

Investigation of earthquake environmental effects in Fennoscandia

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The Fennoscandian Peninsula in northern Europe is an intraplate domain where instrumental data must be extended back in time to improve knowledge of earthquake consequences. We opted to search for hitherto disregarded earthquake environmental earthquake effects (EEEs) for the important earthquakes of 1626, 1759, 1819, and 1904, and analyze their geographical distribution. We mainly investigated EEEs using contemporary newspaper accounts.

The compiled data sets are most probably incomplete, but testify to such EEEs as rockfalls and turbulent waters. In 1759, turbulent waters were reported from distances up to approximately 380 km. In 1904, they caused trouble to sailors on many lakes. Numerous rockfalls and landslides were reported in 1819 and 1904. In the 1904 rockfalls, boulders fell onto a roadway and into a river, causing flooding that reached rye crops.

We assessed the EEEs for 27 localities of interest using the Environmental Seismic Intensity scale ESI-07. A challenge in using slope failures for intensity assignment is that the triggering of landslides is highly dependent on the level of water saturation in the slope prior to the earthquake. This precipitation effect poses an extra uncertainty in the assignment of ESI-07, which is especially pronounced in areas of high precipitation, such as western Norway. EEEs are also affected by temperature: the winter earthquake of 1759 cracked ice on many lakes.

The overall agreement between ESI-07 values and EMS-98 intensities is good, but many assigned ESI-07 intensities remain uncertain due to the character of the textual information and brevity of the documentation. However, the ESI-07 scale also has practical importance for regions with infrequent EEEs. For a full understanding of seismic risk, EEEs must be incorporated in the analyses also in Fennoscandia.

Reference

Mäntyniemi P, Sørensen MB, Tatevossian RE (2021) Testing the Environmental Seismic Intensity scale on data derived from the earthquakes of 1626, 1759, 1819, and 1904 in Fennoscandia, northern Europe. *Geosciences* 11, 14. <https://doi.org/10.3390/geosciences11010014>