Periodic Sedimentation

I scaled the equation with time $t^* = t/\tau_B$, where $\tau_B = \beta\sigma^2/\Gamma$. We have:

$$\frac{\partial \rho}{\partial t} = \Gamma\nabla\left(\rho\nabla\frac{\delta F[\rho]}{\delta\rho}\right)$$

and so

$$\begin{aligned}\frac{\partial \rho}{\partial t^*} &= \Gamma\tau_B\nabla\left(\rho\nabla\frac{\delta F[\rho]}{\delta\rho}\right)\\ &= \beta\sigma^2\nabla\left(\rho\nabla\frac{\delta F[\rho]}{\delta\rho}\right).\end{aligned}$$

Since we set $\beta = 1$, I have scaled the equation in the code by σ^2. Choosing $\sigma = 1$, $\bar{\rho} = 0.072$, $\epsilon = 3.5$ and $a = 0.1$, where the only choice I made is σ, the rest is determined by the paper. I checked before that the points are random and they are and the interval is $\bar{\rho} \pm \frac{1}{20}$. Then I let this run up to $t^* = 300$, like in the paper. Then I chose the initial condition with more

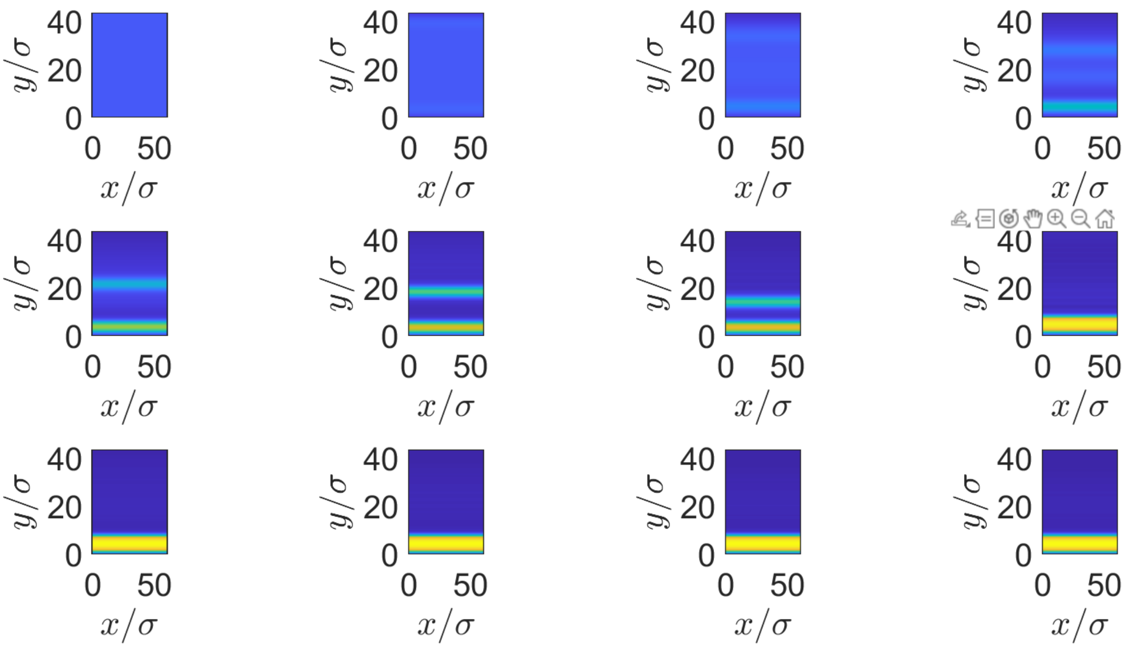

Figure 1: Figure 8 from paper with $\sigma = 1$.

