Megathrust seismicity through the lens of explainable artificial intelligence

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Different mechanisms have been proposed to control megathrust seismicity

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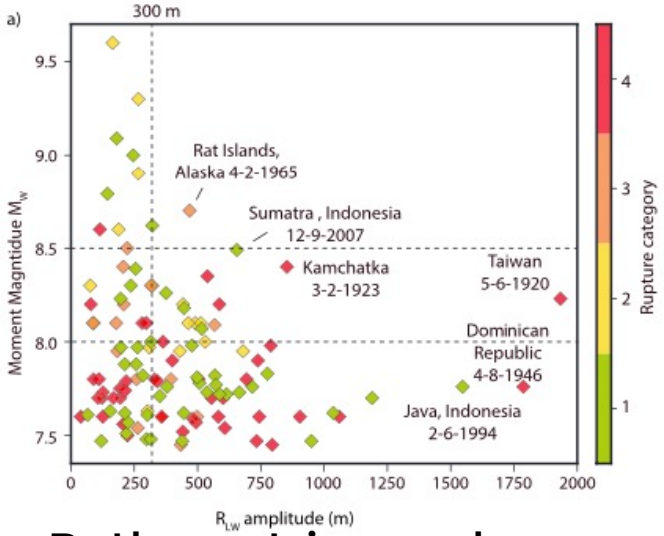
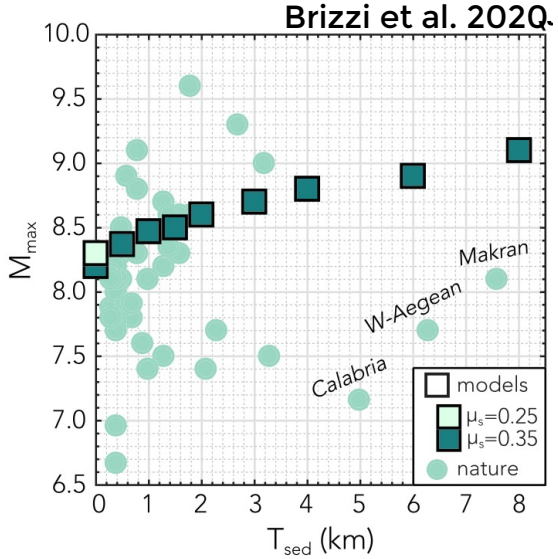
Van Rijsingen et al. 2020



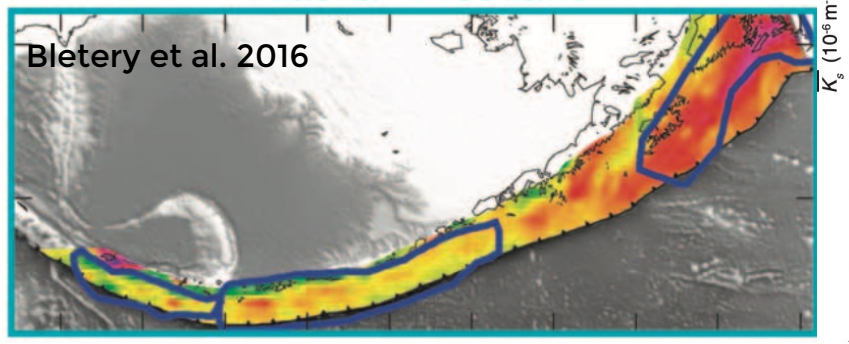
Bathymetric roughness

Brizzi et al. 2020



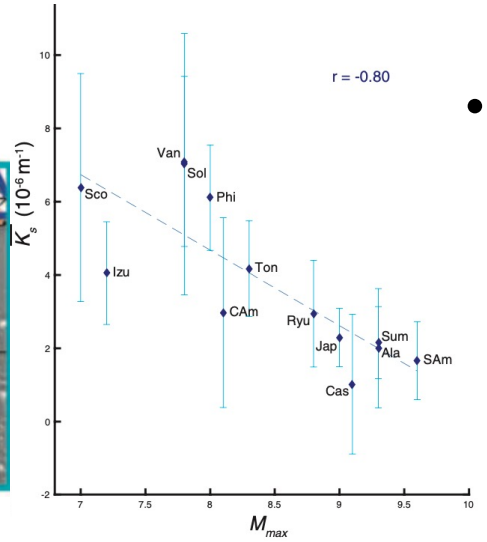
Sediment thickness

Alaska - Aleutians



Bletery et al. 2016

Curvature



- Mechanisms may interact and some may dominate
- Linear methods don't always work
- Machine learning is non-linear and can handle high dimensional data
- Use explainable artificial intelligence (XAI) techniques for interpreting model results

