

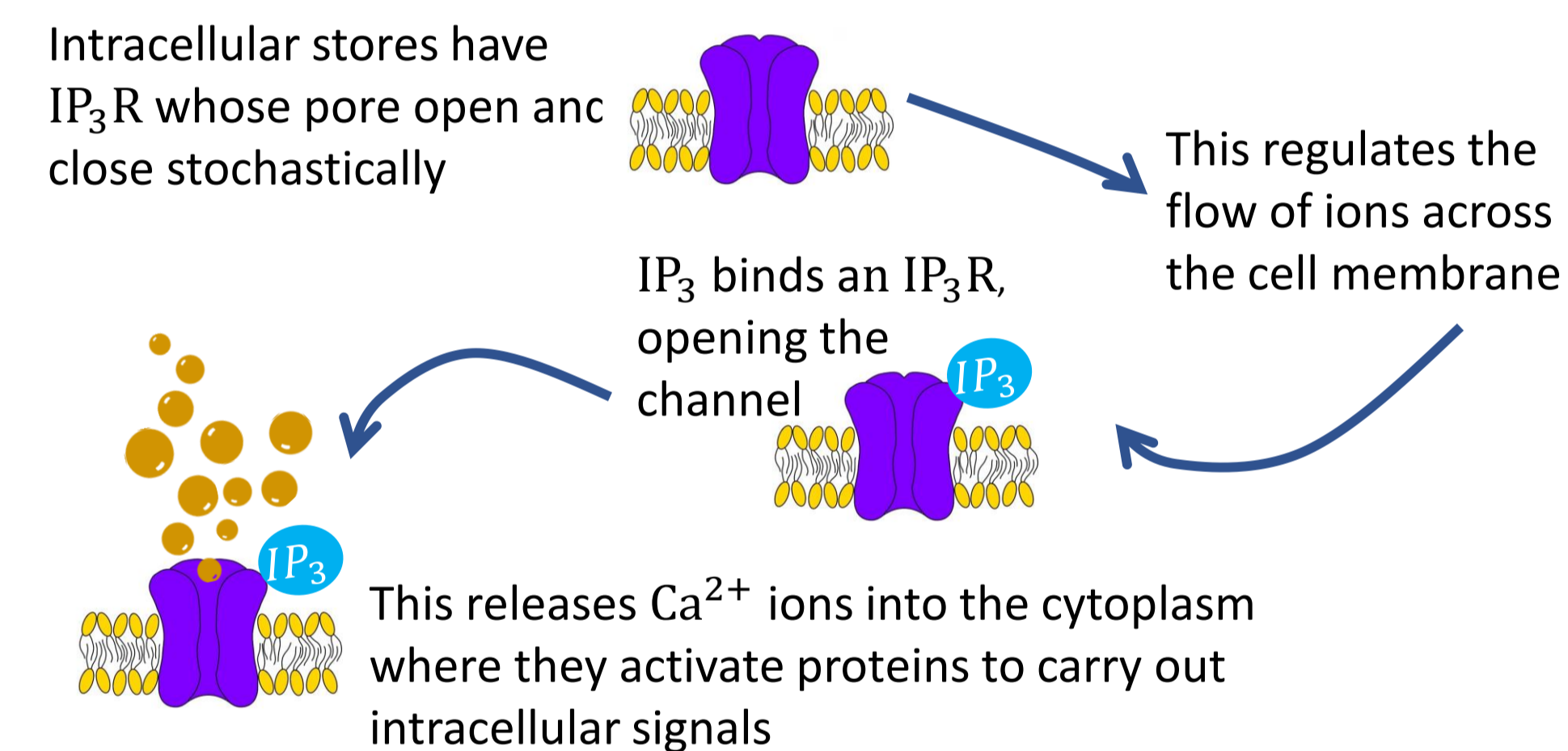
Cracking the calcium code - data-driven modelling of Ca^{2+} puffs

