Issues in earthquake modelling

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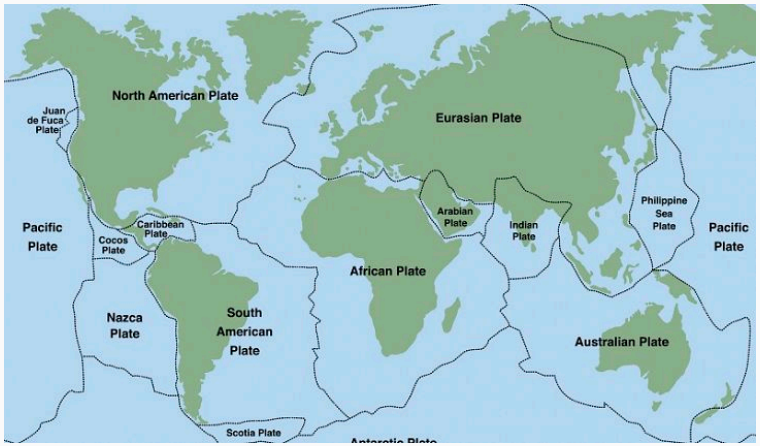
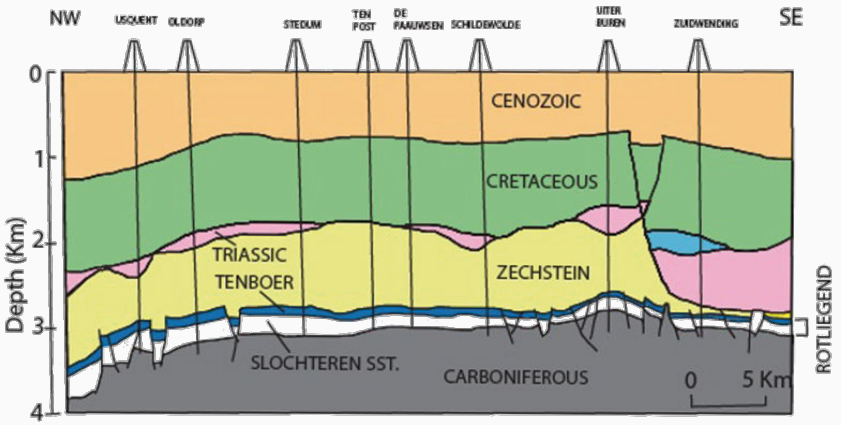
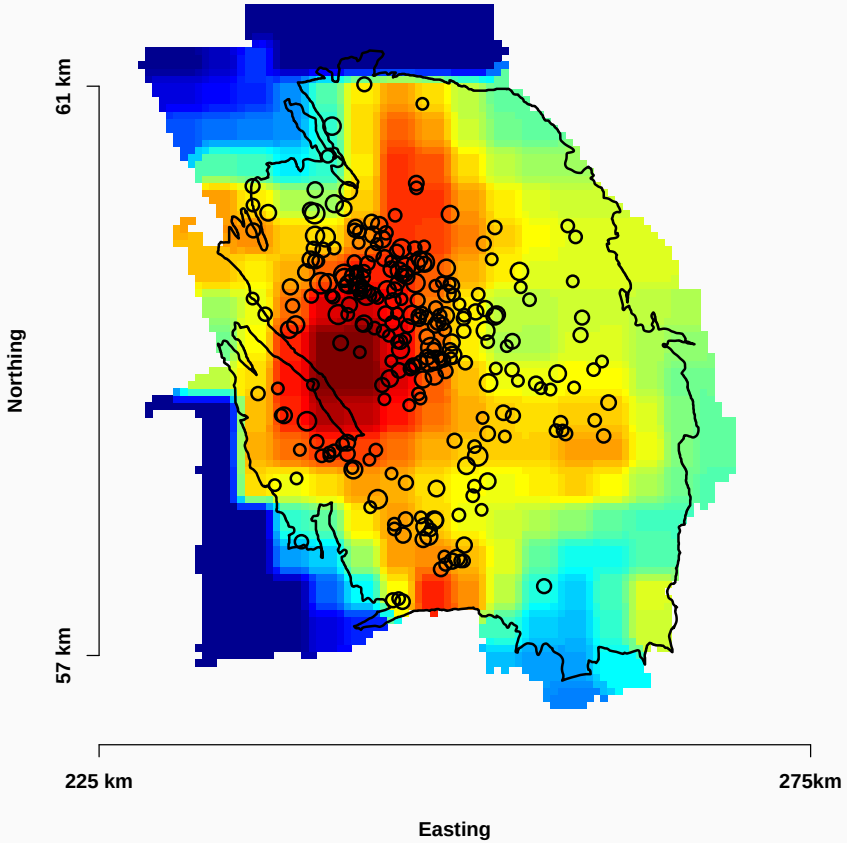




What do we want to do?

