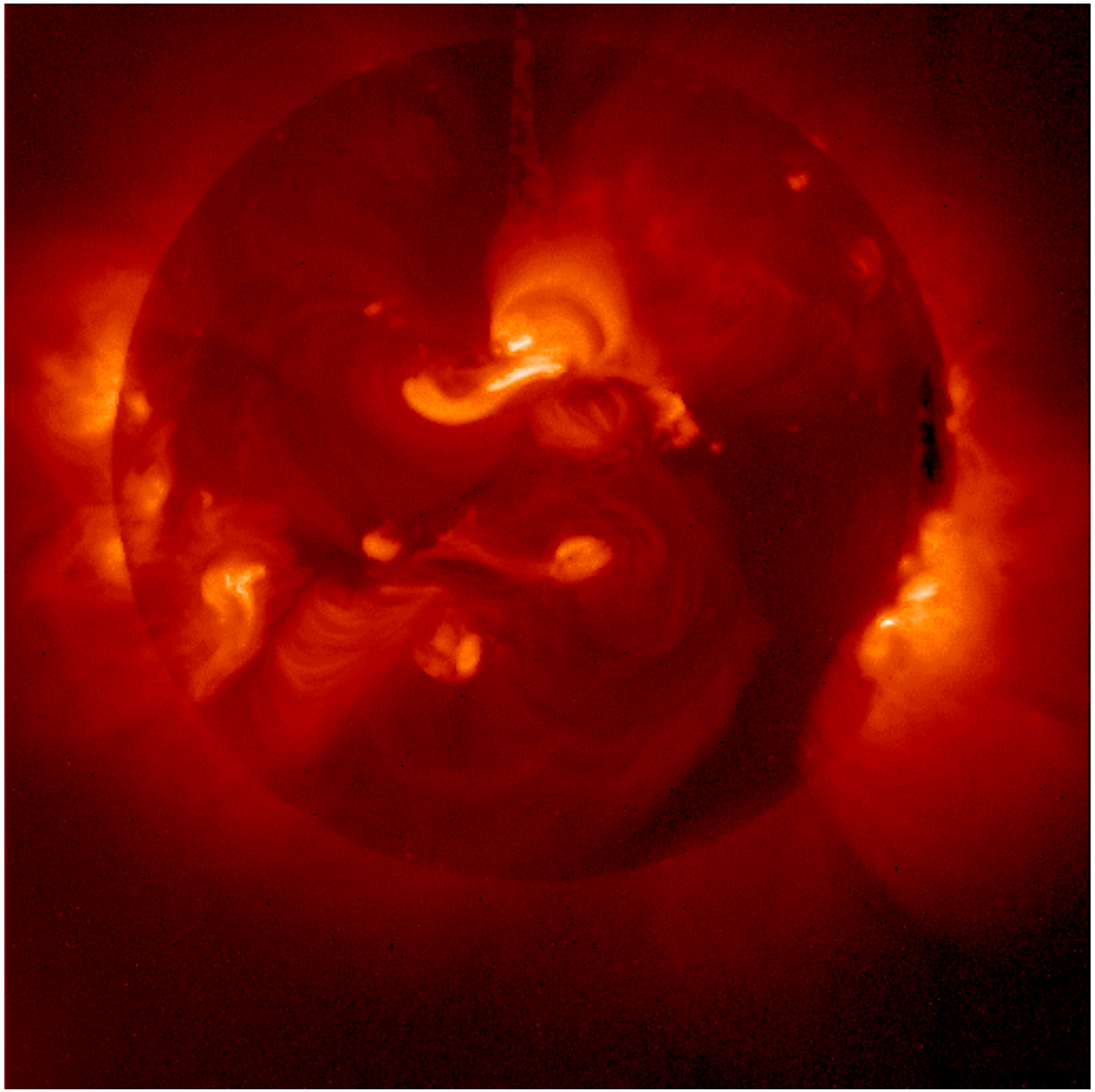
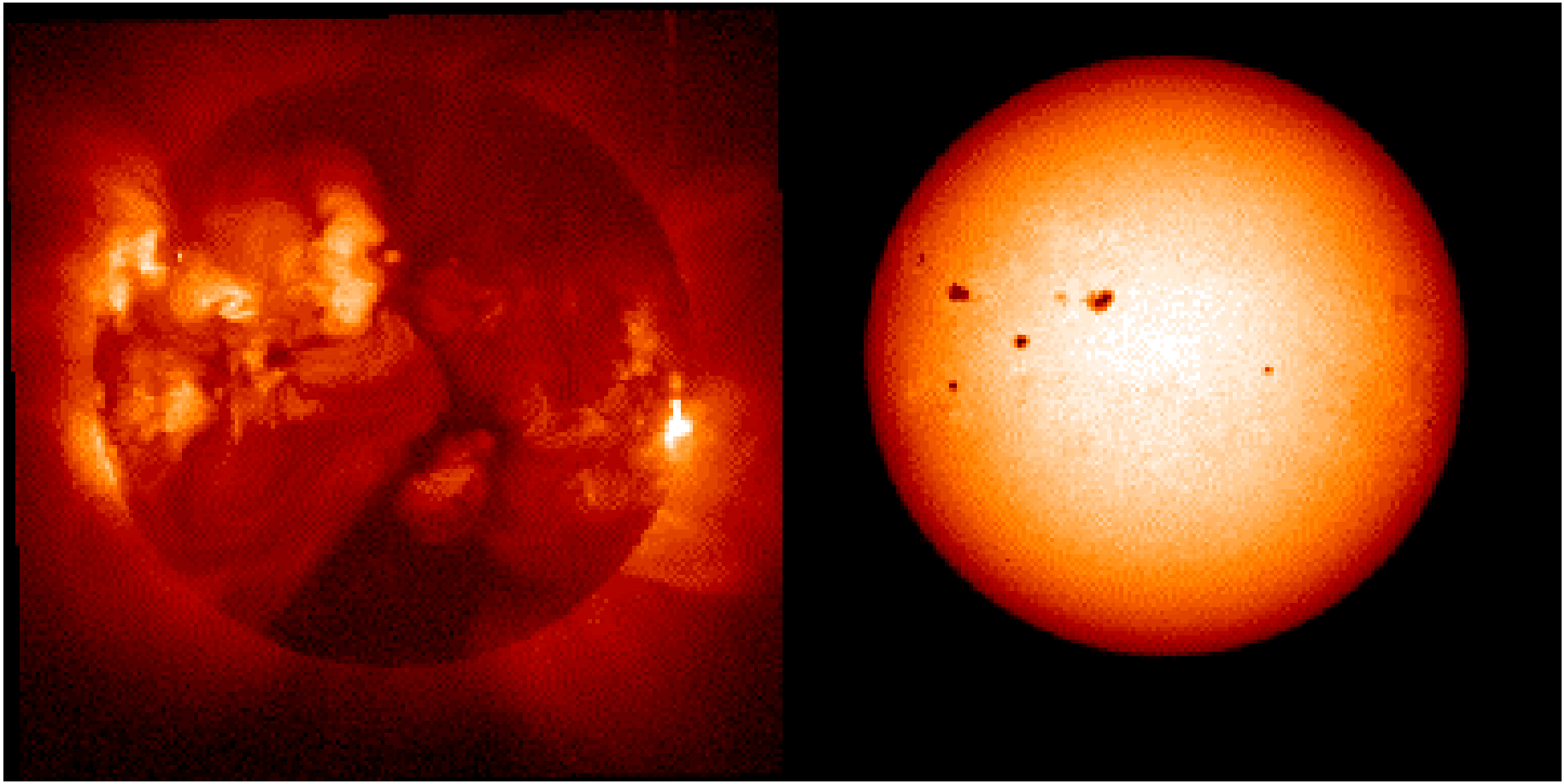
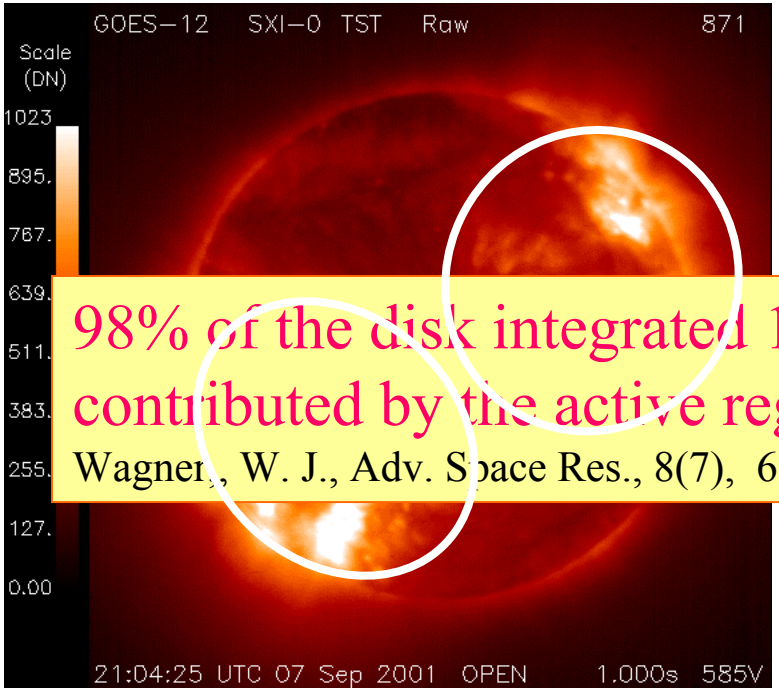
Photospheric large scale strong field regions as a measure of coronal x-ray brightness

