Place your programme code here [Arial Bold; 10,5pt.] Example **P2.4-123**

Advancing Earthquake Localization Using Deep Learning in Gas Storage Fields

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INTRODUCTION AND MAIN RESULTS

We applied PhaseNet and the REAL package to 19 years of seismic data from the Qom gas storage field. This approach produced a detailed catalogue of induced and regional earthquakes, showing improved accuracy and reliability. A full analysis will be presented in a forthcoming publication.

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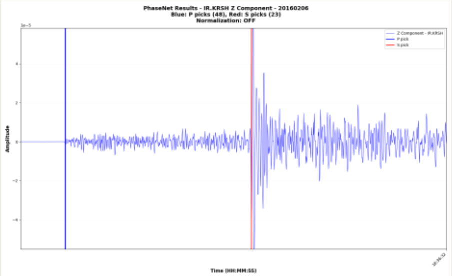
Introduction

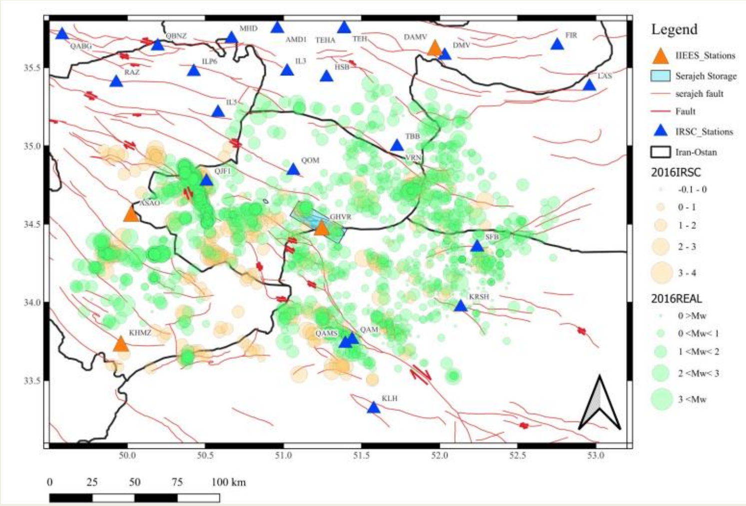
Accurate earthquake localization is a cornerstone for understanding seismicity and mitigating risks, particularly in regions influenced by industrial activity. Traditional seismological methods often struggle with noisy data and sparse networks, limiting the resolution of induced seismicity studies. Recent advances in deep learning, such as PhaseNet, offer a transformative opportunity by automating robust seismic phase detection. This project applies these techniques to a gas storage field in Iran, aiming to construct a reliable earthquake catalogue and to enhance monitoring of reservoir-related seismicity.

In addition to deep learning–based phase picking, we employed the REAL (Rapid Earthquake Association and Location) package to associate picks and calculate precise earthquake locations. REAL provides an efficient framework for clustering seismic arrivals and estimating hypocenters in near–real time. By integrating PhaseNet picks with REAL, we ensure that automatically detected phases are reliably associated with seismic events, leading to accurate determination of origin time, epicenter, and depth. This combination of AI-driven phase detection and classical location algorithms creates a robust hybrid workflow, maximizing both detection sensitivity and location accuracy in the gas storage field.

Method

We analyzed 19 years of waveform data from seismic stations near the Qom gas storage field. The workflow included three steps: (1) preprocessing of continuous records, (2) automated P- and S-phase picking with PhaseNet, and (3) event association and location using the REAL package. This hybrid approach combines deep learning and classical location methods, resulting in a high-resolution induced seismicity catalogue validated against analyst-reviewed picks.





Results

Our preliminary results show that the combination of PhaseNet and REAL provides reliable and accurate earthquake detection and localization within the gas storage field. The generated catalogue captures both small-magnitude induced events and larger regional earthquakes, offering new insights into the seismicity of the area. The method demonstrates robustness against noise and performs well in an industrial environment where conventional approaches are often limited. A more comprehensive analysis of the full 19-year dataset, including statistical evaluation and comparisons with traditional catalogues, is currently in progress and will be presented in a forthcoming publication.

Conclusion

Our study demonstrates that deep learning significantly enhances the accuracy and reliability of earthquake phase picking and localization in industrial environments. By leveraging PhaseNet, we generated a comprehensive seismicity catalogue for the gas storage field, improving monitoring capacity and contributing to risk assessment. The approach shows strong potential for real-time applications in energy-related infrastructures, ensuring safer management of strategic resources.