Research Journal of Recent Sciences _____ ISSN 2277-2502
Vol. **1(2),** 100-103, Feb. **(2012)** *Res.J.Recent Sci.*

Short Communication

Linkage between Cyclonic storms, Geomagnetic storms, Sunspot numbers and Climate Change

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Available online at: www.isca.in
(Received 17th January 2012, revised 22nd January 2012, accepted 27th January 2012)

Abstract

Several studies have been made using geomagnetic activity as one of the parameters principally to determine its possible effects on meteorological parameters such as atmospheric circulation, pressure changes and atmospheric electricity, seismic activity. These studies led one to believe that geomagnetic activity affects the troposphere phenomena[4] . In this paper a study has been undertaken to examine the relation between the geomagnetic storm activity, cyclonic storm activity, Sunspot numbers and climate Change.

Key words: Sunspot numbers, cyclonic storms, climate change.

Introduction

Although industrial countries are responsible for the accumulation of greenhouse gas Emissions, the effects of global warming are most severe in the poorest countries. Climate change due to global warming is expected to influence crop and livestock production, Hydrologic balances, input supplies and other components of agricultural systems an atmosphere with higher CO_2 concentration would result in higher Net photosynthetic rates higher concentrations may also reduce transpiration (i.e. water loss).

Several studies have been made using geomagnetic activity as one of the parameters principally to determine its possible effects on meteorological parameters such as atmospheric circulation, pressure changes and atmospheric electricity, seismic activity[1]. These studies led one to believe that geomagnetic activity affects the troposphere phenomena [2, 3,4].

Plausible climate change scenarios include higher temperatures, changes in precipitation and higher concentrations of atmospheric CO_2 The extent to which the recent global warming has an anthropogenic origin (e.g. via the enhanced greenhouse effect) as opposed to a natural origin (e.g. through volcanic activity or solar variability) is of crucial importance for our understanding of how the Earth's climate has varied in the past and how it may vary in future[5]. Detailed fits of global and hemispherical temperatures since the mid-19th century with empirical models involving the enhanced greenhouse effect and solar variability require at least one parameter linked to solar activity for a satisfactory fit in the mid-20th century[6,7]. A study[8] "once again about global warming and Solar activity", states that the index commonly used for quantifying long-term changes in solar activity, the sunspot number, accounts for only one part of solar activity and using this index leads to the underestimation of the role of solar activity in the global warming in the recent decades. A more suitable index is the geomagnetic activity which reflects all solar activity, and it is highly correlated to global temperature variations.[9], states that "a doubling of the Sun's coronal magnetic field during the last 100 years", and "the magnetic flux in the solar corona has risen by 40% since 1964 and by a factor of 2.3 since 1901." Keeping the above in view a study has been undertaken in this paper to examine the linkage between cyclonic storms, geomagnetic storms and sunspot numbers.

Data and Analysis: Data of geomagnetically disturbed days (AA index>60) from 1891-2011 are collected from the URL http://www.ngdc.noaa.gov/stp/Solar. Sunspot numbers data also collected from the above URL. Cyclonic storms with maximum wind speed over 47 knots formed in the Bay of Bengal and Arabian seas from 1891 to present are collected from the data published by India Meteorological Department(IMD).Decadal frequency distribution of geomagnetically disturbed days(AA index>60), cyclonic storms and Sunspot numbers during June-September are shown in table-1. Decadal frequency of geomagnetically disturbed days, cyclonic storms and Sunspot numbers during October –December are shown in table 2. Annual decadal frequency of geomagnetically disturbed days, cyclonic

storms and Sunspot numbers are shown in table 3. Correlation coefficients between geomagnetic storms, cyclonic storms and Sunspot numbers are shown in table 4. Decadal frequency of Cyclonic storms, geomagnetic storms and sunspot numbers during October-December are shown in figure 1.

Table-1
Decadal frequency of geomagnetic storms (AA index>60) Cyclonic storms (wind speed>47Knots) sunspot numbers during June-September

S.no.	Year	AA index	Cyclonic storms	Sunspot numbers
1	1891-1900	31	77	49
2	1901-1910	20	55	37
3	1911-1920	24	55	48
4	1921-1930	43	76	41
5	1931-1940	38	84	58
6	1941-1950	52	92	77
7	1951-1960	89	70	93
8	1961-1970	47	76	60
9	1971-1980	49	78	68
10	1981-1990	67	52	84
11	1991-2000	76	35	67
12	2001-2010	49	33	42

Table-2
Decadal frequency of geomagnetic storms (AA index>60) Cyclonic storms (wind speed>47Knots) sunspot numbers during October-December

S. No.	Year	AA index	Cyclonic storms	Sunspot numbers
1	1891-1900	17	11	42
2	1901-1910	11	9	40
3	1911-1920	19	7	38
4	1921-1930	29	12	43
5	1931-1940	14	9	53
6	1941-1950	57	7	72
7	1951-1960	51	9	92
8	1961-1970	20	22	57
9	1971-1980	33	17	67
10	1981-1990	51	16	84
11	1991-2000	49	14	64
12	2001-2010	27	3	43

Table-3
Decadal frequency of geomagnetic storms (AA index>60) Cyclonic storms (wind speed>47Knots) and sunspot numbers

