The global statistical distribution of time intervals between consecutive earthquakes

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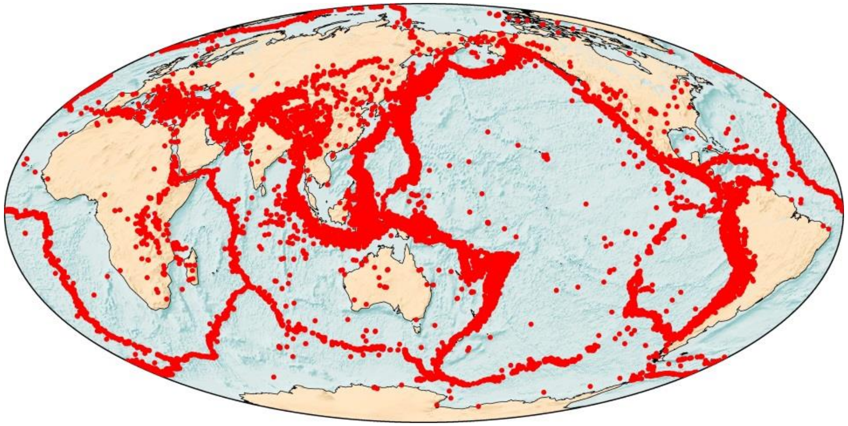
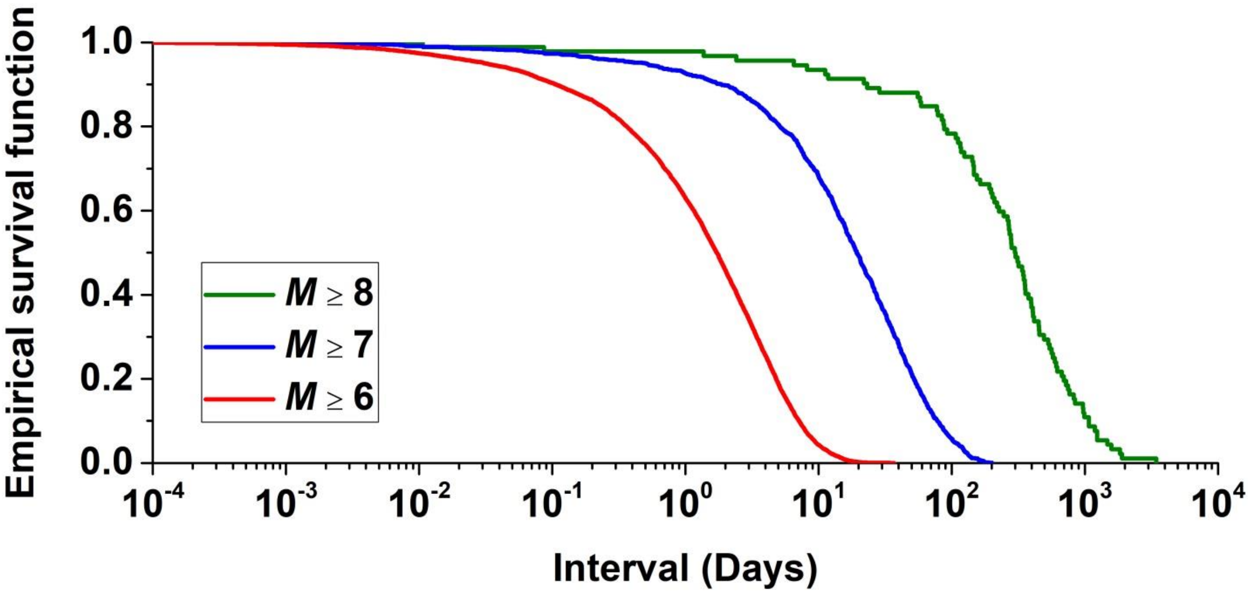




Goals:

- Which statistical distribution best fits the data?
- Is there a universal distribution?
- Can Poissonian occurrence be rejected for the whole series of the largest earthquakes?

Data used:

- **ISC-GEM catalogue**
  (International Seismological Centre, 2020).

