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MONITORING POTENTIAL SOURCES OF EMERGENCY EVENTS BY A THREE-COMPONENT SEISMIC STATION

Military actions as a result of Russia's armed aggression increase risk of hazards at potentially dangerous man-made facilities. Besides, earthquakes are one of natural hazards that can occur in Ukraine and lead to an emergency. Therefore, improving capabilities of disaster monitoring system by expanding monitoring methods becomes an urgent task. One such method is seismic, the main advantages of which are high efficiency and possibility for remote monitoring of potential sources of emergency (PSE), which reduces the risk to equipment and personnel.

One information segment in the Civil Protection System on the seismic situation in Ukraine and neighboring countries is the Main Center for Special Monitoring (MCSM). But territorial limitation of the PSE seismic observation network makes it necessary to develop methodological principles for solving area of responsibility monitoring tasks by individual observation points (OPs) with three-component seismic stations (TCSS).

Polarization features within the seismic signal components from seismic sources with centers in the near-field (Δ<500 km) are considered in the report. A relationship between angular characteristics for the main seismic signal components and position of the PSE relative to OP is established. Accounting for polarization, angular, and velocity characteristics of main seismic signal components from events with a focal point in a near zone, a dynamic-kinematic model (DKM) of expected seismic signal was proposed by a special TCSS to realize continuous monitoring PSE based on observations. Input data for forming a DKM are expected angle of the first seismic signal arrival on day surface (P-wave) and distance between OP and PSE. DEM of seismic signal taking into account properties of volumetric seismic waves (P- and S-waves) for PSE in near-field has a general form as follows:

$$F(t) = \Omega(\alpha_P, \gamma_P, \tau_{PS}, t) = \Omega_P(\alpha_P, \gamma_P, t) \cdot \Omega_S(\alpha_S, \gamma_S, t + \tau_{PS}),$$

where, $\Omega_P(\alpha_P, \gamma_P, t)$ and $\Omega_S(\alpha_P, \gamma_P, t + \tau_{PS})$ – assessment of linearity degrees of sections in three-component seismic record corresponding to *P*- and *S*- waves, respectively[1], their compliance with expected azimuths α and angles γ on the day surface; τ_{PS} – time difference between *P*- and *S*- waves arrivals, determined from the hodograph [2].

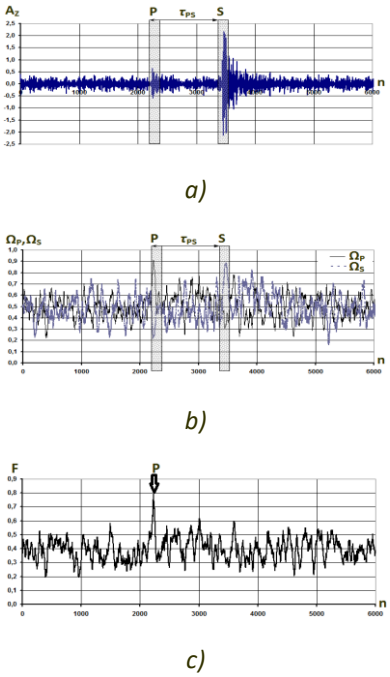

Fig. 1. Recording of seismic signal from earthquake 11.01.2024, M = 3.7 (a), determination of linearity degree for DKM components (b) and value of solving function (c)

Fig. 1 shows results of DKM application for monitoring of the Vrancea seismic core (Romanian part of the Carpathians). DKM parameters for seismic signals from this area relative to Malyn OP are as follows $F(t) = \Omega(204°,-48°,58',t)$ ·

Using DCM makes it possible to significantly reduce seismic recording processing time compared to manual processing and eliminate influence of seismic signals with centers in other directions and distances.

This research is an integral part of planned research aimed at developing a safety system and is focused on studying processes of emergency occurrence and spread of seismic emergencies.

References

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