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A new model of pump noise in supercontinuum and rogue wave generation is presented. Simulations are compared with experiments and show that the new model provides significantly better agreement than the currently ubiquitously used one-photon-per-mode model. The new model also allows for a study of the influence of the pump spectral line width on the spectral broadening mechanisms. Specifically, it is found that for four-wave mixing (FWM) a narrow spectral line width (0.1 nm) initially leads to a build-up of FWM from quantum noise, whereas a broad spectral line width (1 nm) initially leads to a gradual broadening of the pump spectrum. Since the new model provides better agreement with experiments and is still simple to implement, it is particularly important that it is used for future studies of the statistical properties of nonlinear spectral broadening, such as the formation of rogue waves.

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