Modélisation physique de la réactivation de la faille

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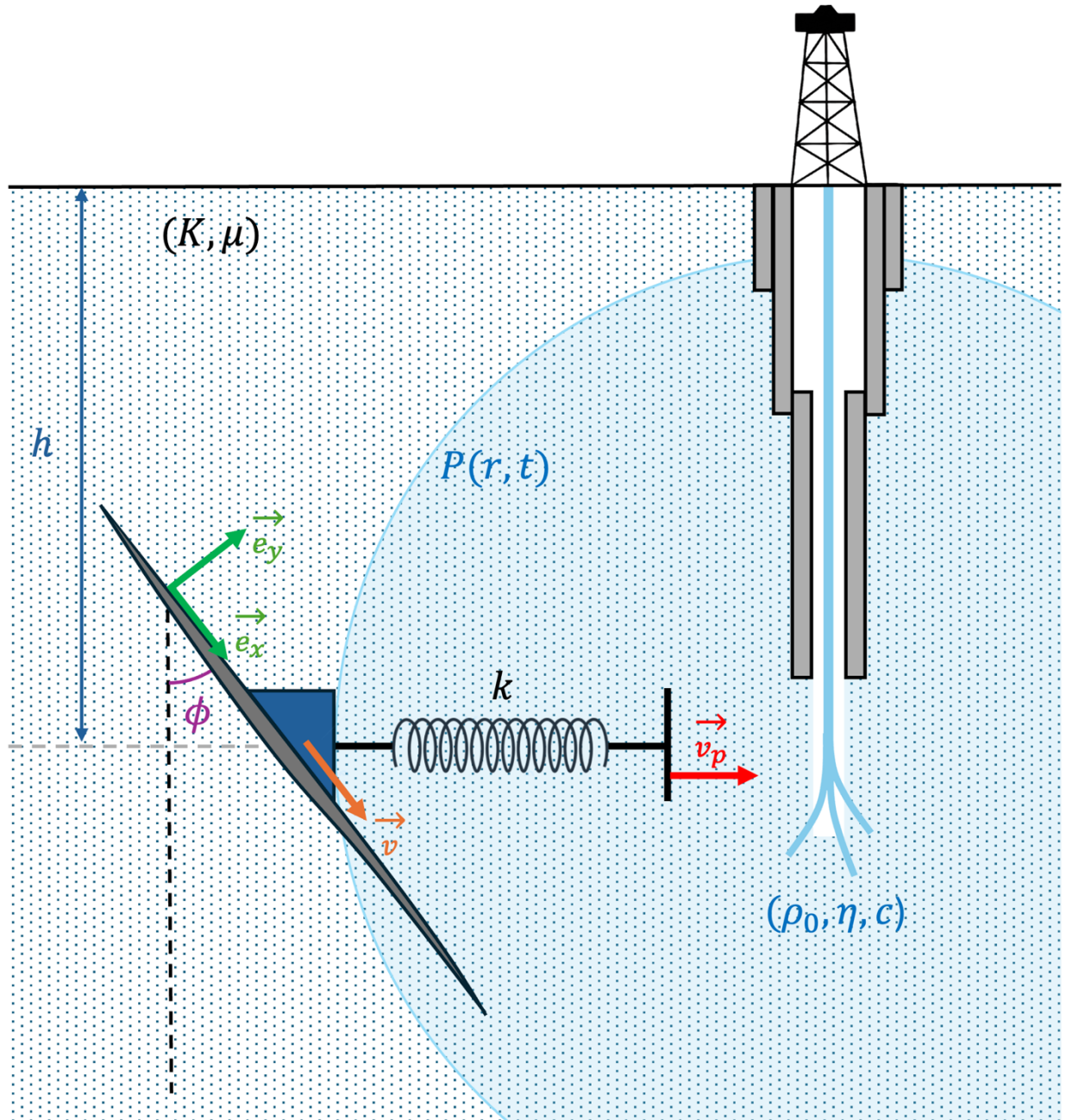

(K, μ)
h
$P(r,t)$
$\vec{e_y}$
$\vec{e_x}$
ϕ
k
$\vec{v_p}$
$\vec{v}$
(ρ_0, η, c)

