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The Solar Radio Burst Activity Index (I,) and the Burst Incidence (B_i) for 1968-69

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Daily values of the Solar Radio Burst Activity Index (I_b) and of the Burst Incidence (B_i), as defined in the text, are computed for the period 1968-69 at the frequencies 8800, 4995, 2695, 1415 and 606 MHz from data collected at Sagamore Hill and Manila. Due to their geographical position, these two observations provide almost continuous coverage of the sun with similar equipment. Characteristics of I_b and B_i at different frequencies corresponding to different levels in the solar atmosphere are discussed.

Valôres diários dos índices de atividade de "bursts" solares em rádio (I_b) e de incidência de de erupções (B_i), como definidos no texto, foram computados para o período de 1968-69 nas freqüências de 8800, 4995, 2695, 1415 e 606 MHz utilizando os dados provenientes dos Observatórios de Sagamore Hill e de Manilha Devido a suas posições geográficas, êsses dois observatorios fornecem observação quase contínua do sol com equipamentos similares. São discutidas as características dos índices I, e B_i em diferentes freqüências correspondentes a níveis diferentes da atmosfera solar.

An index of solar radio burst activity, which is a measure of the excess energy emitted per hour by the sun in the form of radio bursts, has been recently developed by the author' . At a particular frequency and for each day, it is given by

$$I_b = \frac{\Sigma \phi_m \cdot D}{T},$$

where ϕ_m is the mean flux in $10^{-22}\ \mathrm{Wm^{-2}\ Hz^{-1}}$ for each burst and D is the corresponding duration in seconds while T is the total period of observations per UT day in hours, the summation being carried over all the events observed during T hours. A second quantity termed the 'burst

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incidence' (B_i), and defined at any frequency as simply the number of bursts observed per hour, was also considered for the sake of comparison. Thus

$$B_i = \frac{N_b}{T},$$

where N_b is the total number of bursts recorded during T hours of observation. The burst index and the burst incidence were calculated for the period 1961-67 from the 10.7 cm records of the National Research Council of Canada and the correlation of both I_b and B_i with optical indices of solar activity was established' .

The work is extended here at other frequencies representing different regions of the solar atmosphere in order to see how the index values compare with one another. Furthermore, values calculated from half a day observation of one station alone are useful only when averaged over a month. For daily activities of the sun, obviously, the index must be computed from 24 hours observation data. However, this requires the same frequency to be observed with similar equipments from two or three stations geographically well separated from each other in longitude. Fortunately, at present there are two such stations, viz., Sagamore Hill (42°.632 N, 70°.821 W) and Manila (14".633 N, 121°.083 E), operated by U. S. Air Force Cambridge Research Laboratories (AFCRL), observing the sun at the same frequencies with equipments having about the same accuracy[2] and covering round the clock observation in UT. We were, therefore, prompted to compute the daily values of the burst index and the burst incidence utilizing the data of these two observatories at the common frequencies at which they operate.

The common frequencies of operation for the two stations are 8800, 4995, 2695, 1415 and 606 MHz (the last frequency being observed in Manila since February 15, 1969). Fig. 1 shows the combined patrol period for Sagamore Hill and Manila throughout the year which is 24 hours in summer and somewhat less in winter months. All types of events published by the AFCRL[3] were included in the computation. The calculations covered the period from January 1968 to Decernber 1969 except for the frequency of 606 MHz. This period corresponds to the last sunspot maximum.

The burst index and the burst incidence are plotted against each other in Fig. 2 at four frequencies. The most obvious feature of the plots is the distinction between the quieter days and the disturbed days. However,

