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VI.2 NORESS noise and signal characteristics

The analysis of seismic noise characteristics in Fennoscandia as documented in our previous Semiannual Report (Bungum, 1982) has continued through an extensive analysis of noise level variation at the NORESS stations, and with two purposes: to obtain estimates of the long term noise levels and to study possible day/night differences.

Three different time periods between day 76/1982 (17 March) and day 195/1982 (14 July) were analyzed, as shown in Table VI.2.1. Values are given for five frequencies (0.25, 0.5, 1.0, 2.0 and 4.0 Hz), and the day/night differences are calculated for the same frequencies. From the averages and the standard deviation at the bottom of Table VI.2.1 we see that the difference is significant only at 2.0 and 4.0 Hz (values above 4.0 Hz could not be obtained because of dynamic limitations). The difference is quite small, 1.5-2.0 dB, which is consistent with the results of Ringdal & Bungum (1977). It is noteworthy that the standard deviation of the daily variations increases for decreasing frequencies, which is due to variations in the levels of ocean-generated noise.

The results with respect to absolute noise level in Table VI.2.1 are consistent with one of the conclusions in Bungum (1982), namely, that the noise level falls off with about 20 dB/octave below 1-2 Hz, and with about 10 dB/octave above that frequency. The average noise level at 1 Hz is 3.3 dB, corresponding to about 2 nm^2/Hz.

In Fig. VI.2.1 the average NORESS noise levels are plotted on top of noise spectra for the SRO stations ANMO (Albuquerque, New Mexico), NWAO (Mundaring, Australia) and the ASRO station KONO (Kongsberg, Norway), as taken from Peterson (1980). While a certain variation occurs for lower frequencies, the levels are quite similar for 2 and 4 Hz. At around 10 Hz, however, the typical level for southeastern Norway is lower than for all of the SRO/ASRO sites analyzed by Peterson (1980).

The NORESS 40 Hz data are now also being used in analysis of signal spectra and signal-to-noise ratio at higher frequencies. In Figs. VI.2.2-VI.2.3 there are given two examples of local earthquakes (distance 3° and 5°), and it is obvious that the SNR just continues to increase at least up to 10 Hz for those events. This high-frequency predominance is of course not being preserved for the distances of 26° and 38° presented in Figs. VI.2.4-VI.2.5 (presumed nuclear explosions in the Caspian Sea area and in Eastern Kazakh). The peak in SNR now occurs around 2 Hz, but there is still (with the exception of the weakest of the E. Kazakh events) good SNR up to about 8 Hz.

H. Bungum

References

Bungum, H. (1982): Fennoscandian noise study, in NORSAR Semiannual Technical Summary, 1 Oct 1981 - 31 Mar 1982 (J. Torstveit, ed.), NORSAR Sci. Rep. No. 2-81/82.

Peterson, J. (1980): Preliminary observations of noise spectra at the SRO and ASRO stations. USGS Open File Report 80-992, Albuquerque, New Mexico.

Ringdal, F. & H. Bungum (1977): Noise level variation at NORSAR and its effect on detectability. Bull. Seism. Soc. Am. 67, 479-492.

