NORSAR

ROYAL NORWEGIAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH

NORSAR Scientific Report No. 4-75/76

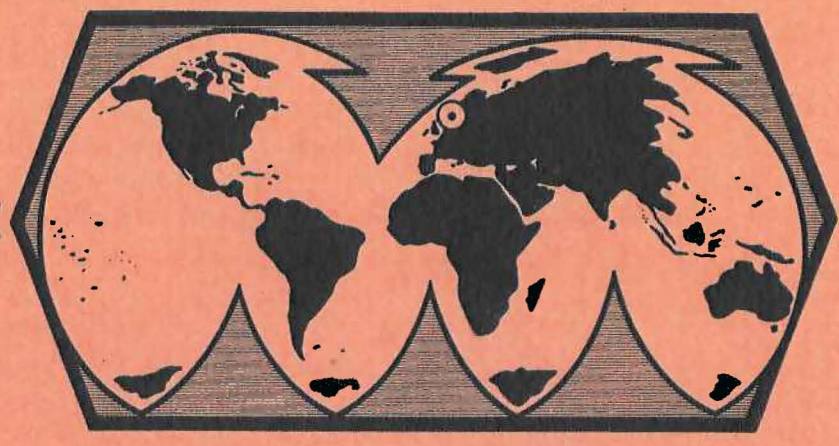
SEMIANNUAL TECHNICAL SUMMARY

1 January – 30 June 1976

Prepared by
K. A. Berteussen

Kjeller, 23 July 1976

Sponsored by
Advanced Research Projects Agency
ARPA Order No. 2551



VII.8 Noise level variation at NORSAR and its effect on detectability

Fluctuations in seismic noise level, both on a seasonal and a diurnal basis have a significant effect on the earthquake detectability of seismic stations and networks. Several sources contribute to these variations, such as microseisms generated by atmospherically induced oceanic conditions, local meteorological factors and cultural noise sources. For the Norwegian Seismic Array (NORSAR) several spectral studies of microseisms have been performed (e.g., Capon, 1972; Korhonen and Pirhonen, 1976), and a correlation between peak noise levels and storms in the North Atlantic Ocean has been clearly established. The purpose of the present paper is to give a detailed, quantitative analysis on the extent of seismic noise level fluctuations at NORSAR, both for short and long period data. This has been made possible by the recording of noise level estimates performed on-line at the array; a total of three years of densely sampled noise data has been used for this study.

Fig. VII.8.1 shows the variation in noise amplitude level (averaged across the array) for the vertical LP component (unfiltered) and the SP sensors (1.2-3.2 Hz filter) during 1973-75. The seasonal fluctuation is particularly pronounced for the LP data, and we note the predominance of sharp peaks (duration typically 1-2 days) corresponding to microseismic storms during fall and winter months. The amplitude distributions for these data are shown in Fig. VII.8.2, in a logarithmic scale. We note that the distribution of short period noise amplitudes is approximately lognormal, while the LP data show a skewness that cannot be represented by a lognormal distribution. Table VII.8.1, summarizes the noise level statistics for NORSAR; we note in particular that the noise standard deviation, expressed in magnitude units, is 0.1 and 0.3 for short and long period data, respectively.

Diurnal fluctuations in noise level were found to be quite small, but definitely present both for short period and horizontal long period data (Fig. VII.8.3-4). In view of the weekly pattern observed on Fig. VII.8.3, we attribute the short period variability to cultural activity, while the long period fluctuations may be adequately explained by athmospheric pressure fluctuations (Murphy & Savino, 1975).

Event detection performance at NORSAR was found to generally follow noise level trends. Only insignificant diurnal variation was observed, while we found an increase in the number of reported events during summer of approximately 50 per cent relative to winter. (Fig. VII.8.5)

F. Ringdal
H. Bungum

REFERENCES

Capon, J., 1972: Long-period signal processing results for LASA, NORSAR and ALPA, Geophys. J. R. Astr. Soc., 31, 279-296.

Korhonen, H. and S. Pirhonen, 1976: Spectral properties and source areas of storm microseisms at NORSAR, NORSAR Sci. Report No.2-75/76, NTNF/NORSAR, Kjeller, Norway.

Murphy, A.J. and J.M. Savino, 1975: A comprehensive study of long-period (20-200 sec) earth noise at the high-gain world wide seismograph stations, Bull. Seism. Soc. Am., 65, 1827-1862.