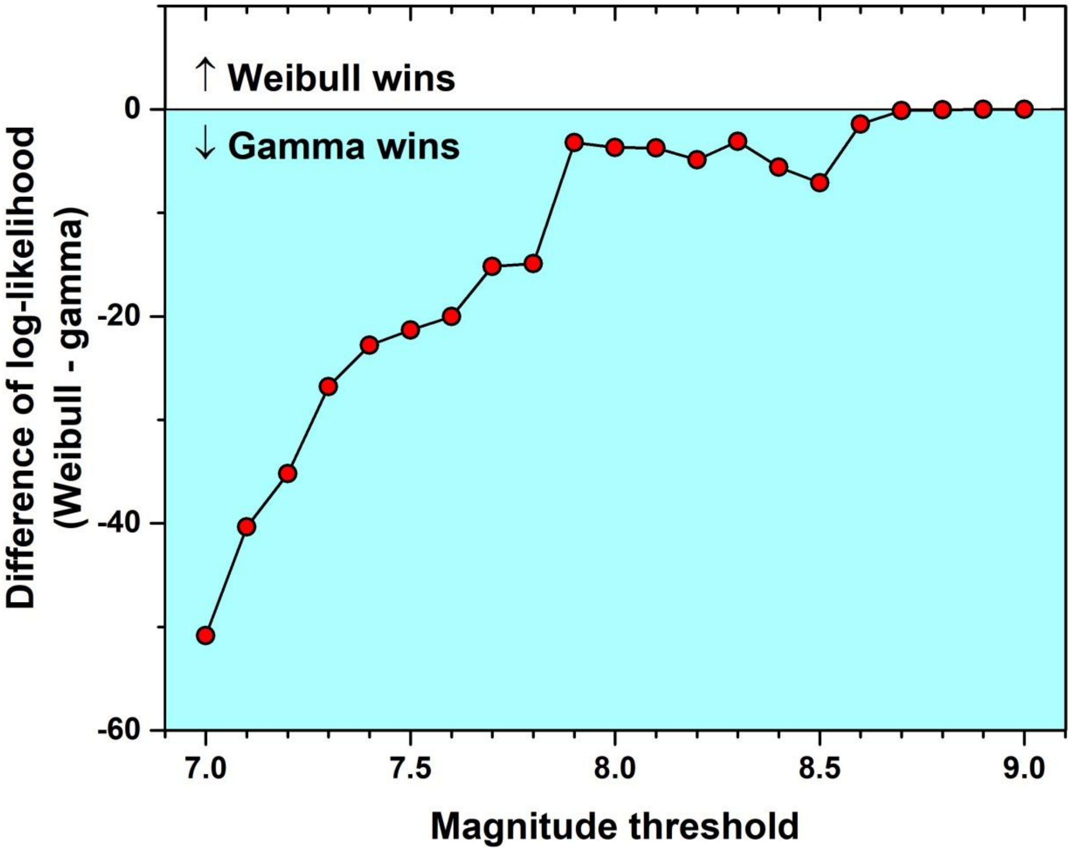
- **GCMT catalog**
  (Dziewonski *et al*., 1981; Ekström *et al*., 2012).

- **Minimum magnitude used was 5.7, but the completeness thresholds were taken into account (Di Giacomo *et al*., 2018).**

Phylosophy:

- **The catalogues were not declustered.**
- **No attempt to distinguish mainshocks, aftershocks or foreshocks beforehand.**
- **Different magnitude thresholds were considered** (similarly to Moriña *et al*., 2019).

