COMPARISONS OF MONTHLY MEAN COSMIC RAY COUNTING RATES OBSERVED FROM WORLDWIDE NETWORK OF NEUTRON MONITORS

Jai Young Ryu and Masami Wada*

Department of Physics, Kunsan National University,
Miryoung-Dong,Kunsan-city, Chullapuk-Do,511 Korea

* Cosmic Ray Laboratory,Institute of Physical and Chemical Research,
7-13 Kaga-1, Itabashi-Ku, Yokyo 173, Japan

ABSTRACT

In order to examine the stability of neutron monitor observation, each of the monthly average counting rates of a neutron monitors is correlated to those of Kiel neutron monitor. The regression coefficients thus obtained are compared with the coupling coefficients of isotropic intensity variation. The results of the comparisons for five year periods during 1963 to 1982, and for whole period are given. The variation spectrum with a single power law with an exponent of -0.75 upto 50 GV is not so unsatisfactory one. More than one half of the stations show correlations with the coefficient greater than 0.9. Some stations have shifted the level of mean counting rates by changing the instrumental characteristics which can be adjusted.

INTRODUCTION

The relation between the long lived Forbush decreases and the 11 year variation has long been interested (see for example, Lockwood and Webber, 1984; Burlaga et al. 1984). In order to examine whether the neutron monitor counting rates are satisfactorily stable for periods of months to tens of months to be used to inspect the variations mentioned above, the present paper is given (Ryu and Wada, 1983). After some trials, Kiel has been selected as the main key station of neutron monitor data. Correlations of monthly averages between each of 65 stations and Kiel for 5 year periods during 1963 and 1982 are studied statistically. The years 1963-67 and 1973-77 are of the sunspot minimum periods, and those of 1968-72 and 1978-82 are nearly during the sunspot maximum years. All of the stations have more than five years continual data which are refered to WDC-C2.

ANALYSIS AND RESULTS

The correlation diagrams are prepared for any pairs of stations. Form inspections of these diagrams, we can classify them into three groups as a, b, and c. Group a shows close correlation of which the coefficients are greater than 0.9. There are 37 stations in the group a out of 65. For example, the diagrams between Thule and Kiel are given in Fig.1, and for Kerguellen and Kiel in Fig.2. The scales of both axes are of natural logarithms, so that the variational amounts are approximated in the values relative to the counting rates of each point. As seen in the figures, the standard deviation of the scatter about the regression line is extimated to be around 0.5 percent at the best condition.

Using the results of correlation, the regression coefficients are plotted in Fig.3 against the coupling coefficients of isotropic varistion normalized to that of Kiel. The coupling coefficients are derived from the variation spectrum of primary cosmic rays of a single power law with an exponent

-0.75 upto 50 GV (Yasue et al. 1982). From Fig.3, it can be seen the correlations are rather well, though there are some scatters in points. Most remarkable scatter is seen for the figure of 1968-72, the sunspot maximum period. There seems some tendency of downward shift of southern stations. The spread of decreases seen in plot of whole period in Fig.2 (left hand side) is also noticable aspect. We have examined whether this trend is statistically significant or not. After variaous test, we found no clear conclusion to prove the situation given above. That means the existence of limitation of the data stability.

Group b contains stations which have rather low correlation coefficients. Those stations are mostly situated in lower latitudes, and the amounts of variation are relatively small, which result lower coefficients. There are continuities from the stations whose coefficients are higher than 0.9. Some stations reveal hysteresis, but there is no systematic trend of hysteresis.

Group c diagrams in Fig.4 show significant level changes of the mean counting rates. They may mostly arise from artificial instrumental changes such as the number of counters. There are 15 stations in this group. We are trying to get the amounts of level changes for those stations by using reasonable method.

CONCLUSION

The monthly average counting rates of most of the existing neutron monitors are examined from a point of view of the stability of operation. More than a half of the stations treated show satisfactory operations. If the artificial level changes are adjusted, we can use practically all of the stations, except small number of stations whose data are significantly deviate with time. The standard deviation of the residual variation is around 0.5 percent in the best condition, which makes some limitation of the analysis. It can be improved if one uses multiple number of stations for such variations spanning months to tens of months period.

REFERENCES

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Lockwood,J.A. and W.R.Webber (1984), J. Geophys. Res. 89, 17.
Ryu,J.Y. and M.Wada (1983), Conf. Papers 18th ICCR,3,511.
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FIGURE CAPTIONS

Fig.1. Correlation diagrams of monthly average neutron monitor counting rates between Thule and Kiel for 5 year periods and for all the period (left hand side).