Type of Data	Reference	LOGARITHMIC SCALE					LINEAR SCALE	
		Mean Values (nm)				St. Dev. (dB)	Mean (nm)	St. Dev. (nm)
		1973	1974	1975	1973-75	1973-75	1973-75	1973-75
LP Z	Single sensor	29.2	26.7	29.4	28.4	7.26	49.6	57.3
LP N/S	Single sensor	25.7	22.9	24.5	24.3	6.00	37.7	37.0
LP E/W	Single sensor	26.8	25.0	27.0	26.3	6.24	41.6	42.1
SP 1.2-3.2 Hz	Array beam	0.083	0.080	0.083	0.082	2.42	0.087	0.023
SP 1.6-3.2 Hz	Subarray beam	0.163	0.155	0.163	0.160	1.80	0.164	0.034
SP 1.2-3.2 Hz	Single sensor*	0.95	0.92	0.95	0.94	2.42	1.00	0.25
SP 1.6-3.2 Hz	Single sensor*	0.40	0.38	0.40	0.39	1.80	0.40	0.08

* Estimated values.

Table VII.8.1

Noise level statistics (both in logarithmic and linear scales) for short and long period data at NORSAR. Note that the logarithmic mean values have been converted back to equivalent ground motion, i.e., representing the "geometric mean values" of the amplitude data.

