(ENSO) as a Criterion for the Definition of Public Pol

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OUTLINE

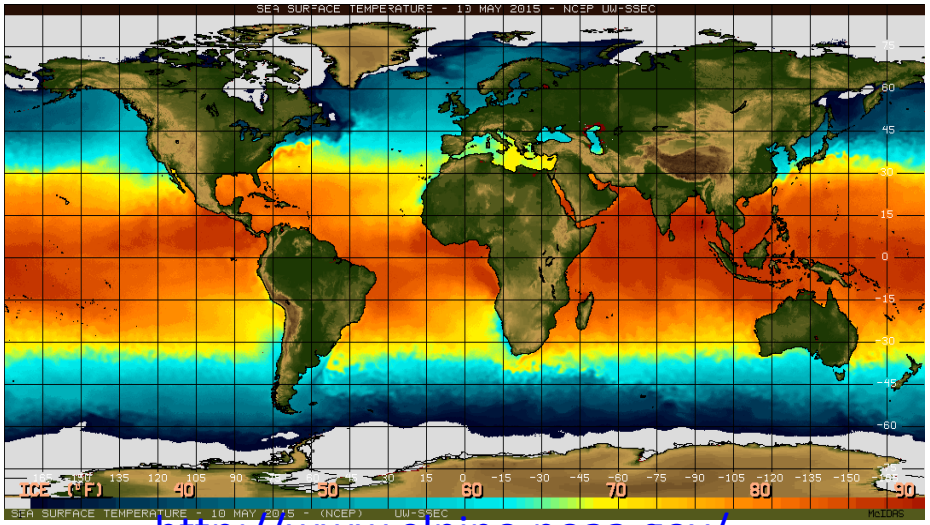
I.- Introduction
II.- Objective
III.- Methods
IV.- Results
V.- Conclusions
VI.- References

I.- Introduction

Phenomena studied as evidence of change on Earth's climate :

1). The Solar Cycle (SC).

2). The Sea Surface Temperature (SST)



http://www.elnino.noaa.gov/

I.- Introduction

The start:

- Gilbert Walker (1923) discovers the Southern Oscillation.
- It becomes strongly associated to the discourse on Climatic Change during the last decades.
- Addressed – with noticeably high frequency – by various instances, among them, by the National Oceanic and Atmospheric Administration (NOAA).

I.- Introduction

Major contributors:

- Johan R. Wolf: Solar Cycle
- Wladimir P. Köppen:
  Solar Cycle $\leftrightarrow$ Meteorological phenomena on Earth

  • • • •

more recently:

- Friss-Christensen
- Lassen
- Svensmark

Claims:
a striking correlation between
i). global temperatures and length of the sunspot cycle during the period 1860-1986.
ii). cloud cover and solar activity plus cosmic ray intensities.

However:
P. Laut and others strongly question the validity of son

I.- Objectives

1. Find correlations between the SC and the ENSO.

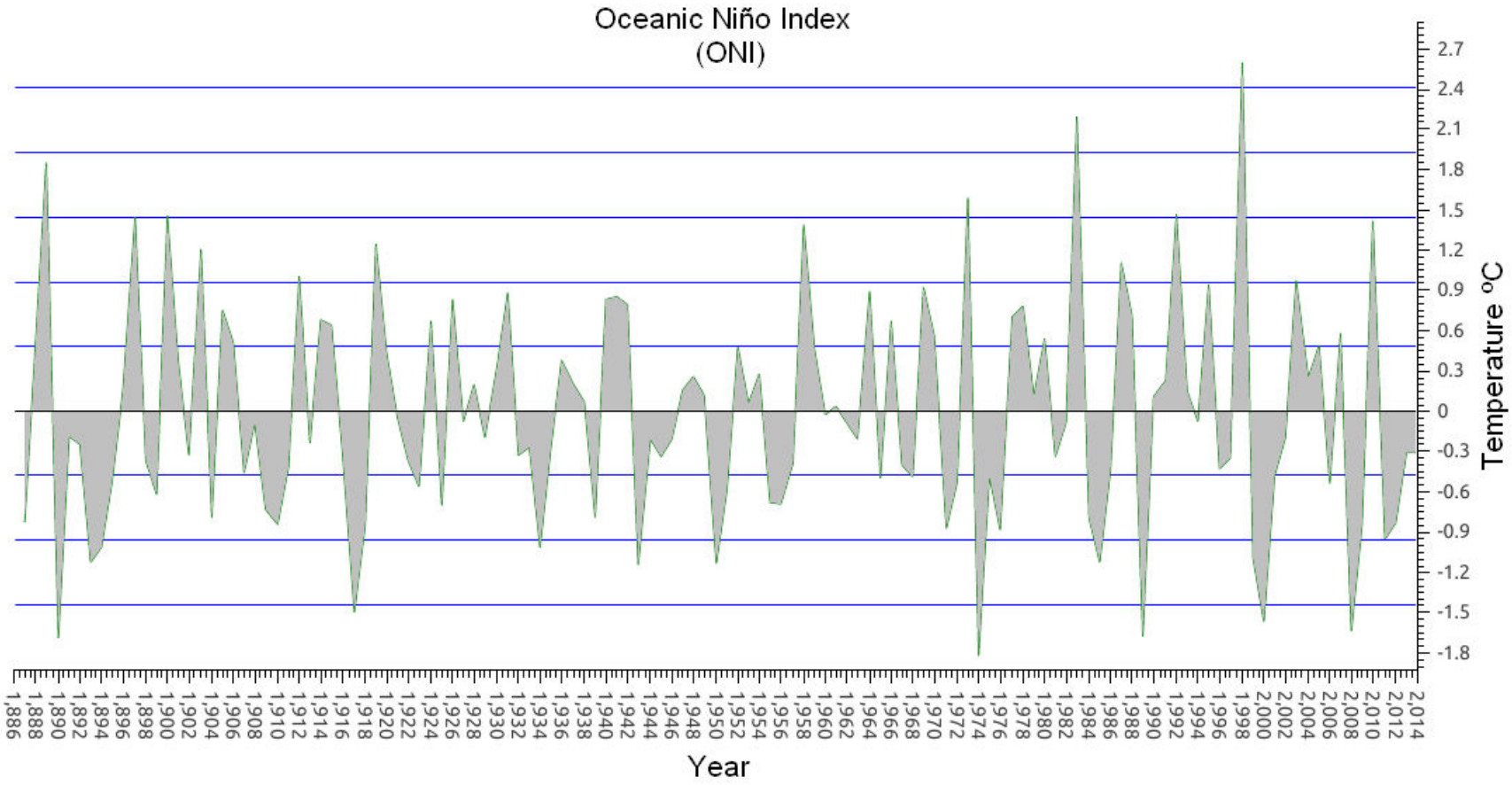
2. Find out whether they have common aspects and from thereon, define possible criteria for public policies that might counteract the impact they could have on future environmental and social issues, among others.