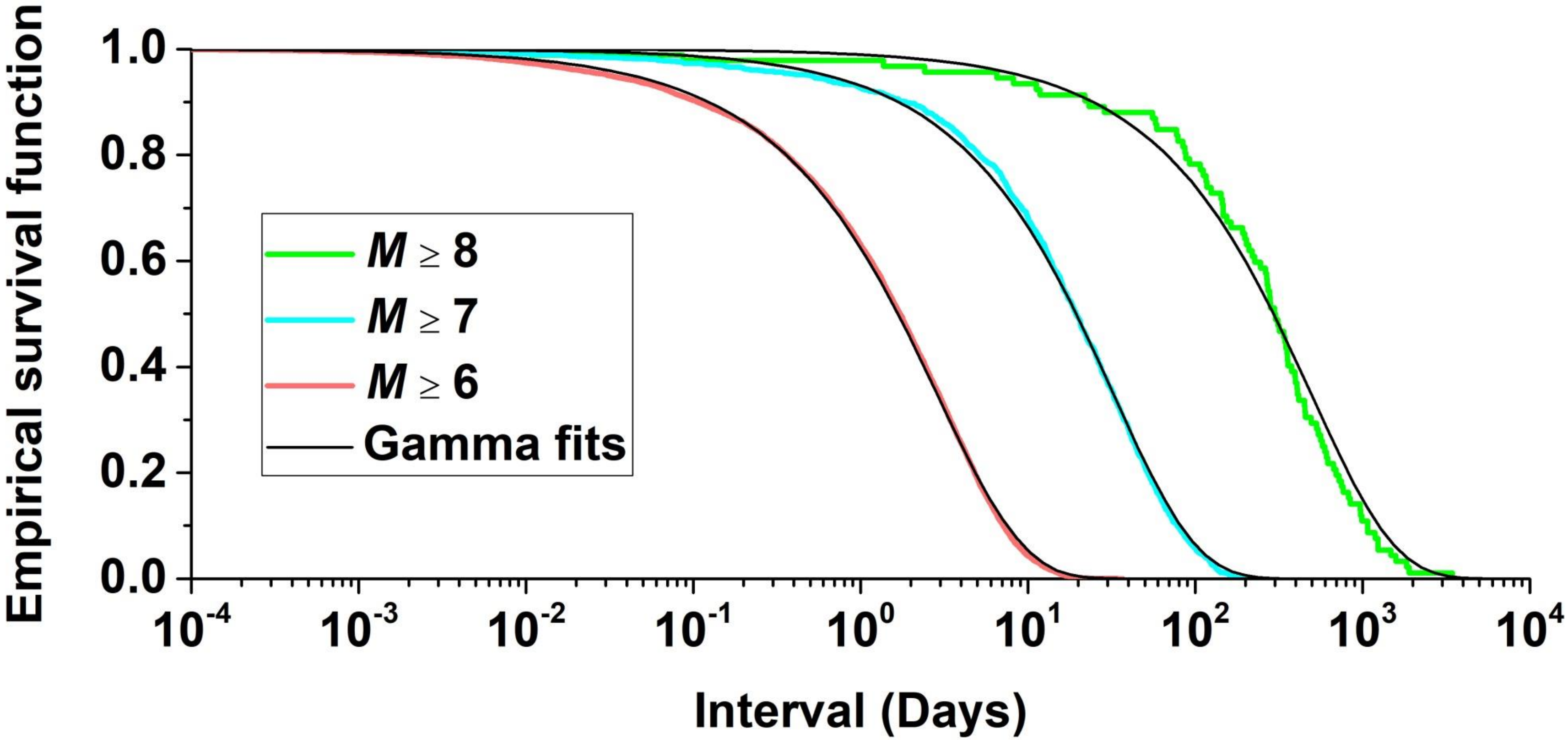
Which distribution best fits the data?



Gamma (which is a power law with an exponential tail for long intervals) provides a good fit. Already suggested by Corral (2004).

