Inverting stop-flow leaching experiments and detection of physical and chemical non-equilibria

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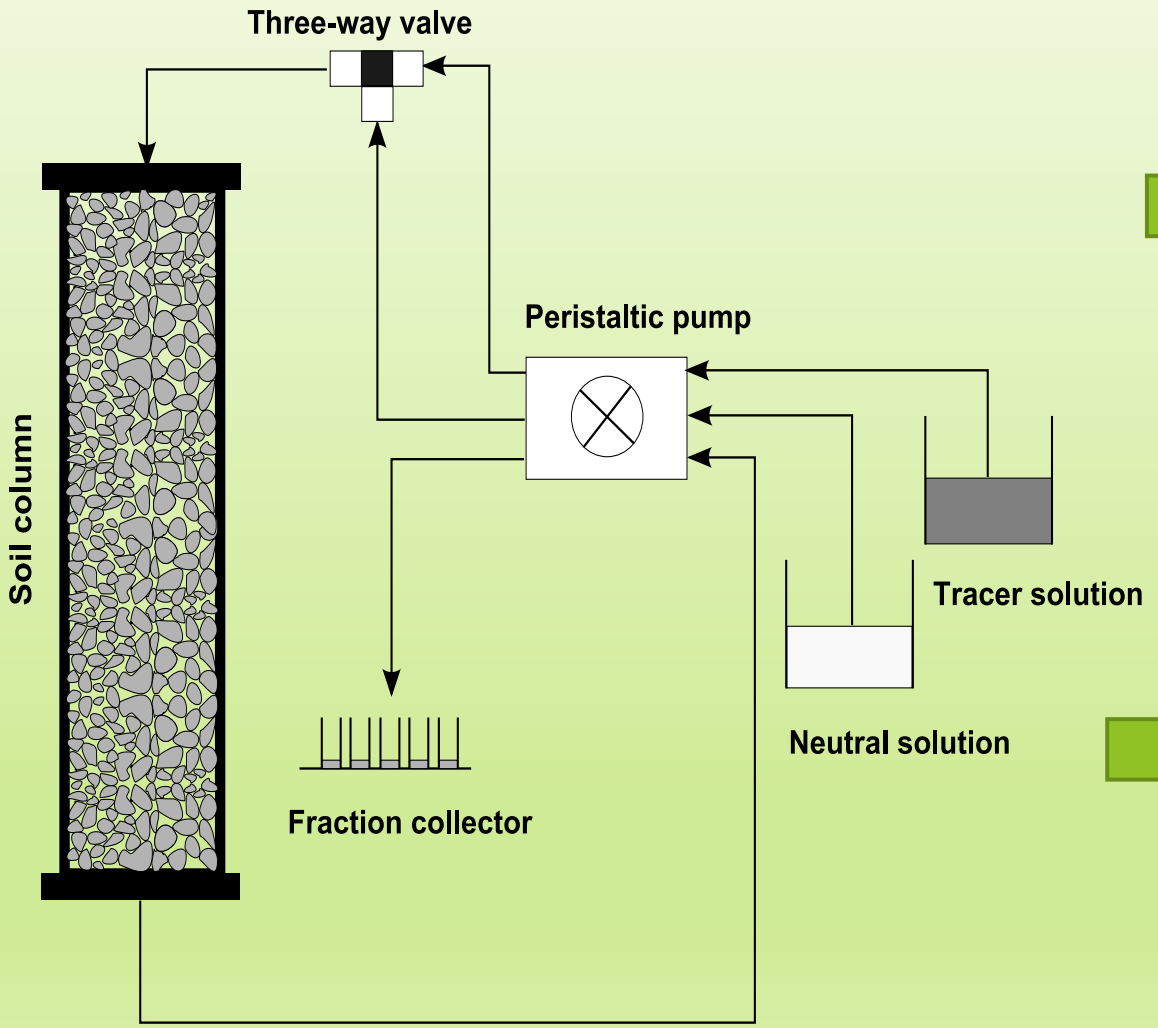
Principle of column experiments