II.- Methods

We consider the range from -0.5 to 0.5 °C as the variation of

This operational definition from the NOAA for “El Niño” an

II.- Methods



ure 1. ONI variations for the period 1886-2014

II.- Methods

These measurements are reported as Sunspots Number and i

These values - called International Sunspot Numbers - are a

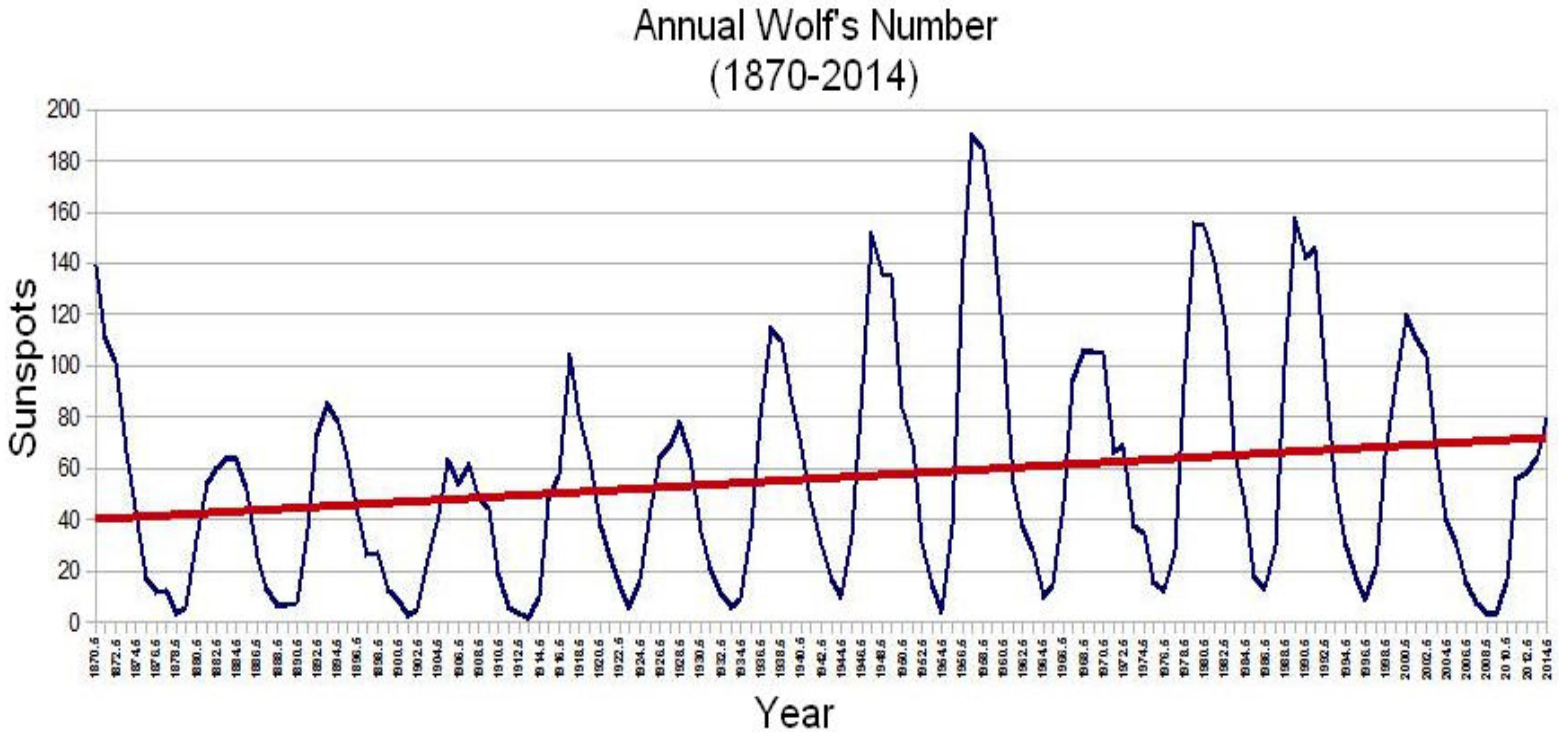
II.- Methods

The comparison between the Solar Cycle and El Niño is ma

The monthly data for the analysis method is the same as the

II.- Methods

Figure 2. shows these data:



lf's Number behavior for the period 1870-2014

II.- Methods

The tables and graphs for the ENSO correspond to the NOAA documentation for the Oceanic Niño Index.

The monthly data for the analysis method is the same as that

III.- Results

The regions for “El Niño” are defined in the followi

- El Niño-3 region in the eastern Pacific
  (Latitude: 5°S-5°N, and Longitude: 150°W-90°W)
- El Niño-4 region in the west-central Pacific
  (Latitude: 5°S-5°N, Longitude: 150°W-160°E)
- El Niño-3.4 region, which overlaps with both “El Niño-3” and “El Niño-4”
  (Latitude: 5°S-5°N, Longitude: 170°W-120°W).

III.- Results

The Solar Cycle (SC) can form composed larger cycles knov

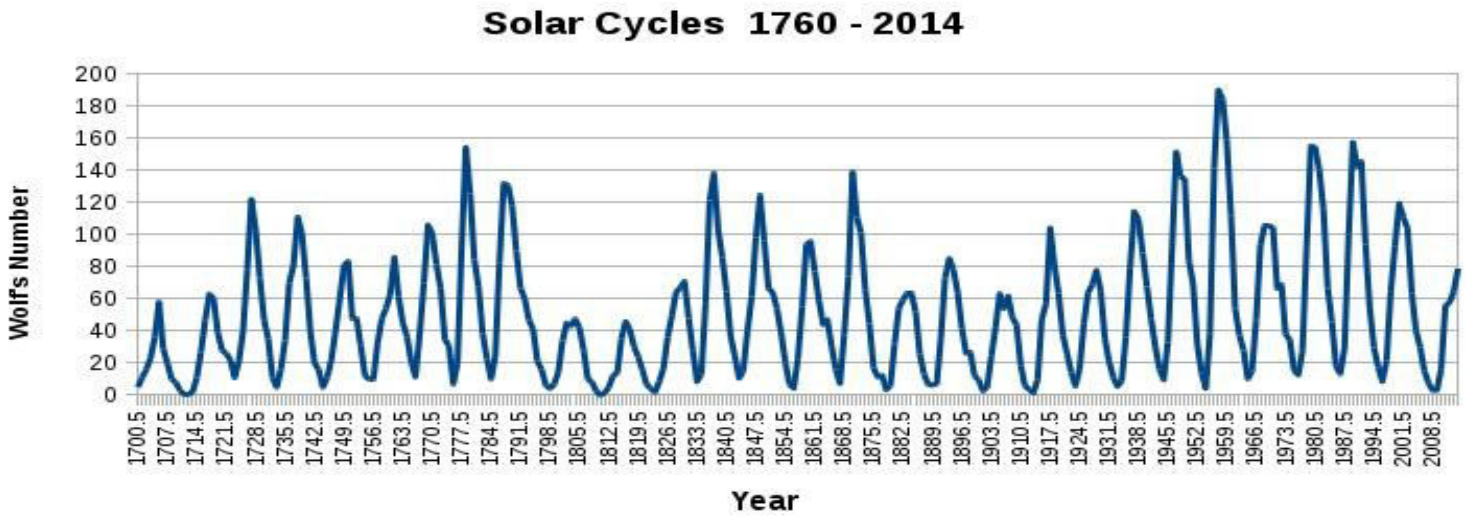


Figure 3. Solar Cycles for the period 1700 -2014 showing the Double Minimum of Gleissberg near 1810.

