Supplementary Material

Controlling Ca^{2+}-activated K^+ channels with models of Ca^{2+} buffering in Purkinje cells

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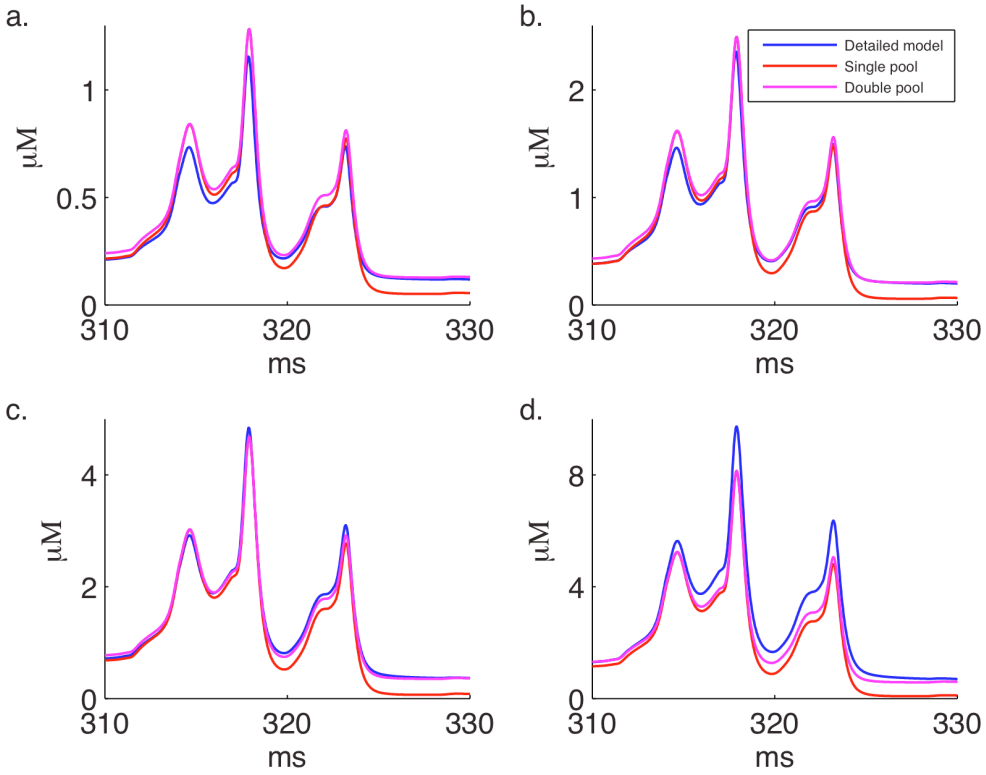
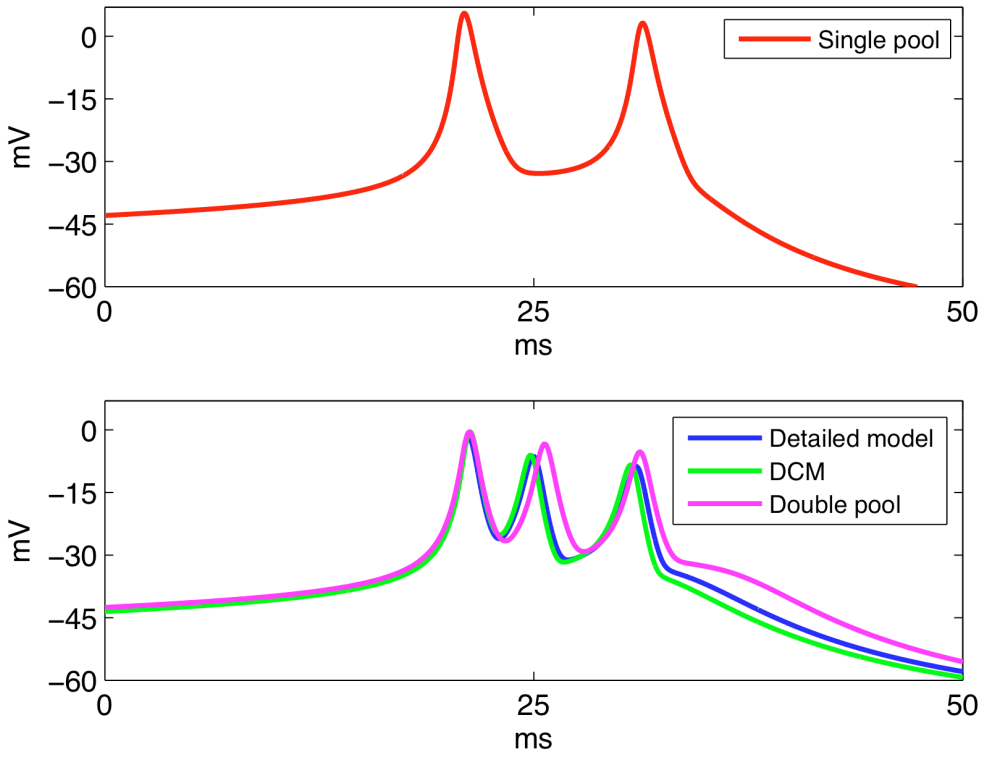