In most column experiments, the rate is fixed constant through the whole experiments

Stop-flow experiments: in that case, the flow rate is interrupted for a period between successive injections

Principle of modelling physical and chemical non equilibria

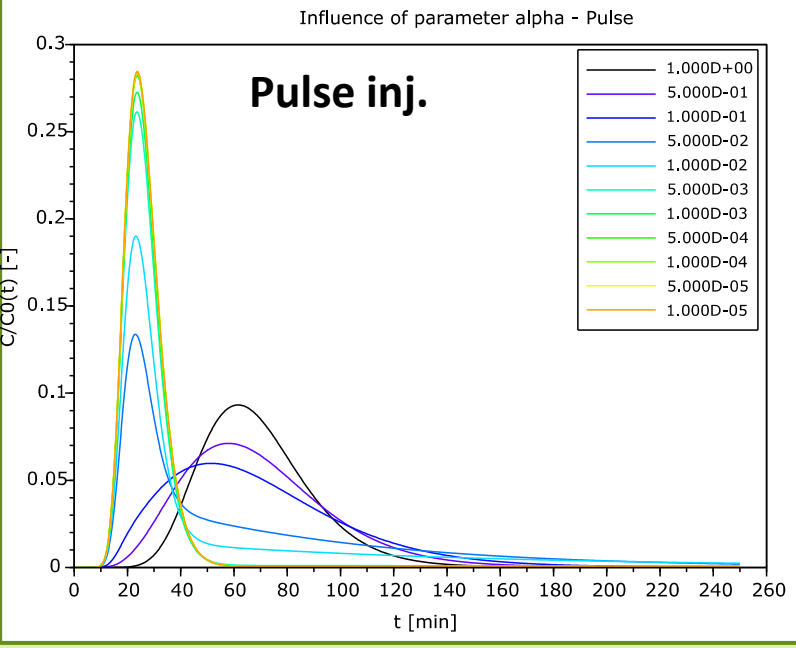
Physical non-equilibrium

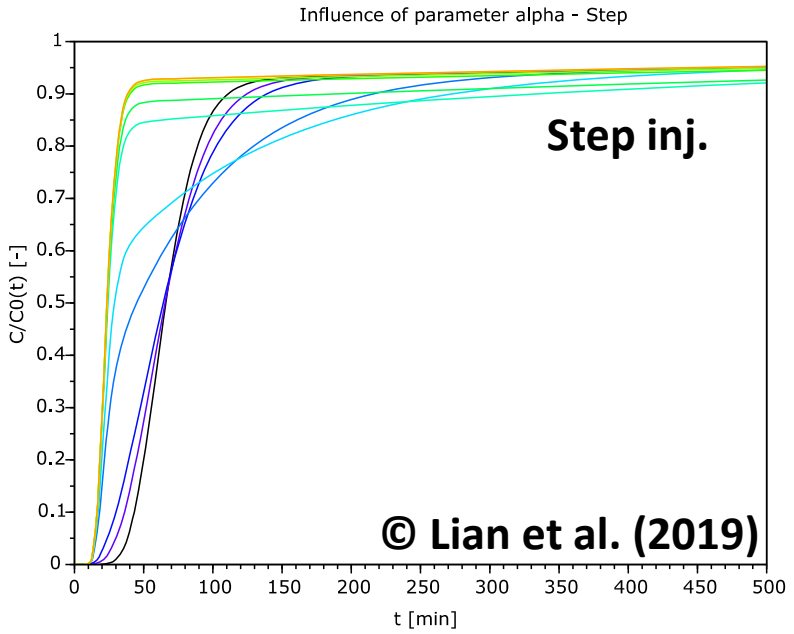
$$\begin{cases} \theta_m \dfrac{\partial C_m}{\partial t} + \theta_{im} \dfrac{\partial C_{im}}{\partial t} + f_m \rho_d \dfrac{\partial S_m}{\partial t} + f_{im} \rho_d \dfrac{\partial S_{im}}{\partial t} = \theta_m D_m \dfrac{\partial^2 C_m}{\partial z^2} - q \dfrac{\partial C_m}{\partial z} \\ \theta_{im} \dfrac{\partial C_{im}}{\partial t} = \alpha (C_m - C_{im}) \end{cases}$$

