Using Artificial Intelligence to forecast the location of earthquake- and post-earthquake-induced landslides

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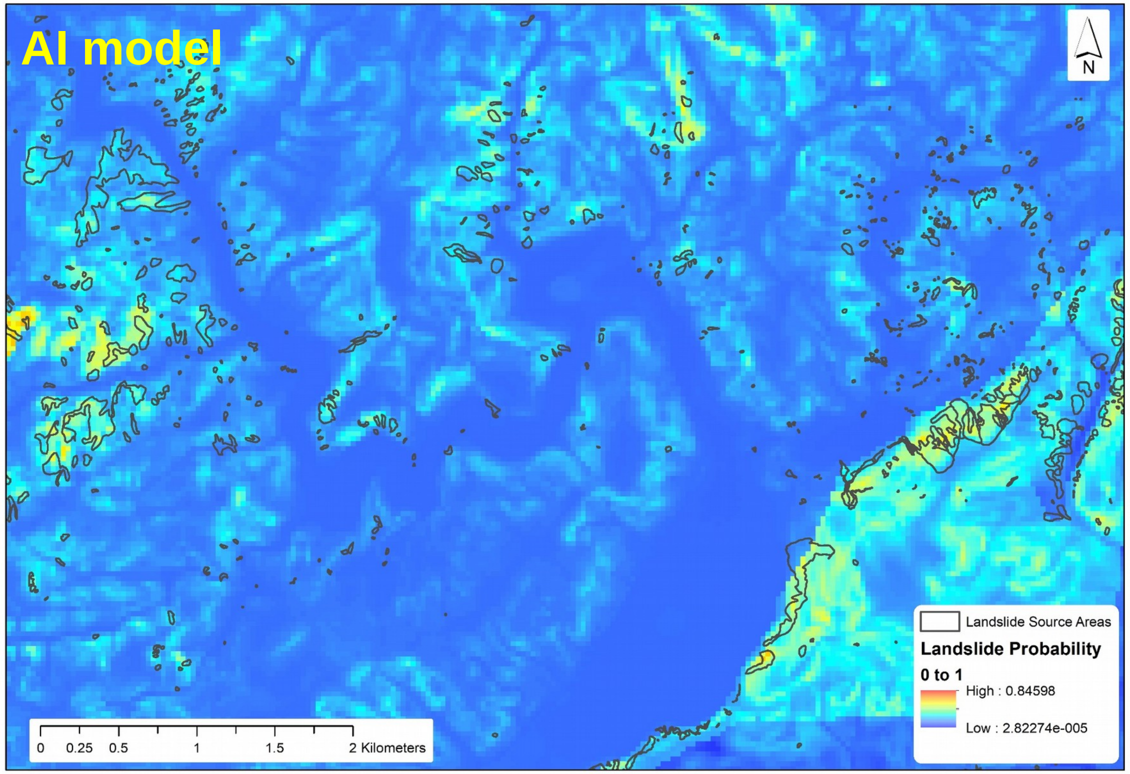
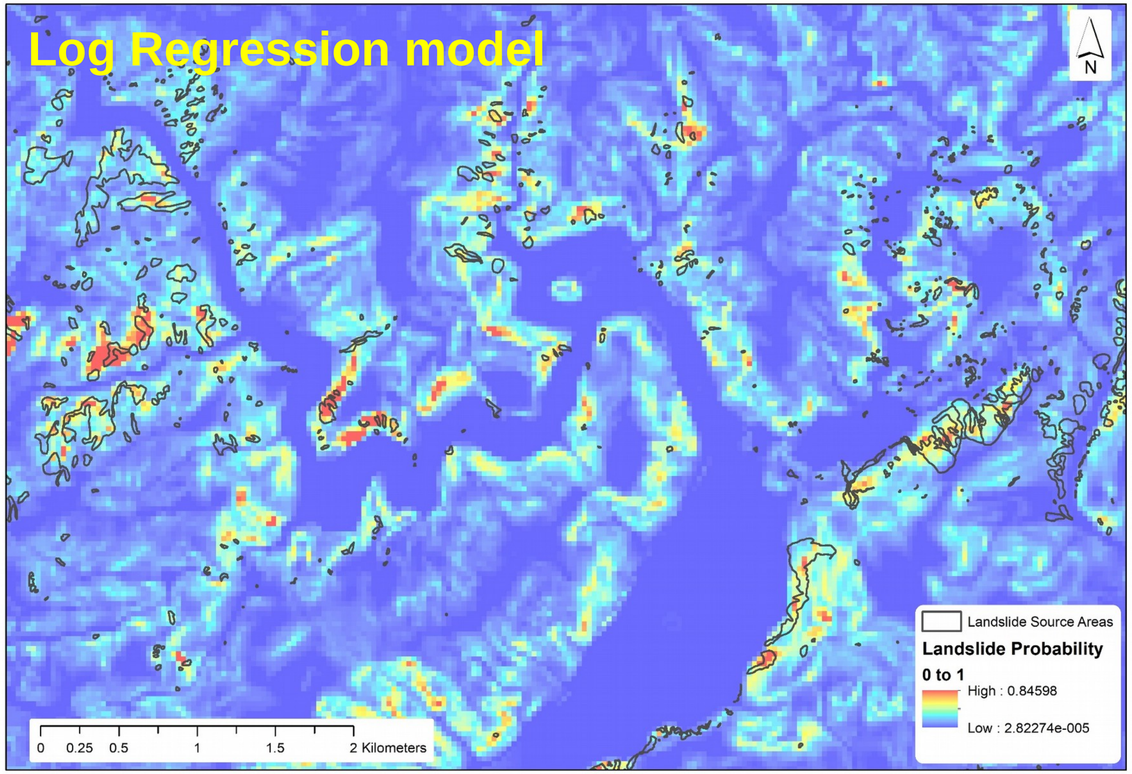
Contents