Motivation

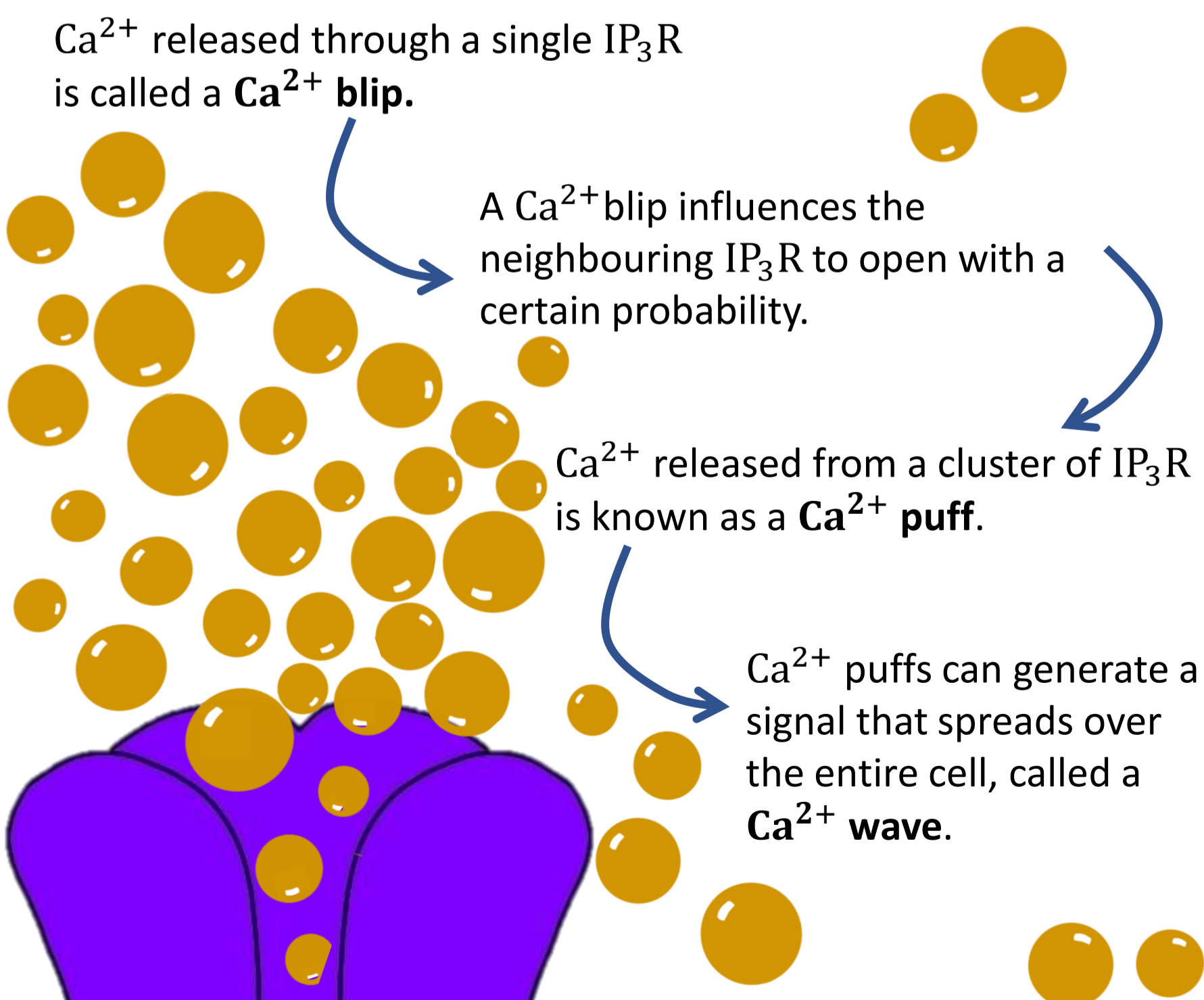
The Ca^{2+} signalling system...

- is vital for cellular function
- plays an important role in the function of muscle contraction of the heart and survival in neurons
- can be harmed by disease, the side effect of drugs or mutation
- when abnormal, has been linked to heart failure and neurological diseases