POWER DENSITY (DB REL TO 1 NM**2)						POWER DENSITY DIFFERENCE(DB)				
DAY	HOUR	.25	.50	1.0	2.0	4.0	.25	.50	1.0	2.0	4.0
76	1542	48	30	7	-12	-25					
77	0200	48	30	5	-14	-27					
							0	0	2	2	2
77	1606	48	28	3	-15	-27					
78	0200	48	27	1	-18	-28					
							0	1	2	3	1
80	1405	38	25	5	-17	-28					
81	0200	40	23	2	-17	-28					
							-2	2	3	0	0
83	1545	48	30	7	-13	-26					
84	0200	49	28	5	-15	-28					
							-1	2	2	2	2
84	1507	50	33	7	-13	-26					
85	0200	50	29	5	-15	-27					
							0	4	2	2	1
123	1400	58	34	9	-10	-23					
124	0200	57	33	9	-13	-27					
							1	1	0	3	4
124	1400	54	33	9	-10	-24					
125	0200	51	29	8	-14	-27					
							3	4	1	4	3
125	1400	52	31	7	-13	-25					
126	0200	52	30	4	-14	-27					
							0	1	3	1	2
127	1400	43	26	3	-14	-25					
128	0200	42	29	5	-14	-26					
							1	-3	-2	0	1
128	1400	43	29	5	-15	-27					
129	0200	42	27	3	-16	-27					
							1	2	2	1	0
129	1400	40	26	2	-16	-27					
130	0200	37	21	0	-18	-28					
							3	5	2	2	1
130	1400	38	20	0	-14	-25					
131	0200	36	20	0	-17	-27					
							2	0	0	3	2
186	1500	40	28	7	-13	-24					
187	0200	46	27	3	-15	-27					
							-6	1	4	2	3
187	1400	46	25	2	-15	-26					
188	0100	48	27	4	-17	-28					
							-2	-2	-2	2	2
188	1400	43	24	2	-15	-27					
189	0159	44	26	4	-16	-28					
							-1	-2	-2	1	1
189	1400	40	25	3	-14	-26					
190	0200	43	28	3	-17	-28					
							-3	-3	0	3	2
191	1440	42	25	3	-16	-27					
192	0200	45	26	2	-18	-29					
							-3	-1	1	2	2
192	1405	40	21	2	-17	-27					
193	0205	36	20	0	-18	-29					
							4	1	2	1	2
194	1400	40	27	0	-15	-26					
195	0205	37	26	0	-16	-28					
							3	1	0	1	2
AVERAGE		44.8	26.6	3.3	-15.9	-27.6					
ST. DEV		5.8	3.4	2.5	1.6	0.7					
AVERAGE DIFFERENCE (DB)							0.0	0.7	1.1	1.8	1.7
STANDARD DEVIATION (DB)							2.4	2.2	1.7	1.0	1.0

Table VI.2.1 NORESS (40 Hz data) noise power spectral density values at 5 frequencies separated by one octave, for a number of cases with measurements 12 hours apart. The day/night spectral differences are also given, together with average values and standard deviations both for the spectral levels and for the daily variations. The average values are plotted in Fig. VI.2.1.