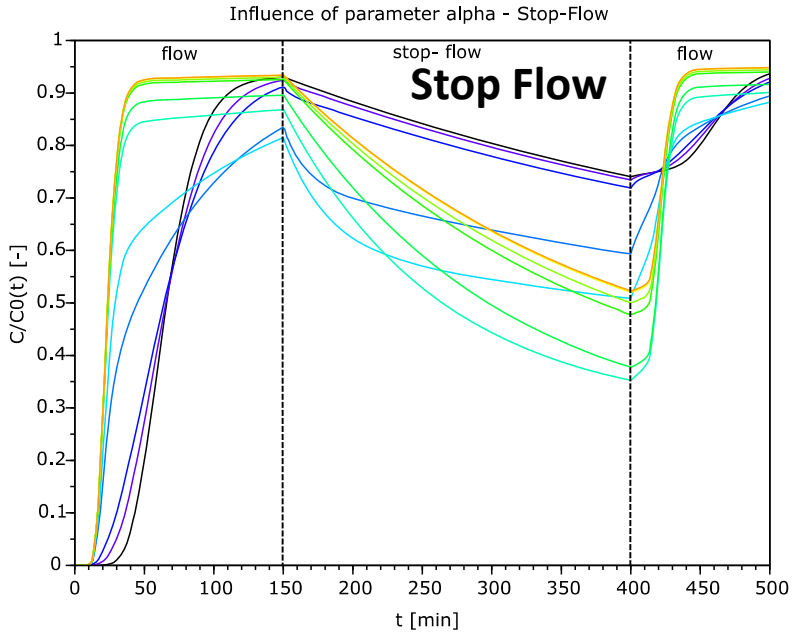
Chemical non-equilibrium

$$\begin{cases} S_e = K_d C^\beta & \text{equilibrium} \\ \dfrac{dS_k}{dt} = \omega \left(K_d C^\beta - S_k \right) & \text{kinetical limitation} \end{cases}$$