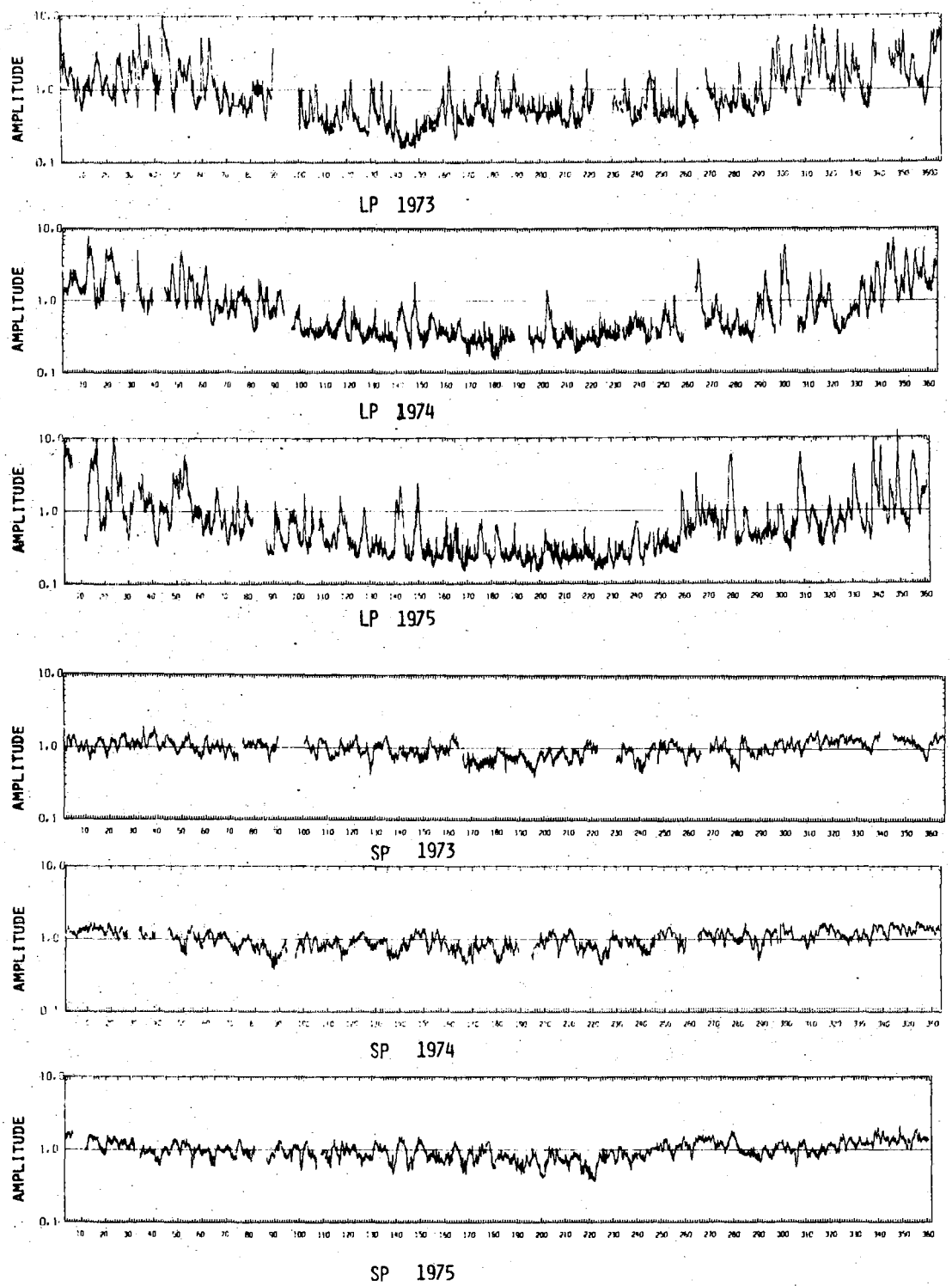


Fig. VII.8.1 For text, see next page.

Fig. VII.8.1 (previous page) Fluctuation in noise amplitudes at NORSAR for the three years 1973-75. The upper three traces represent the average of the long period vertical components, while the lower three traces are average short period noise values in the band 1.2-3.2 Hz. All amplitudes are scaled relative to the average value of each year. Gaps in the data indicate lack of recorded noise estimates for the corresponding time intervals.

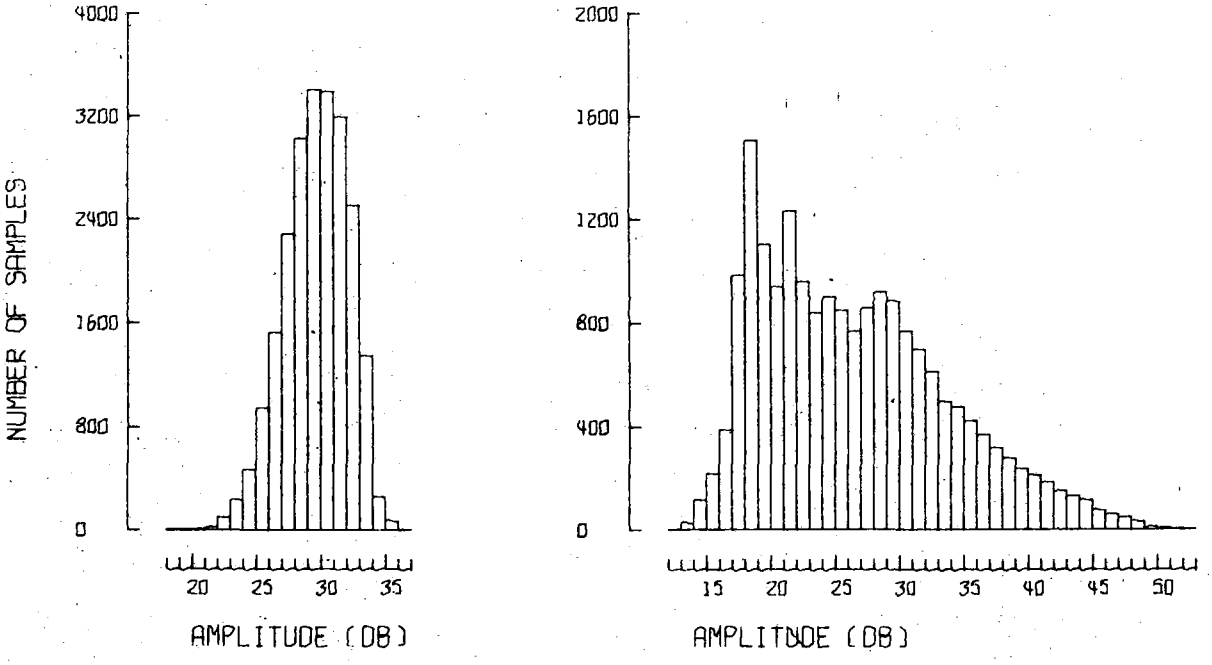


Fig. VII.8.2 Noise amplitude histogram (logarithmic scale for SP data in the band 1.2-3.2 Hz (left) and unfiltered vertical component LP data (right).

