The Effect of the Rising Snow Level on the Counting Rate of the Sanae Neutron Monitor

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During 1971 and 1972 the snow accumulated fast at Sanae as a result of the wind obstruction by the new buildings. During the second half of 1972 the snow accumulation around the neutron monitor hut caused reduction in the counting rate when the elevation of the snow rose above the screening wax layer around the 3NM64 neutron monitor. This reduction in counting rate was found to be related to the snow profile around the hut.

Gedurende 1971 en 1972 het die sneeu by Sanae vinnig opgehoop vanweë die uitwerking van die nuwe geboue daar op die windbeweging. Gedurende die tweede helfte van 1972 het die sneeu om die neutronmonitorhut begin ophoop tot bo die wasafskerming om die 3NM64-neutronmonitor. Die afname in teltempo wat deur hierdie ophoping veroorsaak is, word in verband gebring met die profiel van die sneeu om die hut.

Introduction

A 3NM64 neutron monitor records cosmic rays at Sanae, on the Antarctic Ice Shelf of Dronning Maud Land. This monitor was installed in January 1964 in a hut of which the floor was 3 metres above snow level. Two years later, in January 1966, the snow had accumulated to floor level and the hut was raised to 3 metres above the snow level. It was necessary to raise the hut again in January 1968. The hut was still well above the snow level in January 1971 when the monitor was dismantled and moved to the site of the new base, about 1 km from the old site.

Kühn et al. (1970) have shown that the rising snow level had no effect on the counting rate of the Sanae neutron monitor for the period February 1964 to December 1966. They concluded that the screening of the sides and bottom of the standard 3NM64 by 13,8 cm of paraffin wax, in addition to the 7,5 cm polyethylene reflector, was sufficient to prevent the changing snow environment from affecting the counting rate of the neutron monitor.

Snow accumulated very fast after the erection of the neutron monitor at the new base in February 1971, as a result of wind obstruction by the new buildings on the surface. After 18 months (August 1972), the wind scoop underneath the hut had filled up. The profile of the snow level around the hut on 11 September 1972 is described by the numbers in Table 1, for the elevations defined in Fig. 1. Further accumulation occurred with each storm. The effect of this accumulation on the counting rate of the neutron monitor will be described.

Data Analysis

The ratio of the monthly mean pressure-corrected counting rate of the Sanae neutron monitor relative to the corresponding counting rate of another neutron monitor at a high latitude shows a seasonal variation, with a maximum during the southern winter and a minimum during the southern summer. The average difference between maximum and minimum for 1970 and 1971 was 0,83% for Sanae with respect to Port aux Français, and 1,4% for Sanae with respect to Deep River and to Dumont D'Urville.

Since no data were available for the Deep River neutron monitor for the major part of 1972, the ratio of the pressure-corrected counting rate of the Sanae neutron monitor for 1972 was calculated with respect to the monitors at Port aux Français, Dumont D'Urville and Kiel. These ratios were compared with the corresponding ratios for 1970 and 1971. The results for the second half of 1972 are illustrated in Fig. 2. The solid line in the figure represents the 30-day running mean ratio, Sanae/Dumont D'Urville, for the second half of 1970 and 1971. The continuous broken line represents the same ratio for 1972, and the broken line under the shaded areas shows this ratio averaged over periods of unchanged snow profile. The profile of the snow level changed during the storms of 25 September, 10-11 November, 21-22 November and 2-3 December (see Table 1). The operation of the monitor had to be terminated on 17 December 1972 on account of moisture filtering into the detector because of warm weather.

