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Analysis of Aftershock Parameters for the Alaskan Subduction Zone Tectonic Region

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Analysis of Aftershock Parameters for the Alaskan Subduction Zone Tectonic Region

Undergraduate Thesis

Gabrielle Paris

Thesis advisor: Richard Hugo

USGS Advisor: Andrew Michael

Terminology

- Earthquake Magnitude
 - The intensity of shaking from an earthquake.
- Earthquake Sequence
 - A large earthquake (mainshock) and the earthquakes that follow (aftershocks).
- Productivity
 - Describes whether the number of aftershocks above a given magnitude is higher or lower than expected.
- Reasenberg and Jones model
 - Rate of aftershocks of at least some magnitude, since some time after the mainshock.

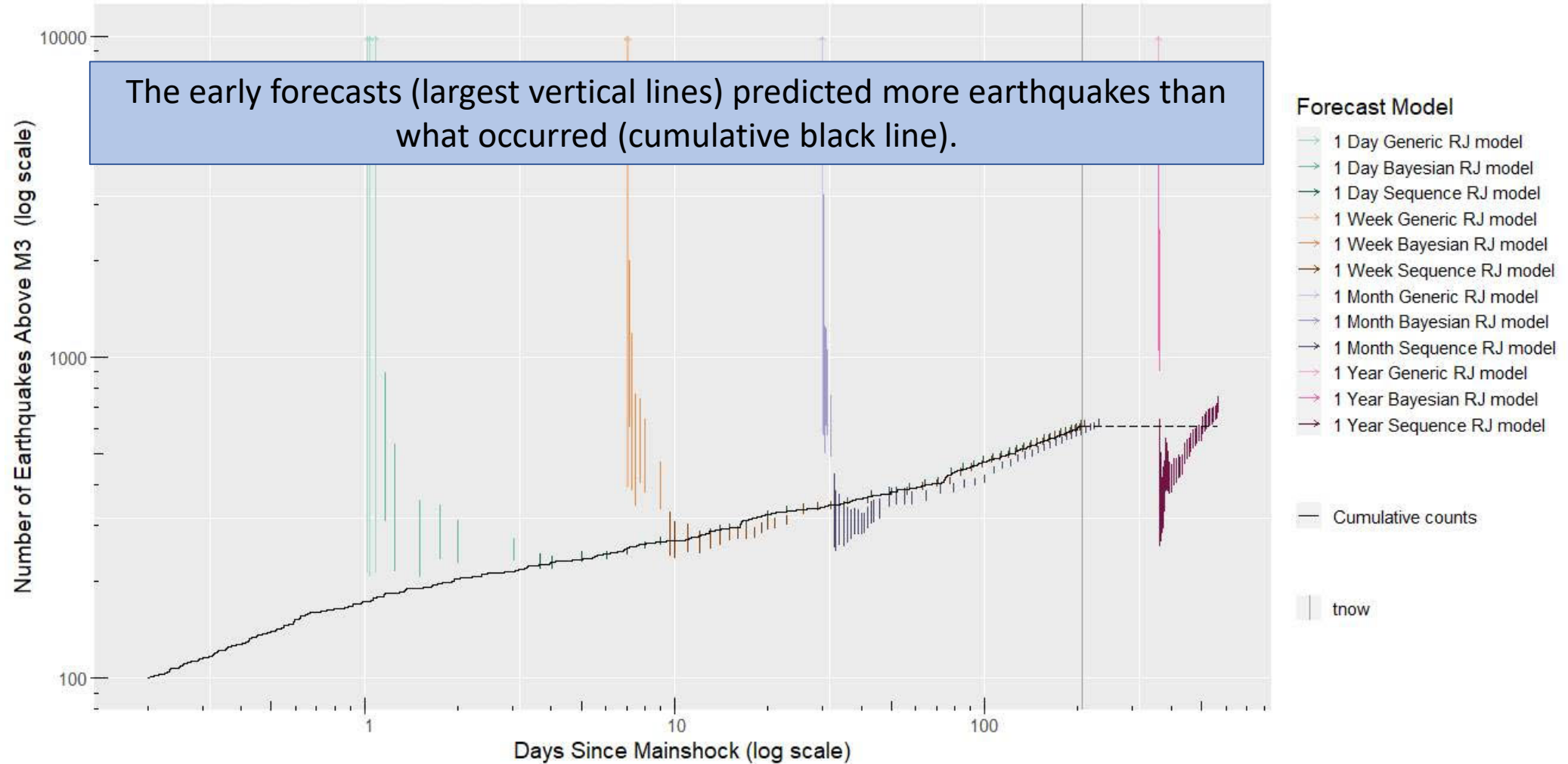
$$R = 10^{a+b(M_{\text{main}}-M)} (T + c)^{-p}$$