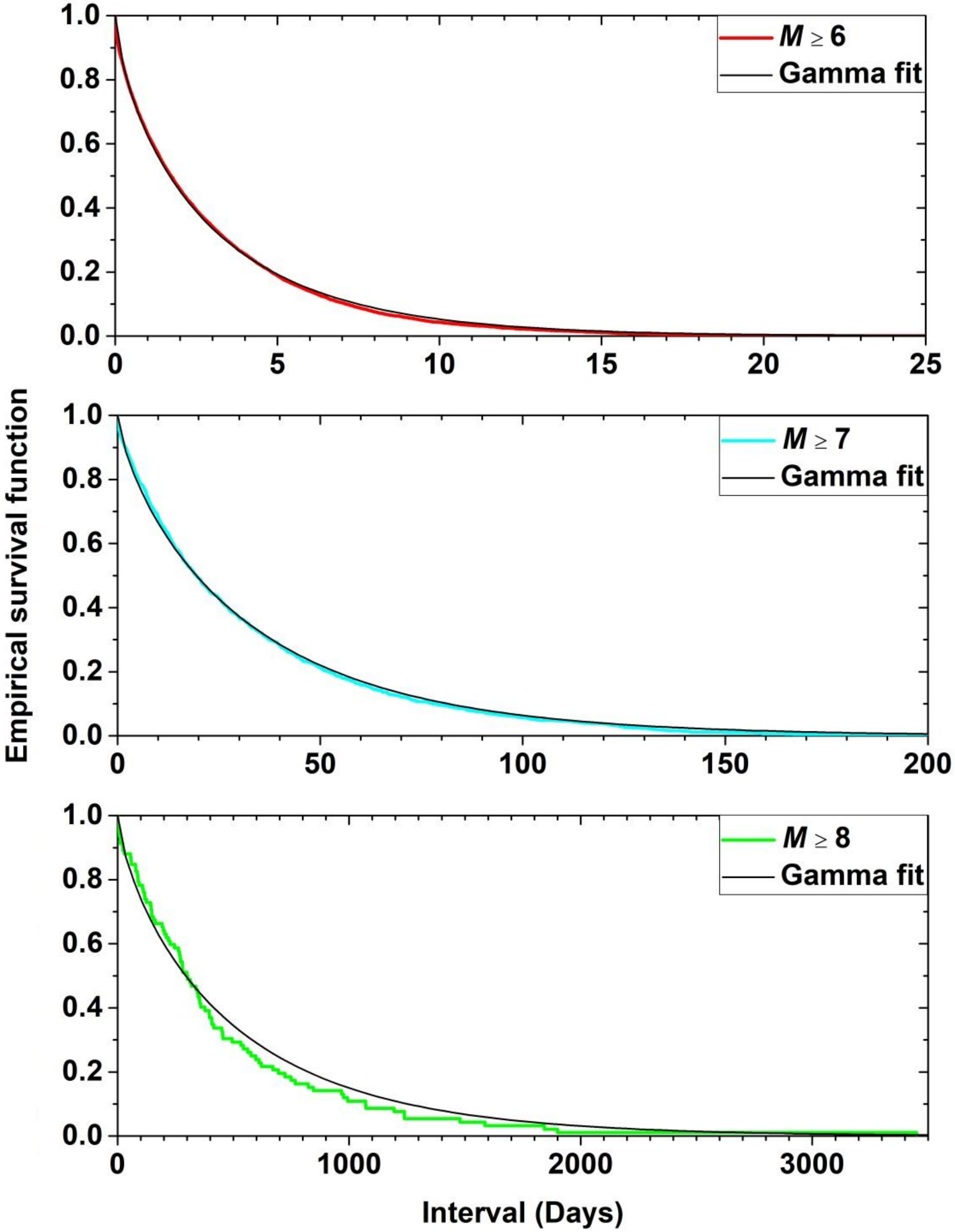
Weibull (advocated e.g. by Abaimov *et al.*, 2007; Hristopulos & Mouslopoulou, 2013) actually fits worse than gamma for *M* < 8.7.

Example gamma fits



- **Fits by maximum likelihood (two parameters).**
- **Similar shape parameters (perhaps universal).**
- **Different scale parameters, due to the higher frequency of smaller earthquakes (implying shorter intervals).**