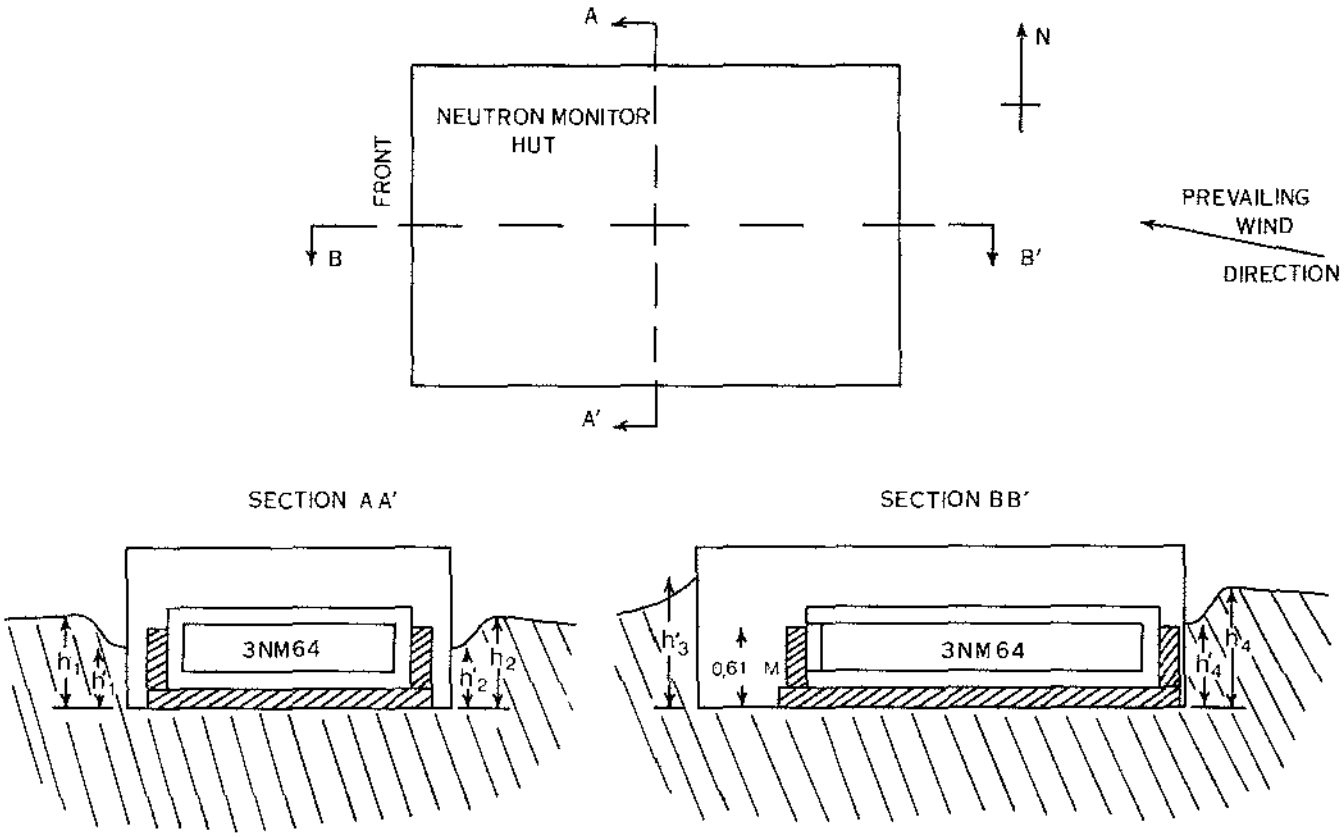

Fig. 1 Plan of the neutron monitor hut and direction of the prevailing wind. Sections AA and BB show the temperature-controlled container of the 3NM64 in the hut, together with the 13,8 cm paraffin wax layer below and on the sides of the container. Also shown are the typical profiles of the snow after the wind scoop underneath the floor of the hut had filled up. The elevations h are given in Table 1 for different periods between storms. The plan and sections are drawn to the same scale (cf. height of paraffin wax screen = 0,61 m).

The percentage reduction in counting rate, compared to the counting rate of the monitor at Dumont D'Urville, is shown in Fig. 2 and in Table 1. Similar results were obtained with respect to the neutron monitors at Port aux Français and Kiel. The counting rate of the Sanae neutron monitor was then corrected for the snow effect, using for each period a correction factor obtained from the combined results from all three monitors.

The neutron monitor was put into operation again in February 1973. A system of hydraulic jacks will ensure that the hut is kept well above the snow level, eliminating the effect of rising snow levels.