Training the model

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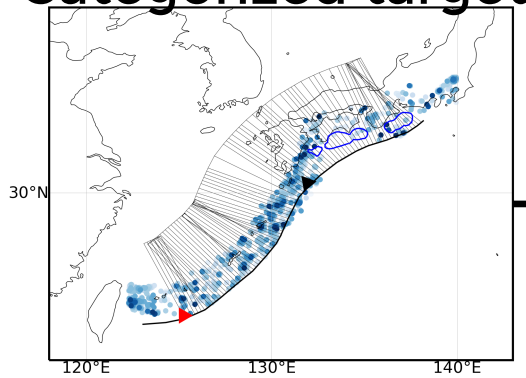
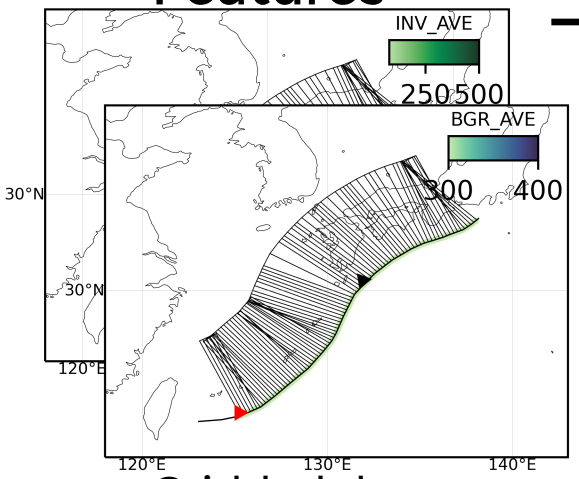
Categorized target