Biological Overview



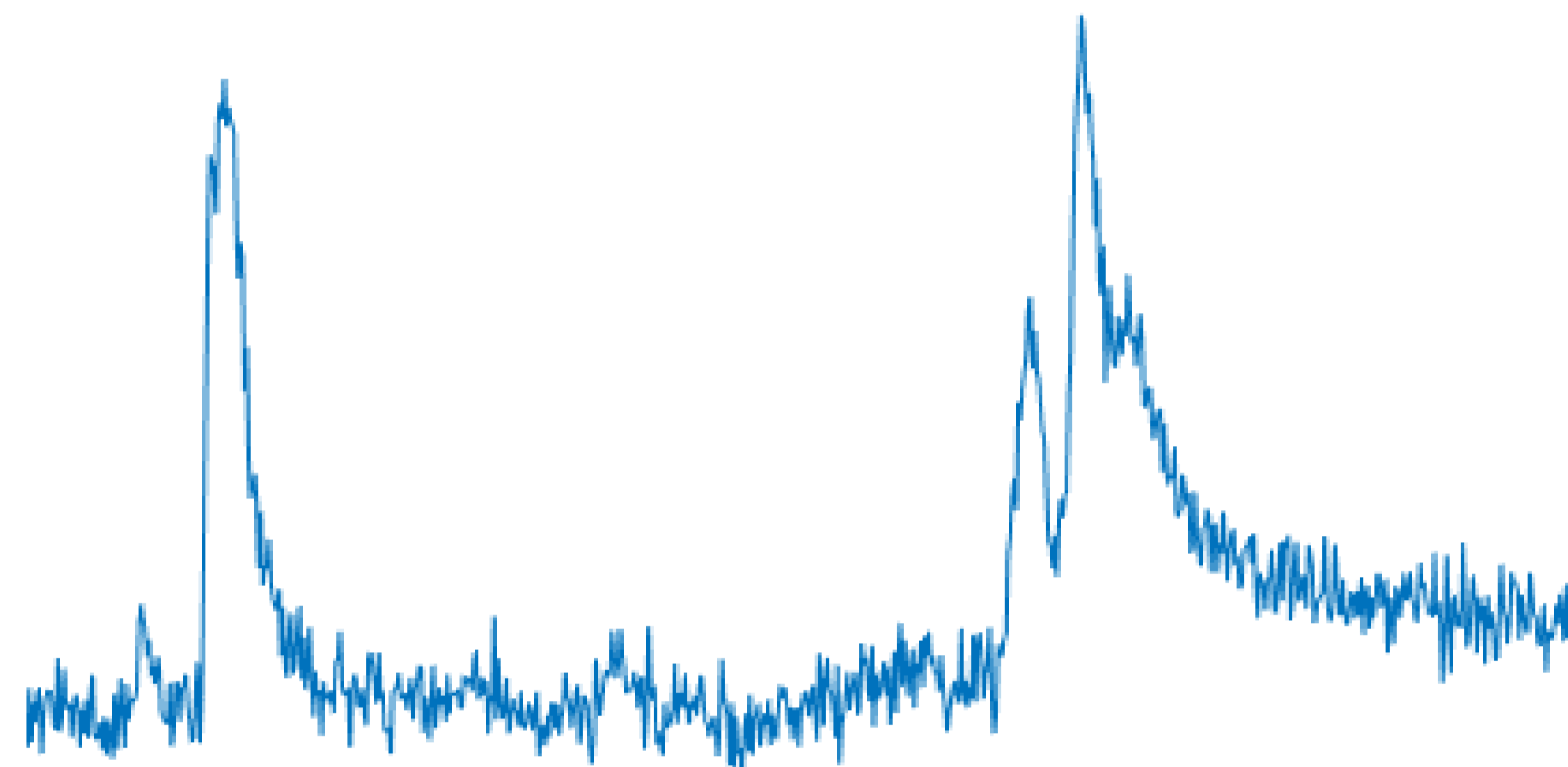
Ca^{2+} Blips, Puffs and Waves



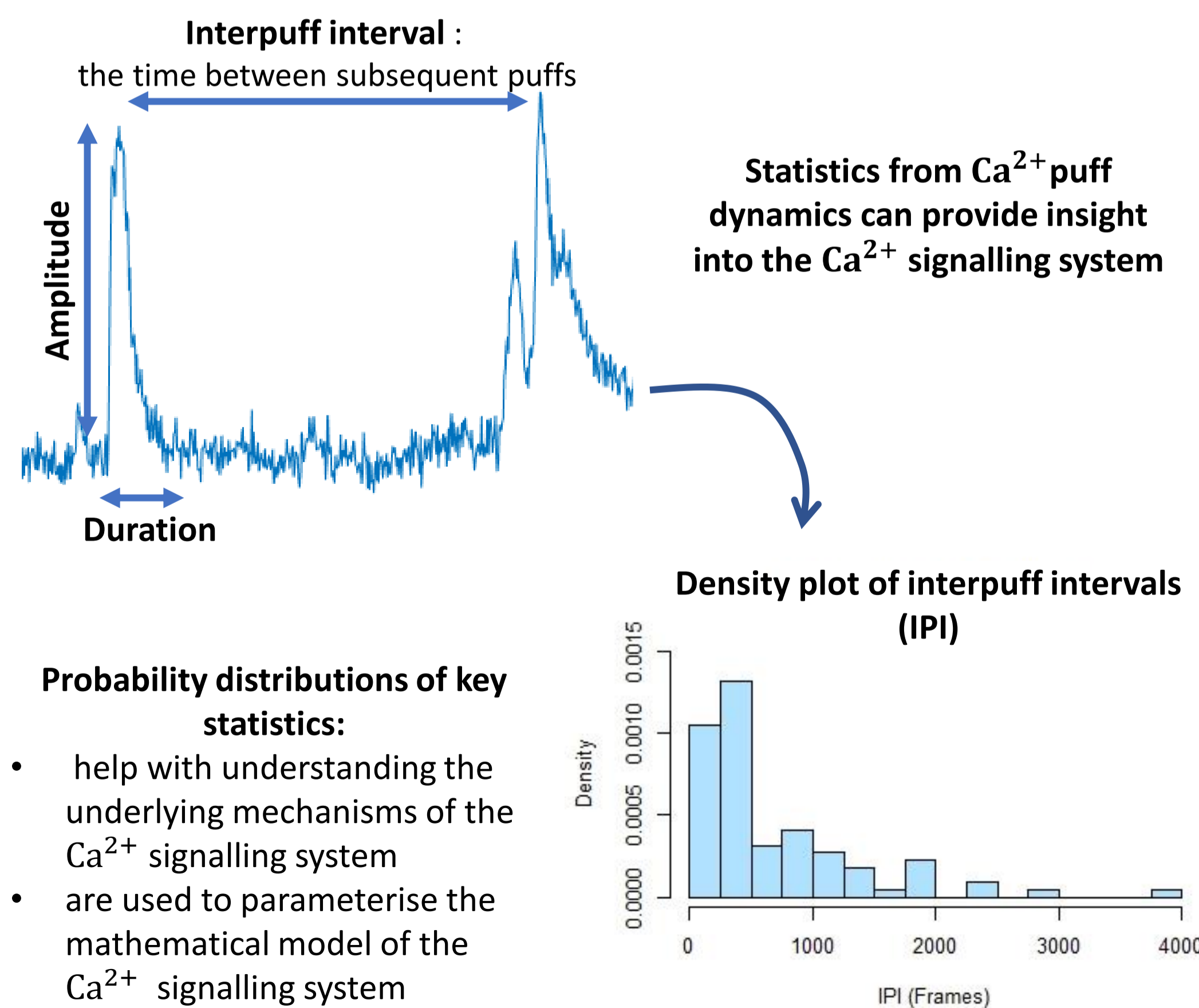
<https://neuroscientificallychallenged.com/glossary/ion-channel>

Research Aim

To study how to molecular modifications of the IP_3R channel affect Ca^{2+} signalling



