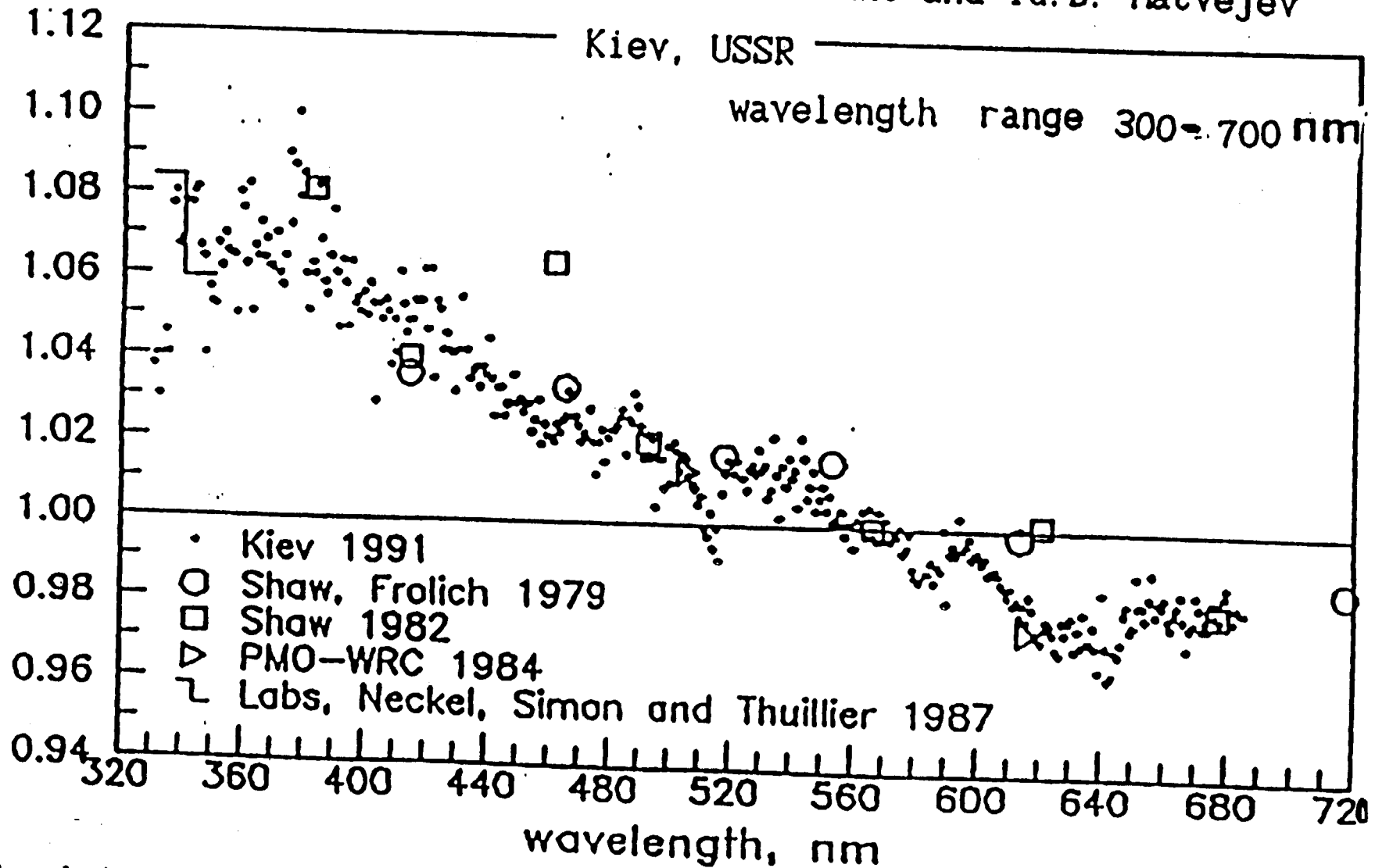


**EXAMPLES OF SOLAR CYCLE BEHAVIOR OF SELECTED  
FRAUNHOFER LINES**

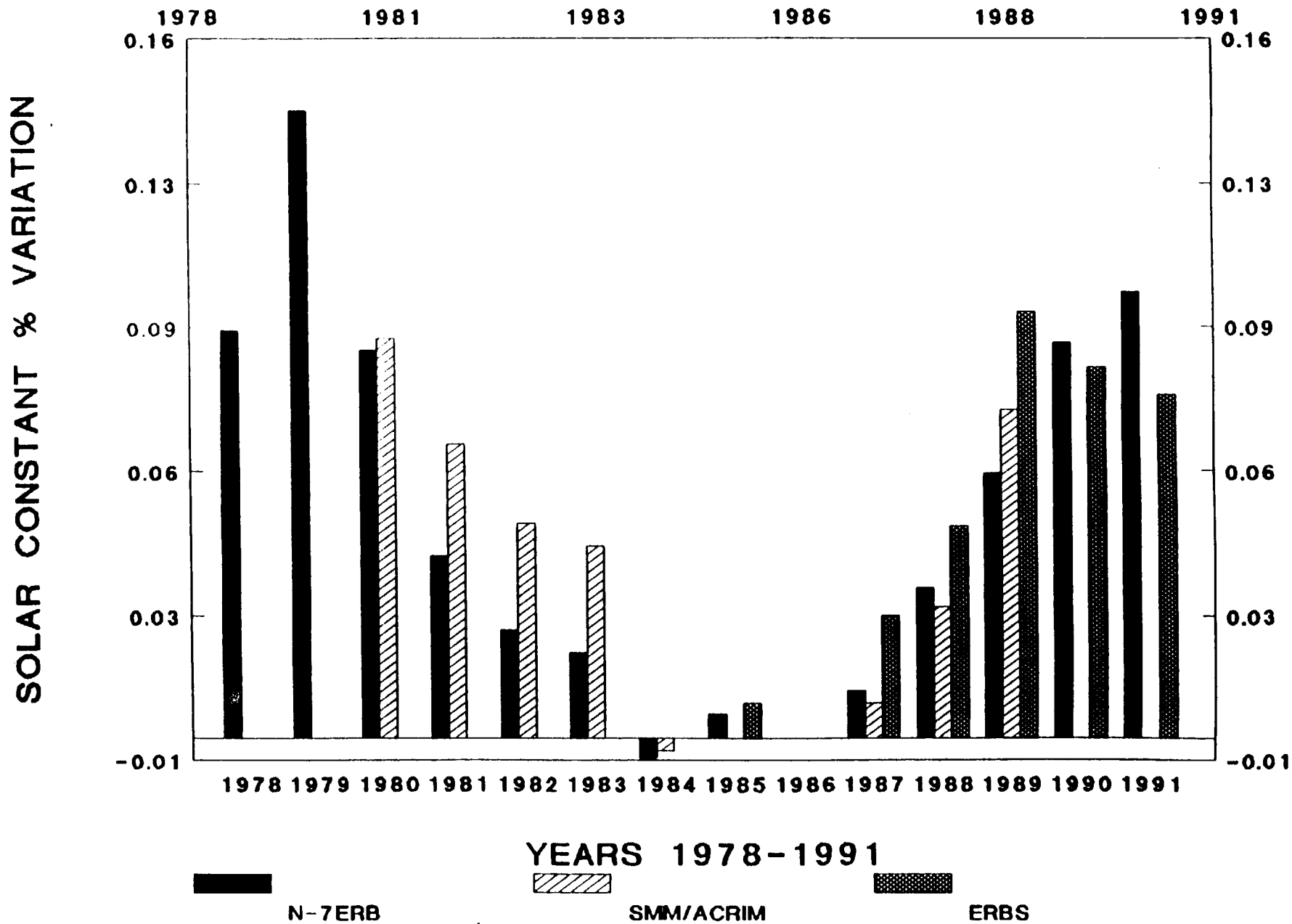
W. Livingston

THE SOLAR RADIATION BETWEEN 310 - 680 nm.

K.A. Burlov - Vasiljev, E.A. Gurtovenko and Yu.B. Matvejev



absolute measurements of the disk - center intensity, (h = 3100 m)  
1986 - 1989



# SOLAR IRRADIANCE VARIATIONS

1. SHORT TERM - DAYS & MONTHS  
2-4  $\text{Wm}^{-2}$

2. INTERANNUAL VARIABILITY  
1-2  $\text{Wm}^{-2}$

3. IN PHASE WITH ENVELOPE OF  
SOLAR ACTIVITY CYCLE

# **SOLAR SPECTRAL IRRADIANCE VARIABILITY IN THE VISIBLE**

**1981-1987**

**500-560 NM FRAUNHOFER LINES INCREASED IN**

- DEPTH ( INTENSITY)**
- EQUIVALENT WIDTH ( TOTAL ENERGY ABSORBED  
BY THE LINE FROM CONTINUUM)**

**< 4% OF SOLAR CONSTANT DECREASE ARISING  
IN THE 500-560 NM**

**32%-58% OF THE SOLAR CONSTANT CHANGE  
ARISING IN THE 300-560 NM**

**ASTROPHYSICAL J. 372: 336-348, 1991 MAY 1  
W.E.MITCHELL & W.C. LIVINGSTON**

**TABLE 9**  
**SPECTRAL DISTRIBUTION OF IRRADIANCE CHANGE**

Waveband (nm)	$S_{\lambda}/S^a$	This Study (%)	Lean <sup>b</sup> (%)
200-300.....	0.012	...	19
300-400.....	0.087	33 to 40	13
400-500.....	0.145	3 to 15	...
500-560.....	0.083	-4 to 3	...

<sup>a</sup> Goldberg & Pierce (1959),  $S$  = irradiance,  $\lambda$  = waveband.

<sup>b</sup> (Lean 1989). Irradiance not corrected for sunspot blocking.



# Solar Total Irradiance Variations and the Global Sea Surface Temperature Record