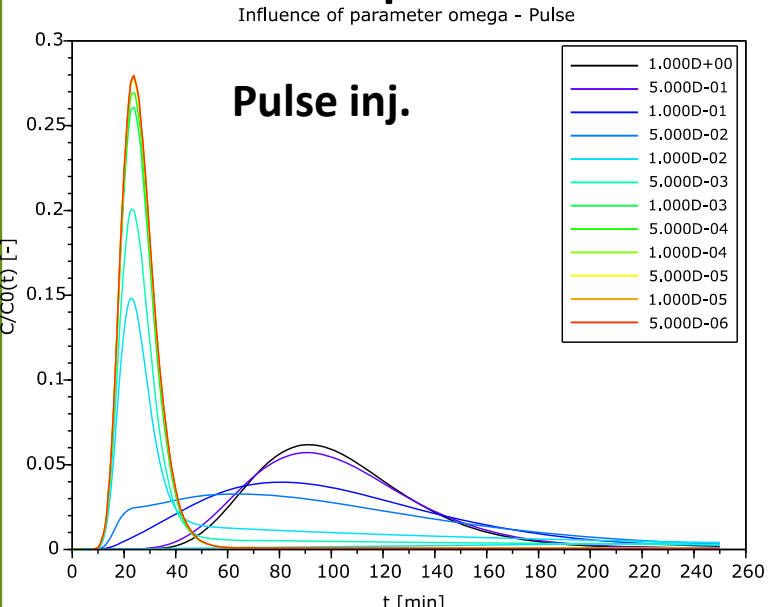
Physical non-equilibrium

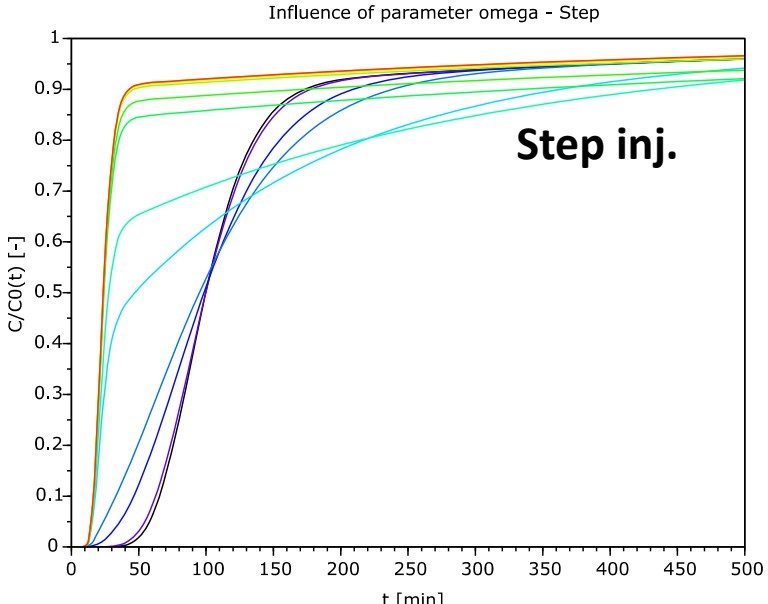