K. B. Ramesh



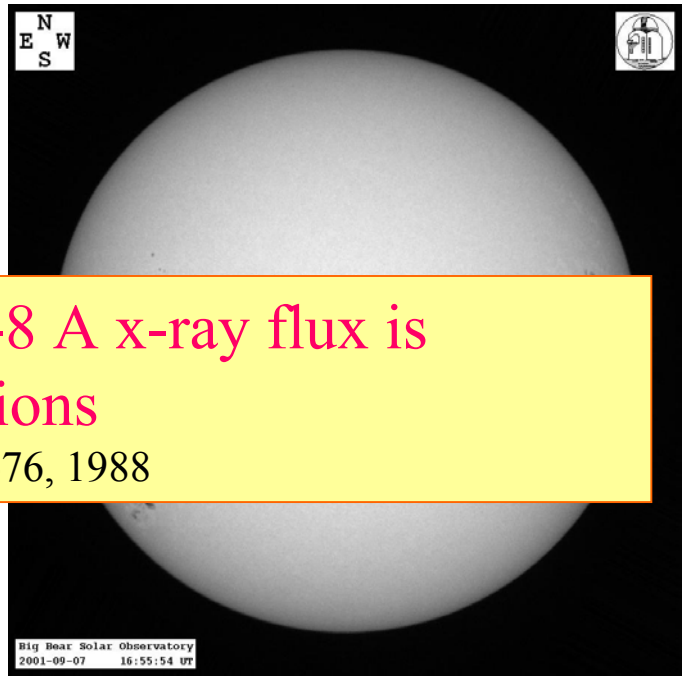


- Coronal haze
- Background x-ray emission
- Energetic events associated emission



98% of the disk integrated 1-8 A x-ray flux is contributed by the active regions

Wagner, W. J., Adv. Space Res., 8(7), 67-76, 1988



GOES 1-8 A

White light

7 Sep 2001

Fig 4.

