

Deep Learning Derived Seismic Event Catalog Using Surface Sensors for a Carbon Capture & Storage Site in Decatur, Illinois

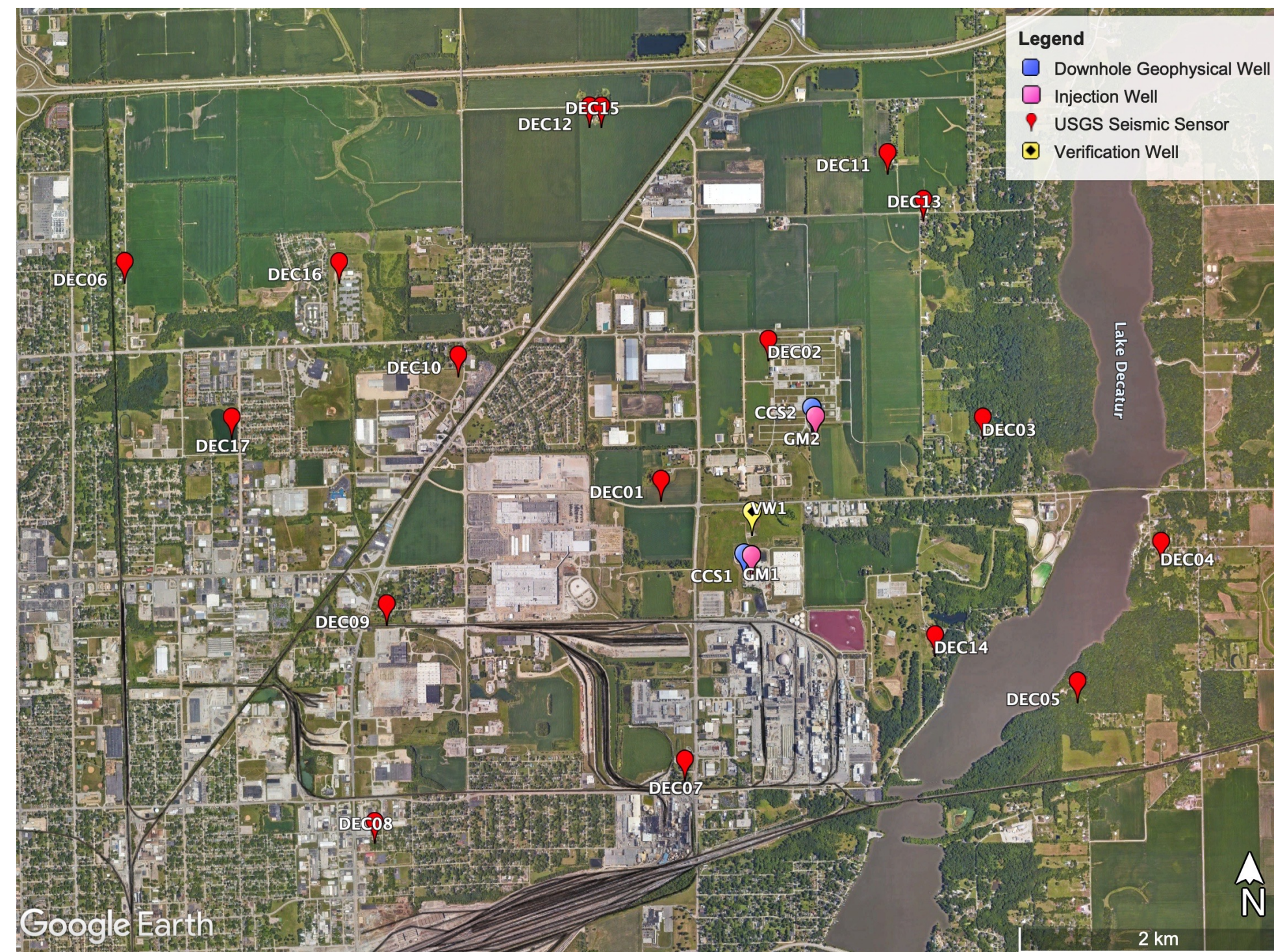
