Magnitude-Frequency Characteristics of Seismicity Detected Using Template Correlation: Implications for Geographically and Geometrically Restricted Fault Source Scaling

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The magnitudes of earthquakes detected using matched filters and other correlation-based methods commonly exhibit the power-law scaling relationships characteristic of seismicity in general. In particular, microearthquakes detected by individual templates in a variety of tectonic settings typically have Gutenberg-Richter magnitude-frequency characteristics with exponents of ~1 that are similar to those of conventional seismicity catalogues representing much larger crustal volumes and diverse focal mechanisms. In this presentation, we show examples of Gutenberg-Richter magnitude-frequency distributions for microearthquakes detected using individual templates in tectonically different parts of New Zealand (Taupo Volcanic Zone, central Alpine Fault, Southern Lakes) using magnitudes calculated using singular value decomposition. By design, the earthquakes detected by correlation with a specific template must produce similar waveforms to the template at multiple stations. Consequently, they must have similar hypocenters and focal mechanisms, and this implies that the observed magnitude-frequency scaling of earthquakes detected with individual templates must pertain to a geographically (x, y, z) and, importantly, a geometrically (ϕ, δ, λ) restricted set of sources. By characterizing the magnitude-frequency characteristics of microearthquakes detected by specific templates, controls on earthquake scaling can be studied in increasing detail on individual faults without contamination from adjacent structures.

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