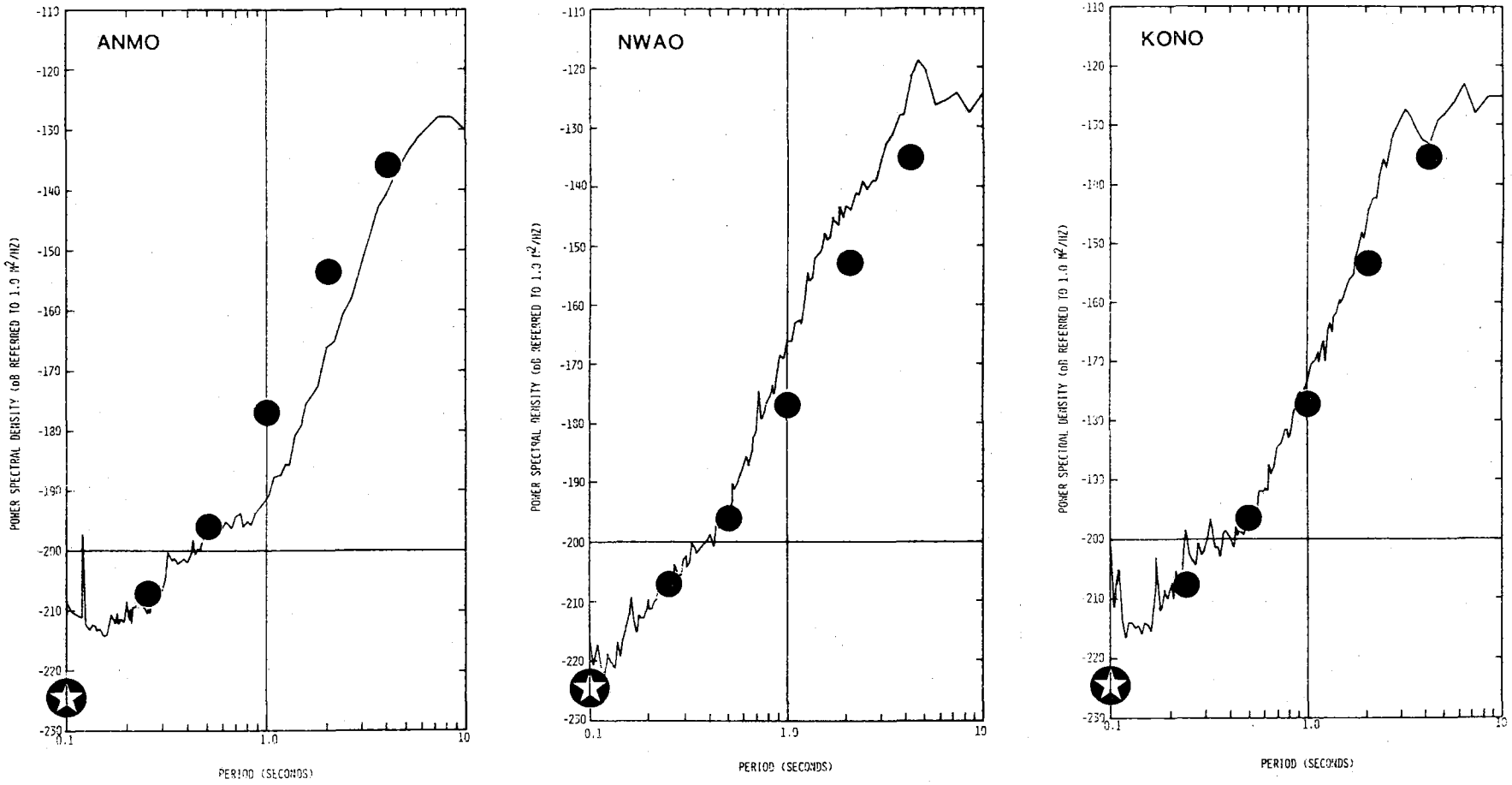

Fig. VI.2.1 Average NORESS noise level values from Table VI.2.1 (dots) plotted on top of SRO noise level curves (Peterson, 1980) for ANMO (New Mexico), NWAO (Australia) and KONO (Norway). The star indicates the typical 10 Hz noise level in southeastern Norway as recorded by independent field measurements.

