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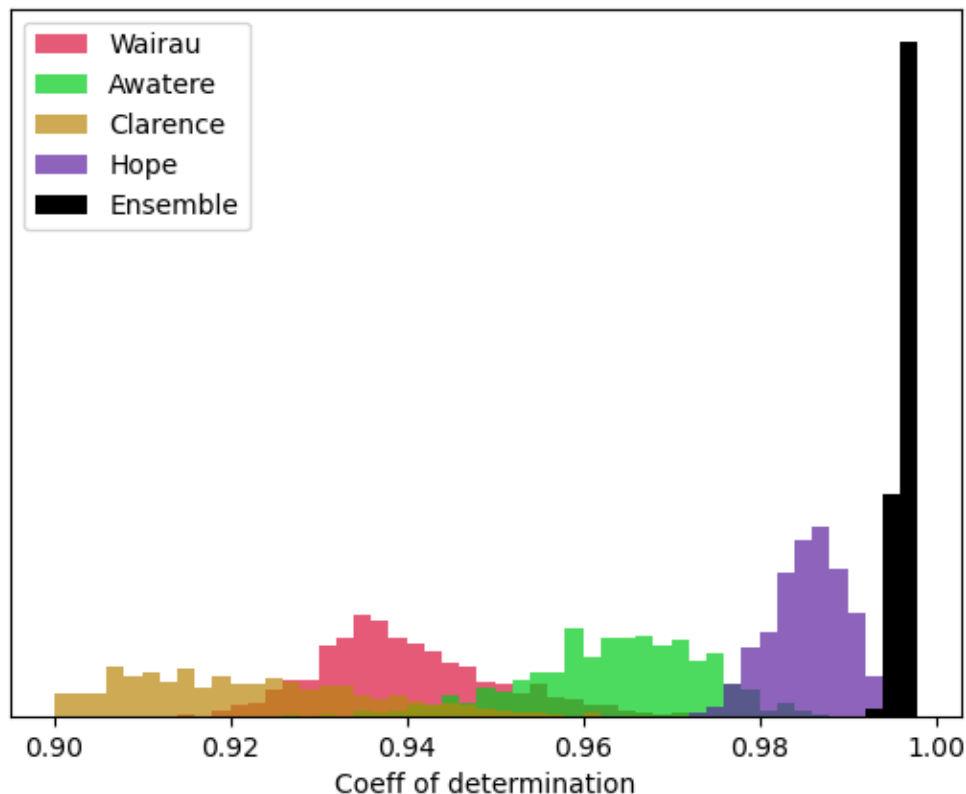


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Supplementary Information 2 – Statistical tests of the relative variability of the incremental slip rate records for each of the four main Marlborough system faults relative to the variability for the ensemble, system-level rate

We test whether the displacement-time ($d-t$) history of the ensemble of all four faults is more constant in time than that of any individual fault. To do this, we compute the coefficient of determination (R^2 statistic) for each of 1,000 randomly sampled $d-t$ paths shown in main text Figure 5. The R^2 value is a measure of how well a series of observations are predicted by a model, which in this case is a linear model in $d-t$ space indicating a constant slip rate. Higher R^2 values indicate less deviation from a straight line fit, and therefore a more constant slip rate.

The results, categorized by individual fault and ensemble, are illustrated below. Each histogram shows the R^2 values for the set of samples indicated. The ensemble of all four fault histories is significantly more linear in time and is therefore described by a more constant rate than any individual fault.



Histograms of the coefficient of determination (R^2 value) for 1,000 sampled displacement-time paths of each fault (red, green, umber, purple), and the summed ensemble history (black). The R^2 value is a measure of how well a series of observations are predicted by a linear model. Values closer to 1.0 indicate a more linear relationship between displacement and time, i.e., a more regular slip rate. The R^2 values for the displacement-time realizations shown above indicate that, for nearly all plausible displacement-time paths, the ensemble history is significantly more linear in time, and therefore had a more constant slip rate than any of the constituent faults.