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INFLUENCE OF LONG TERM CHANGES IN SUN-SPOT ACTIVITY ON ANNUAL MEAN TEMPERATURE OVER SOUTH INDIA

Concern about climatic changes and its effect on human beings has been increasing. Climatic changes affect the food production and the allocation of energy sources. One of the important parameters of the state is the mean annual temperature.

Several workers have analysed the mean temperature variations in the Northern Hemisphere, especially over high latitudes for about hundred years. Jones *et al.* (1982) have analysed the surface air temperature over the Northern Hemisphere from 1881 to 1980. It is shown that there is a general warming of the atmosphere during the first part of the twentieth century upto the mid 40's. Then a cooling trend occurs upto 1970's. In the late 70's there has been a renewed warming. This warming cannot be attributed to the increased amount of carbon-dioxide in the atmosphere.

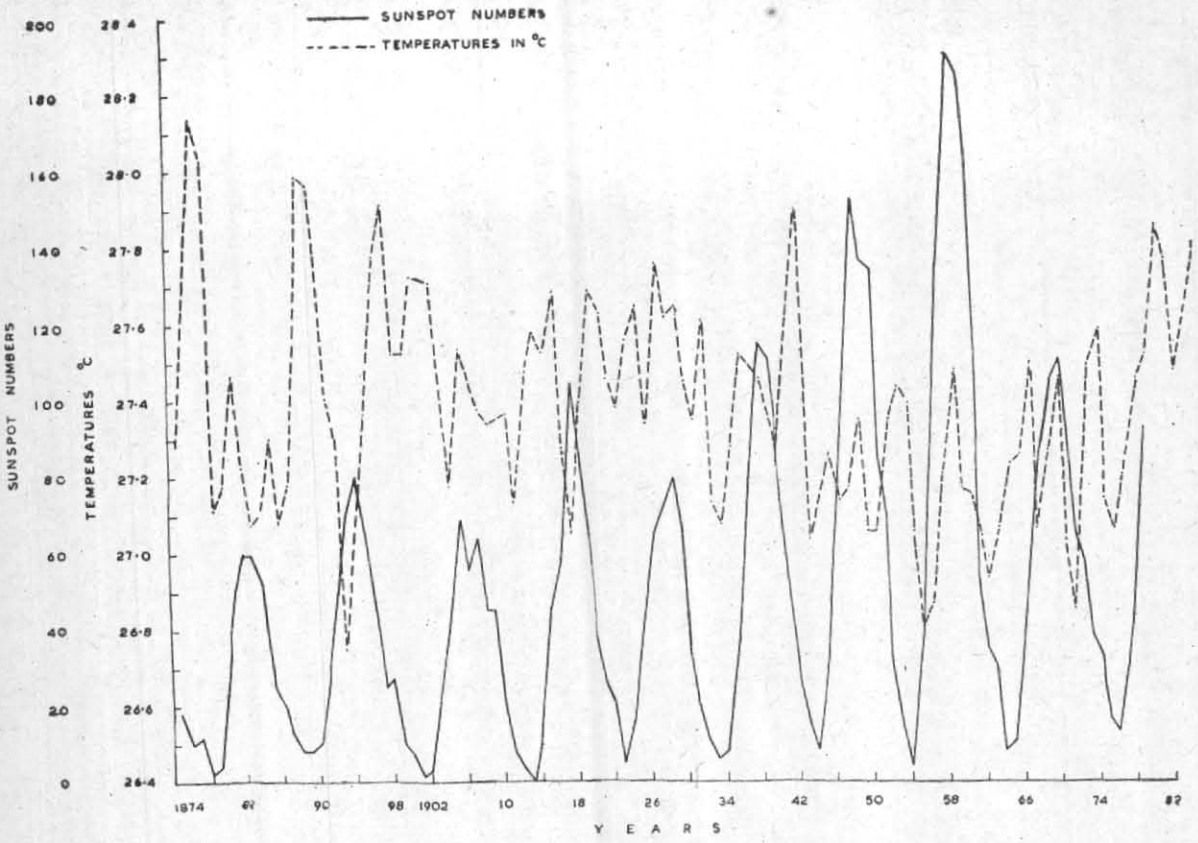

Fig. 1. Temperature variations of south India and the sunspot numbers from 1975 onwards

TABLE 1

List of stations

S. No.	Station	Lat. (°N)	Long. (°E)
(1)	Visakhapatnam	17°43′	83°18′
(2)	Hyderabad	17°27′	78°33′
(3)	Masulipatnam	16°11′	81°08′
(4)	Madras (Nungambakkam)	13°04′	80°15′
(5)	Bangalore	12°58′	77°35′
(6)	Mangalore	12°52′	74°54′
(7)	Coimbatore	11°00′	76°58′
(8)	Trichy	10°49′	78°42′
(9)	Nagapattinam	10°46′	79°51′
(10)	Cochin	09°58′	76°14′
(11)	Trivandrum	08°29′	76°57′

Agee (1980) has given that a cooling trend over the Northern Hemisphere exists amounting to over 0.5 deg. C from about 1940 to 1970 due primarily to cooling at mid and high latitudes. Observations and interpretation of sunspot activity have been used by him to infer a direct thermal response of terrestrial temperature to solar variability on the time scale of the Gleissberg cycle, about 90 years.