III.- Results

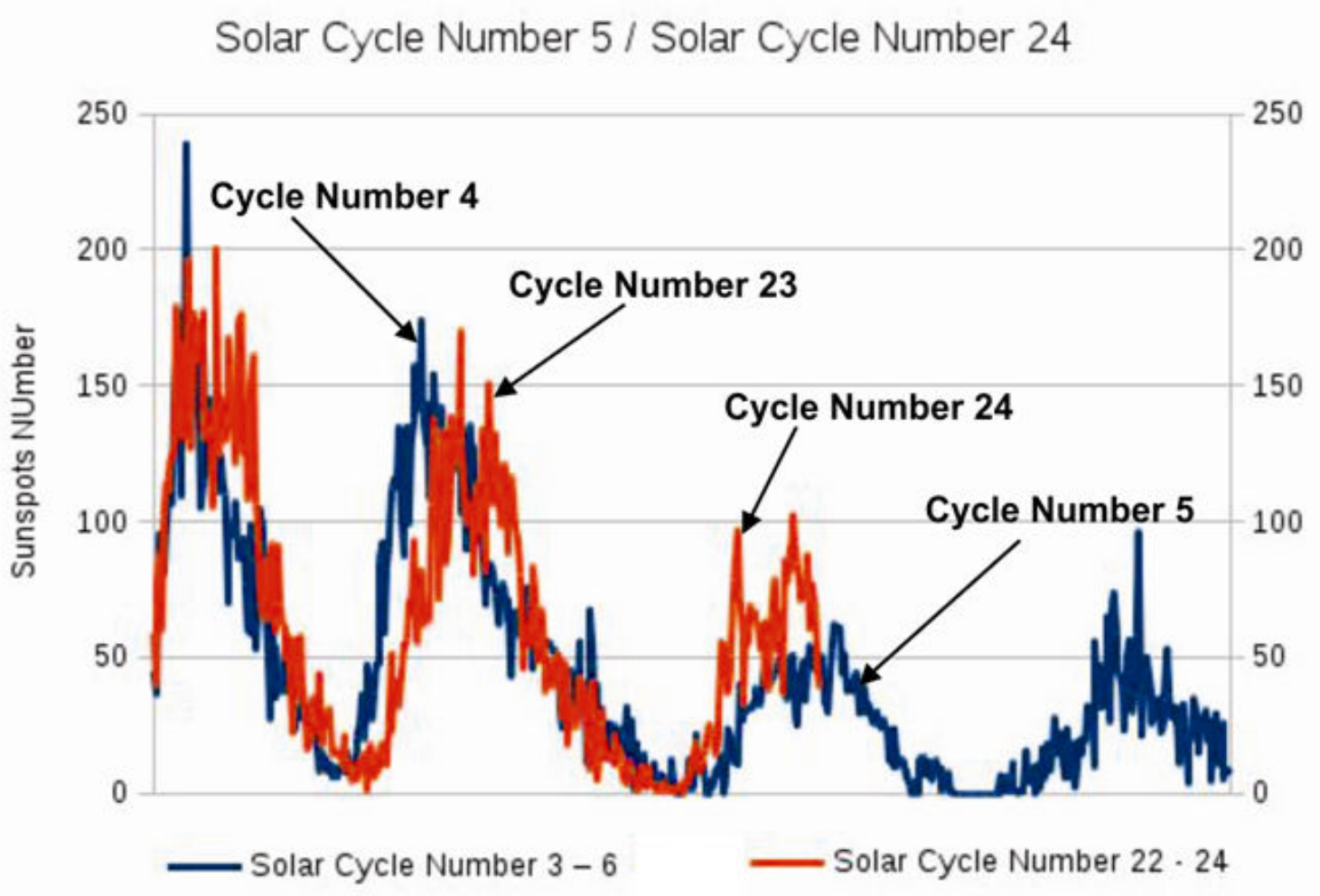


Figure 4. Solar cycles 5 and 24

III.- Results

The last Minima of Gleissberg:

i). around 1810

presented a larger decrease in solar activity than the one in 1910 characterizing

This expectation is documented by the similarities in the behavior with the Sol

ii). around 1910.

III.- Results

1890	-1.8	-1.7	-1.2	-0.8	-0.7	-0.6	-0.8	-0.9	-1.1	-1.0	-0.8	-0.6
1891	-0.2	-0.2	0.1	0.2	0.3	0.3	0.2	0.1	0.0	0.0	0.0	-0.1
1892	-0.3	-0.4	-0.4	-0.5	-0.5	-0.5	-0.5	-0.7	-1.0	-1.4	-1.4	-1.3
1893	-1.2	-1.1	-1.1	-1.1	-1.1	-1.2	-1.2	-1.2	-1.3	-1.3	-1.2	-1.1
1894	-1.1	-1.0	-0.9	-0.8	-0.8	-0.8	-0.8	-0.9	-0.9	-0.9	-0.7	-0.7
1895	-0.5	-0.4	-0.2	0.0	0.0	-0.1	0.0	0.2	0.4	0.5	0.4	0.4
1896	0.2	0.3	0.3	0.2	0.1	0.3	0.6	1.0	1.3	1.4	1.5	1.6
1897	1.5	1.2	0.7	0.3	0.1	0.2	0.2	0.1	-0.1	-0.3	-0.4	-0.4
1898	-0.4	-0.5	-0.5	-0.4	-0.3	-0.3	-0.4	-0.3	-0.2	-0.2	-0.4	-0.6
1899	-0.6	-0.5	-0.4	-0.1	0.1	0.2	0.4	0.5	0.9	1.1	1.4	1.5
1900	1.5	1.4	1.2	0.9	0.9	0.9	1.0	0.9	0.8	0.6	0.5	0.6
1901	0.4	0.5	0.2	0.1	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.3	-0.4
1902	-0.3	-0.3	0.0	0.4	0.7	1.1	1.3	1.5	1.5	1.6	1.5	1.5
1903	1.2	1.1	0.8	0.6	0.4	0.1	0.0	-0.3	-0.3	-0.5	-0.6	-0.8
1904	-0.8	-0.7	-0.6	-0.4	-0.1	0.4	0.7	0.6	0.7	0.5	0.7	0.6
1905	0.8	0.8	0.8	1.0	0.9	1.0	1.0	1.3	1.4	1.3	1.1	1.0
1906	0.5	0.8	0.8	0.6	0.4	0.0	-0.1	-0.5	-0.6	-0.6	-0.5	-0.4
1907	-0.5	-0.4	-0.3	-0.3	-0.3	-0.3	-0.4	-0.3	-0.2	0.0	-0.1	-0.2
1908	-0.1	-0.2	-0.2	-0.4	-0.2	-0.3	-0.3	-0.4	-0.4	-0.6	-0.8	-0.7
1909	-0.8	-0.5	-0.6	-0.3	-0.5	-0.7	-0.9	-0.9	-1.0	-1.1	-1.2	-1.1
1910	-0.9	-0.7	-0.7	-0.9	-1.0	-1.0	-0.8	-0.9	-1.0	-0.8	-0.6	-0.6
1911	-0.4	-0.7	-0.7	-0.8	-0.8	-0.5	-0.3	-0.1	0.0	0.4	0.6	1.1
1912	1.0	1.0	0.8	0.6	0.3	0.0	-0.2	-0.1	-0.2	0.0	-0.2	-0.2
1913	-0.2	0.0	-0.1	-0.1	-0.3	-0.1	-0.1	0.0	0.0	0.3	0.5	0.7
1914	0.7	0.6	0.7	0.5	0.4	0.3	0.6	0.7	0.6	0.4	0.4	0.6
1915	0.7	0.7	0.6	0.7	0.8	0.7	0.5	0.1	0.1	0.1	-0.1	-0.2
1916	-0.3	-0.5	-0.5	-0.3	-0.3	-0.5	-0.9	-1.3	-1.4	-1.5	-1.6	-1.7