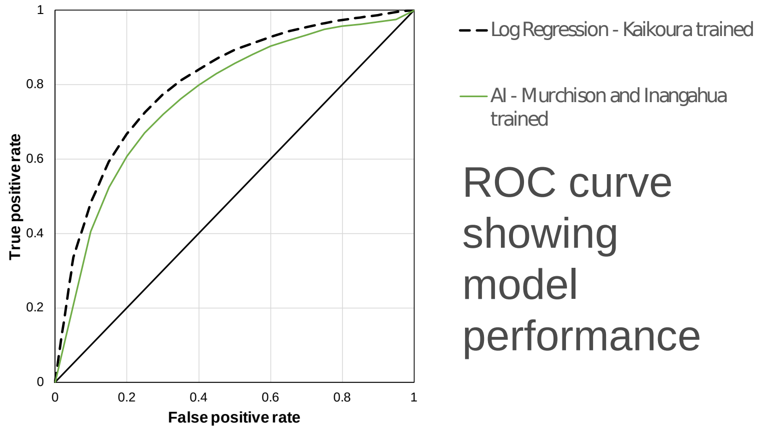
- Development of an Earthquake-Induced Landslide (EIL) forecast tool for NZ
- Model Structure and Training

AI versus Log Regression



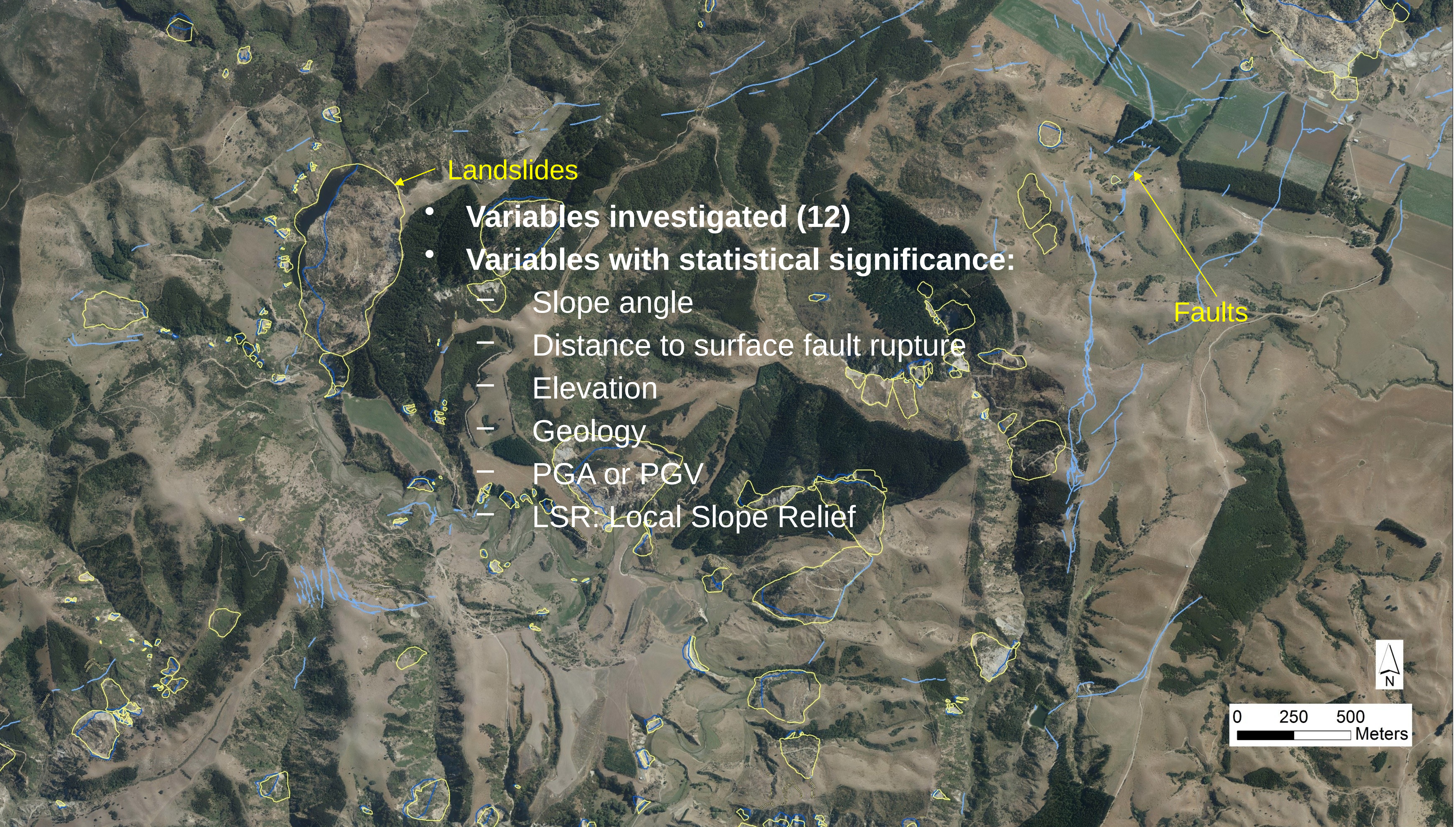


- **AI model trained on Inangahua and Murchison EQ landslide datasets, then used to forecast Kaikoura EQ landslides**
- **Log Regression model trained on Kaikoura EQ and landslides only**
- **AI model statistically preforms well in forecasting Kaikoura EQ landslides**



ROC curve showing model performance

- **Variables investigated (12)**
- **Variables with statistical significance:**
  - Slope angle
  - Distance to surface fault rupture
  - Elevation
  - Geology
  - PGA or PGV
  - LSR: Local Slope Relief



