Random Focusing in Complex Media - Can we Forecast Tsunamis?

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Wave flows propagating through weakly scattering disordered media exhibit random focusing and branching of the flow as universal phenomena. Examples are found on many scales from ballistic electron flow in semiconductor nanostructures [1, 2, 3, 4] to tsunamis traveling through the oceans. Even for very weak disorder in the medium, this effect can lead to extremely strong fluctuations in the wave intensity and to heavy-tailed distributions [4]. Besides statistically characterizing random caustics and extreme events by deriving scaling laws and relevant distribution functions we have recently studied the role of random focusing in the propagation of tsunami waves [5]. We model the system by linearized shallow water wave equations with random bathymetries to account for complex height fluctuations of the ocean floor and determine the typical propagation distance at which the strongest wave fluctuations occur as a function of the statistical properties of the bathymetry. Our results have important implications for the feasibility of accurate tsunami forecasts.

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