Using a Monte Carlo event-order model to compare spatio-temporal eruption forecasts in a monogenetic volcanic field

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Many spatio-temporal models have been proposed for forecasting the location and timing of the next eruption in a monogenetic volcanic field. These have almost invariably been fitted retrospectively. That is, the model has been tuned to all of the data, and hence an assessment of the goodness of fit has not been carried out on independent data. The low rate of eruptions in monogenetic fields means that there is not the opportunity to carry out a purely prospective test, as thousands of years would be required to accumulate the necessary data. This leaves open the possibility of a retrospective sequential test, where the parameters are calculated only on the basis of prior events and the resulting forecast compared statistically with the location and time of the next eruption. In general, events in volcanic fields are not dated with sufficient accuracy and precision to pursue this line of investigation; An exception is the Auckland Volcanic Field (New Zealand), consisting of c. 50 centers formed during the last c. 250,000 years, for which an age-order model exists in the form of a Monte Carlo sampling algorithm, facilitating repeated sequential testing. I examine a suite of spatial, temporal and spatio-temporal hazard models, comparing the degree of fit, and attempt to draw lessons from how and where each model is particularly successful or unsuccessful. It is found that a relatively simple (independent) combination of a renewal model (temporal term) and a spatially uniform ellipse (spatial term) performs as well as any other model. Both avoid over fitting the data, and hence large errors, when the spatiotemporal occurrence pattern changes.