Non-Poisson models in CSEP?

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Panel discussion: Epistemic Uncertainties in CSEP

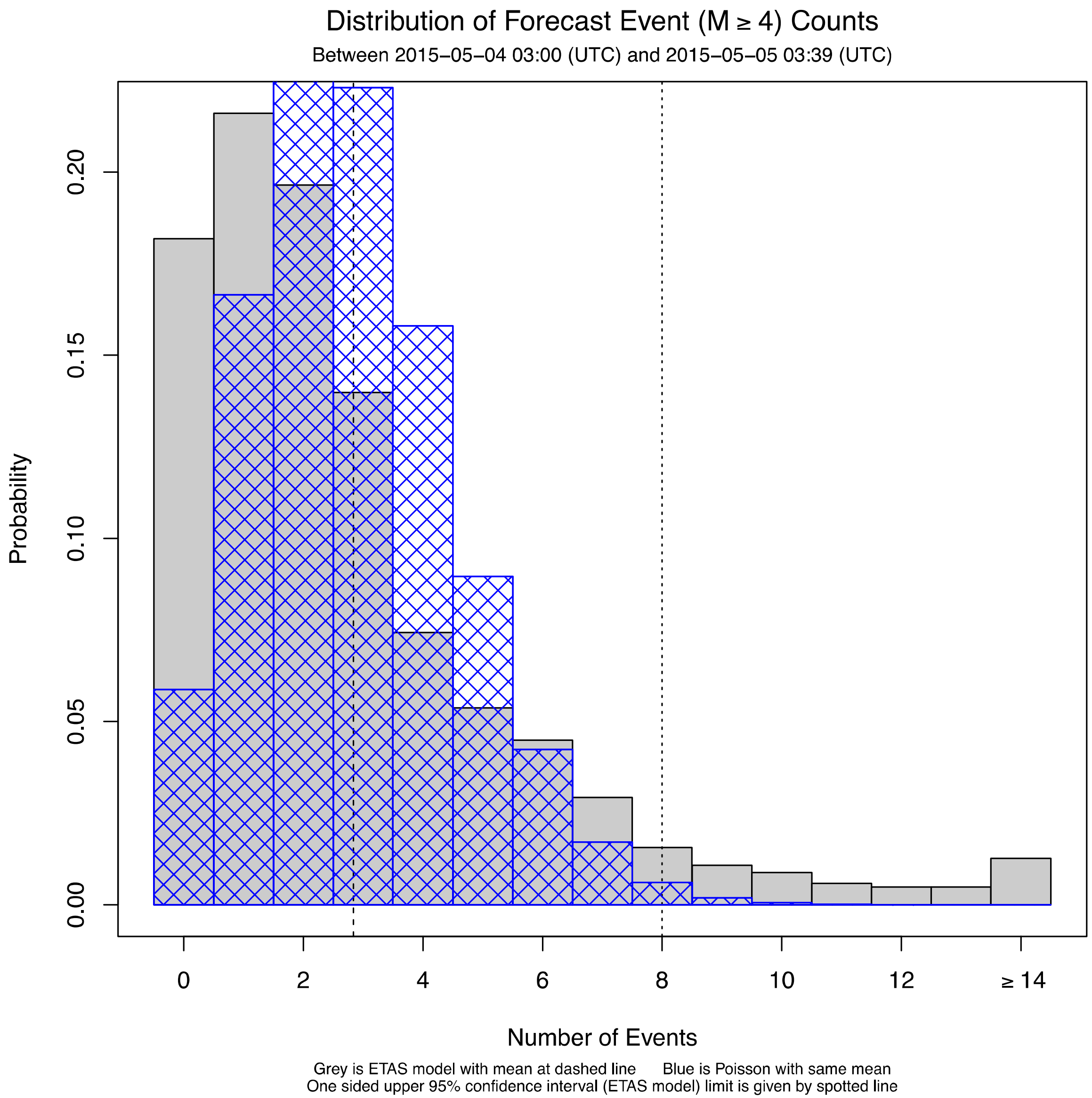
The Poisson assumption

- Earthquake occurrence does not follow the Poisson distribution, but is highly clustered in time and space.
- Poisson assumption adopted in CSEP experiments, as a way of calculating uncertainties in consistency tests, such as the N-test, conditional L-test, S-test and M-test.
- Except for the N-test, where the uncertainties are derived analytically, the testing centres use simulated catalogues based to derive uncertainties of expected number of earthquakes in each grid cell.
- Simplifies the task of the modellers: only need to estimate expected numbers of earthquakes, and not second-order quantities.

The Poisson assumption

- Accepted many as a reasonable for medium-term and long-term experiments at high high target magnitudes and relatively little clustering.
- Short-term experiments tend to have lower magnitude thresholds and much greater clustering of the target earthquakes.
- Modellers of earthquake clustering tend to regard the assumption as simply wrong.
- Consistency tests often wrongly reject ETAS models because of this assumption.

Wanaka earthquake 4th May 2015



Negative binomial distribution (NBD)

- **Demonstrated to fit better than the Poisson distribution to number of earthquakes in successive time periods**
- **Could be used to replace Poisson-based N(umber)-test in all CSEP experiments?**
- **Need to distinguish:**
  - distribution of the observed variability in the number of earthquakes between time periods, from the
  - conditional distribution of uncertainty in the number of earthquakes given a model.
- **Second parameter of NBD would be supplied by modellers.**
- **Not useful for other consistency tests.**

Proposed pilot experiment

- New model class to be set up in the New Zealand testing centre to accept models that are explicitly non Poisson.
- Harte ETAS model would be submitted to this class.
- Models will provide a program to calculate the usual grid forecast (specifying the expected number of earthquakes within magnitude bins for each spatial grid cell), as well as numerous simulated catalogues conforming to the model.
- The simulated catalogues hold information on the distribution of the expected number statistics and also on the joint distribution of expected numbers in different grid cells.
- Model-supplied simulated catalogues will replace testing centre-generated catalogues in the consistency tests.

Efficiency of Catalogue generation

- **Generation of ETAS simulated catalogues is usually quite efficient.**
- **Occasionally the number of earthquakes blows out, especially for high M_{max} and low b-value.**
- **Some modellers already use simulated catalogues to generate the grid cell expectations in CSEP experiments.**
- **Concern that occasional blowing out of the number of earthquakes will make heavy demands on CSEP's computing resources.**

Fixes for simulation blow out

- Limit M_{max} for catalogue simulation. E.g., M_{max} = 8.05, which is larger than any earthquake in the GeoNet instrumental earthquake catalogue.
- Grid forecasts would not need to be restricted to the same M_{max}.
- If an earthquake larger than M_{max} occurs (about once per century!), the daily forecast would restart from immediately after that event.

OR

- Set a computing time limit for the generation of daily simulated forecasts by any model.

CSEP Resource Requirements

- **Masha's time for:**
  - Modification of the CSEP testing code to allow simulated catalogues generated by the model instead of those generated by the testing centre.
  - Programming of new consistency tests.
- **Possible additional computing time.**