Relationship between water level temporal changes and seismicity in the Mingechevir reservoir (Azerbaijan)

Fakhraddin Gadirov (Kadirov)¹, Luciano Telesca², Gulum Babayev¹, Gurban Yetirmishli³, and Rafig Safarov¹

¹Geology and Geophysics Institute, Azerbaijan National Academy of Sciences, H. Javid Ave., 119, Baku, Azerbaijan, AZ1143 (kadirovf@gmail.com)
²Institute of Methodologies for Environmental Analysis, National Research Council, 85050 Tito (PZ), Italy
³Republican Seismological Survey Center of National Academy of Sciences, Nigar Rafibeyli Str., 25, Baku, Azerbaijan, AZ1001

Reservoir-induced seismicity has been studied worldwide due to its potential to provoke damage to buildings and constructions, and, more important, human loss. Reservoir-induced seismicity (RIS) is normally related with additional static loading (the weight of the water reservoir and its seasonal variations), tectonic faults, liquefaction and pore pressure variations. The Mingechevir reservoir is located in the north-west of Azerbaijan on the Kurriver. This water reservoir is extended from north-west towards south-east through Kur river valley by 75 km. The area of the dam is 625 km² with the average width accounting for 6-8 km. The volume of the dam is 16 km³. The dam filling started in 1953. This reservoir is the largest one in the Caucasus and carries a number of geo-hazards interrelated with geodynamics and technogenic factors. The aim of the present study in the Mingechevir reservoir is to investigate relationship between the fluctuations of the water level and the onset of seismicity in the area around the dam more in detail, by using several and independent statistical methods. The temporal variations of the instrumental seismicity (0.5≤M_L≤3.5) recorded in the Mingechevir area (Azerbaijan) between January 2010 to April 2018 and its relationship with the level variation of the water reservoir was analysed in this study. Due to the relative high completeness magnitude (M_C = 1.6) of the seismic catalogue of the area, only 136 events were selected over a period of more than 8 years. Thus, the monthly number of events was analysed by using the correlogram-based periodogram, the singular spectrum analysis (SSA) and the empirical mode decomposition (EMD), which are robust against the short size of the time series. Our results point out to the following findings: 1) annual periodicity was found in one SSA reconstructed component of the monthly number of events; 2) quasi-annual periodicity was found in one EMD intrinsic mode function of the monthly number of earthquakes. These obtained results could support in a rigorously statistical manner that the seismicity occurring in Minghechevir area could be triggered by the yearly cycle of the water level of the reservoir.

Keywords: water reservoir, induced seismicity, water level change, Mingechevir reservoir, Azerbaijan