1890	-35.2	-38.1	-41.1	-38.4	-39.6	-35.9	-34.7	-28.7	-27.1	-25.2	-26.7	-17.8
1891	-10.1	-17.2	-16.0	-9.1	2.5	14.7	11.5	13.7	11.8	15.4	9.3	16.3
1892	26.8	32.3	31.4	33.3	41.1	42.8	49.5	45.4	43.9	32.6	38.8	41.5
1893	43.3	38.6	41.9	46.4	53.5	53.0	67.4	63.8	61.4	44.0	50.3	52.5
1894	54.9	40.8	39.2	45.3	59.8	67.3	56.5	45.9	36.2	32.4	31.4	28.5
1895	31.2	31.2	34.7	35.4	37.9	27.6	27.5	23.3	30.5	24.0	29.3	18.2
1896	2.7	7.5	11.5	2.8	1.3	0.8	0.0	3.8	-0.6	3.9	-1.1	3.6
1897	-0.7	-5.6	-9.7	-11.7	-18.1	-20.2	-20.2	-8.2	-11.6	-15.1	-18.8	-12.8
1898	-4.9	-3.7	-9.8	-12.2	-18.0	-20.8	-19.5	-15.7	-6.1	-5.4	-11.5	-15.8
1899	-24.4	-23.0	-25.7	-25.0	-24.7	-25.9	-28.1	-32.5	-31.5	-29.0	-27.1	-27.5
1900	-27.0	-28.1	-26.8	-25.1	-24.4	-27.9	-32.2	-33.8	-31.1	-30.2	-31.6	-22.8
1901	-19.5	-27.8	-28.4	-25.1	-25.3	-26.5	-30.9	-33.4	-31.4	-29.0	-28.2	-26.6
1902	-28.8	-24.2	-26.6	-25.0	-29.3	-30.4	-31.8	-30.5	-24.5	-20.3	-21.4	-23.1
1903	-21.8	-17.3	-11.8	-12.0	-11.7	-12.5	-9.0	-11.5	-6.9	-0.2	12.3	10.9
1904	3.3	0.9	4.2	9.9	10.8	11.9	16.9	12.2	14.3	9.1	18.3	19.4
1905	34.4	35.5	29.8	17.9	14.8	24.6	26.9	28.1	31.0	48.6	49.8	34.2
1906	-0.6	7.8	10.9	19.8	18.2	32.2	27.7	25.1	-2.4	-3.5	0.7	21.5
1907	43.8	42.5	34.3	12.7	4.8	1.7	4.3	19.0	25.3	29.5	18.3	10.8
1908	0.8	-5.3	0.6	3.0	8.3	0.2	15.6	28.3	27.0	13.8	-0.7	8.7
1909	8.3	17.3	8.9	5.5	-10.2	-11.2	-16.6	-11.5	-2.8	9.9	16.4	6.9
1910	-1.9	-12.8	-19.1	-22.1	-26.2	-26.4	-31.2	-26.8	-17.6	-18.0	-23.4	-22.5
1911	-16.6	-25.6	-21.5	-21.0	-22.6	-28.9	-31.3	-31.7	-31.3	-31.0	-30.5	-29.6
1912	-31.0	-30.6	-29.5	-27.5	-27.5	-30.0	-32.1	-31.2	-30.0	-29.6	-29.5	-28.6
1913	-28.0	-30.4	-31.2	-31.6	-31.5	-33.2	-33.9	-34.5	-33.3	-33.0	-31.0	-29.4
1914	-28.8	-29.5	-25.0	-23.6	-20.5	-26.5	-26.4	-26.9	-25.3	-22.2	-17.9	-11.3
1915	-2.7	2.4	8.2	5.6	15.9	24.0	35.5	28.1	22.7	13.9	10.0	3.5
1916	7.9	16.9	26.1	32.8	32.7	24.5	10.9	3.3	3.2	13.5	16.2	25.2

1999	-1.1	-1.3	-1.0	-0.9	-0.9	-0.9	-0.9	-0.9	-1.0	-1.1	-1.3	-1.6
2000	-1.6	-1.5	-1.2	-1.0	-0.8	-0.7	-0.6	-0.4	-0.4	-0.6	-0.7	-0.8
2001	-0.5	-0.7	-0.5	-0.4	-0.2	-0.1	-0.1	-0.1	-0.2	-0.3	-0.3	-0.3
2002	-0.2	0.0	0.1	0.1	0.3	0.5	0.7	0.7	0.9	1.1	1.3	1.3
2003	1.0	0.7	0.4	0.0	-0.2	-0.2	0.0	0.1	0.2	0.3	0.4	0.3
2004	0.3	0.1	0.0	0.0	0.1	0.2	0.4	0.6	0.7	0.7	0.7	0.6
2005	0.5	0.4	0.3	0.3	0.3	0.2	0.1	0.0	-0.1	-0.2	-0.4	-0.7
2006	-0.6	-0.8	-0.6	-0.4	-0.1	0.0	0.2	0.3	0.6	0.8	0.9	0.9
2007	0.6	0.2	-0.1	-0.2	-0.2	-0.3	-0.4	-0.7	-1.0	-1.3	-1.5	-1.7
2008	-1.7	-1.5	-1.2	-0.9	-0.7	-0.4	-0.2	-0.1	-0.2	-0.3	-0.5	-0.8
2009	-0.9	-0.8	-0.6	-0.3	0.1	0.4	0.6	0.7	0.8	1.0	1.4	1.6
2010	1.5	1.2	0.9	0.5	-0.1	-0.5	-0.9	-1.3	-1.5	-1.6	-1.6	-1.6
2011	-1.0	-1.3	-1.0	-0.8	-0.5	-0.3	-0.4	-0.5	-0.8	-0.9	-1.0	-1.0
2012	-0.9	-0.7	-0.5	-0.3	-0.1	0.1	0.4	0.5	0.4	0.3	0.1	-0.1
2013	-0.3	-0.3	-0.2	-0.2	-0.2	-0.3	-0.3	-0.2	-0.2	-0.1	-0.1	-0.2
2014	-0.3	-0.3	-0.1	0.2	0.4	0.4	0.3	0.2	0.2			

1999	8.1	3.5	3.8	18.2	41.0	56.2	49.8	28.9	30.7	45.9	49.5	41.5
2000	33.9	51.7	63.2	67.1	62.4	75.9	76.7	72.8	49.9	44.0	41.6	29.6
2001	17.5	34.4	38.2	44.5	51.2	41.2	42.3	49.0	64.3	66.3	59.4	56.5
2002	56.0	44.5	46.4	51.9	48.3	39.9	36.3	44.5	44.6	39.6	29.3	24.2
2003	6.9	0.1	-6.7	-2.9	2.4	8.8	12.7	4.2	-1.0	-0.8	-2.2	-10.8
2004	-18.7	-18.1	-17.7	-18.1	-20.3	-17.7	-20.1	-24.1	-24.4	-21.5	-25.5	-30.2
2005	-35.8	-33.8	-36.5	-31.0	-26.2	-22.3	-26.5	-31.2	-40.9	-45.1	-39.4	-21.1
2006	-34.5	-51.9	-47.2	-40.4	-39.5	-46.8	-52.1	-50.8	-50.7	-45.8	-46.8	-43.9
2007	-48.2	-51.5	-56.2	-54.9	-52.5	-51.8	-55.9	-58.0	-60.2	-59.6	-57.7	-56.1
2008	-56.8	-57.3	-57.7	-56.3	-58.4	-60.5	-63.6	-63.2	-61.8	-58.6	-59.4	-59.1
2009	-60.8	-61.0	-61.5	-60.0	-59.4	-60.0	-63.1	-61.5	-60.2	-56.9	-55.4	-51.8
2010	-47.7	-46.4	-48.4	-50.7	-51.5	-50.2	-48.7	-43.7	-40.5	-37.9	-42.2	-28.8
2011	-25.1	-27.4	-15.8	-10.8	-17.3	-22.2	-21.3	-6.5	8.9	26.3	23.9	14.9
2012	-7.2	-10.3	-11.6	1.4	1.3	3.7	-0.5	-0.4	-4.0	-2.4	-10.0	-6.0
2013	-14.7	-9.2	-6.3	8.2	6.3	-0.2	-6.6	-10.7	-0.4	5.5	22.5	22.1
2014	29.5	29.8	30.5	22.5	15.4	9.9	7.6	5.0	2.8			

