4.7.4. SOME FEATURES OF HAZARD DUE TO THE VRANCEA SEISMOGENIC ZONE

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The Vrancea seismogenic zone (*VSZ*) is widely recognized as the most active and important seismogenic zone affecting the Romanian territory. The frequent occurrence of strong earthquakes generated by the *VSZ* and the rich catalogue data at hand are providing a quite comprehensive insight on the features of the activity of this seismogenic zone. The last decades brought new valuable information about the features of *VSZ* earthquakes, mainly due to the fact that numerous strong motion records (more than 150) were obtained during the eartquakes of 1977.03.04 (M_{GR} = 7.2, *h* = 109 km), 1986.08.30 (M_{GR} = 7.0, *h* = 133 km), 1990.05.30 (M_{GR} = 6.7, *h* = 89 km) and 1990.05.31 (M_{GR} = 6.1, *h* = 79 km). A look at the catalogues referred to, e.g. (2), which cover the period starting with the event of A.D. 984, puts to evidence the strong trend to stationarity of the *VSZ* activity. This fact provides good chances of characterizing the earthquake recurrence by means of a classical Poissonian model. On the other hand, the consideration of the trend to cyclicity of VSZ earthquakes provides the chance of more accurate forecasting of major events to come (7).

The use of the Poissonian recurrence model led to following magnitude recurrence law (for Gutenberg-Richter magnitudes):

- **the Richter recurrence law segment corresponds to the analytical law**

(1) $\lg N_M(m, 1\ \text{yr.}) = 3.4 - 0.7 \times m \qquad (6. \le m < 7)$

- **the asymptotic decrease recurrence law segment corresponds, alternatively, to**

(2a) $\lg N_M^*(m, 1\ \text{yr.}) = 0.3 - 0.2 \times m - 0.32 / (7.8 - m) \qquad (7. \le m < 7.8)$

(2b) $\lg N_M^*(m, 1\ \text{yr.}) = 0.4 - 0.2 \times m - 0.5 / (8. - m) \qquad (7. \le m < 8.)$

The recurrence characteristics for some reference magnitudes are as in Table 4.7.4.1.

Table 4.7.4.1. VSZ magnitudes with various return periods

T_{ret} (years)	20	50	100	200	500
M_{GR}	6.7	7.2	7.4	7.5 … 7.6	7.6 … 7.7

An attempt at forecasting a next major event, by exceedeing the Poissonian approach, made in 1996, (7), led to the outcome of Table 4.7.4.2.

Table 4.7.4.2. Windows of forecast for a next major VSZ event, for fractiles of 80%

Forecast windows	Lower fractile	Upper fractile	Expected value
Time window	> 2001	< 2013	2007
Magnitude window	≥ 6.8	> 7.6	7.2

The availability of rich instrumental information subsequently to the events of 1986 and 1990, made it possible to perform an in depth analysis of attenuation. This was made in statistical terms, considering the intensity attenuation, alternatively (6): in global terms, in directional (azimuthal) terms, in directional and spectral terms (the latter, for various frequency bands). The strong variation of attenuation from one event to the other, its high scatter, its dependence on azimuthal direction and on frequency band, were emphasized.

The analysis of local hazard at various sites was based on a probabilistic approach, (4), performing a convolution between the magnitude recurrecnce law and the random attenuation law. A summary look at results obtained (1), (8), is given in Table 4.7.4.3.

Table 4.7.4.3. Intensities with various return periods for several selected locations

T_{ret} (years) →	50	100	200	500
Bucharest, Vaslui	7.9…8.0	8.3…8.4	8.6…8.7	9.0…9.1
Constanţa	6.4	6.8…6.9	7.1…7.2	7.6
Buzău, Câmpina, Focşani, Oneşti, Ploieşti, Văleni	8.4…8.6	8.9…9.1	9.1…9.4	9.5…9.7

The features of spectral characteristics of ground motion were investigated for various locations of accelerographic stations. It turned out that there was a wide variety of spectral characteristics, from one station to the other and from one event to the other. Unusually long dominant periods were observed for the 1977 event, while things were different for subsequent events. Stations (a) with a trend to stability of spectral content, versus stations (b) with a strong trend to variability of the same, were identified. Response spectra of accelerograms, running Fourier spectra of microtremors and transfer functions of upper geologic packages were investigated in this connection. It turned out that stations (a) are located at sites with a strong contrast of *S* wave velocity at small depth, while stations (b) are located at sites where such a contrast is missing. Conclusions were derived on the predictability of spectral contents for future events.

4.7.4.1 References

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