randomness: $\bar{\rho} \pm \frac{1}{10}$.
Then I chose $\bar{\rho} = 0.072(\cos(\pi y_2/15) + 1)$, to see what happens if there are already clusters in the initial condition.
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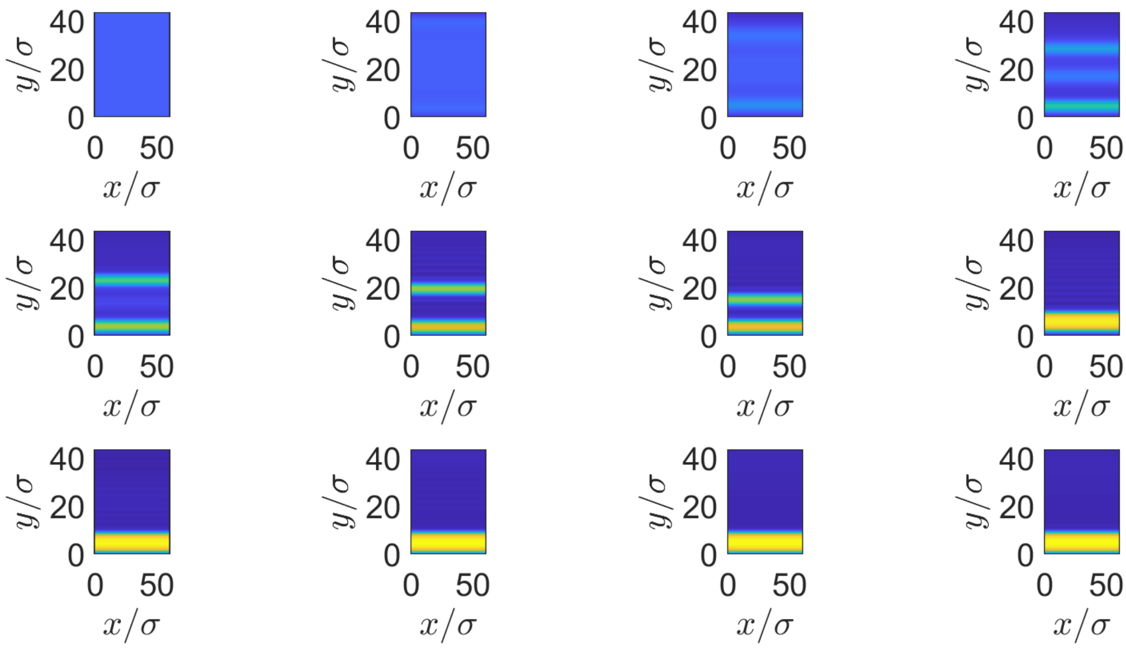

Figure 2: Figure 8 from paper with $\sigma = 1$, more randomness in ρ_0.

1 Constriction Flow

I first tried to rewrite the initial condition in terms of $h = 0$. It does solve for a smaller external potential and without constriction, but I still get the warning with the integration tolerances.

Then I went back to the original problem. This solves well with $V_0 = 10$ instead of $V_0 = 1000$ and the quality of the result becomes worse for higher strengths of the external potential. With this I could put the interaction on. However, they are influenced by the boundaries. Therefore, I put the problem into periodic boundaries. This works but it's not comparable to the results from the paper.