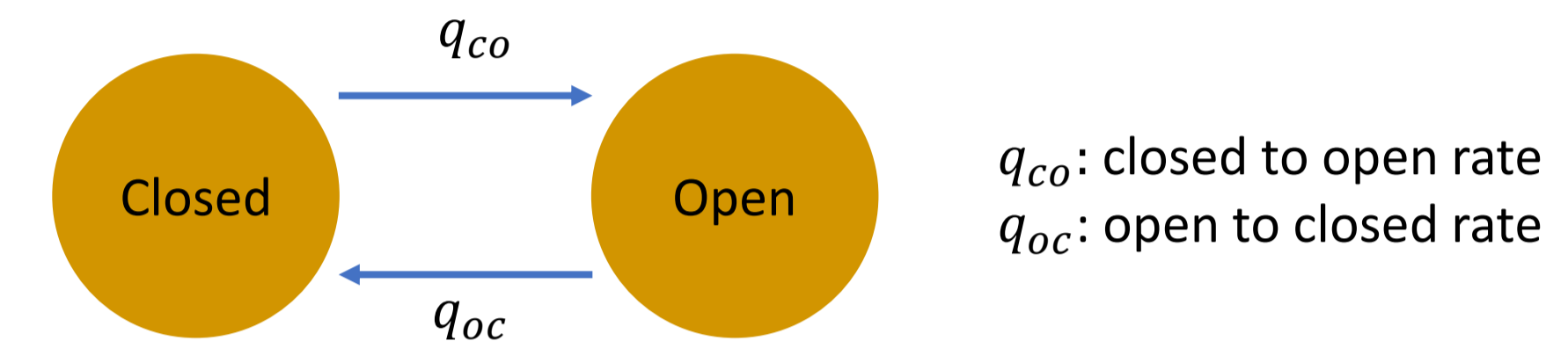
Statistical Analysis of Ca^{2+} Puffs



Methods: Hybrid Stochastic Systems

Ordinary differential equations coupled with Markov models can be used to model the Ca^{2+} signalling system

