INTRAPLATE SEISMICITY: Improving Data of the Brazilian Seismic Bulletin and Relationship Between Earthquakes and Geological Faults Using KNN

Rayssa da Silva Carvalho (IAG/USP), George Sand Leão Araújo de França (IAG/USP)

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Introduction

Intraplate seismicity in Brazil, though of low magnitude (generally below 5.0 on the magnitude), exhibits a relevant spatial distribution, often associated with pre-existing geological structures such as weakness zones. This study addresses two main challenges: correcting inconsistencies in the da-ta from the Brazilian Seismic Bulletin—one of the few seismic databases in the country—and analyzing the relationship between earthquakes and geological faults using the K-Nearest Neighbors (KNN) algorithm, chosen for its efficiency in spatial classification problems.

Methodology

In the data processing stage, it was found that 30% of the bulletin's records contained several inconsistent in coordinates (latitude/longitude), including values outside Brazilian territory (e.g., points in the Pacific Ocean) and insufficient precision (coordinates truncated to just 1 decimal place). To reduce this, we used the "geobr" package for standardization in the WGS84 system, which not only corrected invalid city. This stage also included manual validation of 5% of random records to ensure process reliability. After correction, each earthquake was associated with the nearest geological fault among the 48 analyzed faults (USGS catalog) through simple Euclidean distance between earthquake and fault coordinates. A proximity criterion of 50 km was adopted to validate associations, classifying distant events as "out of pattern."

Results

The partial result was a more coherent and standardized catalog for future research, and its use with KNN will enable the creation of intraplate seismicity zones with specific characteristics, such as notable concentrations along faults. However, a critical limitation persists: dependence on the seismic bulletin's earthquake catalogs, particularly regarding magnitude, coordinates, and depth data. This reinforces the need for continuous and consistent processing of the Brazilian bulletin's seismic data. It is concluded that "geobr" proved effective in standardizing coordinates, and KNN was suitable for correlating earthquakes with nearby faults on a regional scale.