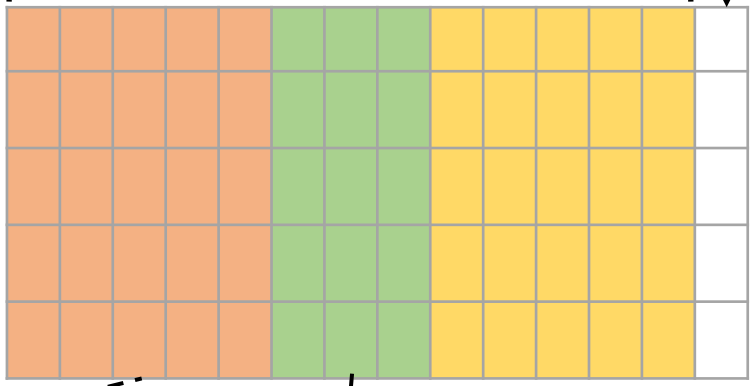


largest event that ruptured grid

Features

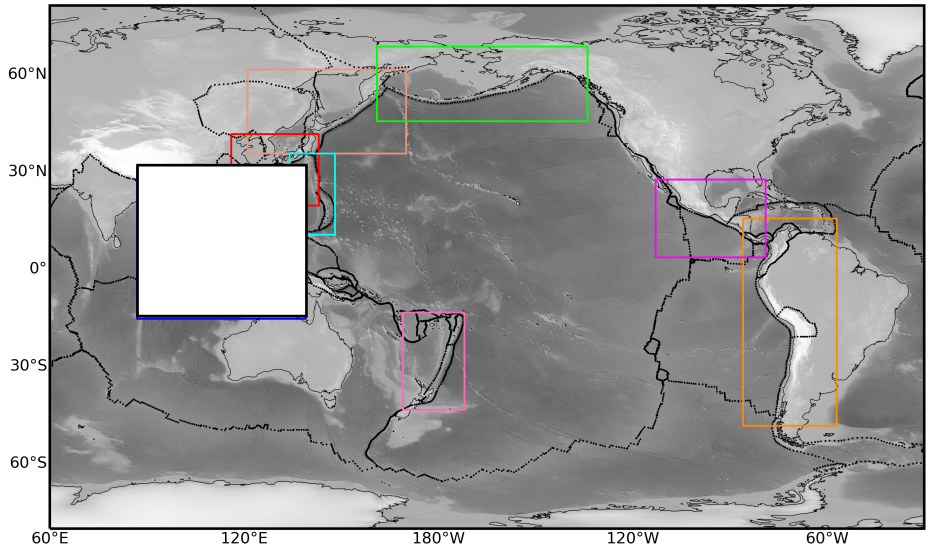


Gridded data



Training & validation: N – 1

Test: 1



SZ physical state

- E.g. stress, gravity anomalies

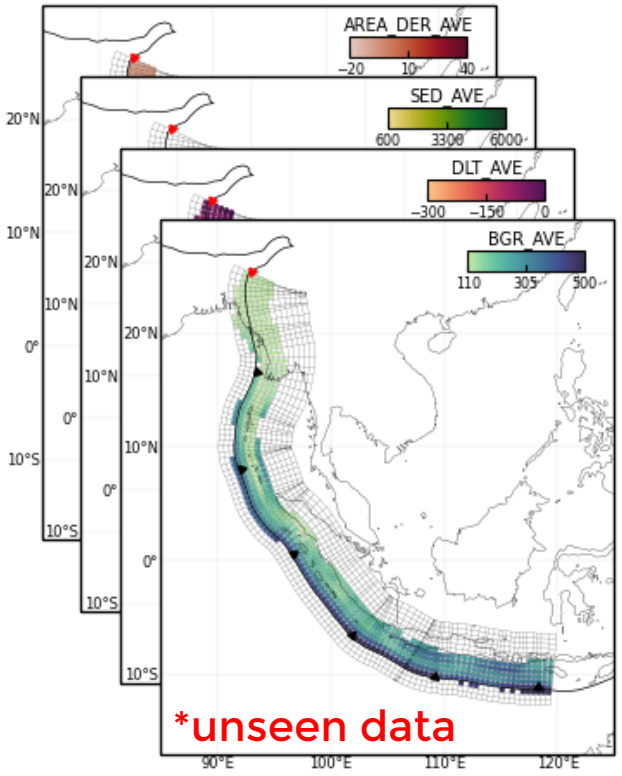
Kinematics