Wagner,, W. J.,
Adv. Space Res., 8(7),
67-76, 1988

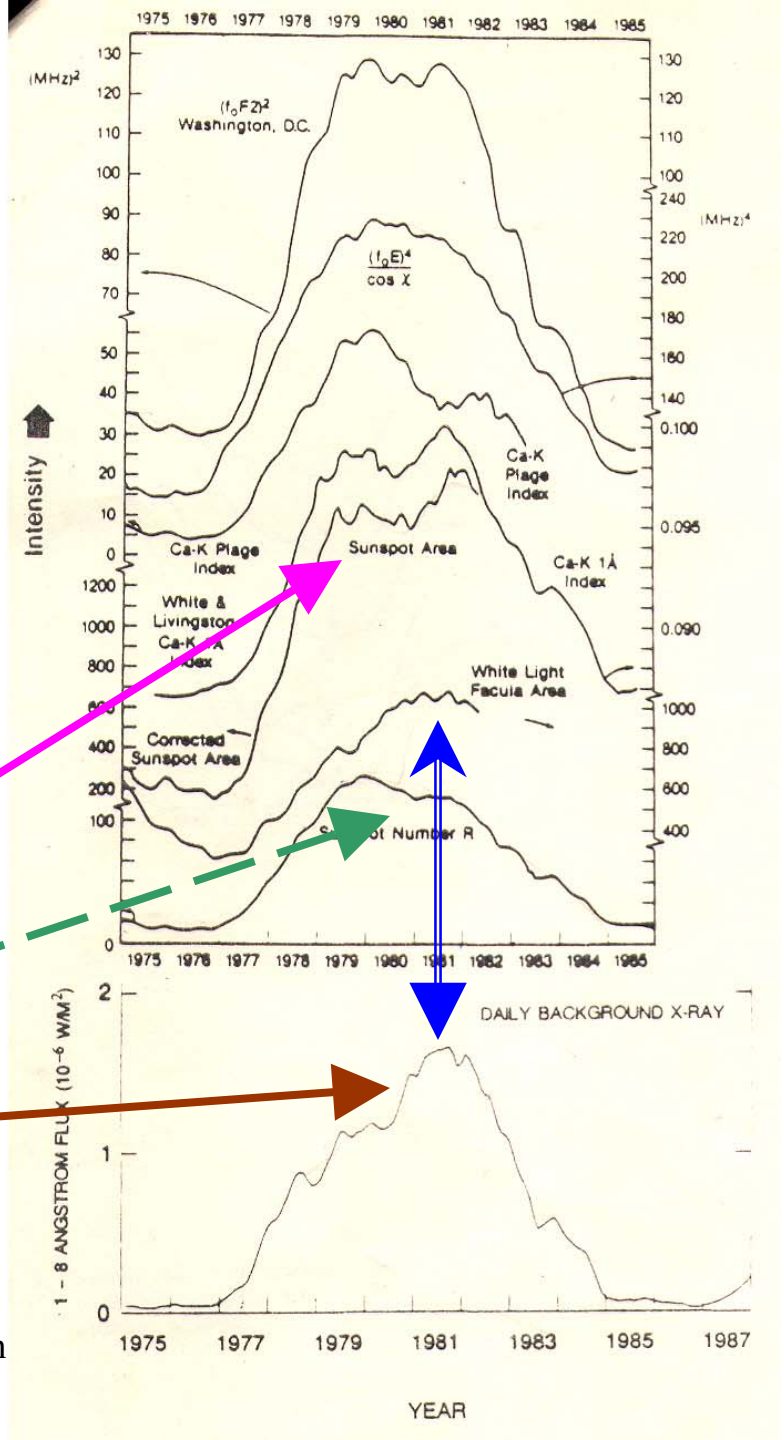
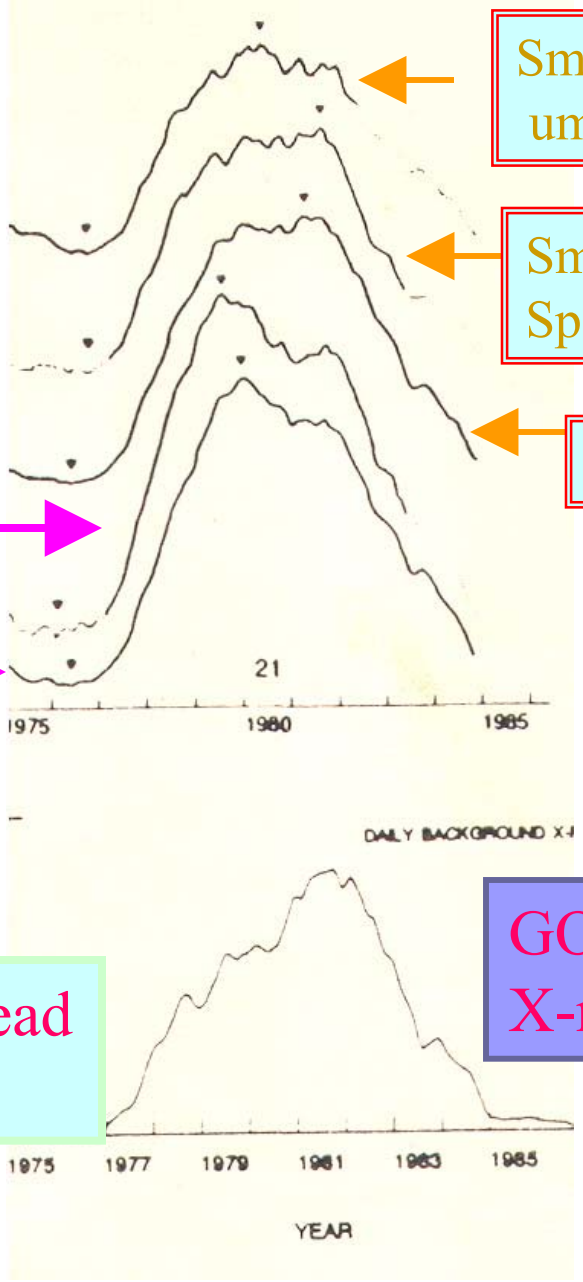
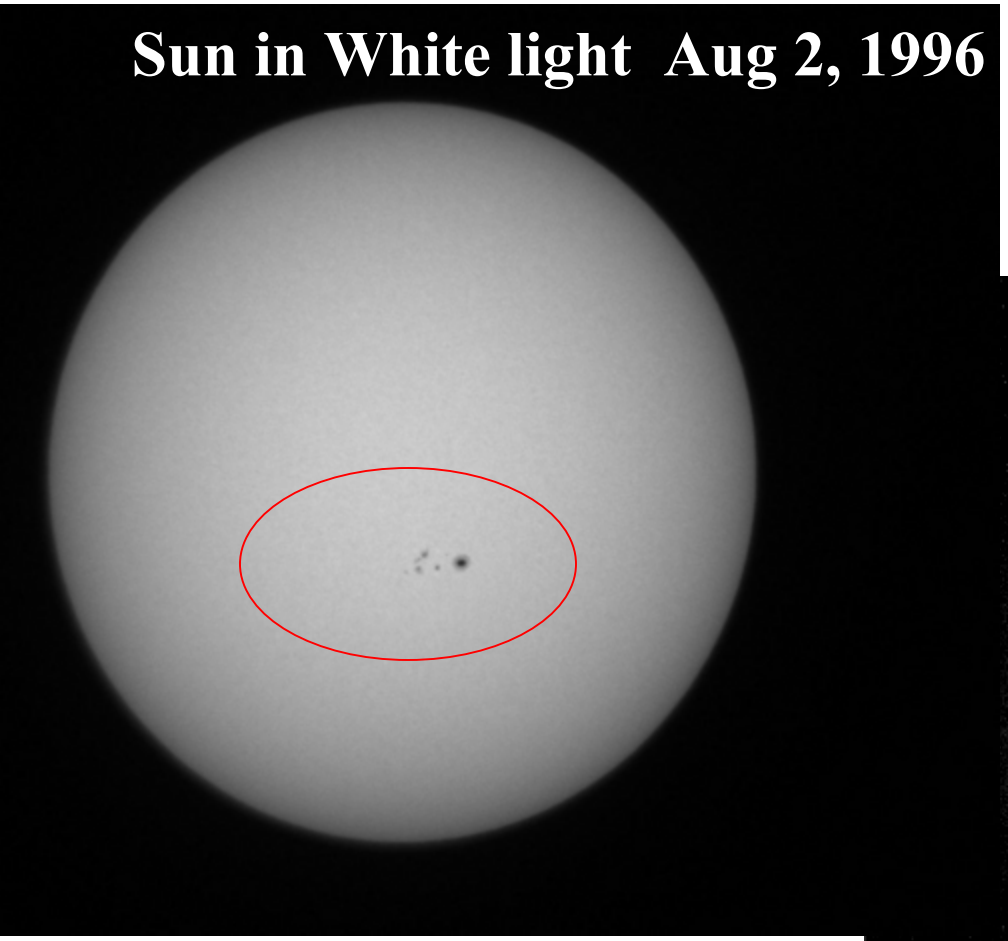


