Assessing probabilistic forecasts of volcanic eruption onsets

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A method for assessing prospectively the quality of a suite of eruption forecasts is proposed. Any forecast of the likely timing of the next eruption onset from a polygenetic volcano can be converted into a probability distribution F(t)=Prob(T $\leq$ t), where T is the time of the onset, and s <t <∞, for some time s at which the forecast is made. Since 0 $\leq$ F(t) $\leq$ 1, if this *conditional repose distribution* is accurate, a series of realizations, which may be on the same or different volcanoes, should produce an IID sample F_1 = F(T_1), F_2,... which has a uniform (0,1) distribution. Hence, given sufficient trials, we can use standard statistical tests, such as the Kolmogorov-Smirnov test, to determine if the forecasts are consistent with the model(s). The use of the Kolmogorov-Smirnov test enables currently open forecasts to be included via the Kaplan-Meier product limit estimator. While consistent (under-) over-estimates of the repose length will result in a median (greater) less than 0.5, the method also assesses whether the method assigns the correct degree of aleatory variability to the forecast. Note that it is possible for the forecasts to be more accurate than claimed. This would be indicated by the median of the sample being around 0.5, but the quartiles being within the (0.25,0.75) interval, for example. The method is illustrated on the author´s library of forecasts dating back 18 years, including renewal models and other point processes, on a gallery of approximately 20 volcanoes including Etna, Aso and Ruapehu.