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Predicting Strong Ground Motion from Weak Ground Motion (Beno Gutenberg Medal Lecture)

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Predicting strong ground motion from future earthquakes is among the most important research topics in seismology. Typically, seismologists do this through ground motion prediction equations that express relationships between earthquake characteristics and ground motion intensity. In some locations (e.g., Cascadia) there is relatively little data to constrain these relationships. For all areas there is the problem that there are few records of ground motion available close to large earthquakes. As a result, seismologists are increasingly turning to simulations to compensate for this lack of data, but validating the accuracy of these simulations is critically important. In this talk I present two new approaches for strong ground motion prediction. Both methods rely on data that is approximately one million times weaker in amplitude than the strong ground motion of interest. The first method uses the recently discovered phenomenon of tectonic tremor to constrain the amplitude decay with distance of seismic waves in subduction zones. The abundant data represented by tremor should allow us to explore the variability of ground motion with distance both regionally, and between different subduction zones. The second method uses the ambient seismic field to construct virtual earthquakes that predict spatial variations in long period strong ground motion for scenario earthquakes.