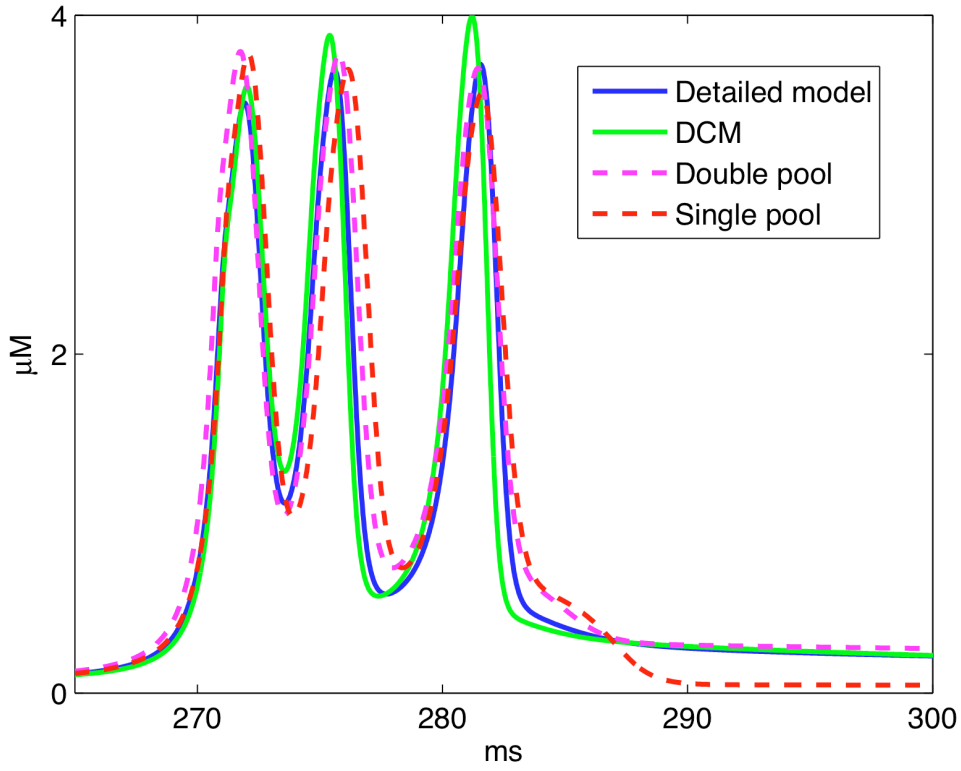


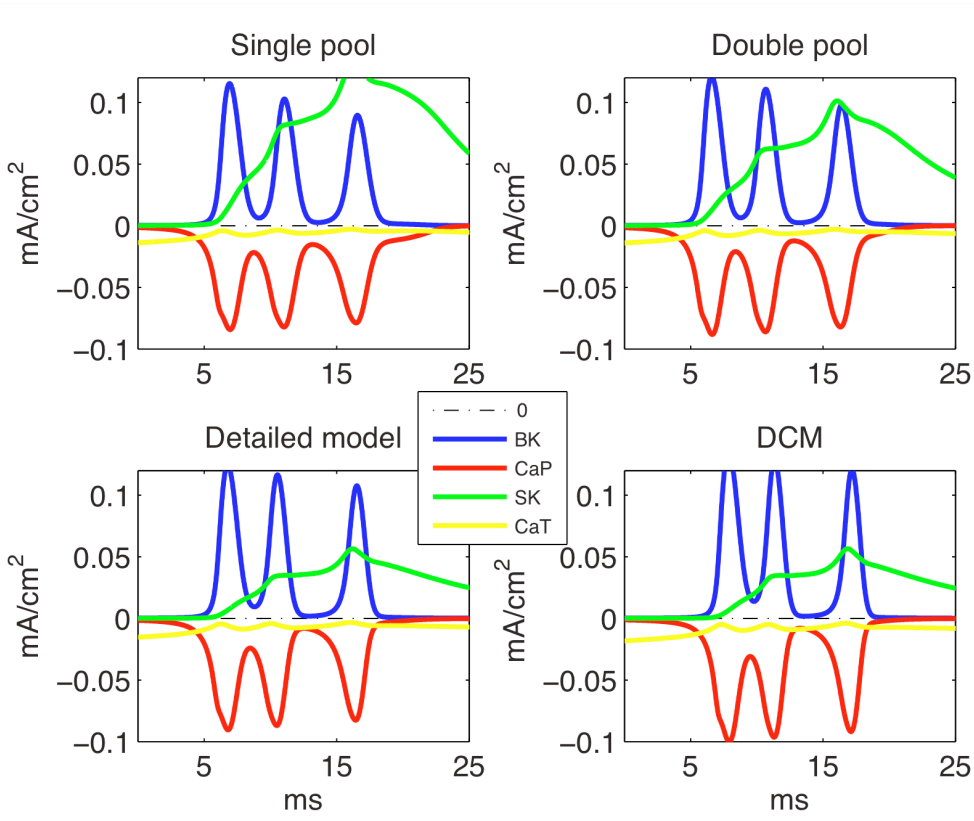
Supplementary Figure 1: Comparison of Ca^{2+} profiles generated with an experimental voltage protocol using single pool, double pool (parameters specified in the text) and detailed dynamics model. Different peak amplitudes of Ca^{2+} a) 1.25 μM, b) 2.5 μM, c) 5 μM, d) 10 μM are simulated to demonstrate the problems the single pool or double pool models have in capturing the complex dynamics of the detailed model. See main text for parameters of the pool models.