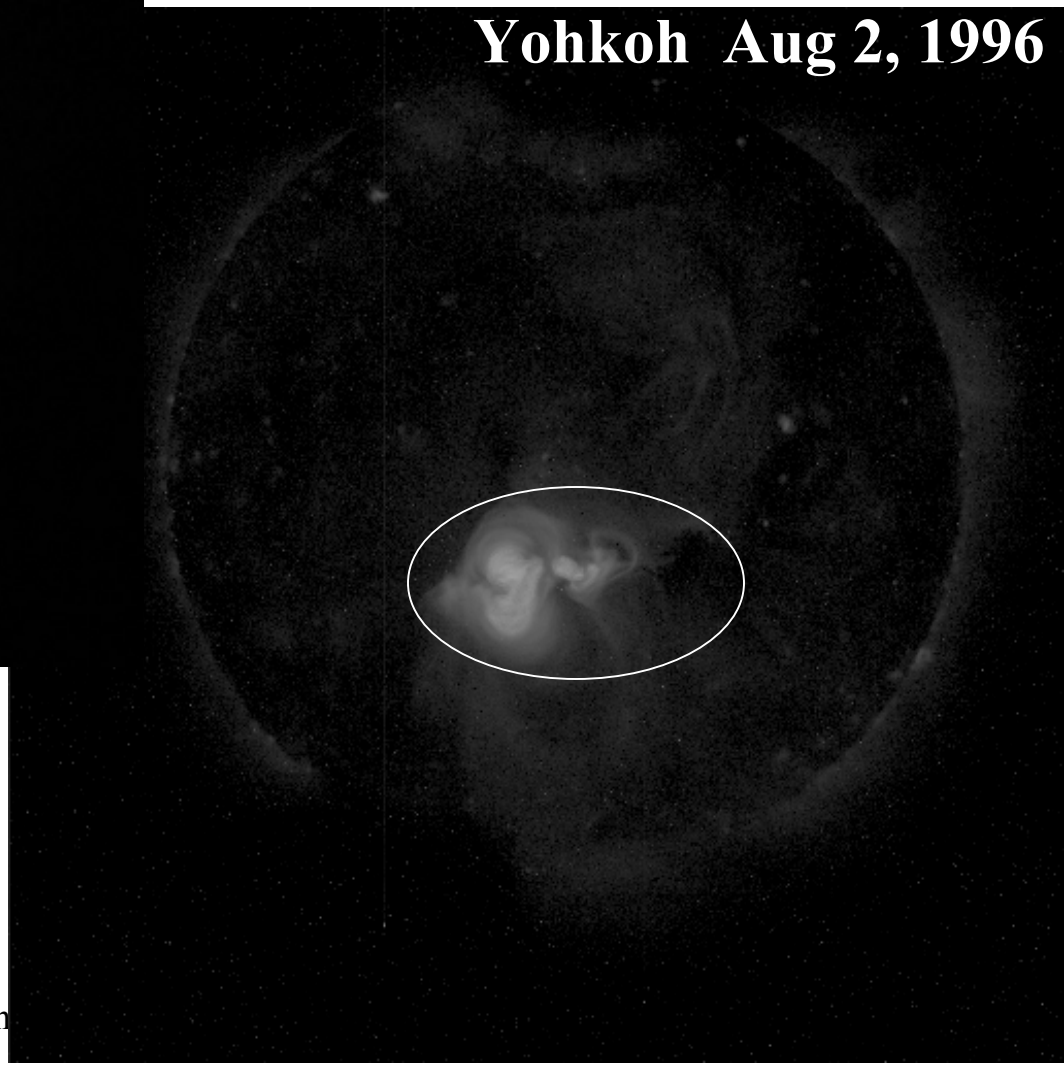
Fig 5.
Wagner,, W. J.,
Adv. Space Res., 8(7),
67-76, 1988