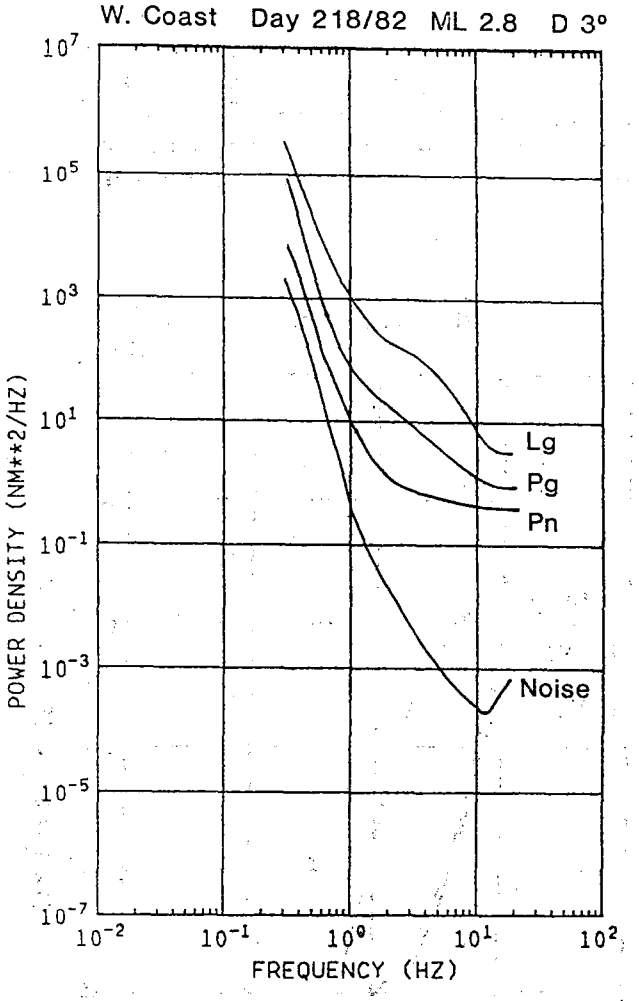

Fig. VI.2.2 NORESS (40 Hz) power spectral density values for a W. coast earthquake on day 218/82, ML=2.8, Δ=3°. The spectra for Pn, Pg and Lg are given, together with the spectrum for the preceding noise. Values above 6-8 Hz are biased upwards by system noise.

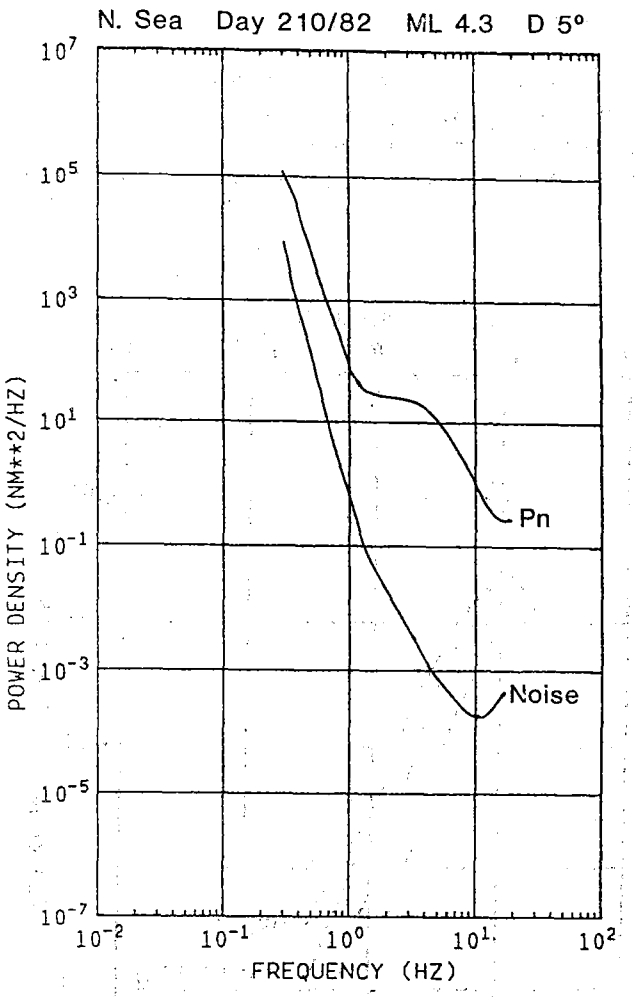

Fig. VI.2.3 Same as for Fig. VI.2.2, but for a N. Sea earthquake on day 210/82, ML=4.3, Δ=5°. The spectrum for Pn is given.

