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Can Machine Learning help us in [re]assessing historical earthquakes?

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Tyrol is one of the provinces with the highest seismicity in Austria. Most of the stronger historical earthquakes occurred around Innsbruck and Hall in Tirol (1572, 1670, 1689).

Within the framework of the project[1] "Historical and recent earthquake activity in Tyrol - sources, data, seismological analysis", a study was carried out from 2014-2020, which mainly deals with historical earthquakes in Tyrol up to 1900 but also in detail with damaging earthquakes in Tyrol in the 20th century. The project's purpose was to create a new earthquake catalog for Tyrol, which for the first time also includes Macroseismic/Intensity Data Points (M/IDPs).

An essential aspect of this study is that the sources and literature references used for all Tyrolean earthquakes up to 1900 are largely documented. Furthermore, selected damaging earthquakes of the 20th century are reported in detail. Numerous Tyrolean archives, such as the Tyrolean Provincial Archives, and the City Archives of Hall in Tyrol, were searched for contemporary earthquake sources. Likewise, the seismic archive of the Austrian Seismological Service at ZAMG (Zentralanstalt für Meteorologie und Geodynamik) contains a wealth of valuable recent information, such as the questionnaires on earthquakes of the entire 20th century.

The very time-consuming research and documentation are followed by the conversion of the written information into earthquake parameters. Briefly outlined, this comprises the following working steps: Interpretation of the sources, assignment of geographical coordinates to the pieces of evidence, evaluation of the intensity according to the European Macroseismic Scale (EMS-98), (re)calculation of the focal parameters of all damaging earthquakes and numerous newly found earthquakes.

The latter is the content of this presentation, namely to (re-)evaluate the focal parameters for historical and recent earthquakes in Tyrol for the first time using the intensity prediction equations (IPE) with the Grid Search (GS) technique. GS has been widely used in many Machine Learning types of research when it comes to hyperparameter optimization, which in this study corresponds to the earthquake focal parameters.

We used IDPs whose intensities were mostly assessed from contemporary historical sources, such

as annals, chronicles, questionnaires, newspapers, etc.

A total of 1750 M/IDPs for 35 damaging earthquakes from the Austrian Earthquake Catalogue (AEC2020) could be determined based on the historical sources. The focal parameters for these earthquakes were reevaluated by means of the IPE and GS.

Likewise, 726 new M/IDPs from a total of 154 non-damaging earthquakes not yet included in the AEC2020 were determined. For 38 of them, it was possible to calculate new sets of focal parameters.

Problems encountered, accuracy, and error of the results will be introduced in the presentation.

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