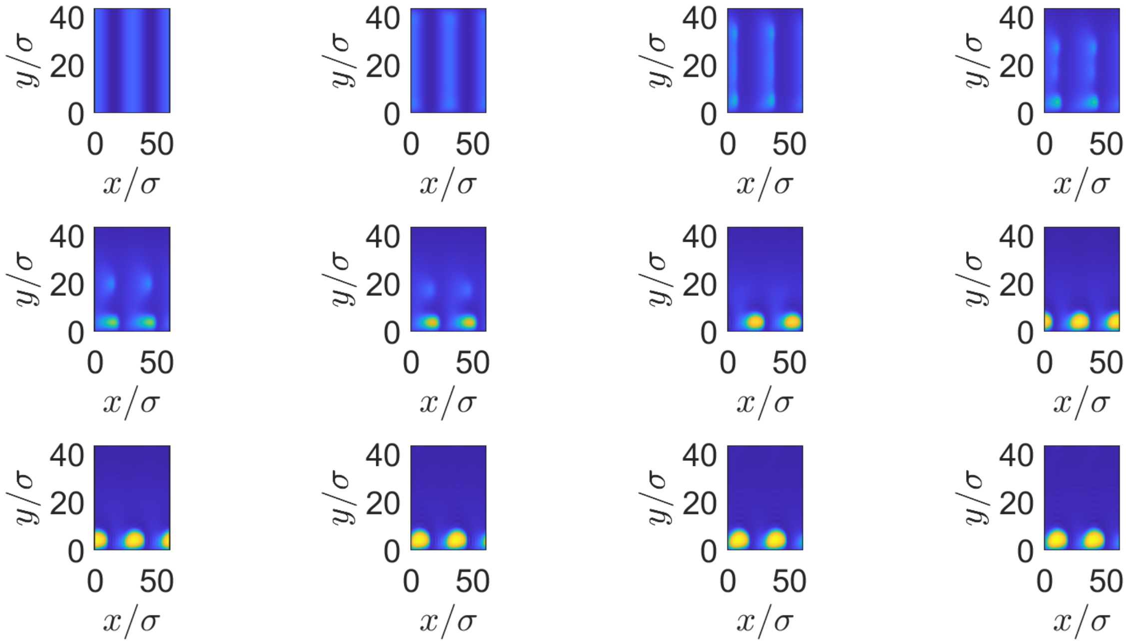

Figure 3: Figure 8 from paper with $\sigma = 1$, $\bar{\rho} = 0.072(\cos(\pi y_2/15) + 1)$.

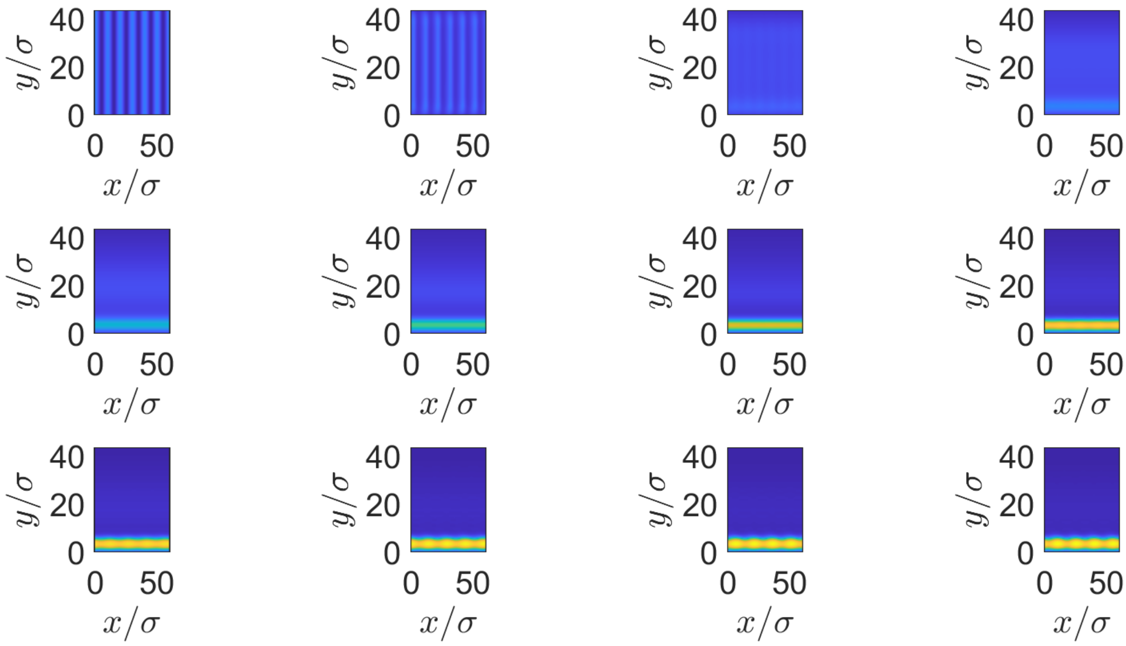

Figure 4: Figure 8 from paper with $\sigma = 1$, $\bar{\rho} = 0.072(\cos(\pi y_2/5) + 1)$.