Initial Observations

M 8.2 - 99 km SE of Perryville, Alaska (2021-07-29 06:15:49.19 UTC)

ID: ak0219neiszm, Days Since Mainshock: 206.692 Days

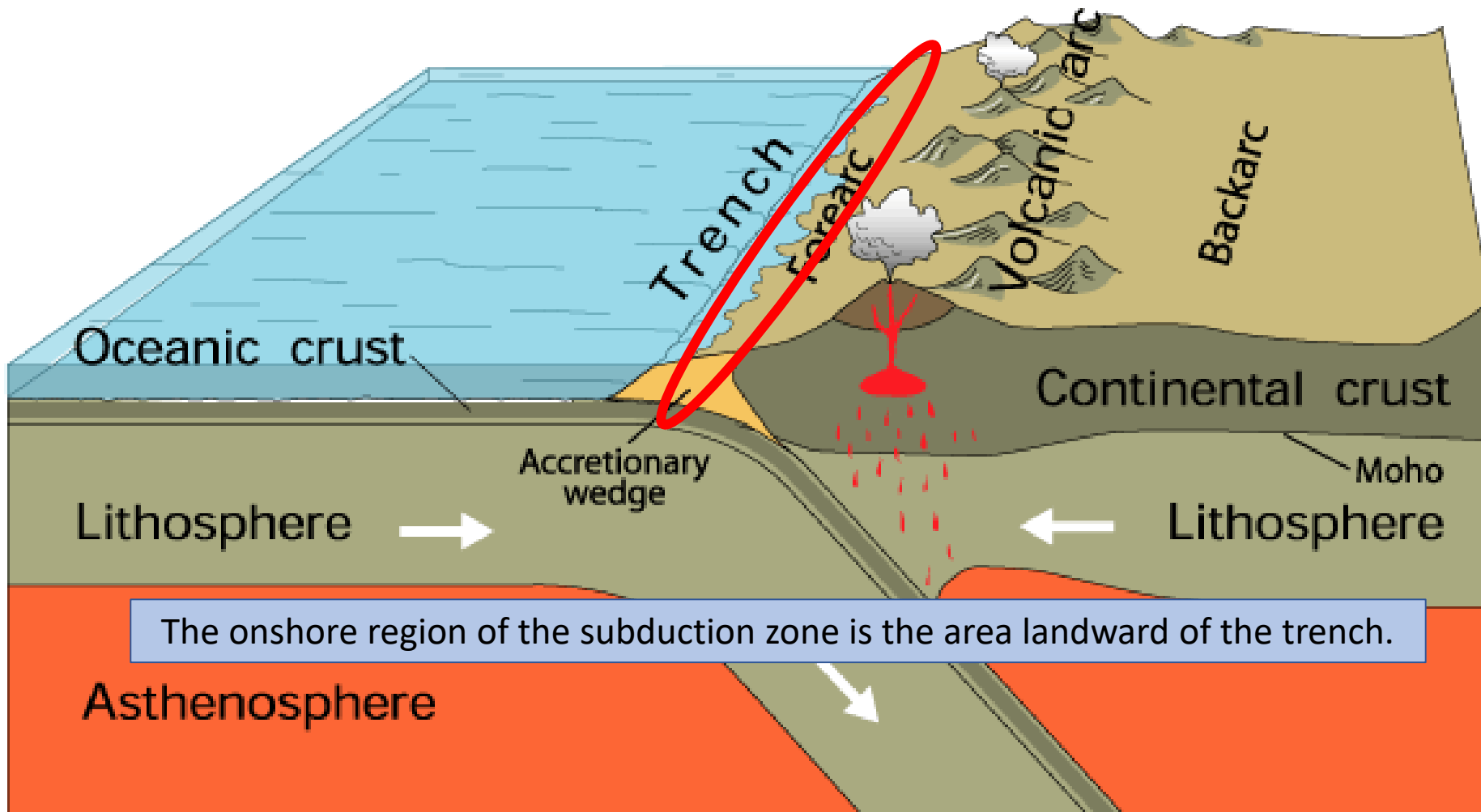
Time of ComCat Query: 2022-02-20 22:52:34 UTC



Are the generic parameters used in aftershock forecasting accurately describing the observed aftershock behavior in Alaska?