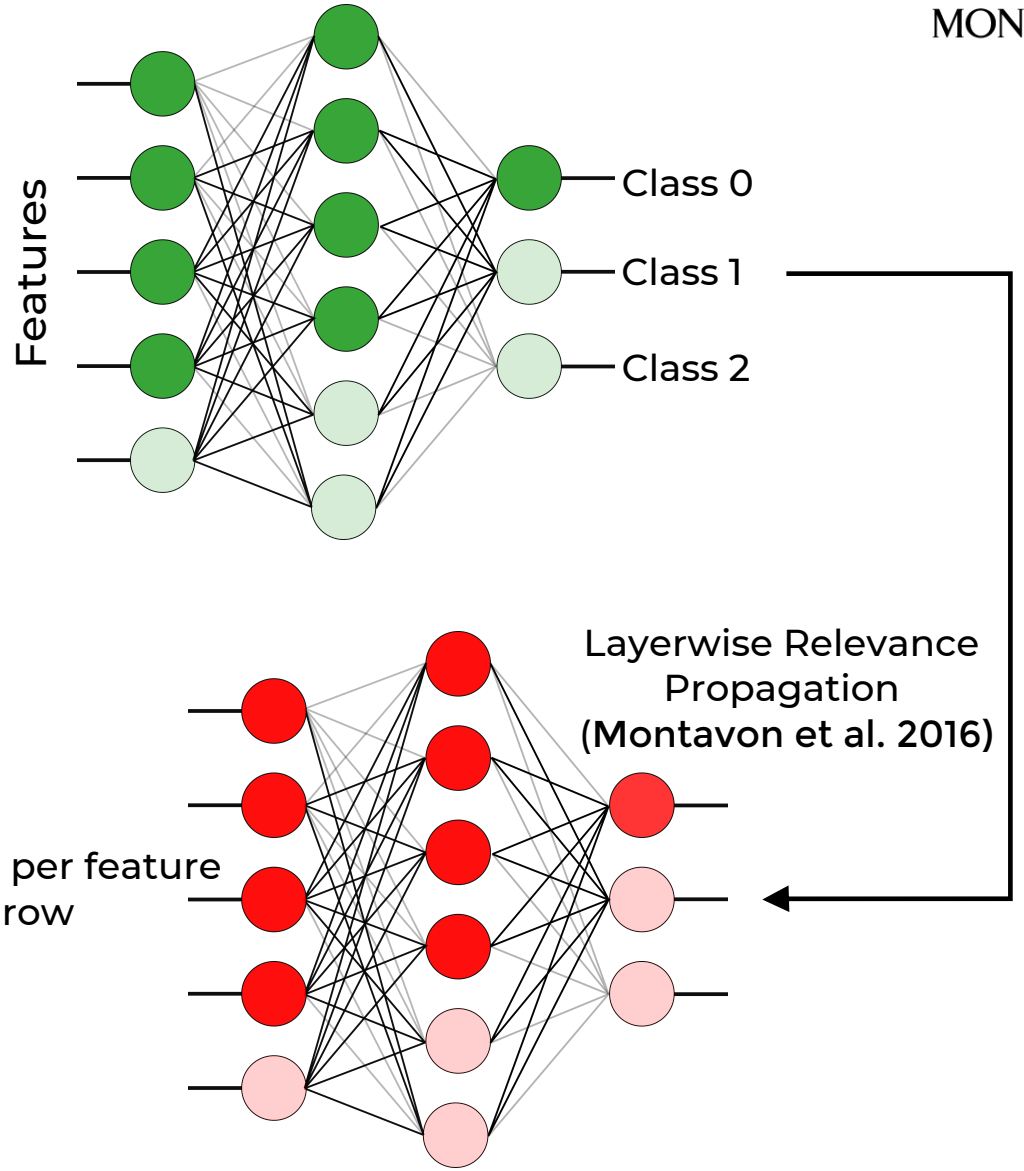
- UP velocity
- SP velocity

Dynamics

- Slab depth gradients

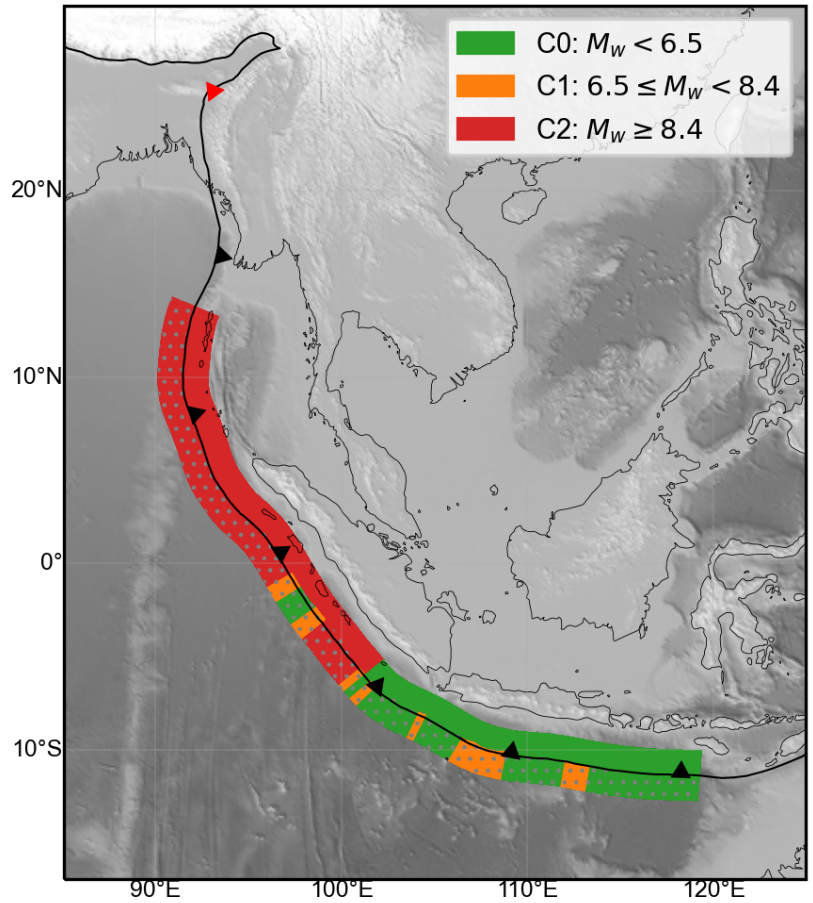
Testing and interpretation

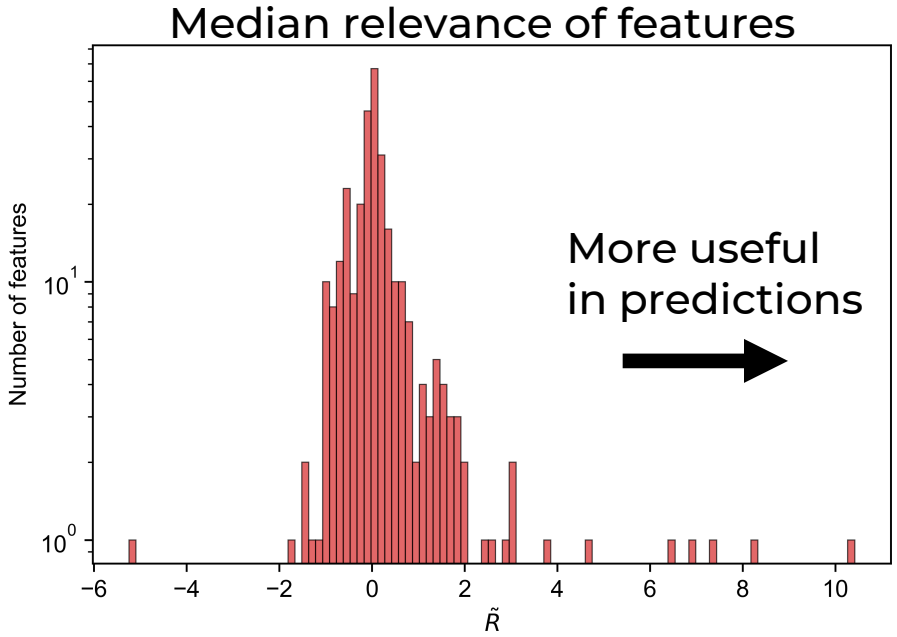


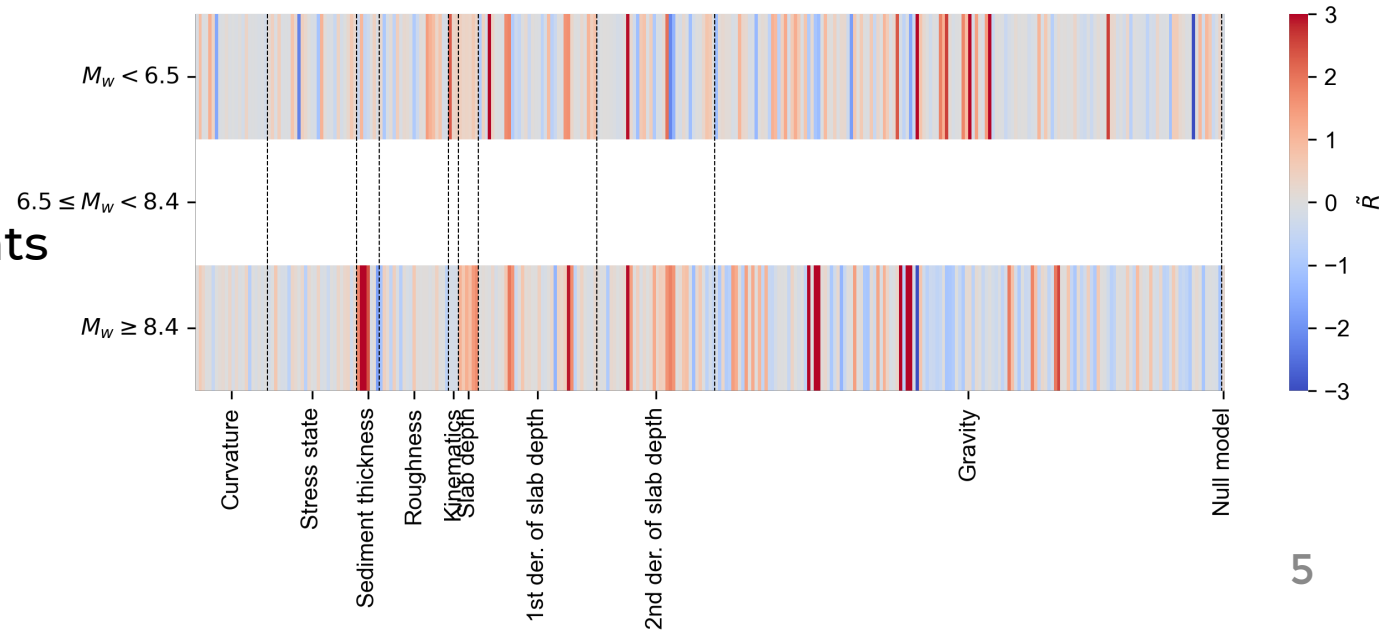


- Analyze relevance to see which geophysical data contributes the most to the network result
- Draw inferences from results

Results for Southeast Asia







- Prediction reasonably well in segments ruptured by large earthquakes
- Most features are irrelevant
- Some are highly relevant (dark red)

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Thank you for listening!