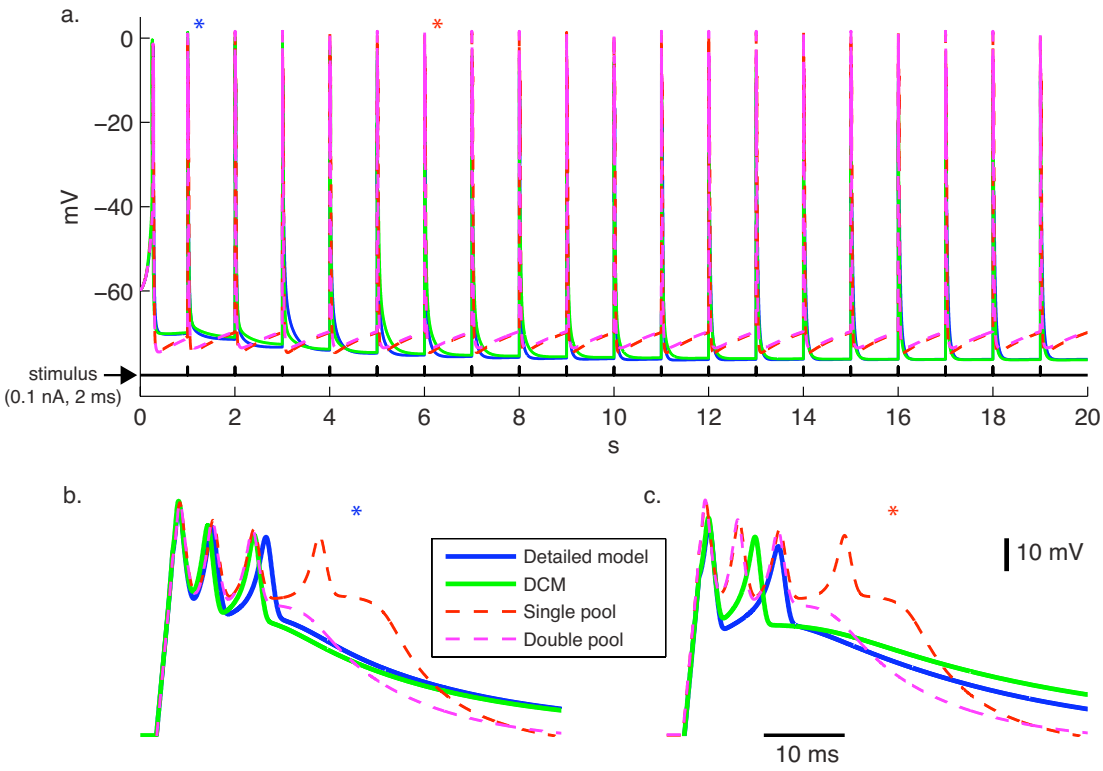
Supplementary Figure 2: Dendritic Ca^{2+} spikes generated using different Ca^{2+} buffering models (aligned at the peak of first spikelet). The parameters used for the pool based models are different from those used in Figure 7, they are the same as in Figure 3. Note that for these parameters the single pool could not produce a triplet of Ca^{2+} spikes. The conductance values used to generate the spikes using detailed model and DCM model are listed in Table 2. (Single pool model conductances: $P_{max}(CaP)$ = 1.97 x 10^{-4} cm/s, $P_{max}(CaT)$ = 7.65 x 10^{-6} cm/s, $G_{max}(BK)$ = 6.17 x 10^{-2} S/cm^2, $G_{max}(SK)$ = 4.72 x 10^{-4} S/cm^2 ; double pool model conductances: $P_{max}(CaP)$ = 1.85 x 10^{-4} cm/s, $P_{max}(CaT)$ = 8.16 x 10^{-6} cm/s, $G_{max}(BK)$ = 7.02 x 10^{-2} S/cm^2, $G_{max}(SK)$ = 3.26 x 10^{-4} S/cm^2).