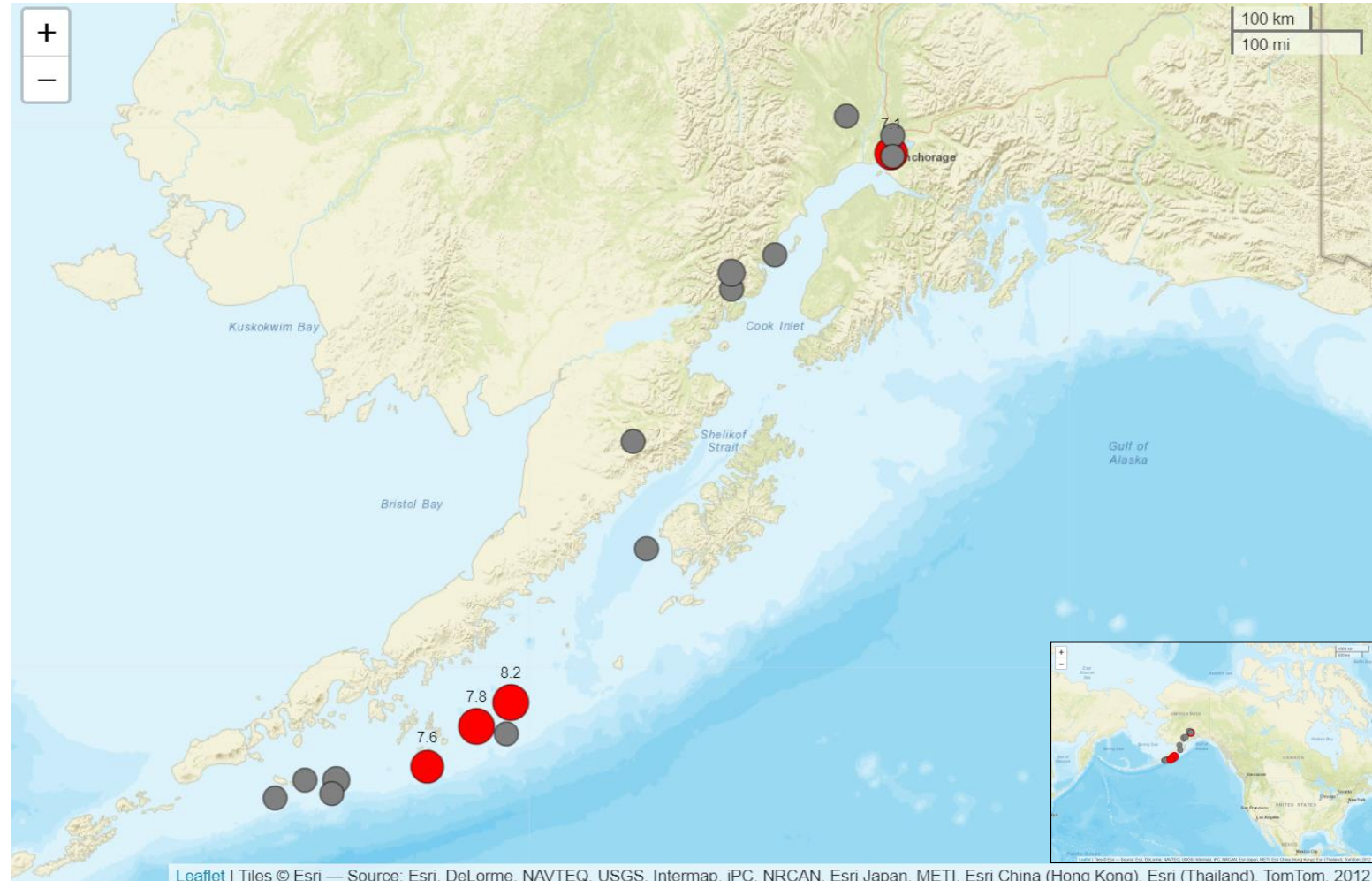
- Percentage of successful forecasts using generic parameters?
- Over-prediction in early-sequence for other events?