III.- Results

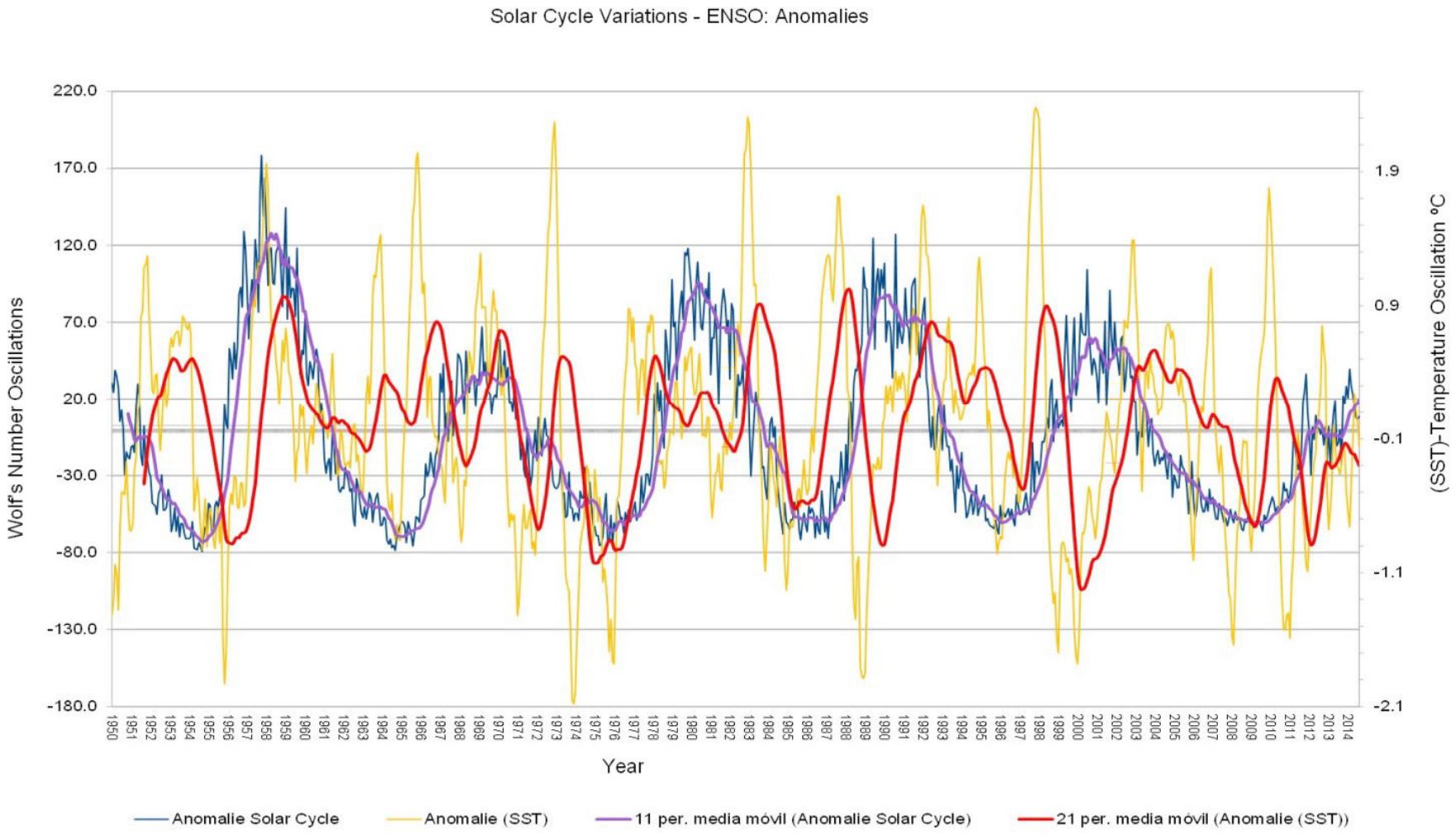


Figure 5. Wolf's Number and (ENSO) anomalies

IV.- Conclusions

- From the material presented and the arguments discusse

  We can conclude that solar activity oscillations impact tl

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IV.- Conclusions

- Based on the similarities of the solar cycles 5 and 24 we

- An issue that of higher importance for those countries lc

IV.- Conclusions

- The apparently perceived expectations will have to consi

- Finally, with this exercise we try to put the Solar Cycle i

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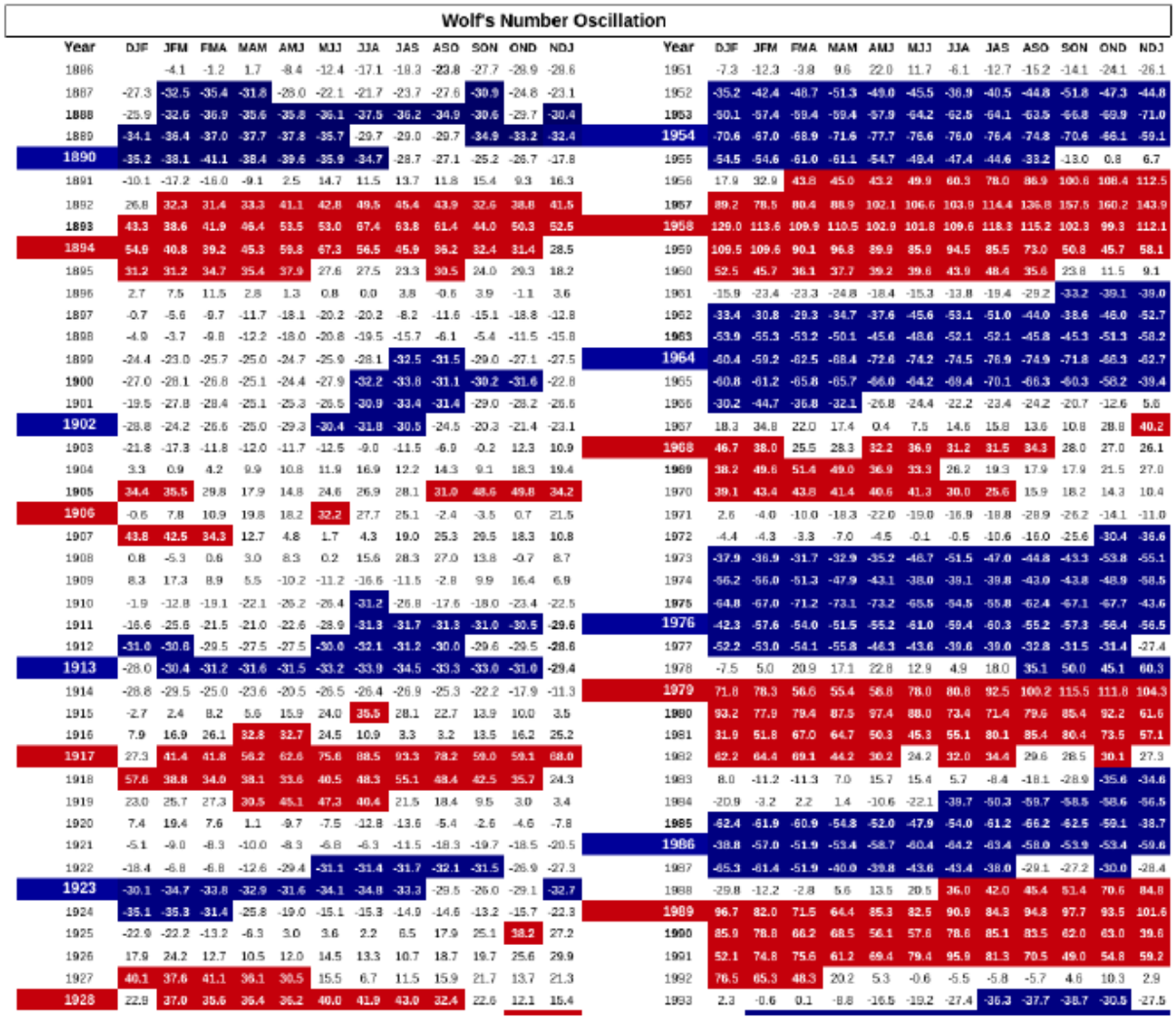
Backup Slides