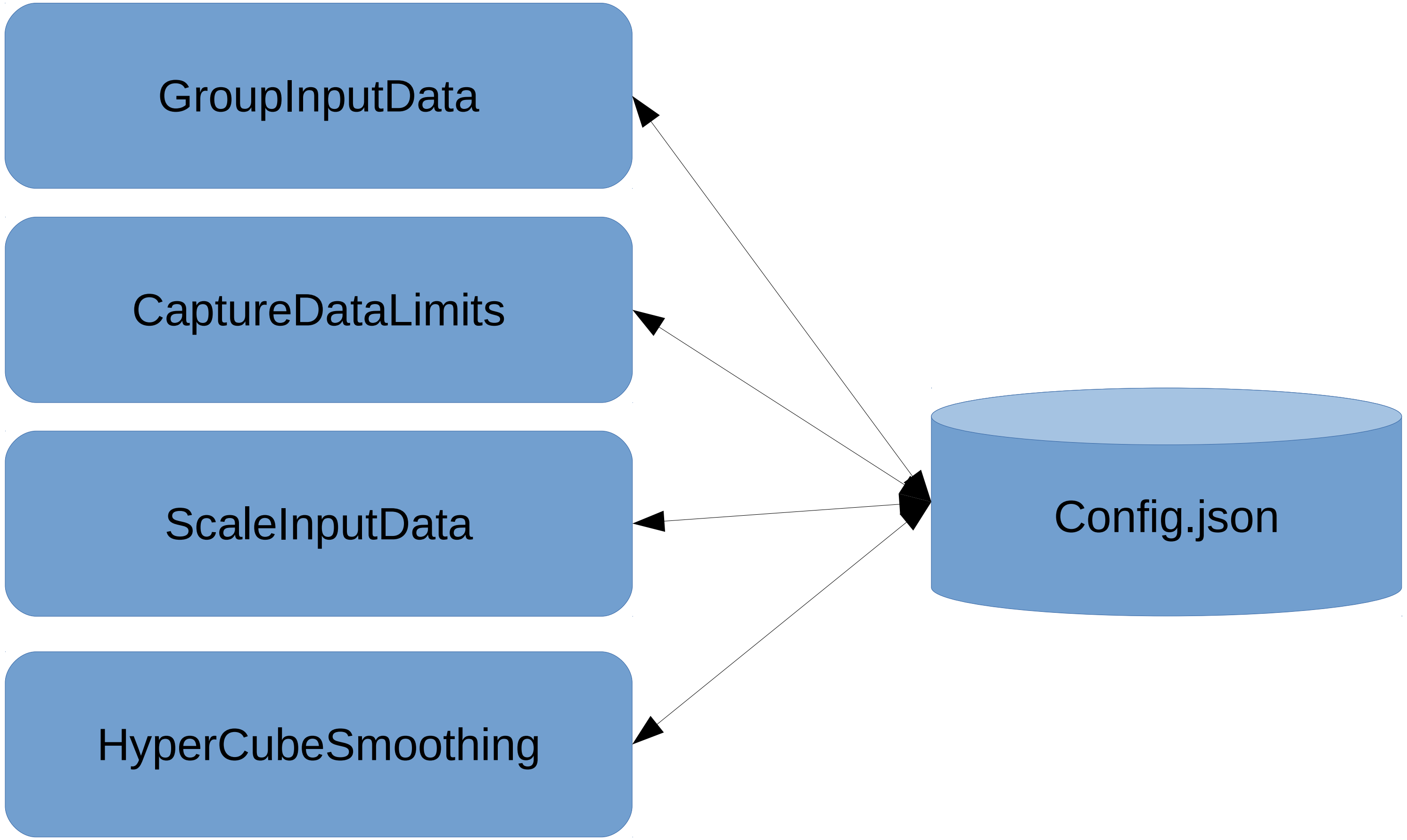
Data Difficulties

- **Data discontinuities and one-hot encoding**
  - Natural ordinal relationship between the categories?
    - ‘cold’, warm’, and ‘hot’
  - Not suitable for one-hot encoding
    - Quaternary gravel, debris, sand
    - Neogene siltstone, sandstone