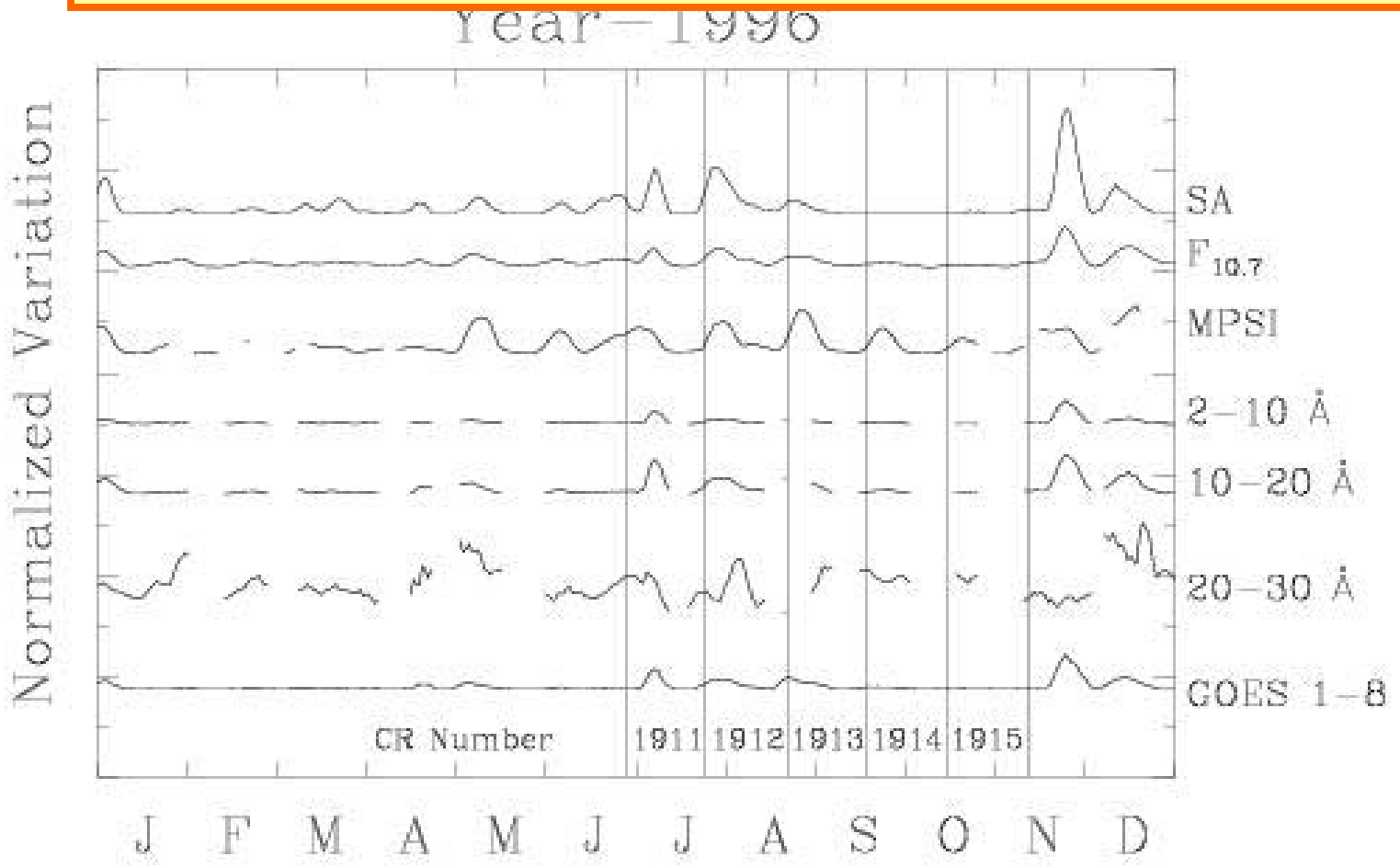
Wolf's sunspot number (now called the International sunspot number or the Zurich number) represents a blend of actual numbers of spots on the sun