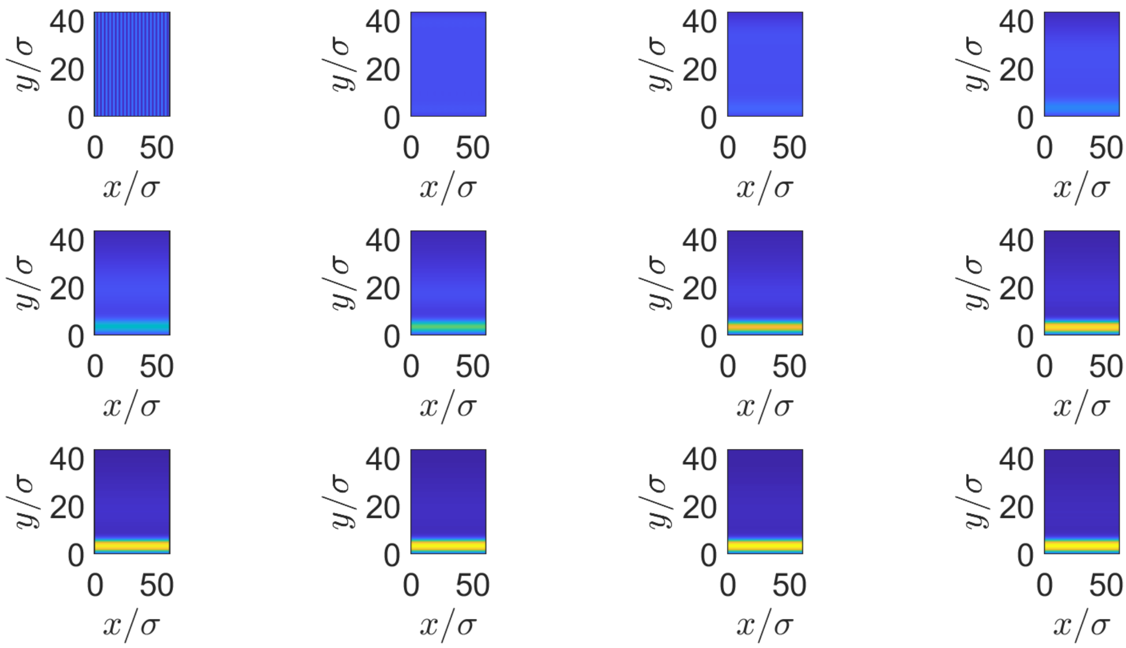

Figure 5: Figure 8 from paper with $\sigma = 1$, $\bar{\rho} = 0.072(\cos(\pi y_2) + 1)$.