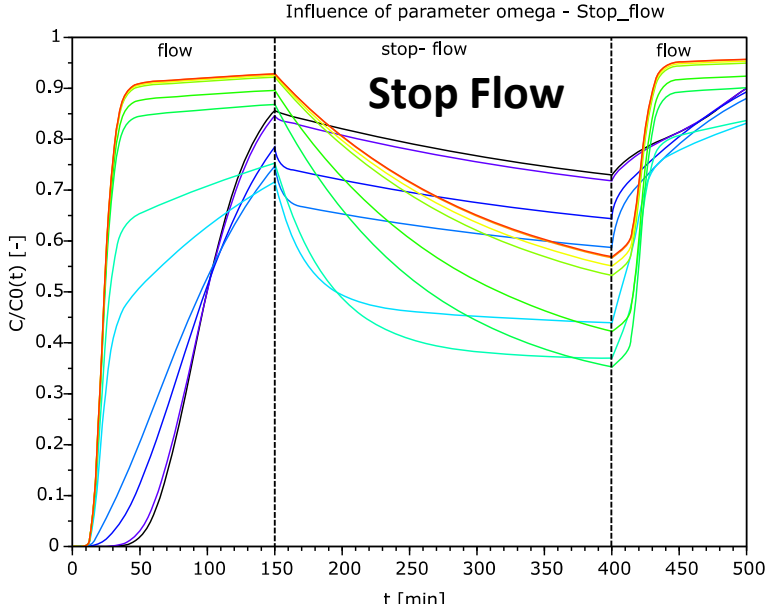




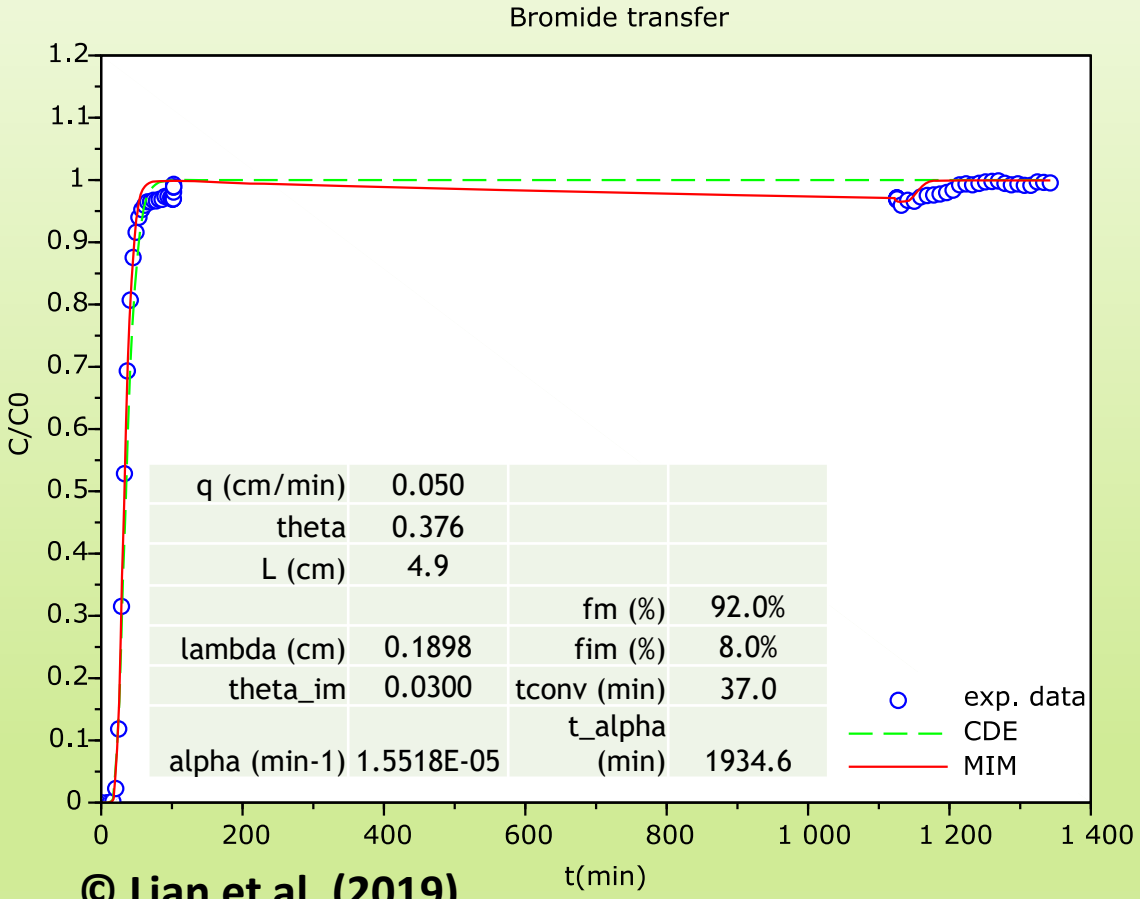
Chemical non-equilibrium