http://science.nasa.gov/newhome/headlines/ast13apr98_1.htm


Sun in White light Aug 2, 1996

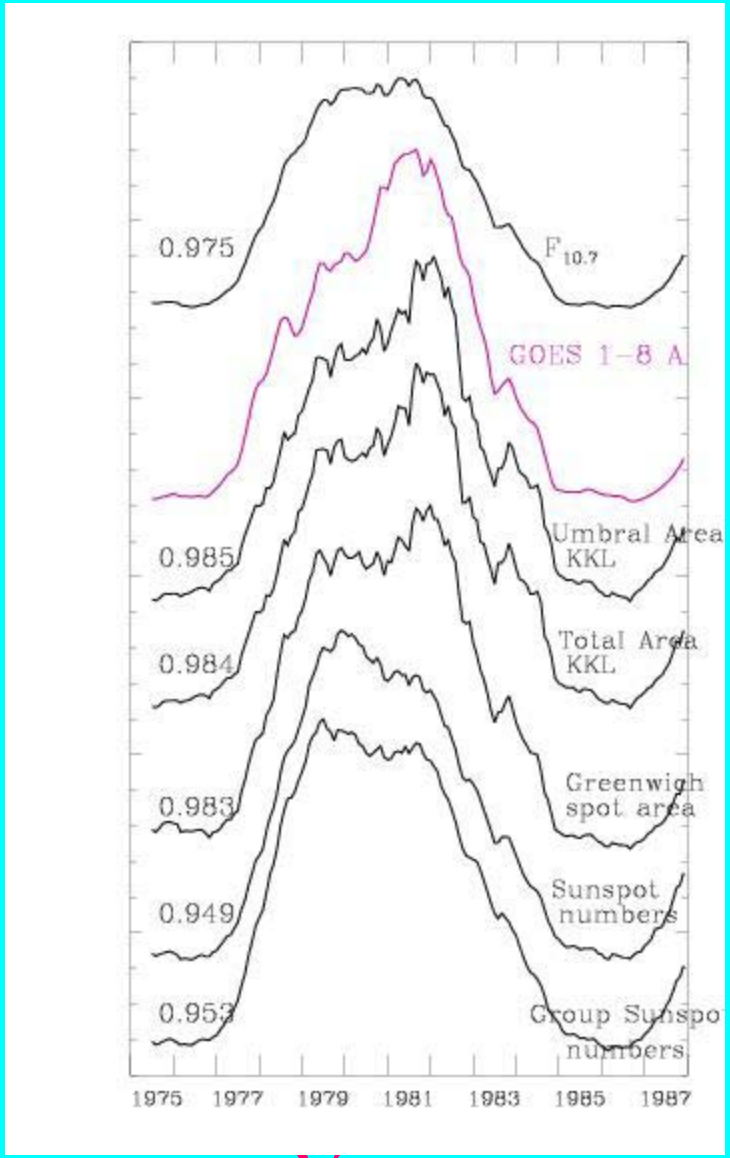

Yohkoh Aug 2, 1996

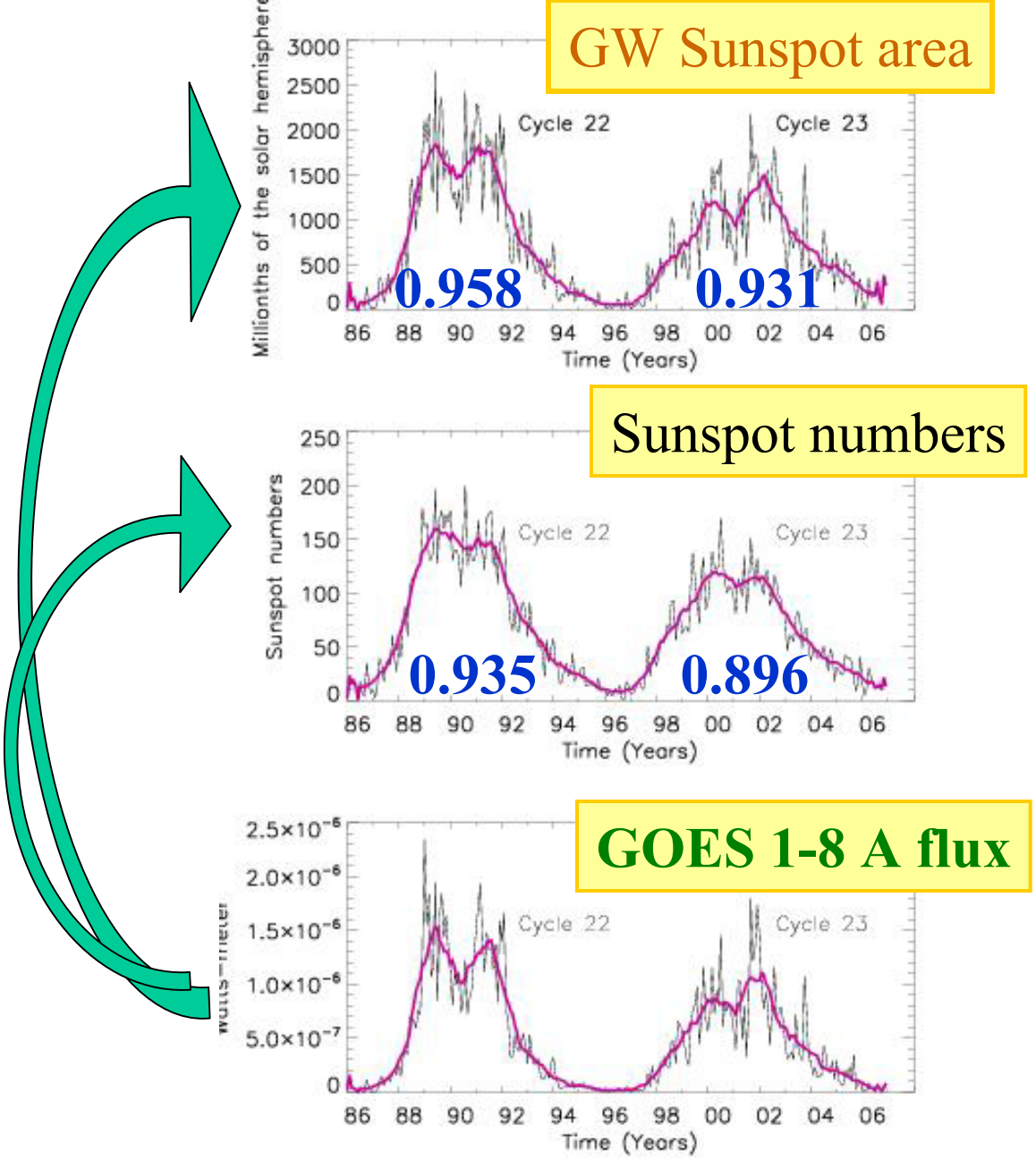
Ramesh & Sundara Raman, Solar Phys., 234, 393-408, 2006



1996

Pevtsov & Acton, ApJ, 554, 416-423, 2001


Normalized Units
0.975
$F_{10.7}$
GOES 1-8 A
0.985
Umbral Area KKL
0.984
Total Area KKL
0.983
Greenwigh spot area
0.949
Sunspot numbers
0.953
Group Sunspo numbers
1975
1977
1979
1981
1983
1985
1987
Year


GW Sunspot area
Millionths of the solar hemisphere
3000
2500
2000
1500
1000
500
0
Cycle 22
Cycle 23
0.958
0.931
86 88 90 92 94 96 98 00 02 04 06
Time (Years)
Sunspot numbers
Sunspot numbers
250
200
150
100
50
0
Cycle 22
Cycle 23
0.935
0.896
86 88 90 92 94 96 98 00 02 04 06
Time (Years)
GOES 1-8 A flux
2.5×10⁻⁶
2.0×10⁻⁶
1.5×10⁻⁶
1.0×10⁻⁶
5.0×10⁻⁷
0
Cycle 22
Cycle 23
86 88 90 92 94 96 98 00 02 04 06
Time (Years)

$$R = k (10 g + n)$$

g = Number of spot groups
n = Number of individual sunspots
k = Correction factor for each observer

In 1848 the Swiss astronomer Johann Rudolph Wolf introduced a daily measurement of sunspot numbers which is still used today, counting the total number of observable sunspots and the number of groups into which they cluster, because neither quantity alone satisfactorily measures sunpsot activity.

Results however vary greatly, since the measurement stongly depends on observer interpretation and experience and on the stability of the Earth's atmosphere above the observing site

"Today, much more sophisticated measurements of solar activity are made routinely, but none has the link with the past that sunspot numbers have." - J.A. McKinnon

Date	g	n	**R= k(10g + n)**	U_A	**Total Area**
11. 9.1976	1	15	25	123	405
10.12.1976	1	16	26	33	198

9. 7.1986	1	3	13	76	229
14.11.1987	1	3	13	224	783

Conclusions

- Sunspots, the regions of strong magnetic fields, represent very well the GOES 1-8 A x-ray emission.
- Sunspot area, among the other parameters studied, seems to be the best suitable proxy for the GOES x-ray emission.
- Basic definition R=k(10g+n) seem to underestimate the sunspot numbers (Particularly during solar maximum) for the studies of longer time scale solar activity. More refined definition of R perhaps is needed.