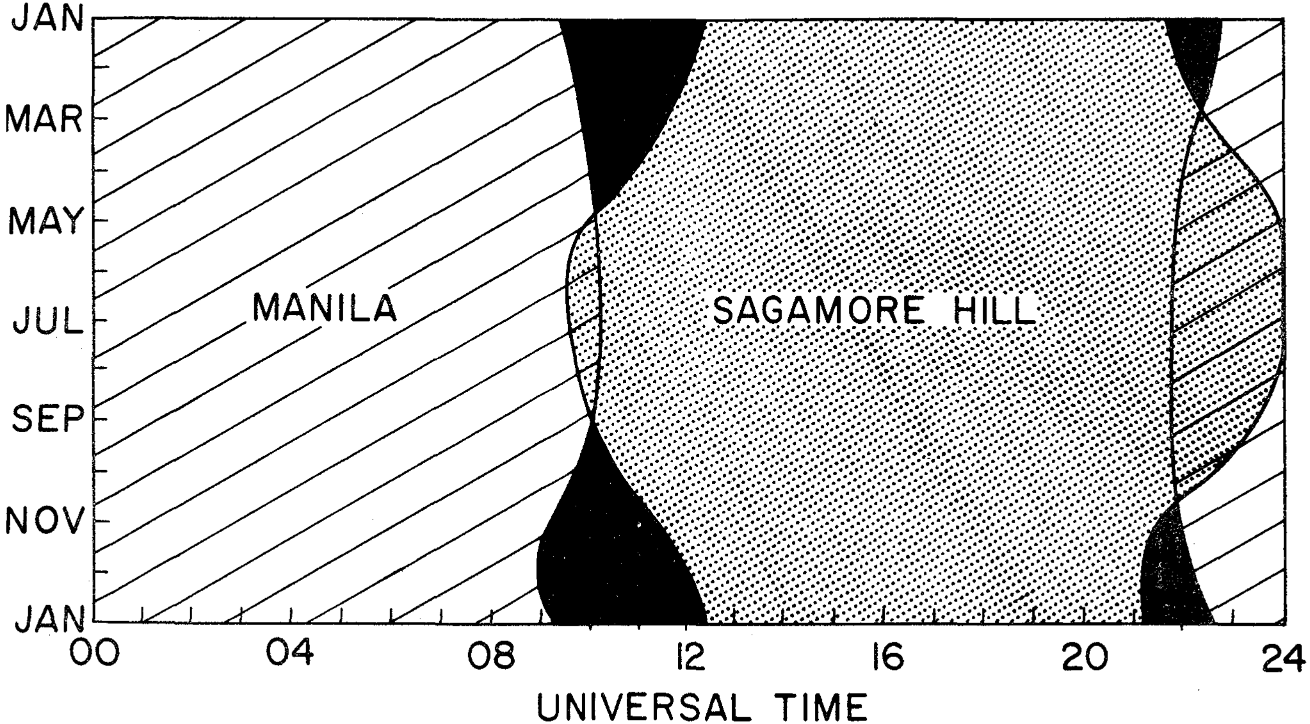

Fig. 1 - Combined observing time of Sagamore Hill and Manila Observatories in the course of the year. Lines and dots represent overlapping while dark areas are periods when neither of the two stations can observe the Sun.