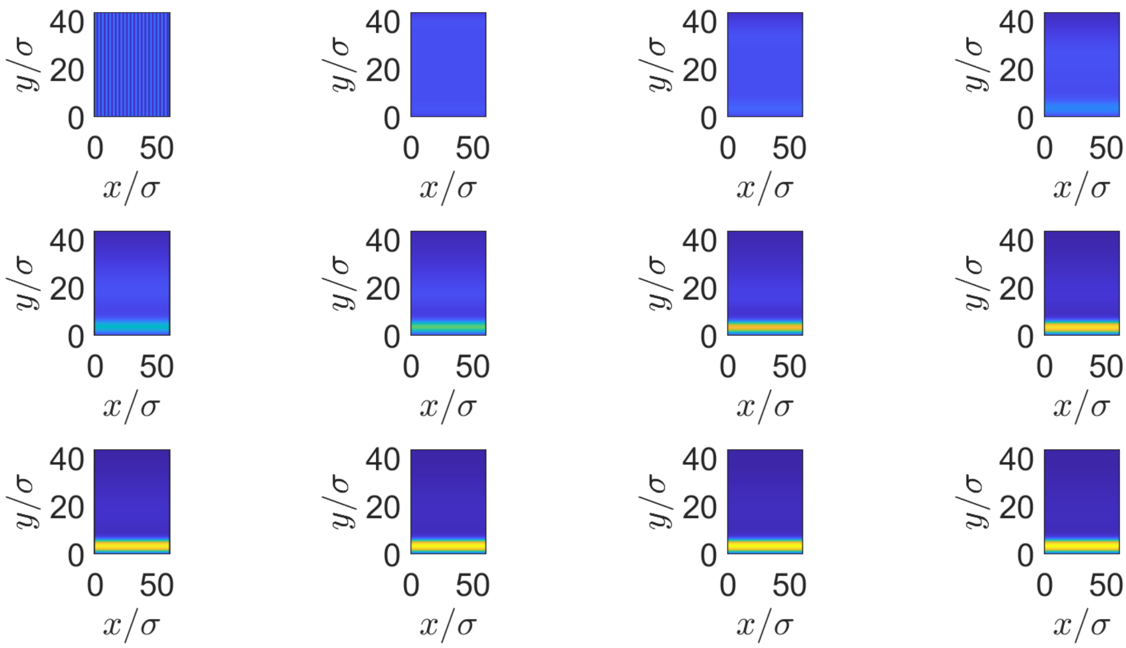

Figure 6: Figure 8 from paper with $\sigma = 1$, $\bar{\rho} = 0.072(\cos(\pi y_2) + 1)$ running up to $t^* = 600$ instead of $t^* = 300$.

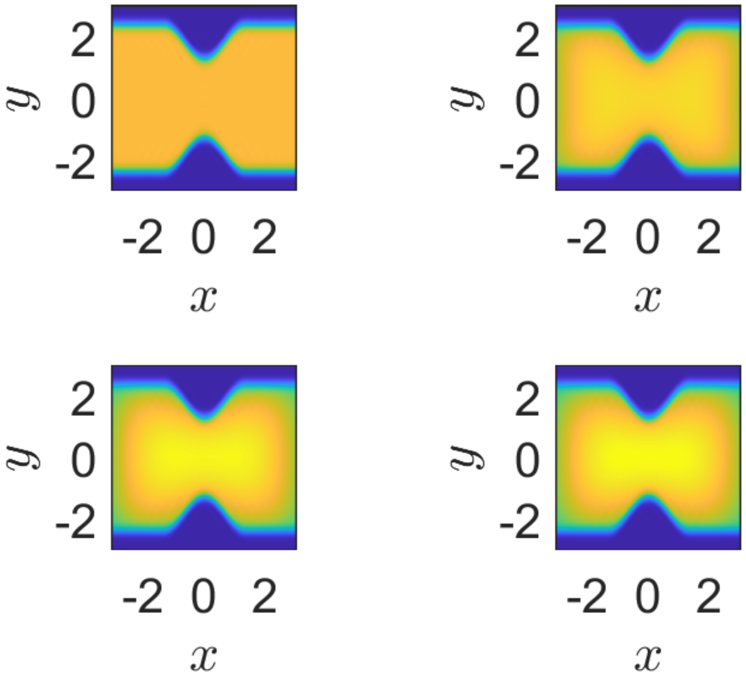

Figure 7: Constriction with $\kappa = -0.2$ and $b = 0.6$, $V_0 = 10$.

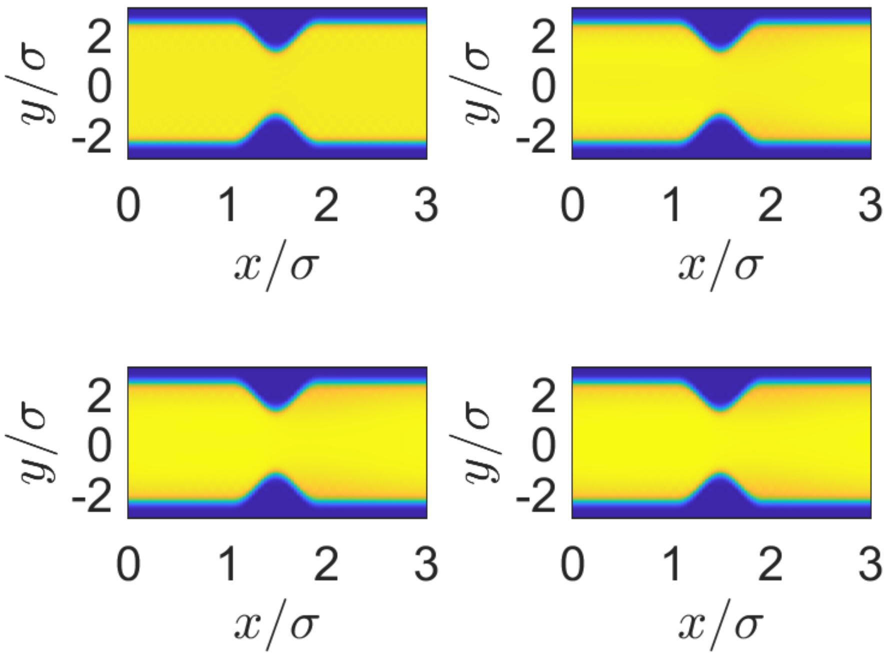

Figure 8: Constriction with $\kappa = -0.2$ and $b = 0.6$, $V_0 = 10$.