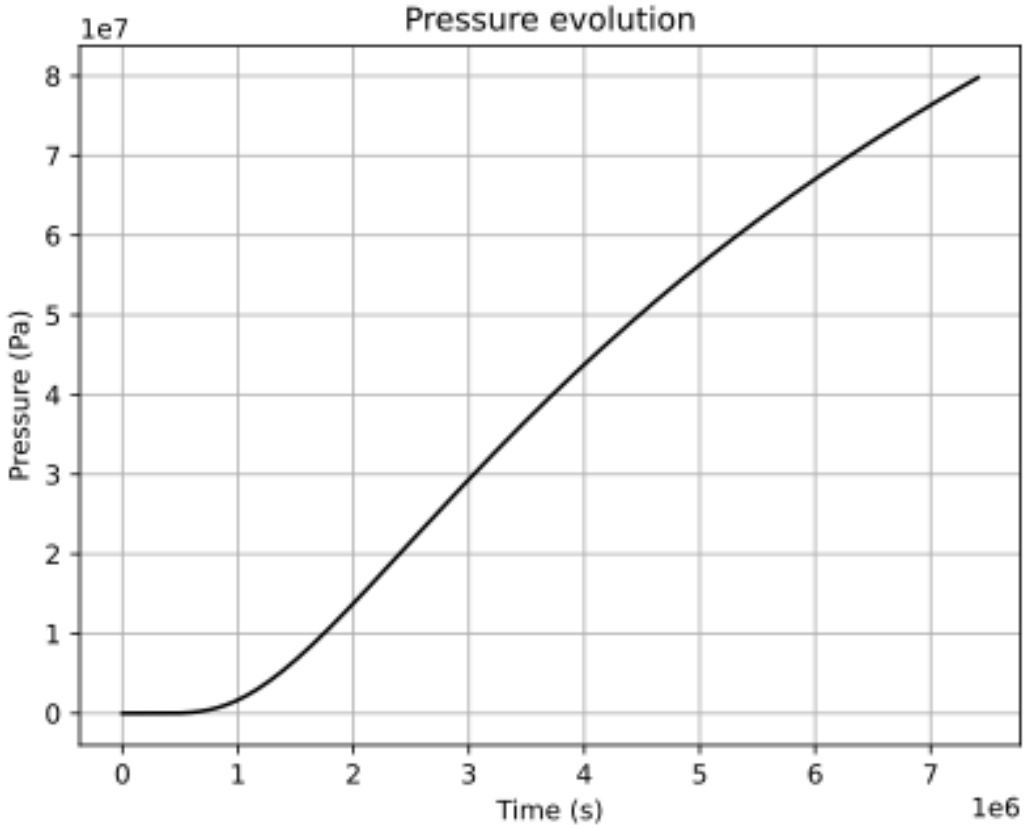
$$\frac{m}{S}\dot{v} = \eta v = -k(l^* + sin(\phi)\,\delta - v_p\,t)sin(\phi) - f(t)\sigma_{eff}(t)$$

$$\frac{d\bar{v}}{\bar{v}} = \frac{-\kappa(\bar{v}\sin\phi - 1)\sin\phi + \left(\bar{v} - \frac{1}{\bar{\theta}}\right)\left(\frac{\sigma(t)}{\sigma_0} - \frac{P(t)}{\sigma_0}\right) - \left(\frac{f_0}{b} + \alpha\ln\bar{v} + \ln\bar{\theta}\right)\frac{d(\sigma-P)}{dt}\frac{d_c}{v_p\sigma_0}}{\bar{\eta}\,\bar{v} + \alpha\left(\frac{\sigma(t)}{\sigma_0} - \frac{P(t)}{\sigma_0}\right)}\,d\bar{t}$$