In the present note, the mean annual temperature of eleven south Indian stations lying between 8° North and 18° North have been analysed for over hundred years from 1875.

2. The stations selected for computing the temperature variations in south India are given in Table 1.

The annual mean temperature of these stations have been collected from the *Meteorology of India, Annual Weather Summary* and *India Weather Review* published by IMD and analysed. The mean annual temperature variations and the sunspot variations are given in Fig. 1, from 1875 onwards. The running means of the above are given in Fig. 2. It can be seen from Fig. 2 that the temperature is more or less constant but comparatively high during the later part of the last century and at the beginning of the present century upto about 1932. After 1932 it is decreasing and the lowest temperature is attained around 1960, then it starts increasing rapidly.

The main cause of the temperature over the earth is the sun's radiation. Most of the sun's energy comes from the photosphere. The main evidence of variation in this region is the occurrence of sunspots. It has been known that the number of sunspots visible in the photosphere varies with the time and there is an eleven year cycle for this variation. There is also an observa-

Fig. 2. Moving averages of temperature over south India and the sunspot number

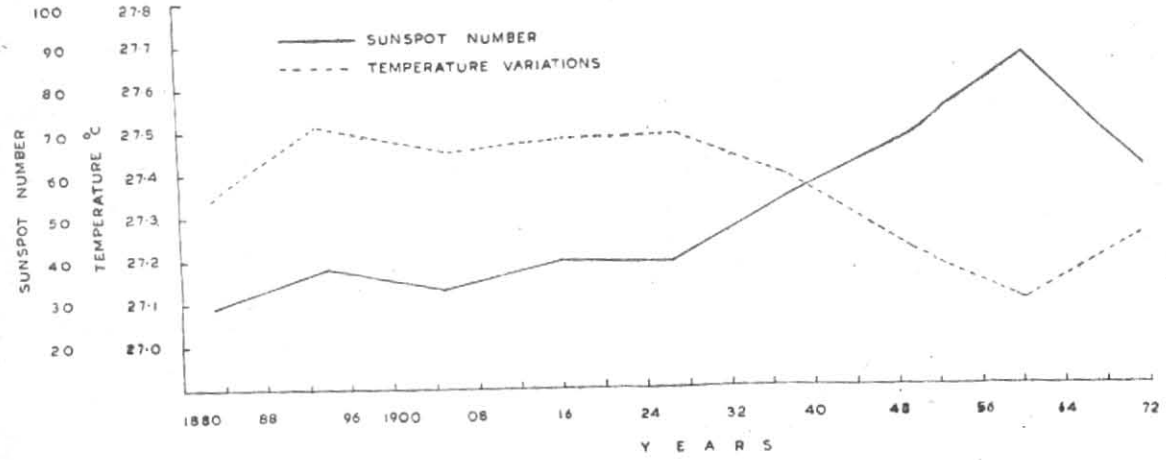

Fig. 3. The 11-year mean of temperature variation over south India and the 11-year mean of sunspot number

tional evidence for an approximately 90 years cycle (the so called Gleissberg cycle) that represent the envelope of maxima associated with eight individual eleven year cycles (Agee 1980). The 11-years mean sunspot numbers (the Gleissberg cycle) and the 11-year mean temperature data are given in Fig. 3.

It can be seen from Fig. 2 that when the mean annual sunspot number exceeds about 50, the temperature in the low latitudes especially over south India starts decreasing and it shows the lowest value when the sunspot number shows maximum. The eleven year mean temperature variation curve over south India show almost similar trend as that of Gleissberg cycle in the reverse scale, which means that the period of variation is about 90 years. Since the available data of temperature is only for about 100 years, no statistical comparisons of these cycles can be done. This is an unavoidable weakness of this note.

3. It can be concluded that the temperature variations during the last hundred years in the low latitudes especially over south India is almost following the Gleissberg cycle in the reverse scale.

The above conclusion requires further confirmation after analysing the mean annual temperature for a large number of stations in the low latitudes and for more number of years.

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