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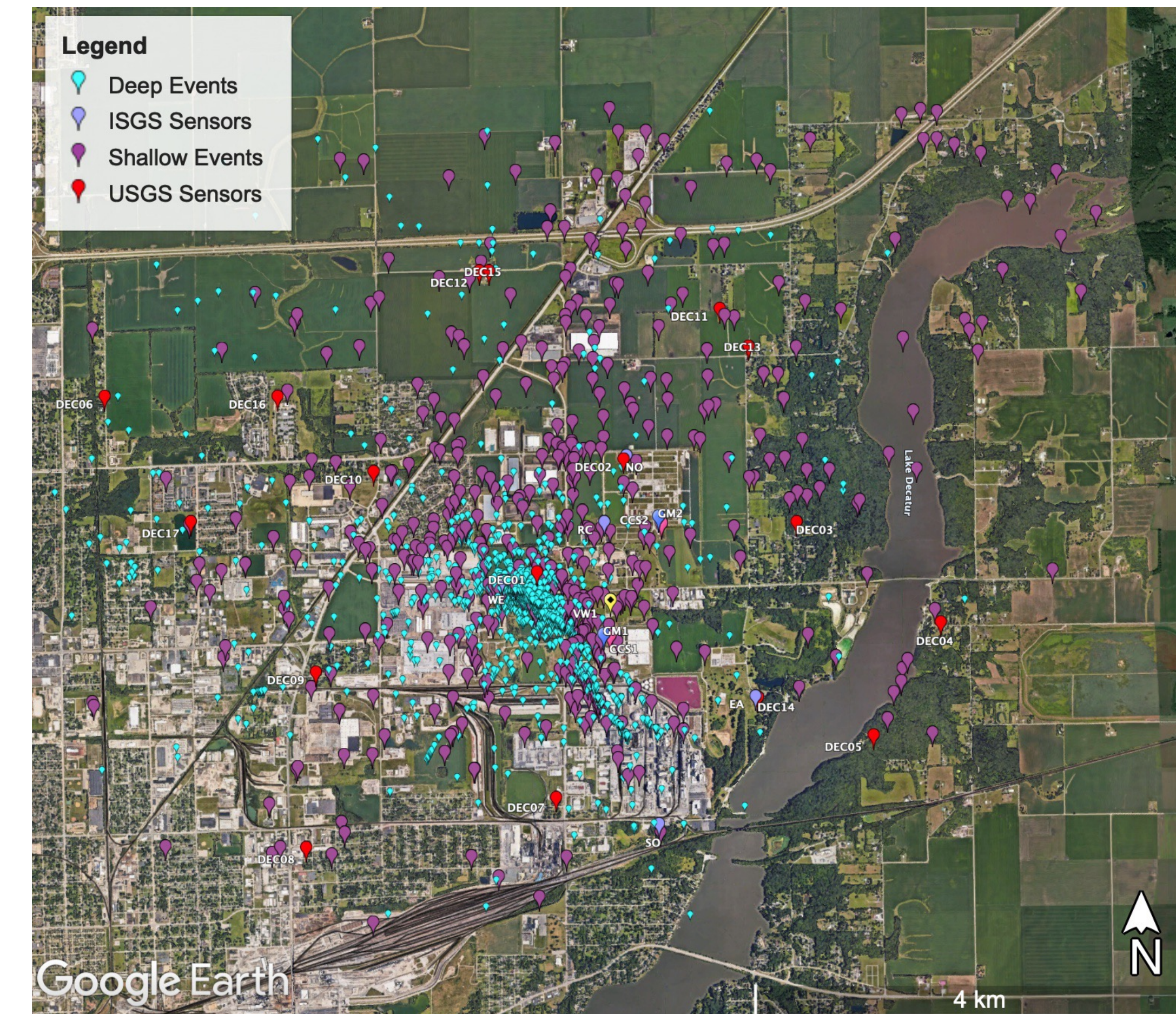
Science-informed Machine Learning to Accelerate Real Time (SMART) Decisions in Subsurface Applications