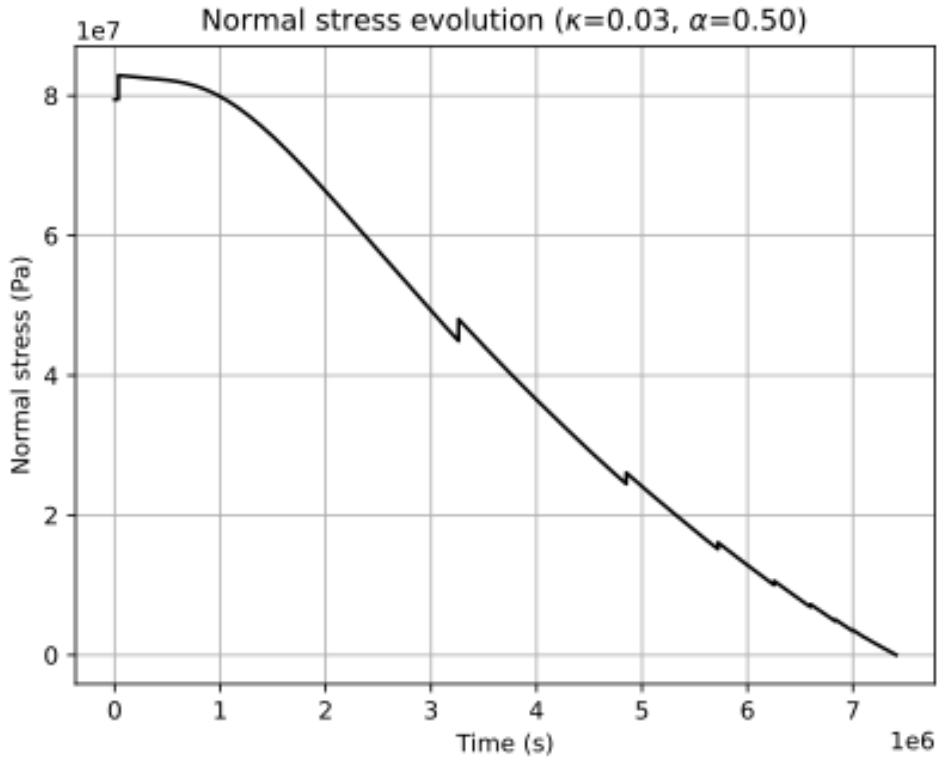
⇒ Algorithme de Runge – Kutta

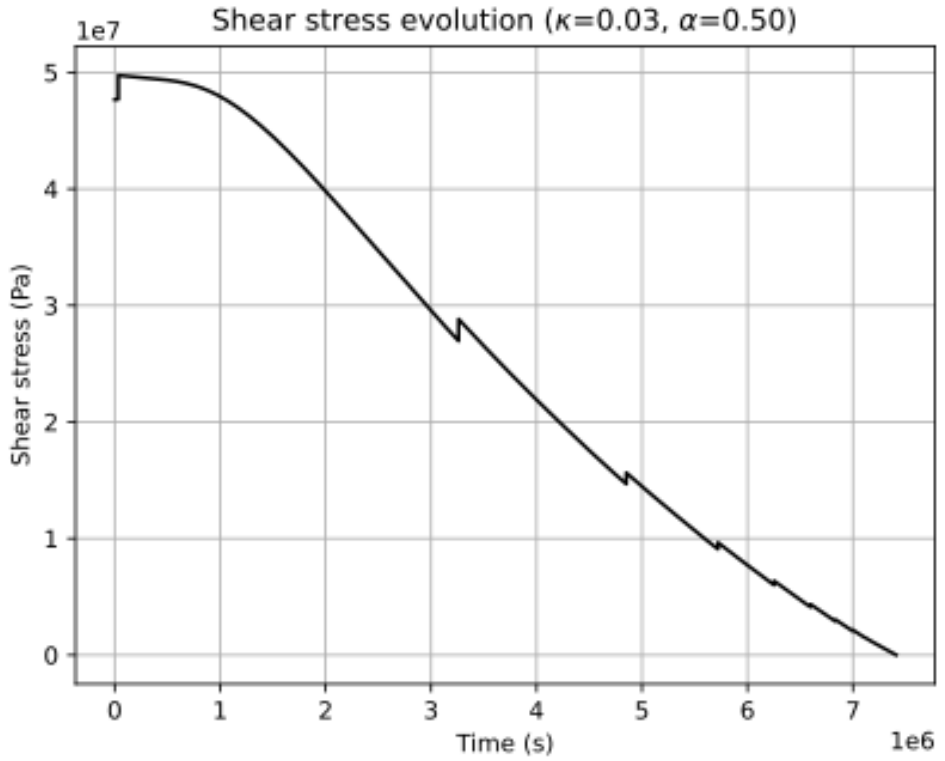
$$P(t) = \frac{q}{4\pi\rho_0 r}\frac{\eta}{K}\operatorname{erfc}\left(\frac{r}{2\sqrt{ct}}\right) = P_\infty \operatorname{erfc}\left(\sqrt{\frac{\tau}{t}}\right)$$

$$P_\infty = \frac{q}{4\pi\rho_0 r}\frac{\eta}{K}, \qquad \tau = \frac{r^2}{4c}$$

