Wallace B Thoreson, Matthew J Van Hook, Caitlyn M Parmelee* (s-cparmel1@math.unl.edu) and Carina Curto. Model-based predictions of vesicle pool size in the ribbon synapse of photoreceptor neurons.

Photoreceptors are cells in the retina that convert light information into changes in membrane potential by a graded release of vesicles. They contain a specialized structure, the synaptic ribbon, which tethers vesicles prior to release. We developed a model of release and replenishment that can predict both maximum pool size $A$ and release probability $P$. The model takes as inputs data from pulse train experiments and helps answer a fundamental question about ribbon synapses. Experiments show that weaker stimuli produce smaller responses and stronger stimuli produce larger responses. What causes this difference in response size? We know post-synaptic response is given by the product of $A$, $P$, and quantal amplitude $Q$. A previous method predicts that changes in response across different stimuli result from changes in $A$, but this method fails to account for the dynamics of vesicle replenishment. Since our model allows both $A$ and $P$ to vary, we can test this theory. In contrast to the previous method, our model-based estimate for $A$ was similar across stimulus types while $P$ was much smaller for the weaker stimulus. This suggests that available pool size does not change with stimulus strength; instead, differences in release result from changes in release probability. (Received August 14, 2015)