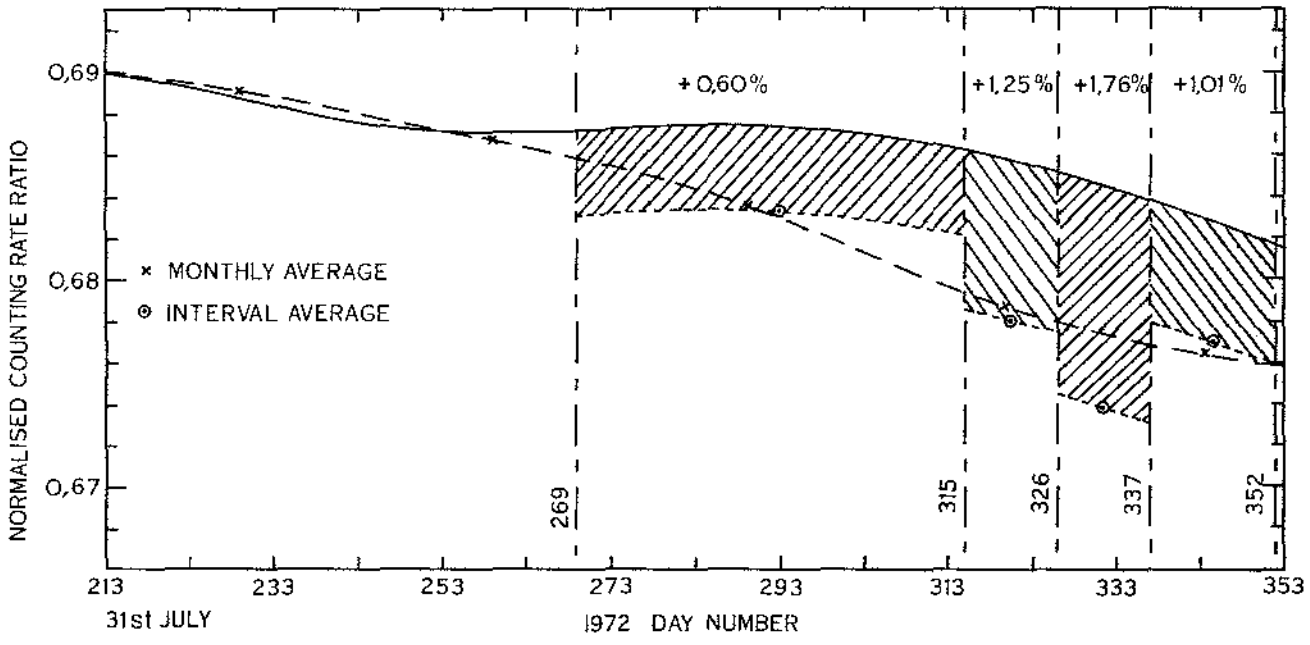

Fig. 2 Ratio of the pressure-corrected counting rate at Sanae and Dumont D'Urville plotted against the day number of 1972.

Table 1

Mean heights of snow (h) around the neutron monitor (as shown in Fig. 1) and reduction in counting rate relative to the neutron monitor at Dumont D'Urville

Period		Mean values in metres							Percentage Reduction
Day	Date	h_1	h_1'	h_2	h_2'	h_3	h_4	h_4'	
255	11 September	0,30	0,0	0,30	0,0	0,91	0,30	0,0	0,0
269–315	25 September–10 November	0,46	0,30	0,46	0,30	1,17	0,91	0,76	0,60
316–326	11 November–21 November	0,76	0,61	0,76	0,61	1,22	1,22	1,22	1,25
327–337	22 November–2 December	1,07	1,07	0,91	0,61	1,22	1,22	1,22	1,76
338–352	3 December–17 December	0,91	0,91	0,81	0,76	1,12	1,07	1,07	1,01

Conclusions

By comparing the elevations of the snow level with the height of the wax screen around the monitor container, it may be concluded that the counting rate is only reduced when the elevation of the snow close to the monitor rises above the wax screen. The reduction is a combined effect of the snow on all four sides of the hut and it is difficult to obtain a single relationship between the elevation of the snow and the reduction in counting rate.

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Reference

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