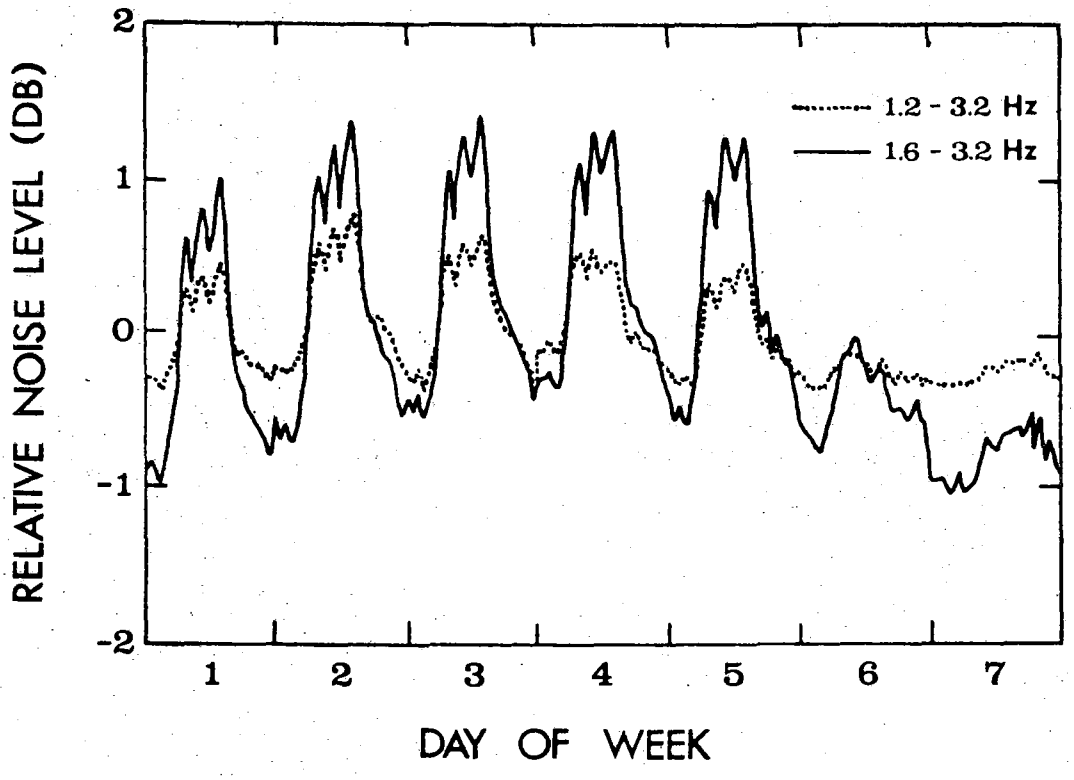


Fig. VII.8.3 Diurnal variation of short period noise level by day of week (Monday through Sunday).