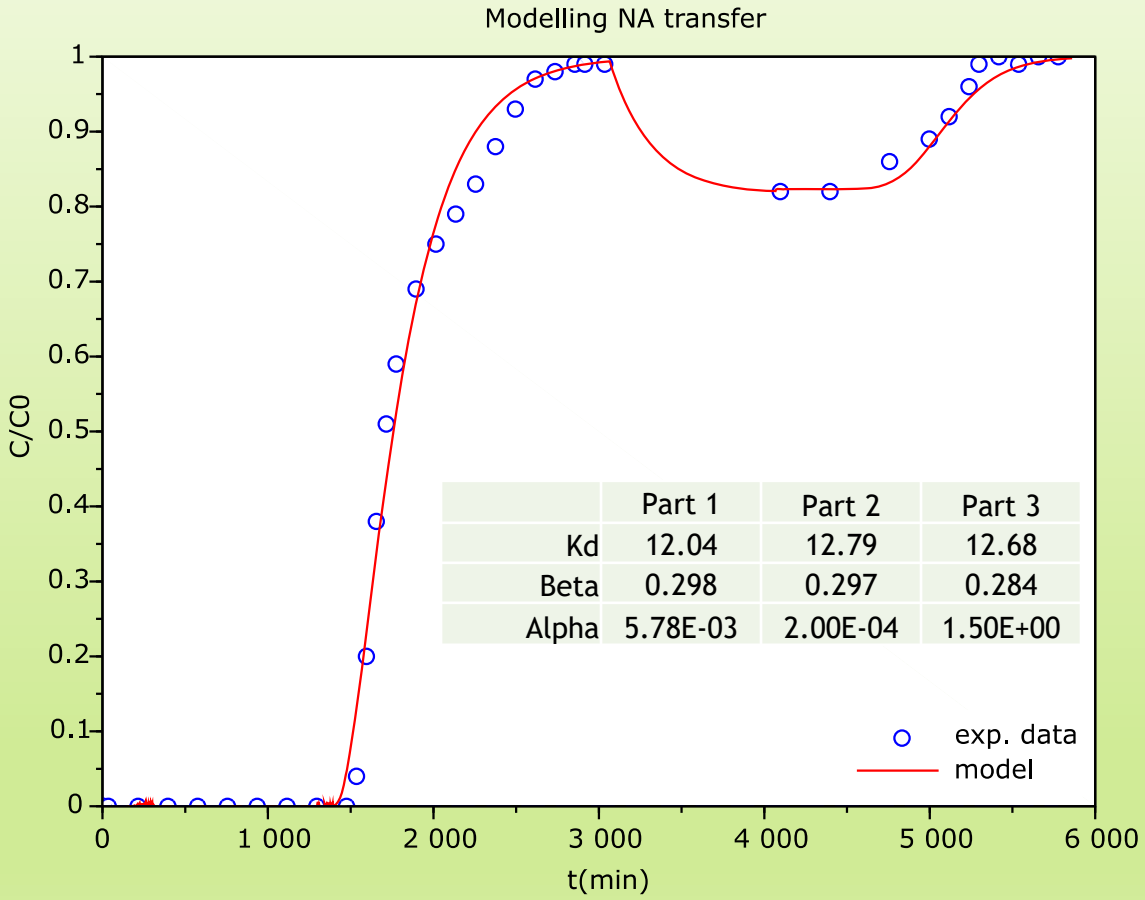






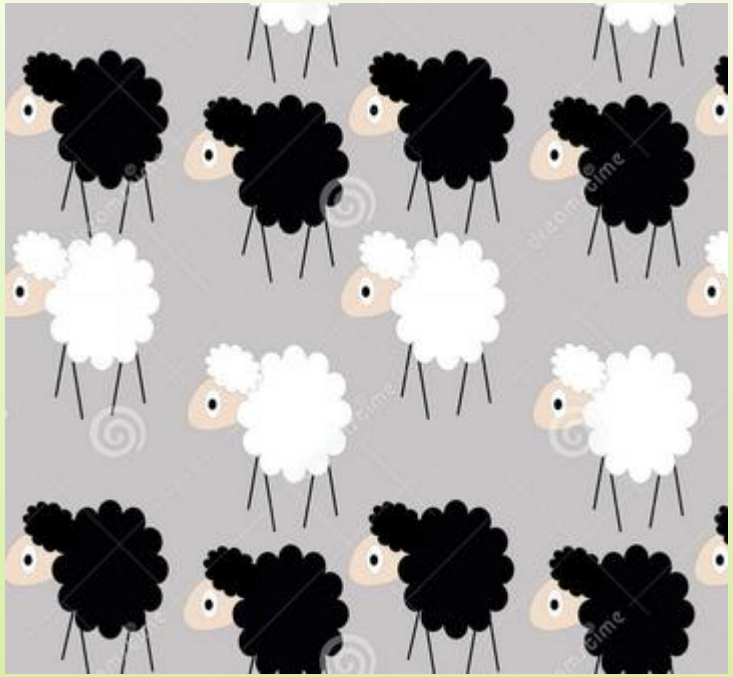
Fit to experimental data





The issue is ….