Fig.2. The same as Fig.1, but for Kerguellen and Kiel.

Fig.3. The correlation diagrams of the regression coefficient against the coupling coefficient normalized to that of Kiel.

Fig.4. The same as Fig.1, but for the stations which show level changes due to artificial change in the operational condition.

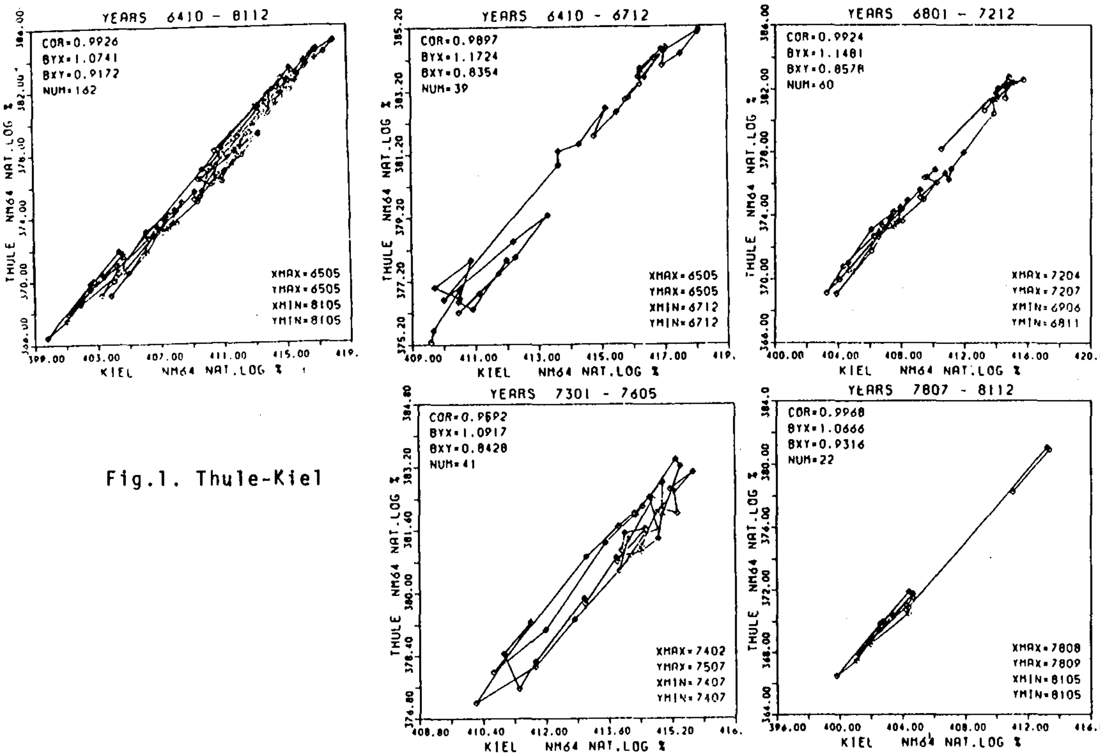


Fig.1. Thule-Kiel

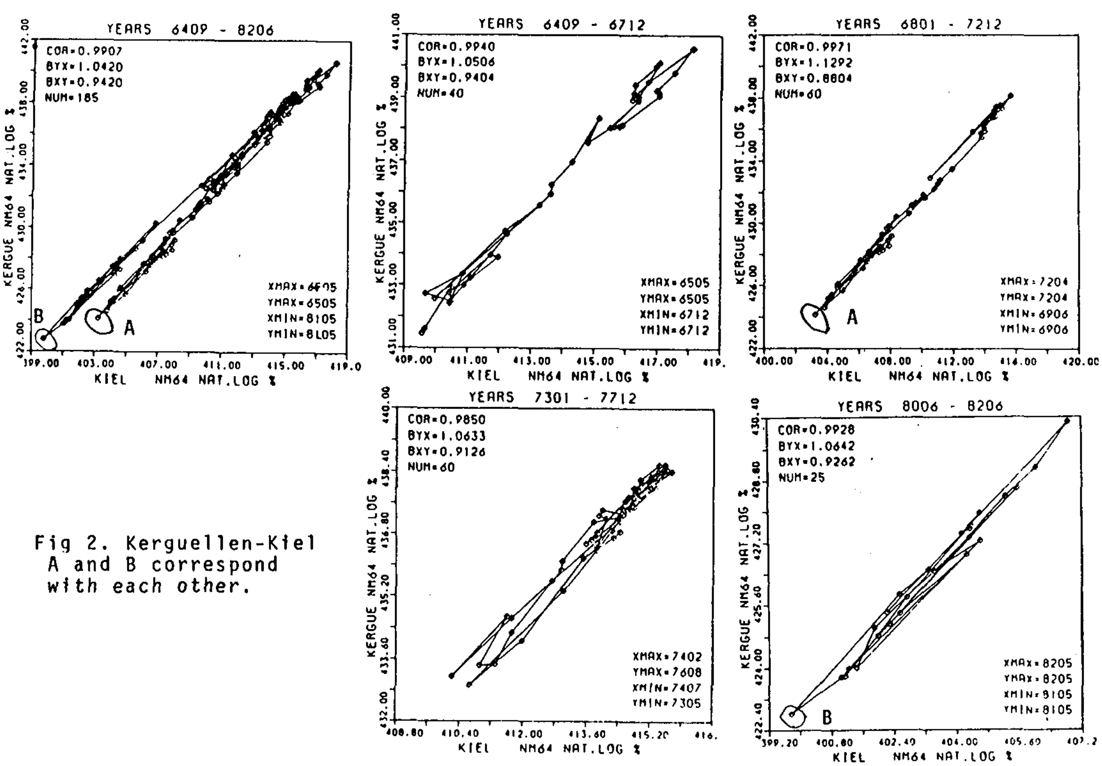
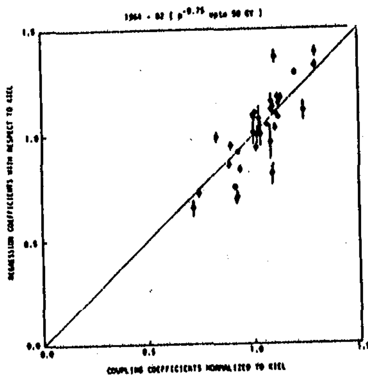


Fig 2. Kerguellen-Kiel
A and B correspond
with each other.



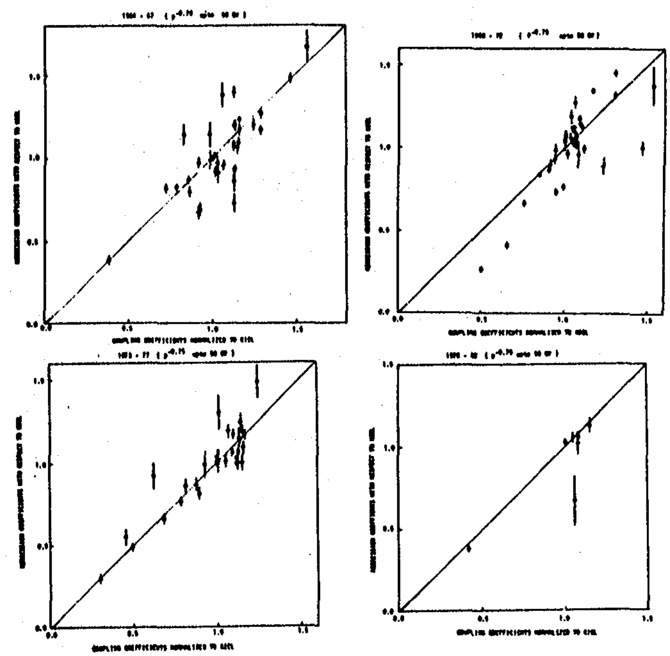


Fig.3.
1964-82 64-67 68-72
73-77 78-82

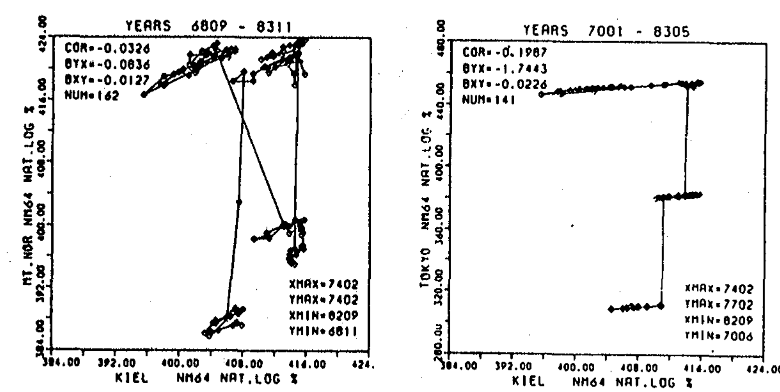


Fig.4.