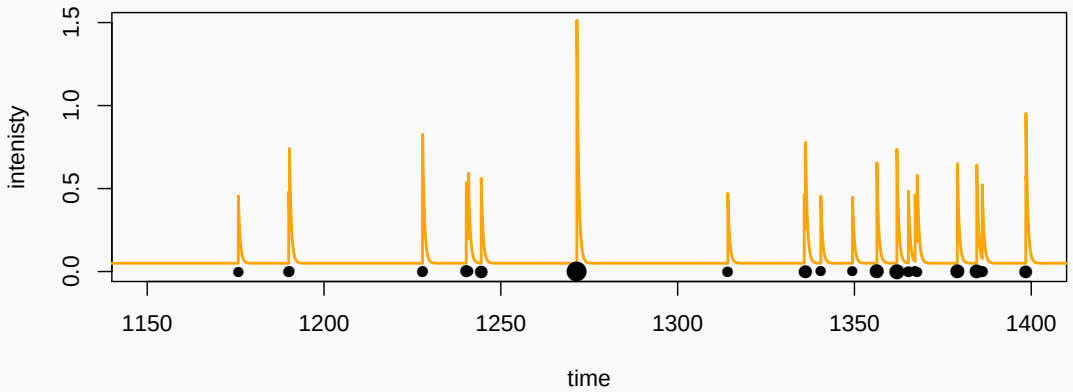
- Link gas extraction and earthquakes above the magnitude of completion.
- Investigate the possibility of aftershocks and their properties.
- Use the resulting model to forecast under different extraction scenarios.



Current approach

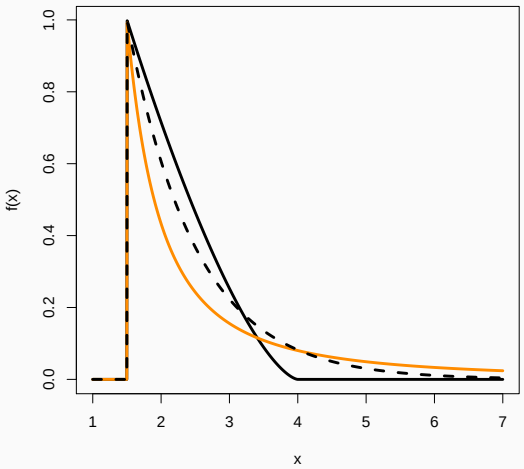
- Model earthquakes as a marked, self exciting point process.
- **Issue:** Highly correlated parameters from using empirical earthquake 'laws'.

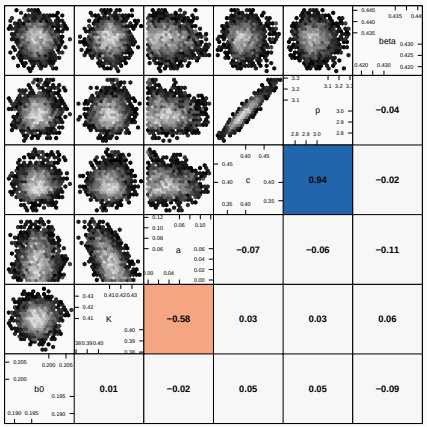
$$\underbrace{\lambda(x, t|X, \mathcal{H}_t, \theta)}_{\text{All earthquakes}} = \overbrace{\mu(x, t|X, \theta)}^{\text{Poisson mainshocks}} + \underbrace{\sum_{i:t_i<t} \kappa(m_i|\theta) g(t - t_i|\theta) h(x - x_i|\theta)}_{\text{ETAS aftershocks}} .$$

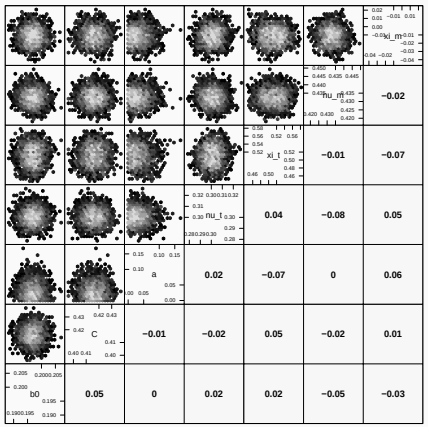


Improvements from extreme value theory

- We want flexible tail models for $g(t)$ and $h(\boldsymbol{x})$ and for magnitudes above a threshold: EVT a natural resource.
- Centre the productivity effect $\kappa(m)$ about mean magnitude.







- Model made more flexible and parameter dependence reduced.

Can you help?

- Many open statistical problems in induced seismicity.
- The current approach benefits from using ideas in EVT.
- How about other areas:
  Epidemiology, survival analysis, finance, ecology?
- Completely different approach inspired by your area?
  Any ideas very welcome!

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