    - Cretaceous conglomerate, igneous rocks, limestone, mudstone, siltstone
    - Early Cretaceous igneous rocks
    - Paleogene igneous rocks, limestone, limestone

Data Difficulties (2)

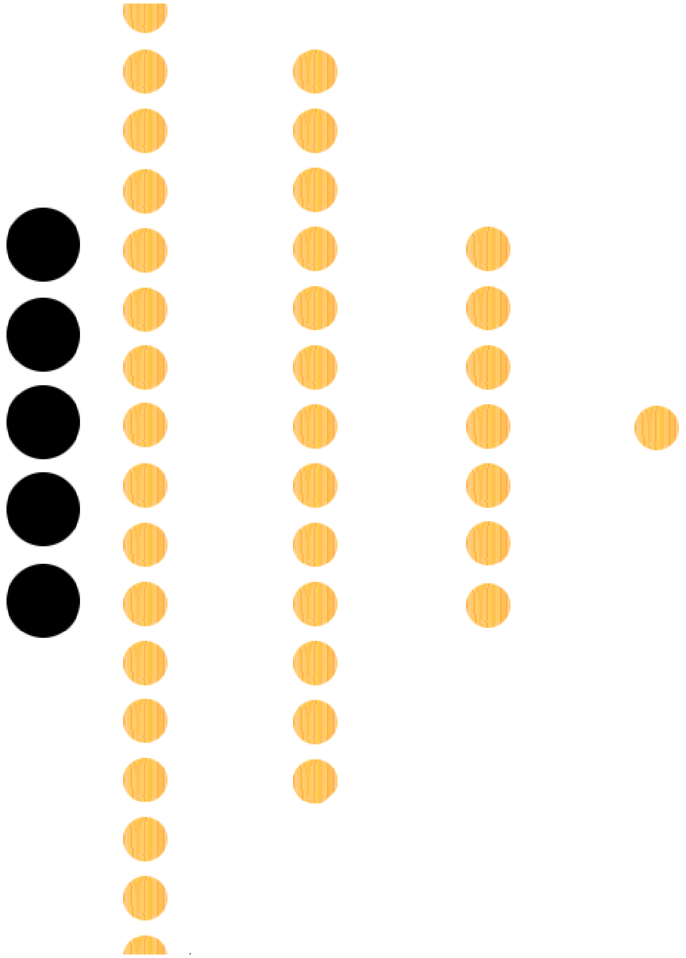
- **Data scales**
  - Distance (~100,000 m)
  - Elevation (~2000 m)
  - LSR (~200)
  - PGA (~100)
  - Slope (~90)
  - GeolCode (1, 2, 3, 4, 5)