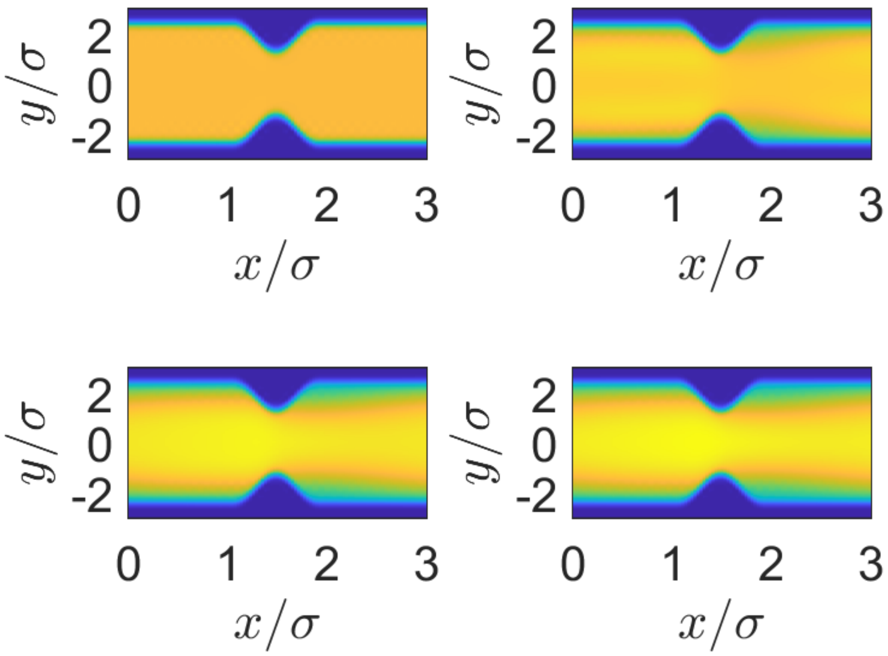

Figure 9: Constriction with $\kappa = -0.6$ and $b = 0.6$, $V_0 = 10$.

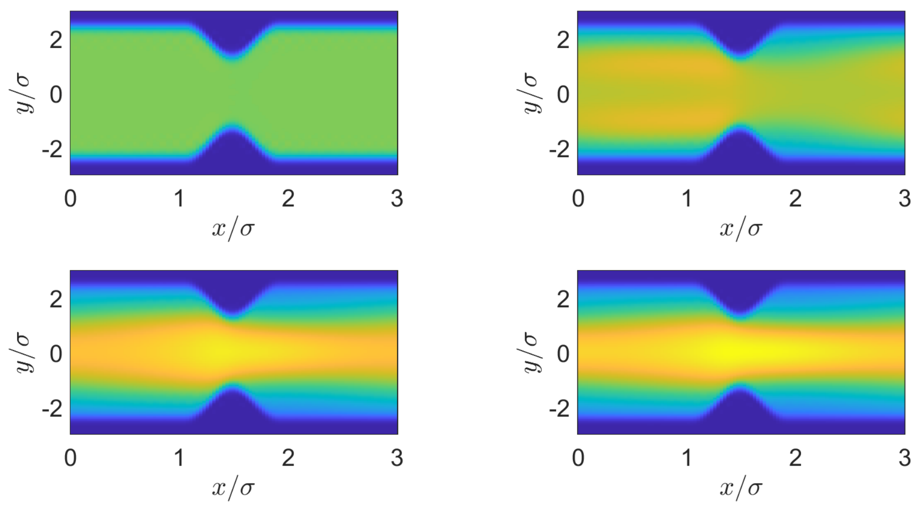

Figure 10: Constriction with $\kappa = -1$ and $b = 0.6$, $V_0 = 10$.