Crash Course Subduction Zone



The Where and What

- Onshore Subduction Zone
 - Alaska Peninsula
 - Kodiak Island
 - Southern Alaska
- 17 sequences
 - 2021 M8.2 Chignik
 - 2020 M7.6 Sand Point
 - 2020 M7.8 Simeonof
 - 2018 M7.1 Anchorage
 - Various M5-M6



Percentage of Successful Forecasts?

Well... pretty successful

M7.8

M5.3

Mag	1 Day	1 Week	1 Month	1 Year	Mag	1 Day	1 Week	1 Month	1 Year
3	54% (7/13)	23% (3/13)	62% (8/13)	100% (13/13)	3	100% (19/19)	100% (19/19)	100% (19/19)	100% (15/15)
4	100% (13/13)	100% (13/13)	100% (13/13)	100% (13/13)	4	100% (19/19)	100% (19/19)	100% (19/19)	100% (15/15)
5	100% (13/13)	100% (13/13)	100% (13/13)	100% (13/13)	5	100% (19/19)	100% (19/19)	100% (19/19)	100% (15/15)
6	100% (13/13)	100% (13/13)	100% (13/13)	100% (13/13)	6	100% (19/19)	100% (19/19)	100% (19/19)	100% (15/15)
7	100% (13/13)	100% (13/13)	100% (13/13)	100% (13/13)	7	100% (19/19)	100% (19/19)	100% (19/19)	100% (15/15)

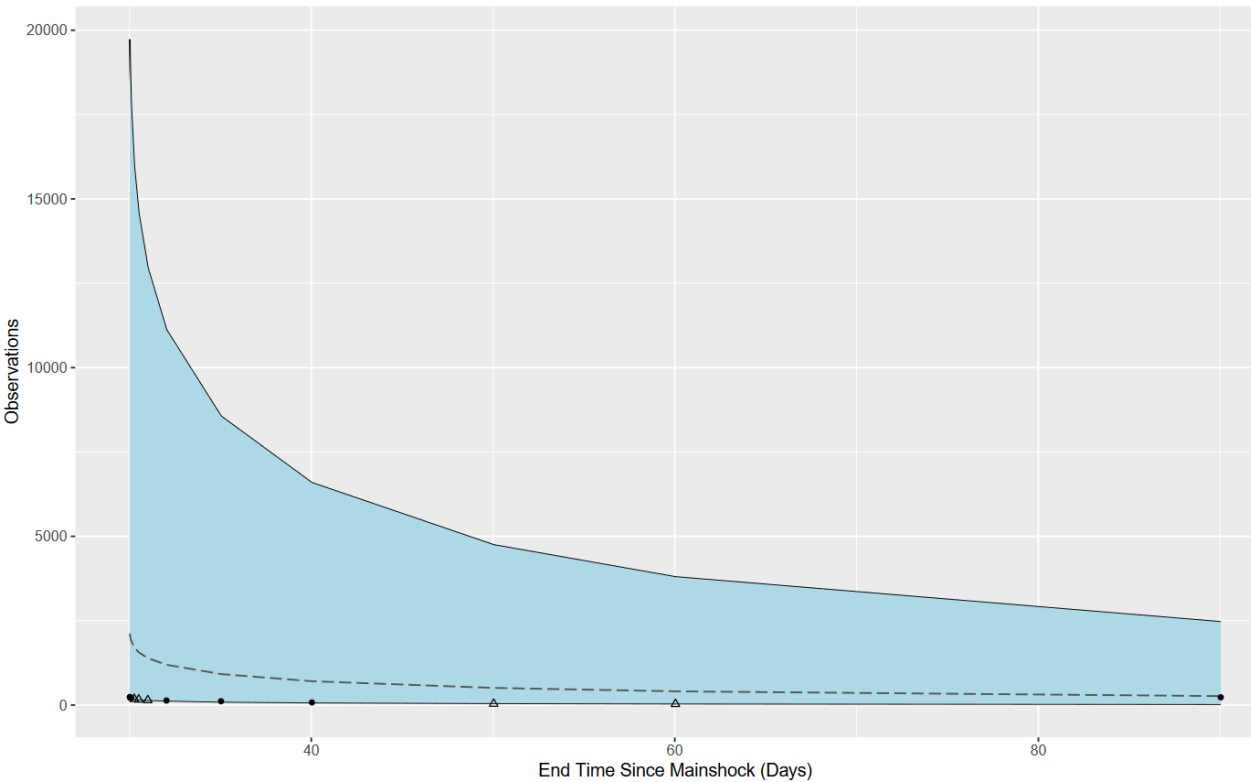
Variation in Observations

The observations, while within the 95% confidence interval (blue, capped by black lines), are consistently on the lower side of the distribution's median (dashed line).