S. No.	Year	Annual AA index	Annual Cyclonic storms	Annual Sunspot numbers
1	1891-1900	86	192	45
2	1901-1910	53	166	37
3	1911-1920	72	171	41
4	1921-1930	97	229	42
5	1931-1940	93	229	55
6	1941-1950	168	231	74
7	1951-1960	225	189	93
8	1961-1970	100	255	60
9	1971-1980	158	255	67
10	1981-1990	203	171	82
11	1991-2000	186	145	66
12	2001-2010	115	140	41

Table-4
Correlation Coefficients between decadal frequency of Geomagnetic storms, cyclonic storms and Sunspot numbers during 1891-2010

S. No	Correlation Coefficient r	June- September	October-December	Annual
1	Correlation value between AA index and Severe Cyclones	-0.21	+0.1	-0.2
2	Correlation value between AA index and Sunspot numbers	+0.42	+0.8	+0.9
3	Correlation value between Severe cyclonic storms and Sunspot numbers	+0.2	+0.3	+0.17

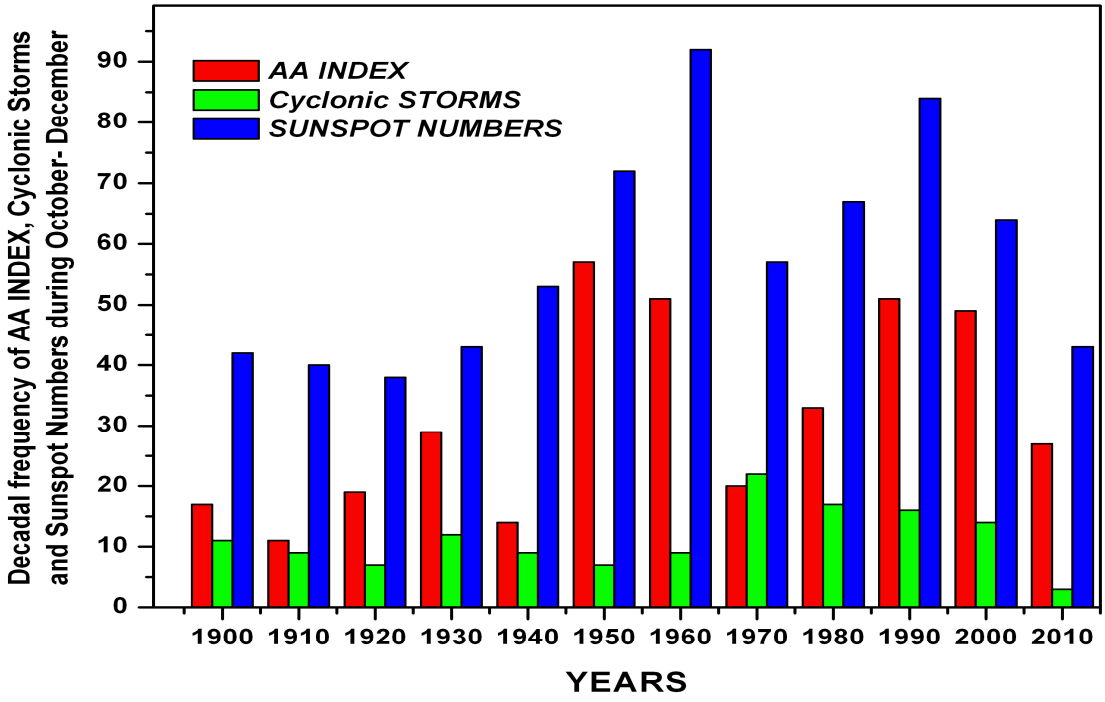

Figure-1
Decadal frequency of Cyclonic storms, geomagnetic storms and sunspot numbers during October-December

Results and Discussion

It is seen from tables 1, 2, 3 that frequency of cyclonic storms forming in the Bay of Bengal and Arabian Sea in the last two decades reduced. The peak cyclonic activity, i.e. during October-December during 2001-2010 decreased. Also it is observed from tables 1, 2, 3 there is an increase in Geomagnetic storm activity from 1930 onwards. From table 4 it is inferred that only in the peak cyclonic activity season, i.e. during October-December an in phase relation between geomagnetic storms and severe cyclonic storms noticed (r = +0.1). Sunspot numbers and severe cyclonic storms are positively correlated, r = 0.35 (average of all seasons). An increase in geomagnetic storm activity associated with an increase in sunspot numbers activity r = + 0.76. Reduction in the use of non-renewable sources of energy and increased use of renewable sources will undoubtedly decrease the emission of GHGs substantially. This decrease in the GHGs will have a positive affect on the health and well being of the people.

Furthermore, switching to cleaner fuels and energy-efficient technologies will reduce local pollutants and therefore, have an added beneficial impact on health. In this media has got the power to change any human being- whether literate or illiterate, rich or poor to educate and persuade about adopting and switching over to practices of using energy only from renewable sources[10].

Conclusion

It is therefore, inferred from the above analysis that changes in Solar activity (Geomagnetic activity and Sunspot numbers) and GHGs strongly influenced the local Climate over the Indian Seas which in turn reduced the formation of cyclonic storms over the Indian Seas and decrease the rainfall activity over India.

Acknowledgment

The authors expresses their deep sense of gratitude to Dr. P.C.S. Devara, Head, PM and A Division and Director, Indian Institute of Tropical Meteorology, Pune for encouragement in preparing the manuscript and for providing all the facilities and infrastructure.

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