Introduction

- Nearly 1 million metric tons of CO₂ have been injected in the CCS1 well between November, 2011, and November, 2014.
- The Illinois Basin – Decatur Project (IBDP) detected and located 4,239 seismic events during this period.
- We are developing machine learning tools to process continuous passive seismic data.
- Continuous seismic data (2TB) from openly available United States Geological Survey (USGS) sensors were used initially.
- Monitoring faults/fractures is important for safe operation of CO₂ storage.



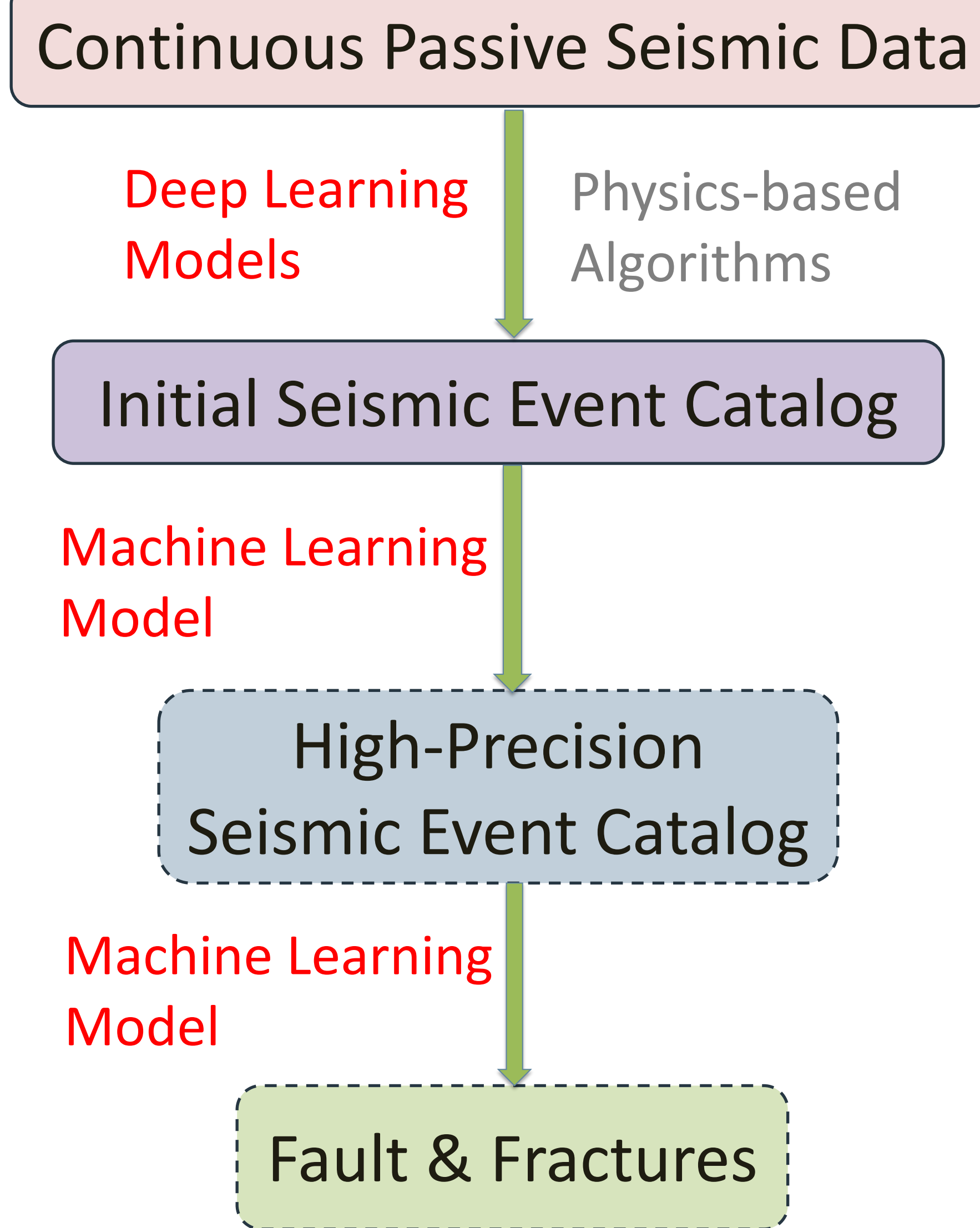
Preliminary Results



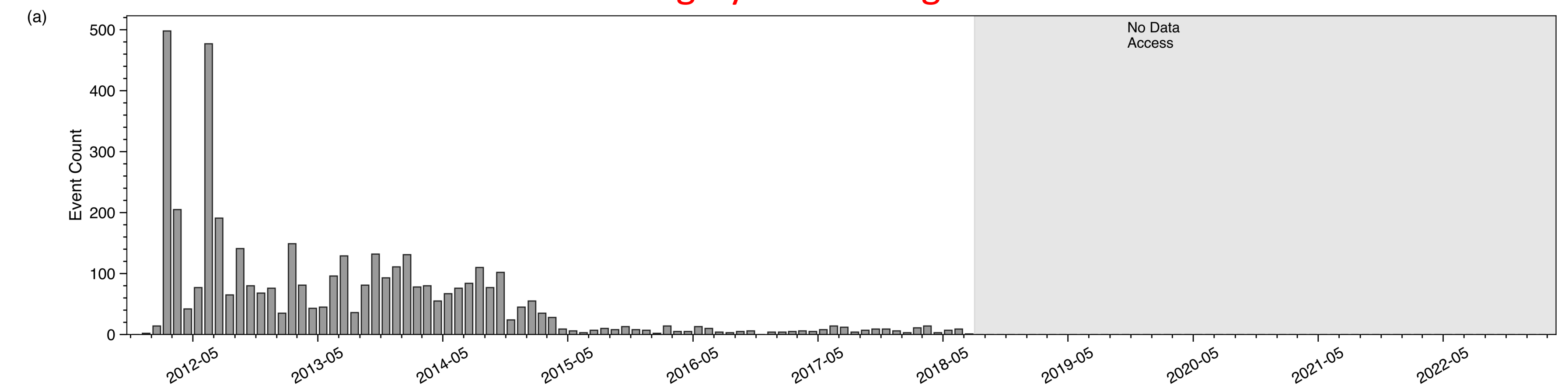
- More than 8,000 seismic events from nearly 10 years data from 17 seismic stations have been identified and located.
- The events occurred between November 2013 and February 2023 with an irregular temporal distribution.
- Many seismic events were located deeper than 5 km.
- IBDP and ISGS data, along with new machine learning tools, will be used to better constrain seismic event locations.
- More precise seismic event locations will help constrain faults and fractures better.

Data & Method

- Data from USGS sensors were used initially due to availability.
- The project is seeking access to 75 TB of continuous passive seismic data from IBPD and Illinois State Geological Survey (ISGS) sensors.
- Deep learning models and physics-based algorithms have been applied to continuous seismic data to identify seismic events and construct an initial seismic event catalog.
- A machine learning model is being developed to improve the location estimation of the initial seismic event catalog.
- A machine learning model will be developed to identify fault and fractures from the high-precision seismic event catalog.



Seismic Event Catalog by IBDP Using Traditional Methods



Seismic Event Catalog from Surface Sensors Using Deep Learning