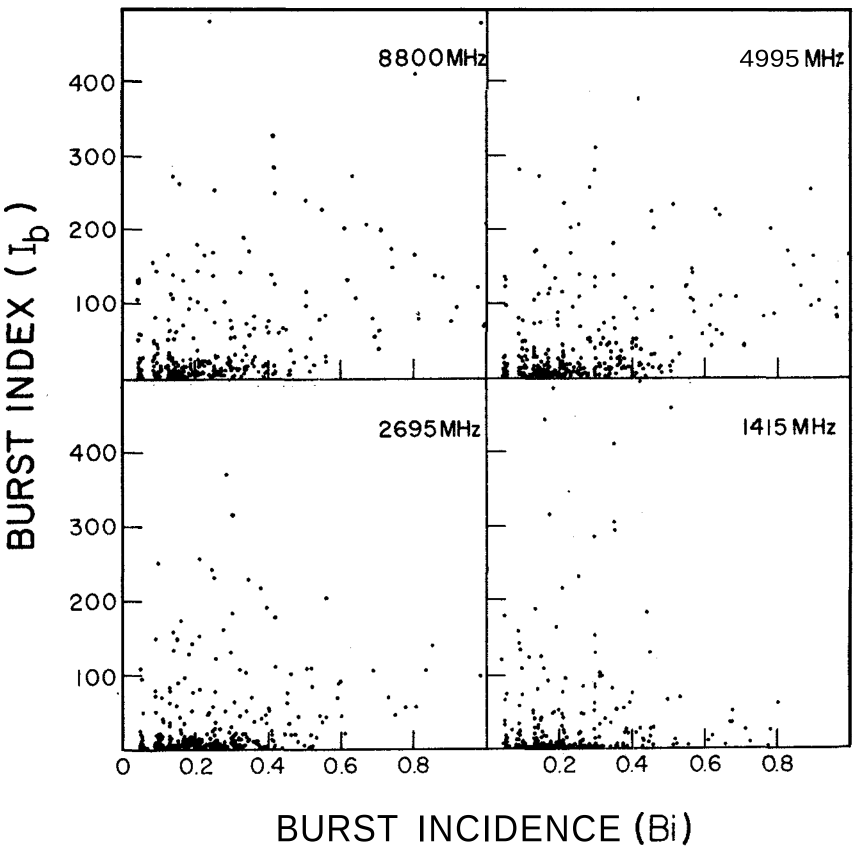

Fig. 2 - Scatter diagrams showing the relation between the burst index and the burst incidence during the 1968-69 period for the four frequencies. Star-marks indicate values that are out of scale. Presence of two wings at each frequency may be noted.

a closer look at the disturbed days will reveal the presence of two wings. Points on the upper wing represent days in which there are very few highly intense bursts while those of the lower wing correspond to days when there are large number of weak bursts and the points connecting the two wings are days with several bursts of moderate intensity.

The frequency 8800 MHz corresponds to the lower level of the chromosphere while **606 MHz** represents higher regions of the corona. The relation of the burst index and the burst incidence at **8800** MHz with those at lower

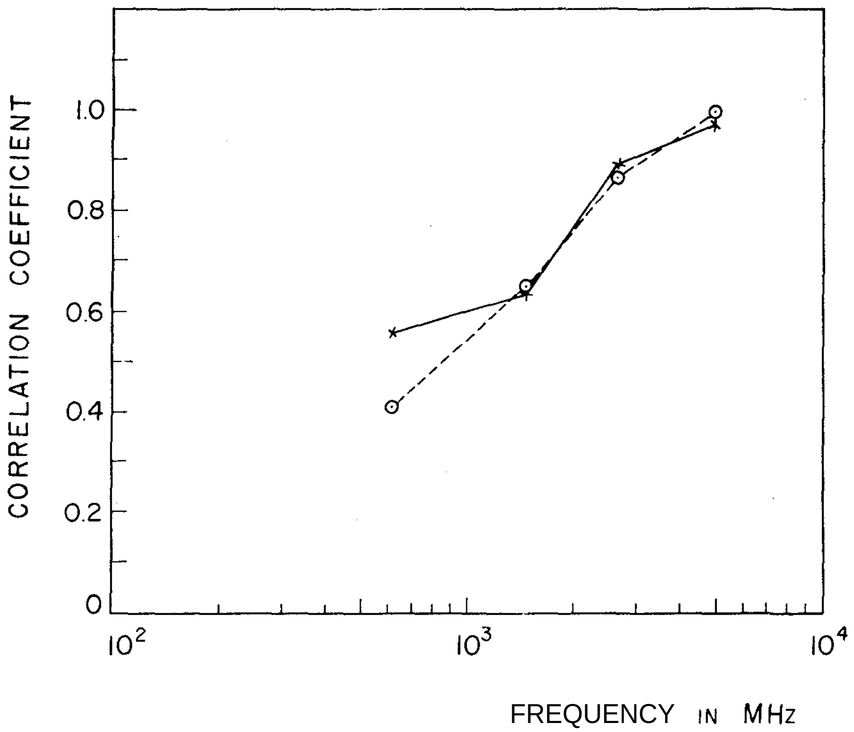

Fig. 3 - Correlation coefficients of the burst index (x - x - x) and the burst incidence (o-o-o) at 8800 MHz with those at lower frequencies.

frequencies will, therefore, indicate correspondence of activities at different levels of the solar atmosphere. Fig. 3 shows the correlation coefficient of I, and B_i at 8800 MHz with those at 4995, 2695, 1415 and 606 MHz. The relation between the frequencies 8800 and 4995 MHz is remarkably good. However, the correlation falls off at lower frequencies in each case which implies that the correspondence decreases as the level difference increases.

The burst index is evidently a measure of the degree of activity or the "noisiness" of the Sun. In analogy with magnetic activity and depending upon the values of the index, "noisy days" and "quiet days" can be marked out separately. Furthermore, when I_b and B_i are considered together, three types of noisy days can be distinguished. These are days with a large number of weak burst (type A), those with very few highly intense bursts (type B) and days with several bursts of moderate intensity (type C).

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3. Quarterly Geophysics and Space Data Bulletins (AFCRL), vols. 5 and *6* (1968 and 1969).