Panel discussion:

How should global experiments be conducted?
How can CSEP's testing methodology be improved?

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Issues for Global experiments

- Opportunity to test forecasting models with high target magnitude threshold, i.e., on events that really matter.
- Difficulty of fitting models to relatively aseismic intra-plate regions.
- Although computer resources are cheap nowadays, having a huge number of cells still creates problems.
- Is it necessary to test at high resolution?
- Is it necessary to treat plate boundary and intra-plate regions with the same resolution?
- Polar regions are over-represented if cells sizes measured in degrees.

Improved test methods?

- Present tests are almost all inefficient, or inefficiently implemented in CSEP – this matters for global experiments.
- Efficient alternatives exist for (nearly) all existing tests.
- High-precision computer-intensive testing not warranted while models have low information gains.
- Abolish simulated catalogues.
- Use standard large sample approximations (central limit theorem).
- As forecasts are computed: create and update histograms of cell rates; update total number of expected events; and extract rates for target earthquakes; to use in testing.

Improved test methods (cont.)

- Think of the grid as a framework for approximating the (continuous) earthquake rate density – not as a set of bins in which to estimate the expected number of earthquakes, i.e., produce forecasts of average rate within each bin.
- Then use point-process log likelihood.
- Then nuisance terms in log likelihood vanish, along with most objections to Poisson assumption, and consistency tests (L, S, etc), will be less sensitive to cell size.
- Relative likelihood of models, i.e., information gain, is unaffected by this change of viewpoint.
- Event-based testing would also reduce objections to Poisson assumption.
- Potential contribution to a hybrid model is as important as consistency and information gain.

CSEP Global Model Test Proposal
Dave Jackson, UCLA

Modeling Parameters

1. 0.1 by 0.1 degree global coverage (6,480,000 cells)
2. Yearly evaluation
3. Magnitude thresholds 5.5, 6.0, 6.5, 7.0, 7.5, 8.0
4. Shallow (<70 km) only
5. No distinction between fore-, main-, or aftershocks
6. GCMT catalog
7. Provide binary mask for regions where forecast not supported by data.

Testing methods

1. N-test for whole earth only; modeler supplies p(n) for year
2. Normalize cell rates to 1.0; result is probability that single event would land in given cell.
3. Specificity I0 = sum of p(j) log2 p(j) over all cells; measured in bits of info relative to spatially uniform model. Reference: Kagan, 2009
4. Info gain I1 from Kagan 2009
5. Use only the observed catalog in testing. No randomization to include uncertainties.
6. For comparing models, use only cells not blocked by either model.

Comments

1. No need for L test, which depends on number of events as well as their locations
2. Simulations can be made based only on p(j); no need for lats, lons, magnitudes.
3. Would have separate forecasts (p(j)) for different magnitude thresholds, although they would be identical (except for p(n)) for globally uniform magnitude distribution
4. Because grid is rectangular matrix, quakes can be assigned to grid points first by latitude (row), then by longitude (column) ; two 1-D computations instead of one 2-D computation.
5. How to deal with forecast uncertainty is issue. For now, I recommend binary mask: yes or no to count cell in test.