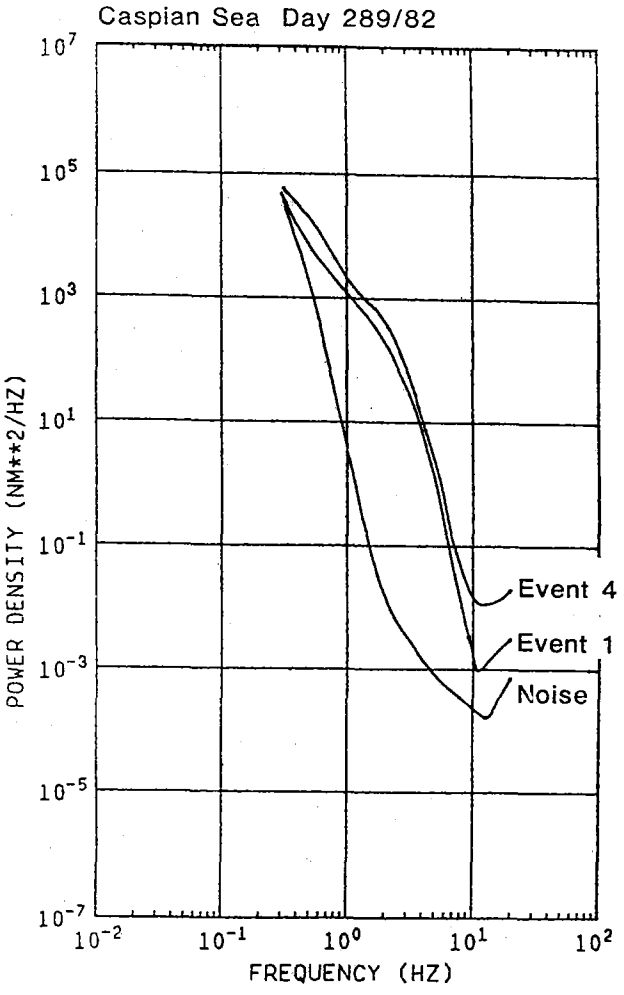

Fig. VI.2.4 Same as for Fig. VI.2.2, but for two Caspian Sea presumed explosions on day 289/82 (m_b 5.3 and 5.7). The two events are the first and last ones in a series of four. The epicentral distance is 26°.

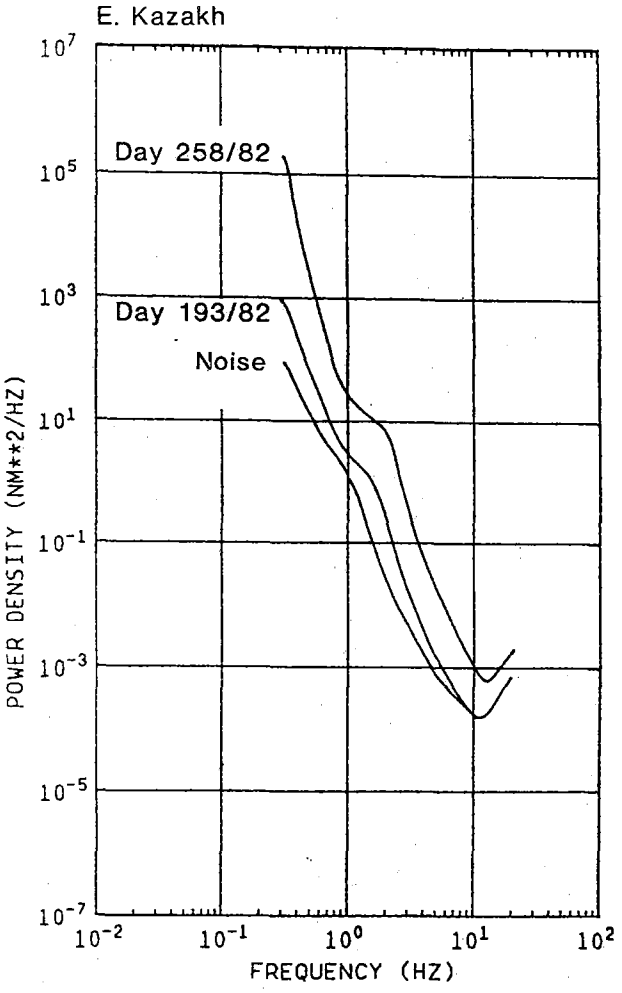

Fig. VI.2.5 Same as for Fig. VI.2.2, but for two E. Kazakh presumed explosions on day 193/82 (m_b=3.9) and 258/2 (m_b=4.2). The epicentral distance is 38°.