Data discontinuities

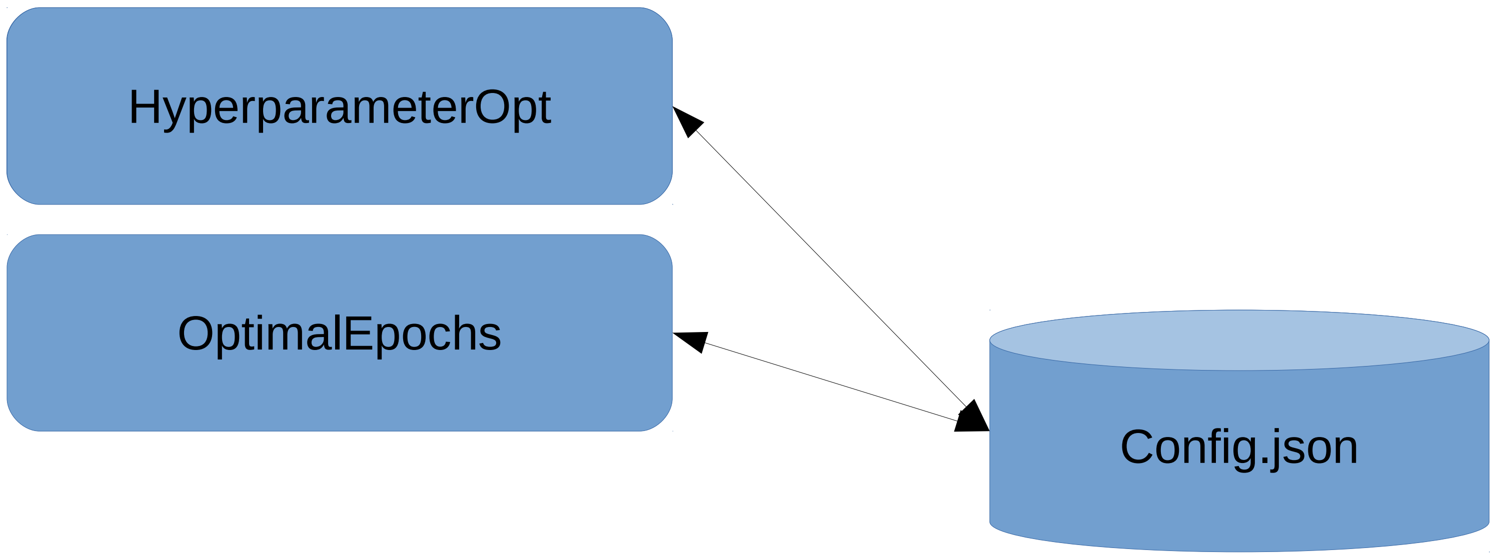


Structure Difficulties

- **Model structure**
  - Number of hidden layers
  - Number of nodes per layer
  - Amount of “Dropout”