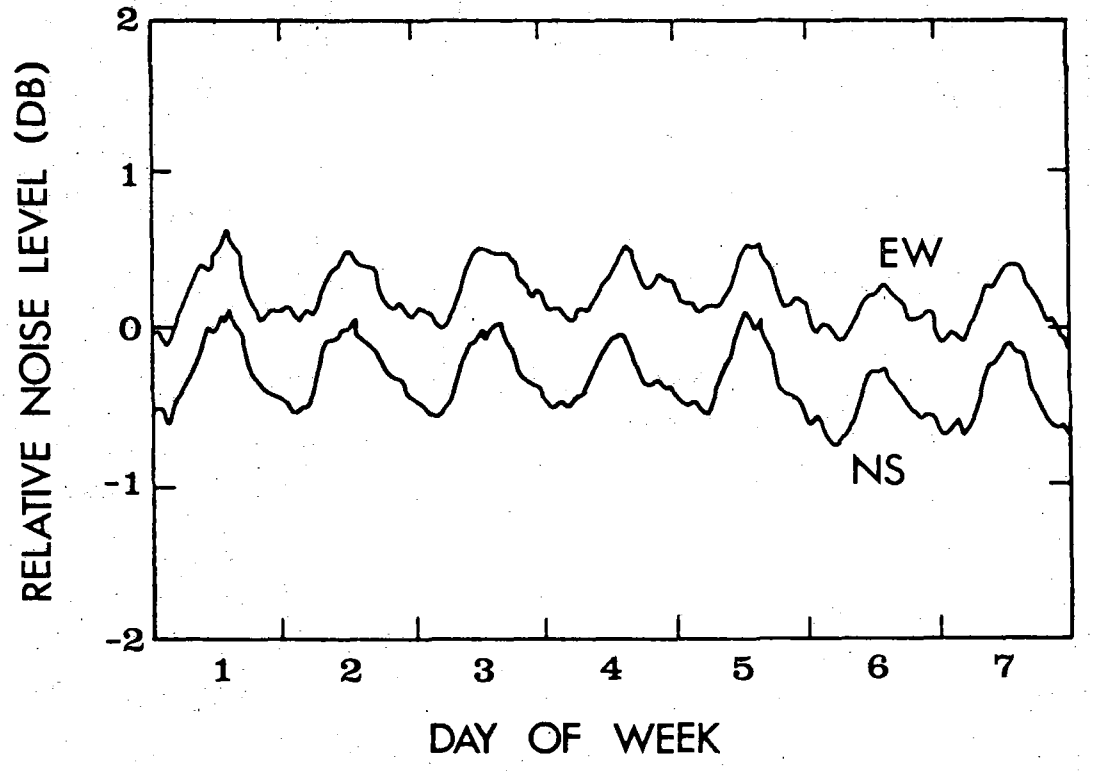


Fig. VII.8.4 Diurnal variation of horizontal component long period noise level by day of week (Monday through Sunday).

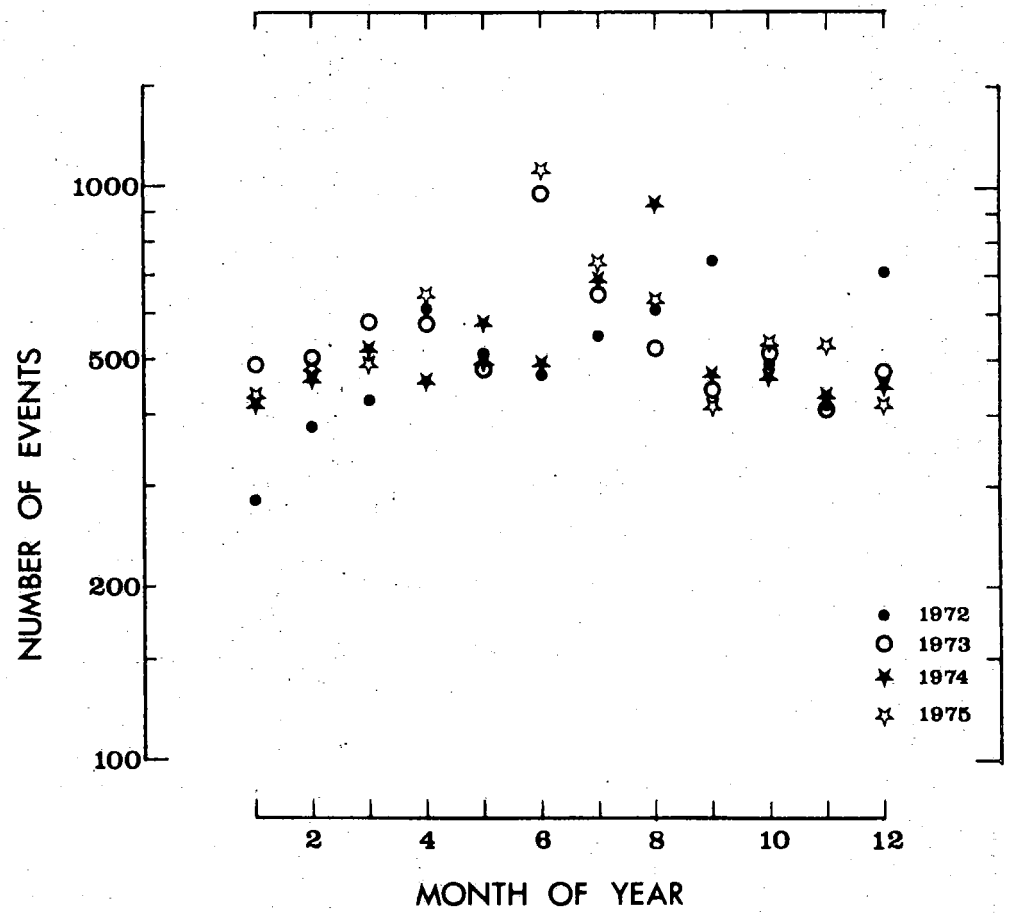


Fig. VII.8.5 Monthly number of NORSAR-reported events for the four-year period 1972-75.