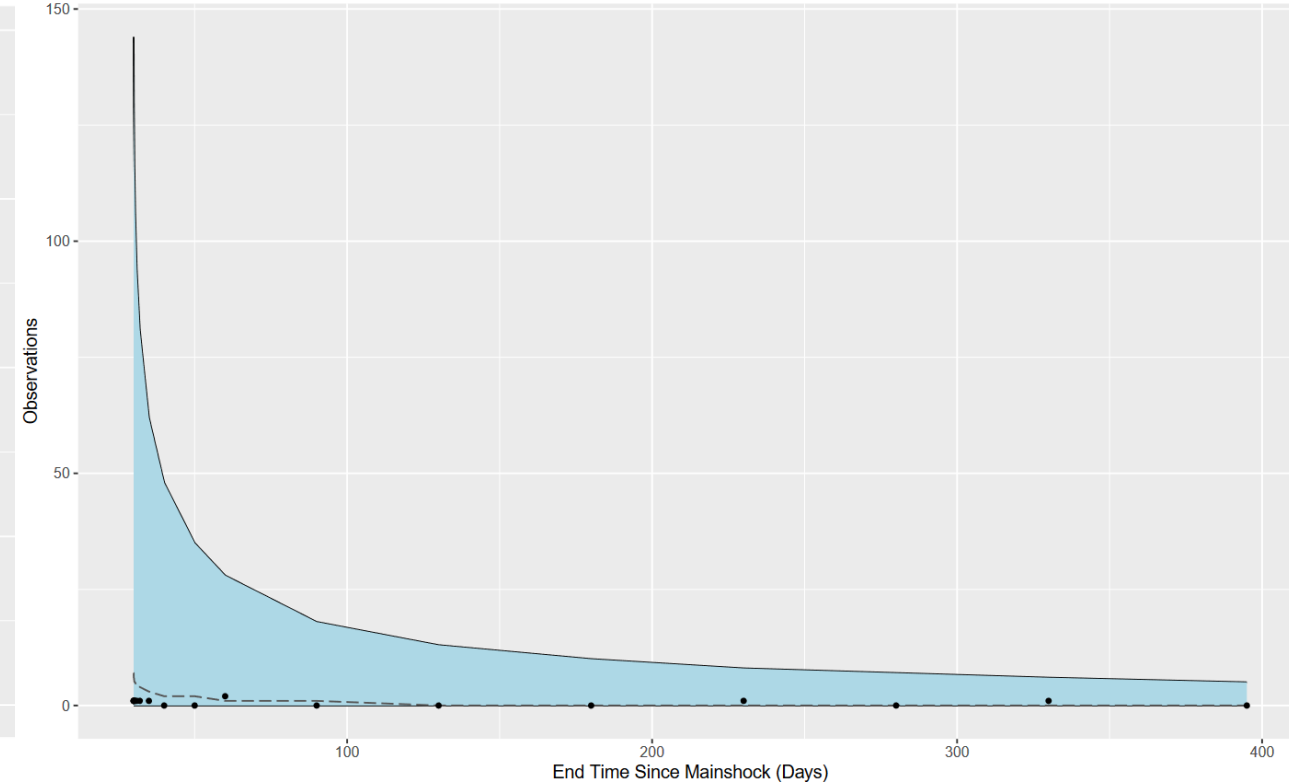
M7.8

M5.3

1 Month forecast for events above M3, Sequence: us7000asvb (Mmain: 7.8)



1 Month forecast for events above M3, Sequence: ak0212o88mof (Mmain: 5.3)



Solid circles indicate the observations lie within the confidence interval and open triangles indicate the observations lie outside the confidence interval

Closing Remarks

- The forecasts, while largely successful, are overpredicting the number of earthquakes
- Future work:
 - Calculate new forecast parameters
 - Generalize code for future use by the USGS