Wolf's Number Oscillation

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1886		-4.1	-1.2	1.7	-8.4	-12.4	-17.1	-18.3	-23.8	-27.7	-28.9	-29.6
1887	-27.3	-32.5	-35.4	-31.8	-28.0	-22.1	-21.7	-23.7	-27.6	-30.9	-24.8	-23.1
1888	-25.9	-32.6	-36.9	-35.6	-35.8	-36.1	-37.5	-36.2	-34.9	-30.6	-29.7	-30.4
1889	-34.1	-36.4	-37.0	-37.7	-37.8	-35.7	-29.7	-29.0	-29.7	-34.9	-33.2	-32.4
1890	-35.2	-38.1	-41.1	-38.4	-39.6	-35.9	-34.7	-28.7	-27.1	-25.2	-26.7	-17.8
1891	-10.1	-17.2	-16.0	-9.1	2.5	14.7	11.5	13.7	11.8	15.4	9.3	16.3
1892	26.8	32.3	31.4	33.3	41.1	42.8	49.5	45.4	43.9	32.6	38.8	41.5
1893	43.3	38.6	41.9	46.4	53.5	53.0	67.4	63.8	61.4	44.0	50.3	52.5
1894	54.9	40.8	39.2	45.3	59.8	67.3	56.5	45.9	36.2	32.4	31.4	28.5
1895	31.2	31.2	34.7	35.4	37.9	27.6	27.5	23.3	30.5	24.0	29.3	18.2
1896	2.7	7.5	11.5	2.8	1.3	0.8	0.0	3.8	-0.6	3.9	-1.1	3.6
1897	-0.7	-5.6	-9.7	-11.7	-18.1	-20.2	-20.2	-8.2	-11.6	-15.1	-18.8	-12.8
1898	-4.9	-3.7	-9.8	-12.2	-18.0	-20.8	-19.5	-15.7	-6.1	-5.4	-11.5	-15.8
1899	-24.4	-23.0	-25.7	-25.0	-24.7	-25.9	-28.1	-32.5	-31.5	-29.0	-27.1	-27.5
1900	-27.0	-28.1	-26.8	-25.1	-24.4	-27.9	-32.2	-33.8	-31.1	-30.2	-31.6	-22.8
1901	-19.5	-27.8	-28.4	-25.1	-25.3	-26.5	-30.9	-33.4	-31.4	-29.0	-28.2	-26.6
1902	-28.8	-24.2	-26.6	-25.0	-29.3	-30.4	-31.8	-30.5	-24.5	-20.3	-21.4	-23.1
1903	-21.8	-17.3	-11.8	-12.0	-11.7	-12.6	-9.0	-11.5	-6.9	-0.2	12.3	10.9
1904	3.3	0.9	4.2	9.9	10.8	11.9	16.9	12.2	14.3	9.1	18.3	19.4
1905	34.4	35.5	28.8	17.9	14.8	24.6	26.9	28.1	31.0	48.6	49.8	34.2
1906	-0.6	7.8	10.9	19.8	18.2	32.2	27.7	25.1	-2.4	-3.5	0.7	21.5
1907	43.8	42.5	34.3	12.7	4.8	1.7	4.3	19.0	25.3	29.5	18.3	10.8
1908	0.8	-5.3	0.6	3.0	8.3	0.2	15.6	28.3	27.0	13.8	-0.7	8.7
1909	8.3	17.3	8.9	5.5	-10.2	-11.2	-16.6	-11.5	-2.8	9.9	16.4	6.9
1910	-1.9	-12.8	-19.1	-22.1	-26.2	-26.4	-31.2	-26.8	-17.6	-18.0	-23.4	-22.5
1911	-16.6	-25.6	-21.5	-21.0	-22.6	-28.9	-31.3	-31.7	-31.3	-31.0	-30.5	-29.6
1912	-31.0	-30.8	-29.5	-27.5	-27.5	-30.0	-32.1	-31.2	-30.0	-29.6	-29.5	-28.6
1913	-28.0	-30.4	-31.2	-31.6	-31.5	-33.2	-33.9	-34.5	-33.3	-33.0	-31.0	-29.4
1914	-28.8	-29.5	-25.0	-23.6	-20.5	-26.5	-26.4	-26.9	-25.3	-22.2	-17.9	-11.3
1915	-2.7	2.4	8.2	5.6	15.9	24.0	35.5	28.1	22.7	13.9	10.0	3.5
1916	7.9	16.9	26.1	32.8	32.7	24.5	10.9	3.3	3.2	13.5	16.2	25.2
1917	27.3	41.4	41.8	56.2	62.6	75.6	88.5	93.3	78.2	59.0	59.1	68.0
1918	57.6	38.8	34.0	38.1	33.6	40.5	48.3	55.1	48.4	42.5	35.7	24.3
1919	23.0	25.7	27.3	30.5	45.1	47.3	40.4	21.5	18.4	9.5	3.0	3.4
1920	7.4	19.4	7.6	1.1	-9.7	-7.5	-12.8	-13.6	-5.4	-2.6	-4.6	-7.8
1921	-5.1	-9.0	-8.3	-10.0	-8.3	-6.8	-6.3	-11.5	-18.3	-19.7	-18.5	-20.5
1922	-18.4	-6.8	-6.8	-12.6	-29.4	-31.1	-31.4	-31.7	-32.1	-31.5	-26.9	-27.3
1923	-30.1	-34.7	-33.8	-32.9	-31.6	-34.1	-34.8	-33.3	-29.5	-26.0	-29.1	-32.7
1924	-35.1	-35.3	-31.4	-25.8	-19.0	-15.1	-15.3	-14.9	-14.6	-13.2	-15.7	-22.3
1925	-22.9	-22.2	-13.2	-6.3	3.0	3.6	2.2	6.5	17.9	25.1	38.2	27.2
1926	17.9	24.2	12.7	10.5	12.0	14.5	13.3	10.7	18.7	19.7	25.6	29.9
1927	40.1	37.6	41.1	36.1	30.5	15.5	6.7	11.5	15.9	21.7	13.7	21.3
1928	22.9	37.0	35.6	36.4	36.2	40.0	41.9	43.0	32.4	22.6	12.1	15.4