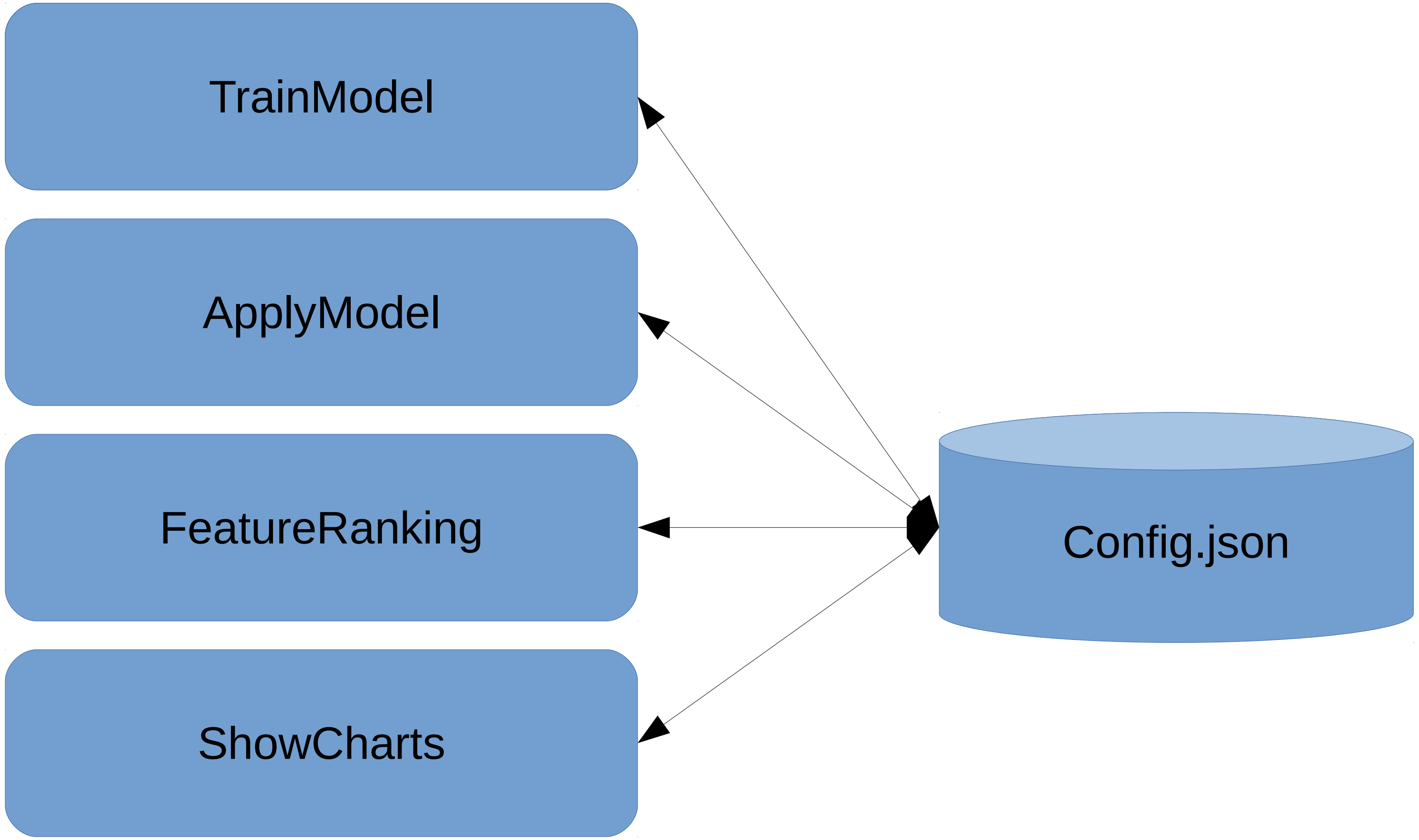
Structure Difficulties



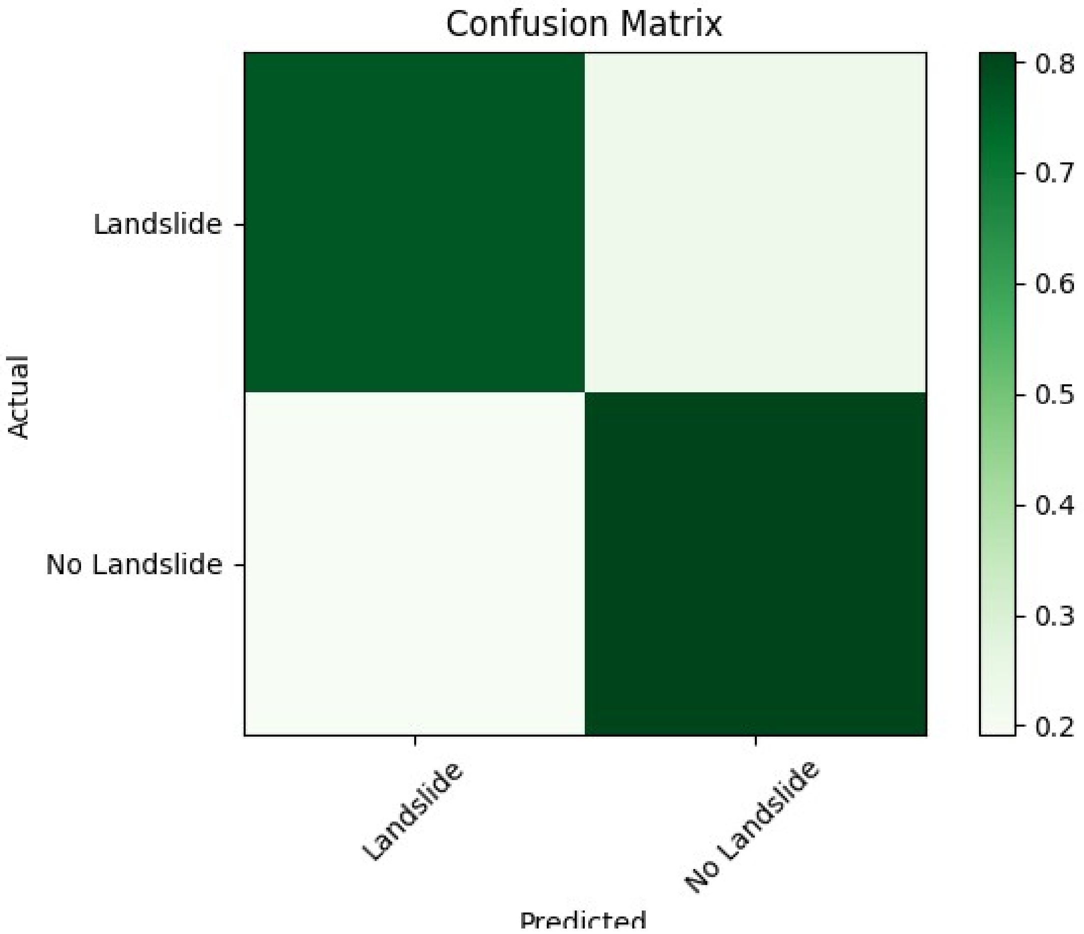
Model Training and Testing

- Train the model
- Apply to Out Of Sample data (if any)
- Rank the input features
- Show charts