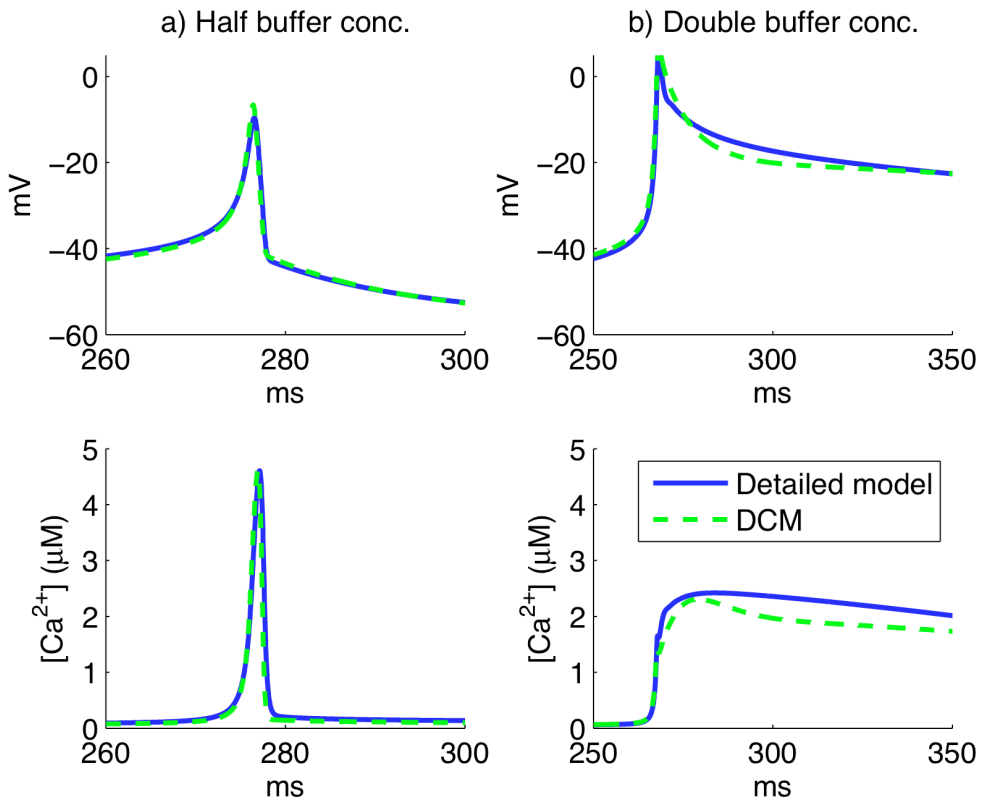
Supplementary Figure 3: Comparison of intracellular Ca^{2+} profiles generated during the simulation of dendritic Ca^{2+} spikes (shown in Figure 7a) using the four different calcium dynamics models.



Supplementary Figure 4: Currents underlying the generation of dendritic Ca^{2+} spikes (shown in Figure 7a) using the four different calcium dynamics models: P-type Ca^{2+} current (red), T-type Ca^{2+} current (yellow), BK-type K_{Ca} current (blue) and SK-type K_{Ca} current (green). Note that T-type and SK-type currents shown in the figure are scaled up 100 times and 10 times respectively for demonstration.



Supplementary Figure 5: Dendritic Ca^{2+} spikes generated using different buffering models by applying repeated current pulses with amplitude of 0.1 nA for 2 ms at 1 Hz. a) stimulated Ca^{2+} spike bursting over 20 s: blue asterisk indicates the burst after first stimulation (shown in b), red asterisk indicates the burst after sixth stimulation (shown in c), b) first stimulated burst of Ca^{2+} spikes, c) sixth stimulated burst of Ca^{2+} spikes.



Supplementary Figure 6: Robustness of DCM. a) Reducing the concentrations of buffers to half of their concentration in the detailed model resulted in a changed Ca^{2+} spike. Same changes in concentration of buffers in DCM model reproduced the Ca^{2+} spike perfectly. (DCM model conductances: $P_{max}(CaP)$ = 2.36 x 10^{-4} cm/s, $P_{max}(CaT)$ = 8.35 x 10^{-6} cm/s, $G_{max}(BK)$ = 7.94 x 10^{-2} S/cm^2, $G_{max}(SK)$ = 4.6 x 10^{-4} S/cm^2), b) Increasing the concentrations of buffers to double of their concentration in the detailed model resulted in a prolonged Ca^{2+} spike. Same changes in concentration of buffers in DCM model approximated this prolonged Ca^{2+} spike. (DCM model conductances: $P_{max}(CaP)$ = 1.62 x 10^{-4} cm/s, $P_{max}(CaT)$ = 7.85 x 10^{-6} cm/s, $G_{max}(BK)$ = 6.19 x 10^{-2} S/cm^2, $G_{max}(SK)$ = 4 x 10^{-4} S/cm^2).