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The Gutenberg-Richter law based on rupture dynamics

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Earthquakes recorded by instruments obey the Gutenberg-Richter law, which expresses the dependence of earthquake frequency on magnitude. The Gutenberg-Richter law reveals the physics of earthquake sources and is important for analyzing the seismicity of active fault systems and vulnerable areas. Based on rupture dynamics, for the first time, we obtain a power-law distribution for the relationship between earthquake frequency and magnitude. The weight of an earthquake relies on its rupture area and recurrence interval. Our derived frequency-magnitude distribution agrees with the Gutenberg-Richter law, which is summarized from global and regional earthquake catalogs. This work provides a new way to understand the Gutenberg-Richter law and the physics of earthquake sources.