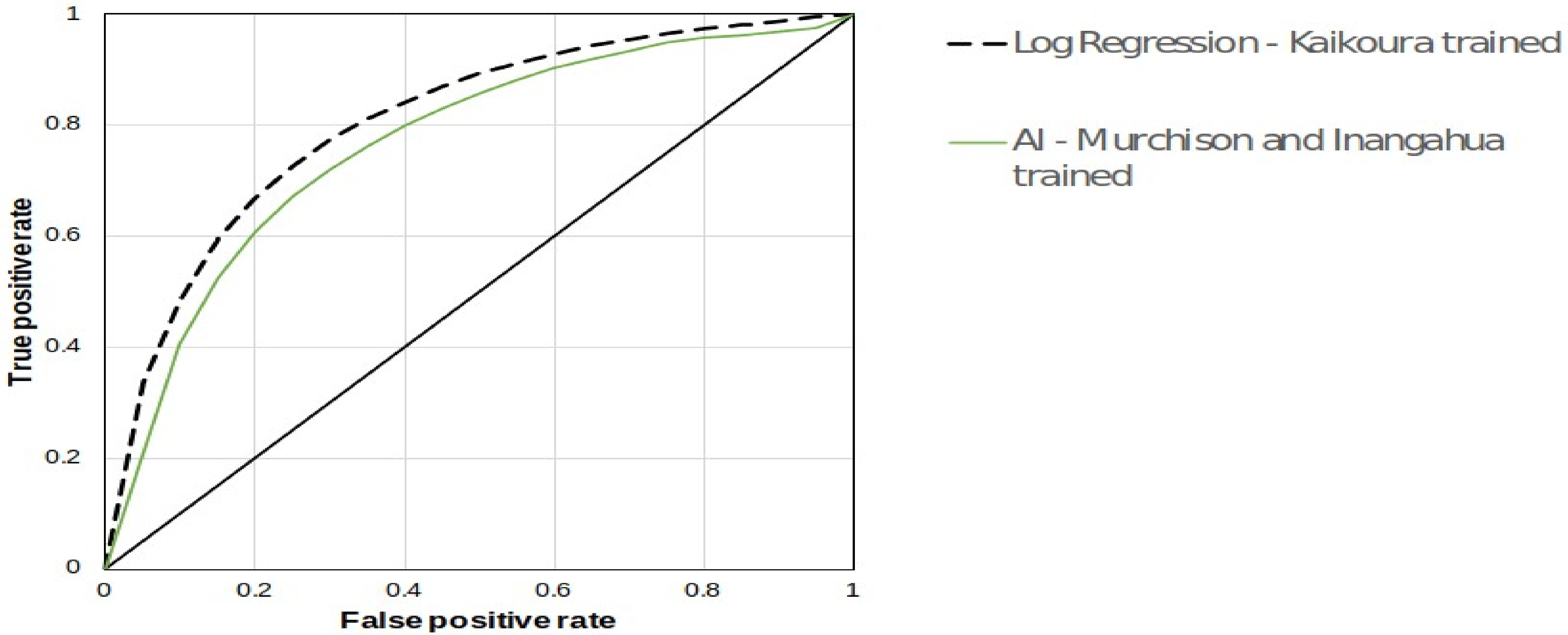
Model Training and Testing



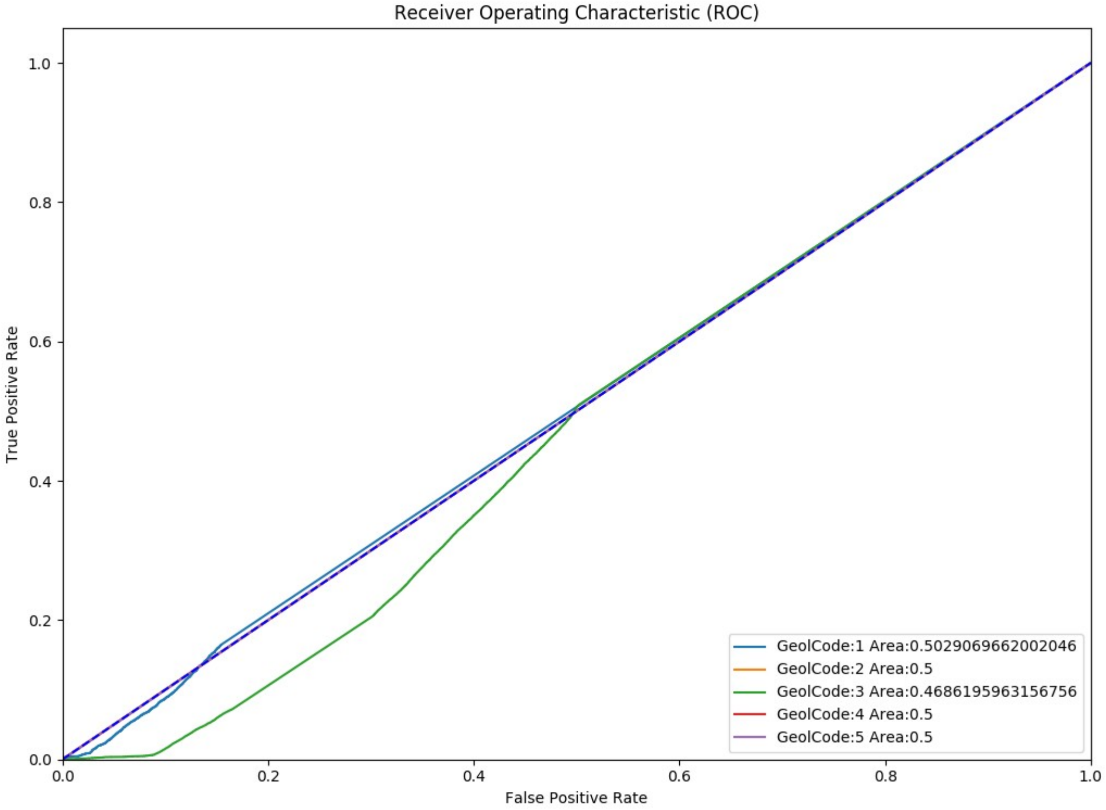
Model Charts – Confusion Matrix



Model Charts – Receiver Operating Characteristic



Model Charts – Receiver Operating Characteristic



Summary

- Rapid forecasts of landslide probability and impacts in near-real time (5-7 minutes) after an event would help to focus such response efforts

- Several discrete steps are required to produce a useful model that can be applied when an earthquake event happens

Questions

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