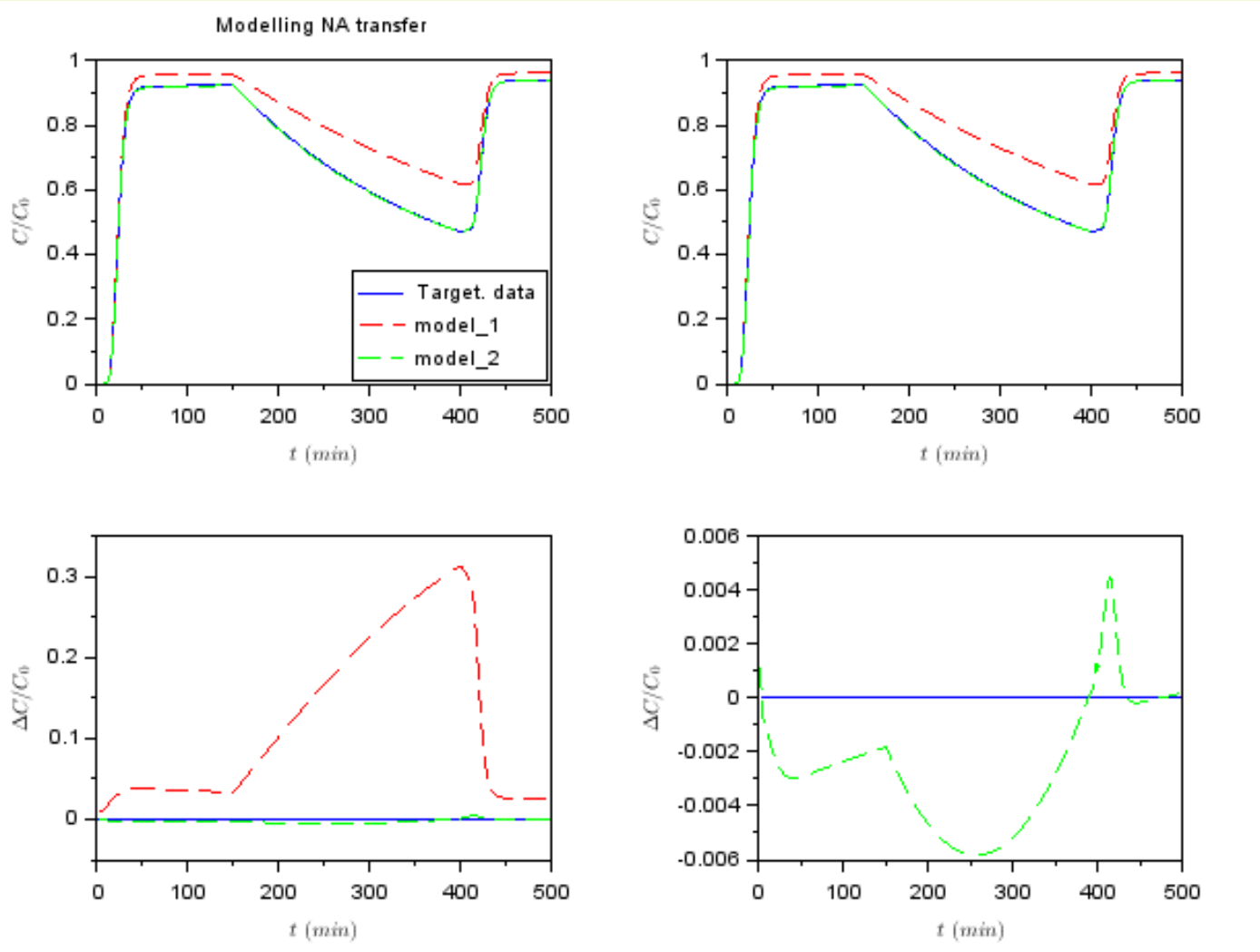
It seems complicated to distinguish the two kinetics with regard to their impact on the shape.



In the following, we try to model a case of physical and chemical equilibrium and see if it can be modelled by another case

Test equifinality

Equifinality exists



Blue model = target

red model = alpha decreased

Green model = alpha decreased + Omega increased

Equifinality must be considered and treated