Year	DJF	JFM	FMA	MAM	AMJ	MJJ	JJA	JAS	ASO	SON	OND	NDJ
1951	-7.3	-12.3	-3.8	9.6	22.0	11.7	-6.1	-12.7	-15.2	-14.1	-24.1	-26.1
1952	-35.2	-42.4	-48.7	-51.3	-49.0	-45.5	-36.9	-40.5	-44.8	-51.8	-47.3	-44.8
1953	-50.1	-57.4	-59.4	-59.4	-57.9	-54.2	-52.5	-54.1	-53.5	-56.8	-59.9	-71.0
1954	-70.6	-67.0	-68.9	-71.6	-77.7	-76.6	-76.0	-76.4	-74.8	-70.6	-66.1	-59.1
1955	-54.5	-54.6	-61.0	-61.1	-54.7	-49.4	-47.4	-44.6	-33.2	-13.0	0.8	6.7
1956	17.9	32.9	43.8	45.0	43.2	49.9	60.3	78.0	86.9	100.6	108.4	112.5
1957	89.2	78.5	80.4	88.9	102.1	106.6	103.9	114.4	136.8	157.5	160.2	143.9
1958	129.0	113.6	109.9	110.5	102.9	101.8	109.6	118.3	115.2	102.3	99.3	112.1
1959	109.5	109.6	90.1	96.8	89.9	85.9	94.5	85.5	73.0	50.8	45.7	58.1
1960	52.5	45.7	36.1	37.7	39.2	39.6	43.9	48.4	35.6	23.8	11.5	9.1
1961	-15.9	-23.4	-23.3	-24.8	-18.4	-15.3	-13.8	-19.4	-29.2	-33.2	-39.1	-39.0
1962	-33.4	-30.8	-29.3	-34.7	-37.6	-45.6	-53.1	-51.0	-44.0	-38.6	-46.0	-52.7
1963	-53.9	-55.3	-53.2	-50.1	-45.6	-48.6	-52.1	-52.1	-45.8	-45.3	-51.3	-58.2
1964	-60.4	-59.2	-62.5	-68.4	-72.6	-74.2	-74.5	-76.9	-74.9	-71.8	-66.3	-62.7
1965	-60.8	-61.2	-65.8	-65.7	-66.0	-64.2	-69.4	-70.1	-66.3	-60.3	-58.2	-39.4
1966	-30.2	-44.7	-36.8	-32.1	-26.8	-24.4	-22.2	-23.4	-24.2	-20.7	-12.6	5.8
1967	18.3	34.8	22.0	17.4	0.4	7.5	14.6	15.8	13.6	10.8	28.8	40.2
1968	46.7	38.0	25.5	28.3	32.2	36.9	31.2	31.5	34.3	28.0	27.0	26.1
1969	38.2	49.6	51.4	49.0	36.9	33.3	26.2	19.3	17.9	17.9	21.5	27.0
1970	39.1	43.4	43.8	41.4	40.6	41.3	30.0	25.6	15.9	18.2	14.3	10.4
1971	2.6	-4.0	-10.0	-18.3	-22.0	-19.0	-16.9	-18.8	-28.9	-26.2	-14.1	-11.0
1972	-4.4	-4.3	-3.3	-7.0	-4.5	-0.1	-0.5	-10.6	-16.0	-25.6	-30.4	-36.6
1973	-37.9	-36.9	-31.7	-32.9	-35.2	-46.7	-51.5	-47.0	-44.8	-43.3	-53.8	-55.1
1974	-56.2	-56.0	-51.3	-47.9	-43.1	-38.0	-38.1	-39.8	-43.0	-43.8	-48.9	-58.5
1975	-64.8	-67.0	-71.2	-73.1	-73.2	-65.5	-54.5	-55.8	-62.4	-67.1	-67.7	-43.6
1976	-42.3	-57.6	-54.0	-51.5	-55.2	-61.0	-59.4	-60.3	-55.2	-57.3	-56.4	-56.5
1977	-52.2	-53.0	-54.1	-55.8	-46.3	-43.6	-39.6	-39.0	-32.8	-31.5	-31.4	-27.4
1978	-7.5	5.0	20.9	17.1	22.8	12.9	4.9	18.0	35.1	50.0	45.1	60.3
1979	71.8	78.3	56.6	55.4	56.8	78.0	80.8	92.5	109.2	115.5	111.8	104.3
1980	93.2	77.9	79.4	87.5	97.4	88.0	73.4	71.4	79.6	85.4	92.2	61.6
1981	31.9	51.8	67.0	64.7	50.3	45.3	55.1	80.1	85.4	80.4	73.5	57.1
1982	62.2	64.4	69.1	44.2	30.2	24.2	32.0	34.4	29.6	28.5	30.1	27.3
1983	8.0	-11.2	-11.3	7.0	15.7	15.4	5.7	-8.4	-18.1	-28.9	-35.6	-34.6
1984	-20.9	-3.2	2.2	1.4	-10.6	-22.1	-39.7	-50.3	-58.7	-58.5	-58.6	-56.5
1985	-62.4	-61.9	-60.9	-54.8	-52.0	-47.9	-54.0	-61.2	-66.2	-62.5	-59.1	-38.7
1986	-38.8	-57.0	-51.9	-53.4	-58.7	-60.4	-64.2	-63.4	-58.0	-53.9	-53.4	-59.6
1987	-65.3	-61.4	-51.9	-40.0	-39.8	-43.6	-43.4	-38.0	-29.1	-27.2	-30.0	-28.4
1988	-29.8	-12.2	-2.8	5.6	13.5	20.5	36.0	42.0	45.4	51.4	70.6	84.8
1989	96.7	82.0	71.5	64.4	85.3	82.5	90.9	84.3	94.8	97.7	93.5	101.6
1990	85.9	78.8	66.2	68.5	56.1	57.6	78.6	85.1	83.5	62.0	63.0	39.6
1991	52.1	74.8	75.6	61.2	69.4	79.4	95.9	81.3	70.5	49.0	54.8	59.2
1992	76.5	65.3	48.3	20.2	5.3	-0.6	-5.5	-5.8	-5.7	4.6	10.3	2.9
1993	2.3	-0.6	0.1	-8.8	-16.5	-19.2	-27.4	-36.3	-37.7	-38.7	-30.5	-27.5