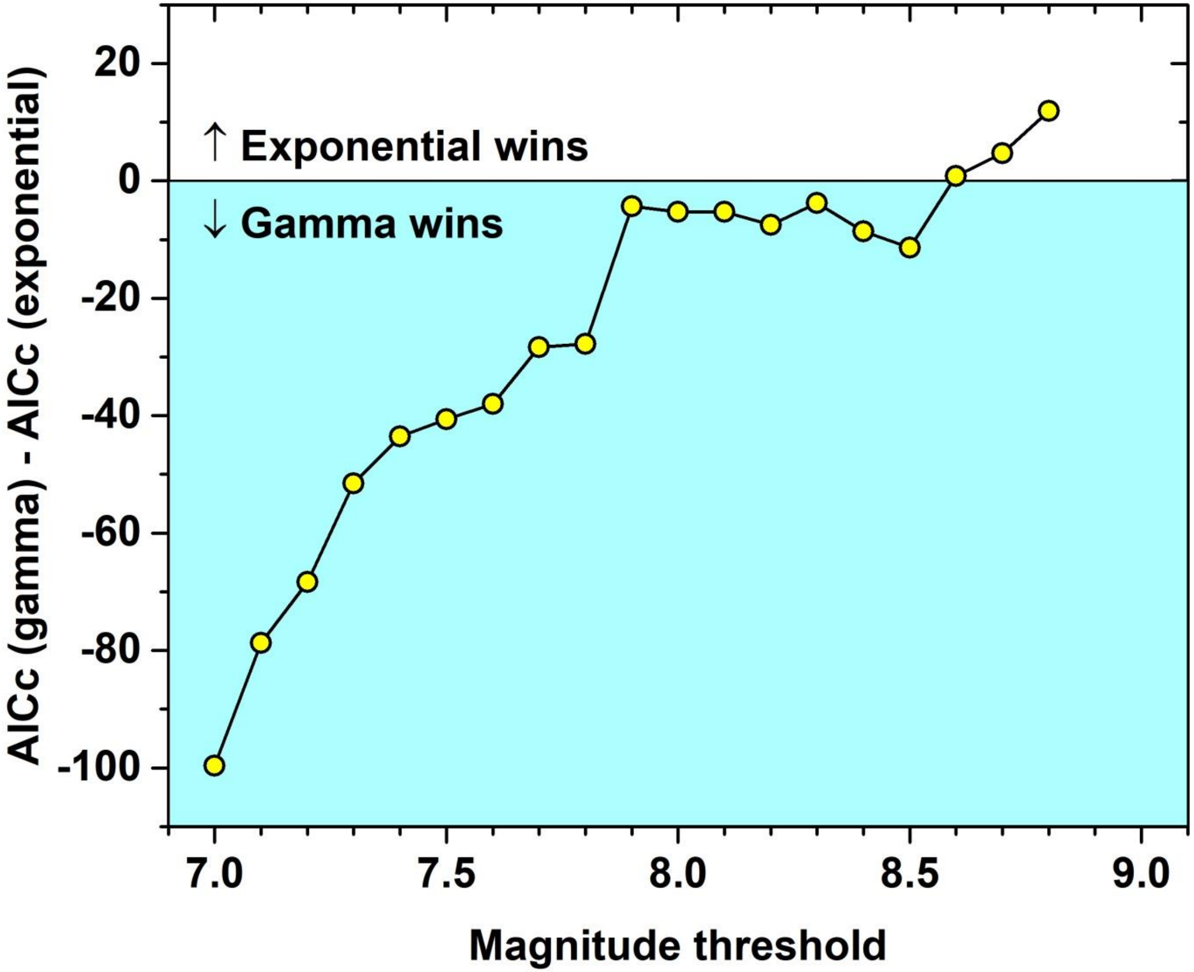
Example gamma fits



Despite the fits are reasonably good, there are systematic departures from the observations.

For example, the fits tend to overestimate the frequency of the longest intervals.

Can Poissonian occurrence be rejected for the whole series of the largest earthquakes?



Only for $M \geq 8.6$, the exponential distribution (Poissonian recurrence) is preferred by the corrected Akaike Information Criterion.

This contradicts earlier findings (e.g. Ben-Naim *et al.*, 2013).

Conclusions and future work

- Gamma distributions with similar shape parameters provide good fits to the data for different magnitude thresholds.
- They may be used to calculate reasonable conditional probabilities of occurrence.
- But systematic departures from the observations exist, indicating the need of more complex models.
- The Weibull model can be rejected in favour of gamma.
- Recurrence is Poissonian only for the largest earthquakes ($M \geq 8.6$), but this may be the result of having very few data (8 intervals).

References cited

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