Simulating the stochastic behaviour of IP_3R using Markov Models

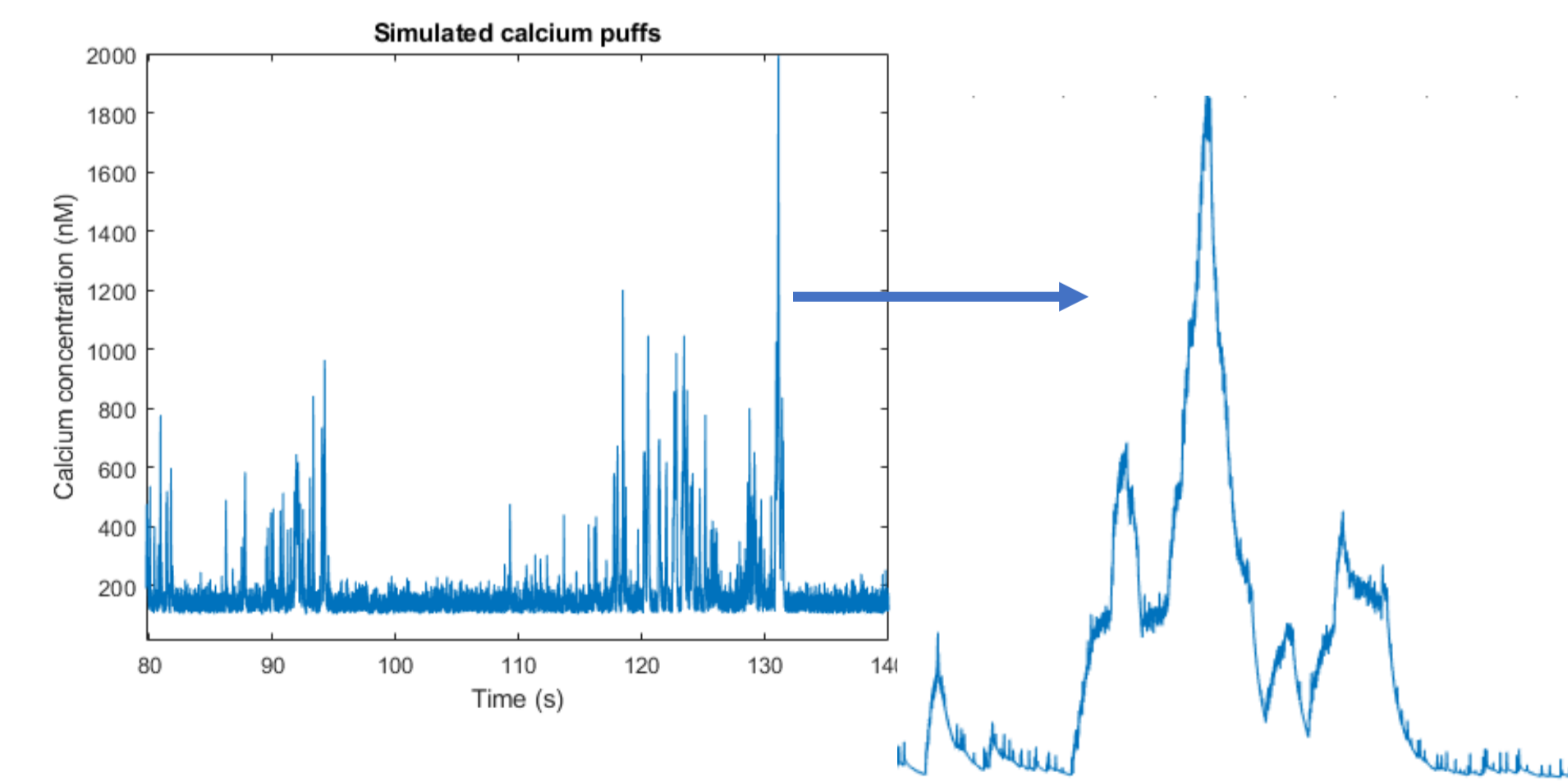


Modelling Ca^{2+} fluxes using ODES

$$\frac{dc}{dt} = J_{increase}N_o + J_{leak} - J_{decrease} - k_{on}(B_{fluor} - b_{fluor})c + k_{off}b_{fluor}$$

Results

Simulated Ca^{2+} puffs using the hybrid stochastic system



Next Steps

- Ca^{2+} puff data from mutated IP_3R will be statistically analysed
- Statistics will be used to parameterise mathematical model
- Model will have the potential to be analysed using deterministic partial differential equations to provide systematic insights.