Backup Slides

1916	7.9	16.9	26.1	32.8	32.7	24.5	10.9	3.3	3.2	13.5	16.2	25.2
1917	27.3	41.4	41.8	56.2	62.6	75.6	88.5	93.3	78.2	59.0	59.1	68.0
1918	57.6	38.8	34.0	38.1	33.6	40.5	48.3	55.1	48.4	42.5	35.7	24.3
1919	23.0	25.7	27.3	30.5	45.1	47.3	40.4	21.5	18.4	9.5	3.0	3.4
1920	7.4	19.4	7.6	1.1	-9.7	-7.5	-12.8	-13.6	-5.4	-2.6	-4.6	-7.8
1921	-5.1	-9.0	-8.3	-10.0	-8.3	-6.8	-6.3	-11.5	-18.3	-19.7	-18.5	-20.5
1922	-18.4	-6.8	-6.8	-12.6	-29.4	-31.1	-31.4	-31.7	-32.1	-31.5	-26.9	-27.3
1923	-30.1	-34.7	-33.8	-32.9	-31.6	-34.1	-34.8	-33.3	-29.5	-26.0	-29.1	-32.7
1924	-35.1	-35.3	-31.4	-25.8	-19.0	-15.1	-15.3	-14.9	-14.6	-13.2	-15.7	-22.3
1925	-22.9	-22.2	-13.2	-6.3	3.0	3.6	2.2	6.5	17.9	25.1	38.2	27.2
1926	17.9	24.2	12.7	10.5	12.0	14.5	13.3	10.7	18.7	19.7	25.6	29.9
1927	40.1	37.6	41.1	36.1	30.5	15.5	6.7	11.5	15.9	21.7	13.7	21.3
1928	22.9	37.0	35.6	36.4	36.2	40.0	41.9	43.0	32.4	22.6	12.1	15.4
1929	19.0	16.8	11.0	9.1	14.2	17.9	20.1	9.3	5.5	11.9	36.2	40.8
1930	29.9	6.2	-3.2	-8.0	-12.2	-19.7	-24.0	-21.2	-15.4	-10.5	-12.9	-9.5
1931	-11.9	-17.6	-12.3	-18.5	-24.8	-31.3	-35.7	-33.1	-34.3	-31.2	-31.8	-30.2
1932	-33.6	-35.5	-36.1	-33.7	-31.4	-33.9	-38.1	-42.8	-41.7	-40.0	-37.9	-35.9
1933	-31.9	-32.0	-35.4	-41.7	-44.7	-46.7	-48.2	-46.9	-45.5	-44.2	-46.0	-44.9
1934	-43.2	-41.7	-39.3	-35.4	-35.9	-38.5	-42.8	-42.4	-42.3	-40.9	-37.3	-32.1
1935	-28.9	-26.1	-28.5	-26.3	-20.1	-14.8	-14.4	-14.2	-8.5	6.1	12.4	10.4
1936	9.7	17.5	19.0	12.1	8.2	0.0	10.4	13.3	26.6	37.8	53.6	70.2
1937	73.6	61.1	50.8	46.5	60.4	71.8	78.3	69.3	63.7	44.3	40.4	33.6
1938	47.6	47.5	45.8	48.2	50.3	71.1	66.8	65.0	44.0	48.0	49.0	44.8
1939	28.9	20.2	27.3	40.6	51.1	46.7	42.1	46.8	44.7	33.9	10.4	0.0
1940	-3.9	10.5	11.4	9.4	8.0	9.7	26.2	21.3	18.2	4.3	4.9	5.5
1941	-7.3	-9.7	-16.2	-22.2	-20.1	-8.7	0.7	3.9	-2.0	-6.9	-17.2	-19.5
1942	-15.3	-7.7	-1.5	-11.8	-28.4	-42.7	-45.1	-42.0	-40.5	-34.8	-32.5	-33.5
1943	-34.7	-32.3	-30.0	-35.9	-44.8	-49.1	-48.1	-46.2	-47.0	-47.8	-44.4	-44.5
1944	-48.4	-50.1	-53.5	-53.8	-58.2	-56.6	-52.8	-48.4	-43.4	-43.1	-38.0	-36.2
1945	-36.2	-37.6	-35.4	-30.4	-27.8	-24.3	-26.6	-25.9	-16.2	-7.2	-9.3	-13.0
1946	-1.1	1.6	8.3	5.5	2.2	15.5	20.8	27.2	23.4	32.2	42.7	49.1
1947	53.5	57.7	66.5	86.7	95.8	98.3	92.1	93.3	96.0	79.0	62.8	46.3
1948	33.6	27.9	52.4	79.2	101.3	85.3	77.8	69.1	67.9	50.5	50.1	46.3
1949	76.4	84.4	91.1	63.3	49.1	41.8	45.6	52.9	55.6	65.5	57.6	49.6
1950	34.6	33.5	34.8	36.2	25.2	17.5	8.5	-2.9	-12.0	-18.9	-16.5	-12.3

1981	31.9	51.8	67.0	64.7	50.3	45.3	55.1	80.1	85.4	80.4	73.5	57.1
1982	62.2	64.4	69.1	44.2	30.2	24.2	32.0	34.4	29.6	28.5	30.1	27.3
1983	8.0	-11.2	-11.3	7.0	15.7	15.4	5.7	-8.4	-18.1	-28.9	-35.6	-34.6
1984	-20.9	-3.2	2.2	1.4	-10.6	-22.1	-39.7	-50.3	-59.7	-58.5	-58.6	-56.5
1985	-62.4	-61.9	-60.9	-54.8	-52.0	-47.9	-54.0	-61.2	-66.2	-62.5	-59.1	-38.7
1986	-38.8	-57.0	-51.9	-53.4	-58.7	-60.4	-64.2	-63.4	-58.0	-53.9	-53.4	-59.6
1987	-65.3	-61.4	-51.9	-40.0	-39.8	-43.6	-43.4	-38.0	-29.1	-27.2	-30.0	-28.4
1988	-29.8	-12.2	-2.8	5.6	13.5	20.5	36.0	42.0	45.4	51.4	70.6	84.8
1989	96.7	82.0	71.5	64.4	85.3	82.5	90.9	84.3	94.8	97.7	93.5	101.6
1990	85.9	78.8	66.2	68.5	56.1	57.6	78.6	85.1	83.5	62.0	63.0	39.6
1991	52.1	74.8	75.6	61.2	69.4	79.4	95.9	81.3	70.5	49.0	54.8	59.2
1992	76.5	65.3	48.3	20.2	5.3	-0.6	-5.5	-5.8	-5.7	4.6	10.3	2.9
1993	2.3	-0.6	0.1	-8.8	-16.5	-19.2	-27.4	-36.3	-37.7	-38.7	-30.5	-27.5
1994	-28.0	-32.3	-46.4	-51.4	-53.6	-48.6	-48.8	-49.4	-47.3	-47.6	-48.0	-52.2
1995	-48.6	-45.5	-49.2	-53.4	-59.6	-60.7	-62.5	-63.6	-62.3	-62.9	-64.1	-44.4
1996	-38.0	-53.8	-56.3	-54.9	-54.2	-54.5	-53.7	-55.9	-57.6	-54.5	-51.3	-48.8
1997	-53.1	-54.8	-51.8	-47.2	-46.0	-49.1	-49.3	-35.3	-30.4	-23.6	-27.6	-23.8
1998	-24.1	-19.8	-12.9	-6.6	-1.5	1.6	11.4	19.0	16.9	12.9	8.5	11.5
1999	8.1	3.5	3.8	18.2	41.0	56.2	49.8	28.0	30.7	45.9	49.5	41.5
2000	33.9	51.7	63.2	67.1	62.4	75.9	76.7	72.8	49.9	44.0	41.6	29.6
2001	17.5	34.4	38.2	44.5	51.2	41.2	42.3	49.0	64.3	66.3	59.4	56.5
2002	56.0	44.5	46.4	51.9	48.3	39.9	36.3	44.5	44.8	39.6	29.3	24.2
2003	6.9	0.1	-6.7	-2.9	2.4	8.8	12.7	4.2	-1.0	-0.8	-2.2	-10.8
2004	-18.7	-18.1	-17.7	-18.1	-20.3	-17.7	-20.1	-24.1	-24.4	-21.5	-25.5	-30.2
2005	-35.8	-33.8	-36.5	-31.0	-26.2	-22.3	-26.5	-31.2	-40.9	-45.1	-39.4	-21.1
2006	-34.5	-51.9	-47.2	-40.4	-39.5	-46.8	-52.1	-50.8	-50.7	-45.8	-46.8	-43.9
2007	-48.2	-51.5	-56.2	-54.9	-52.5	-51.8	-55.9	-58.0	-60.2	-59.6	-57.7	-56.1
2008	-56.8	-57.3	-57.7	-56.3	-58.4	-60.5	-63.6	-63.2	-61.8	-58.6	-59.4	-59.1
2009	-60.8	-61.0	-61.5	-60.0	-59.4	-60.0	-63.1	-61.5	-60.2	-56.9	-55.4	-51.8
2010	-47.7	-46.4	-48.4	-50.7	-51.5	-50.2	-48.7	-43.7	-40.5	-37.9	-42.2	-28.8
2011	-25.1	-27.4	-15.8	-10.8	-17.3	-22.2	-21.3	-6.5	8.9	26.3	23.9	14.9
2012	-7.2	-10.3	-11.6	1.4	1.3	3.7	-0.5	-0.4	-4.0	-2.4	-10.0	-6.0
2013	-14.7	-9.2	-6.3	8.2	6.3	-0.2	-6.6	-10.7	-0.4	5.5	22.5	22.1
2014	29.5	29.8	30.5	22.5	15.4	9.9	7.6	5.0	2.8			

Left Column 13-month Mean Minimum

Left Column 13-month Mean Maximum

Solar cycle MINIMUM – MAXIMUM

Table 2