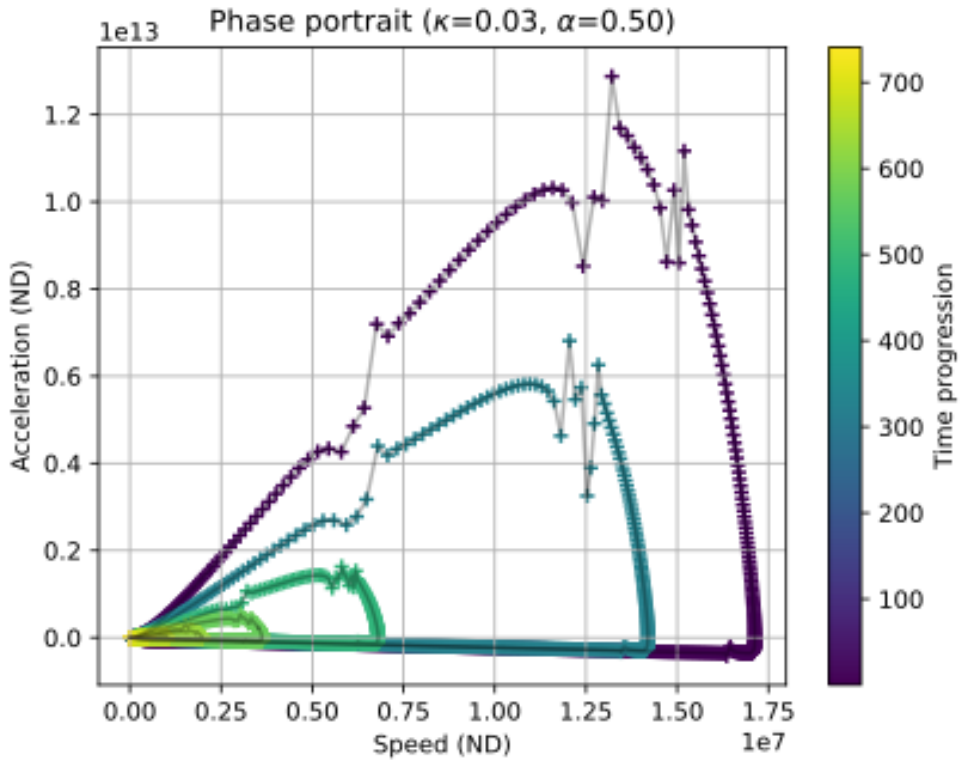


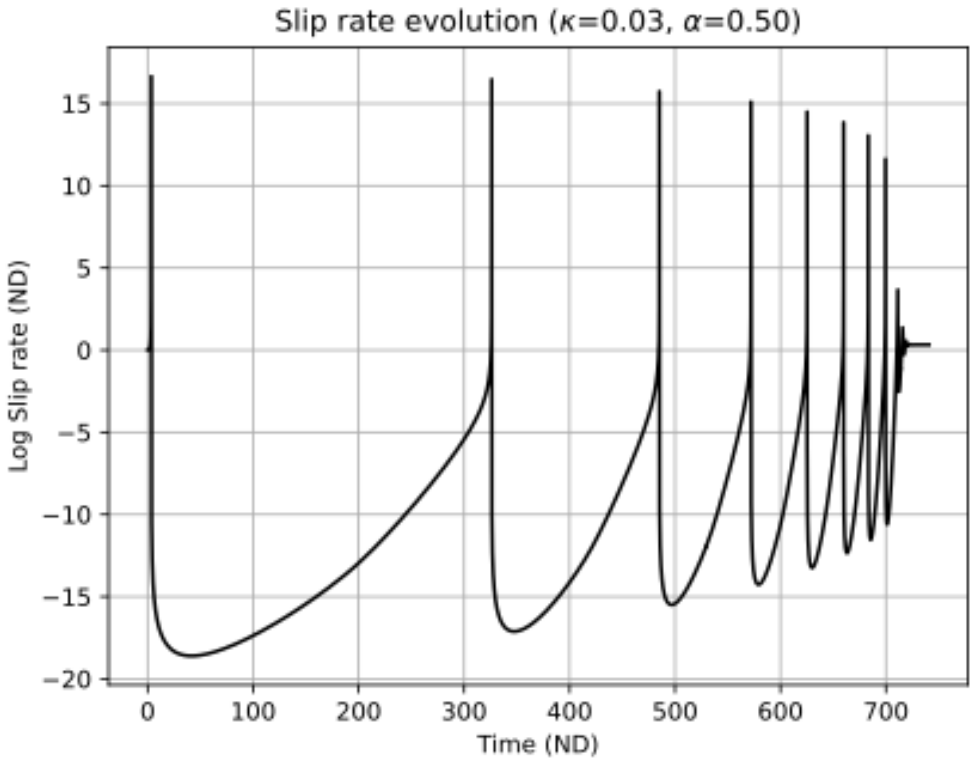
$$\left(\phi = \frac{\pi}{4}\right)$$



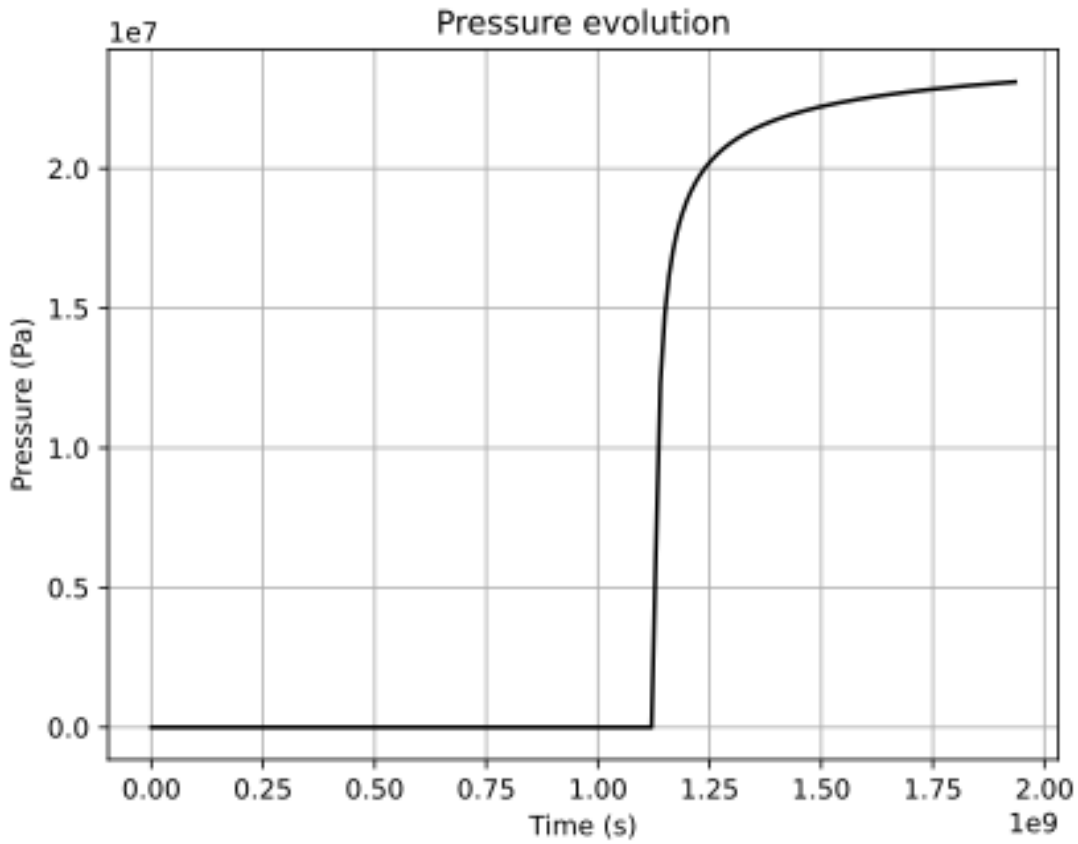


$$\left(\phi = \frac{\pi}{4}\right)$$

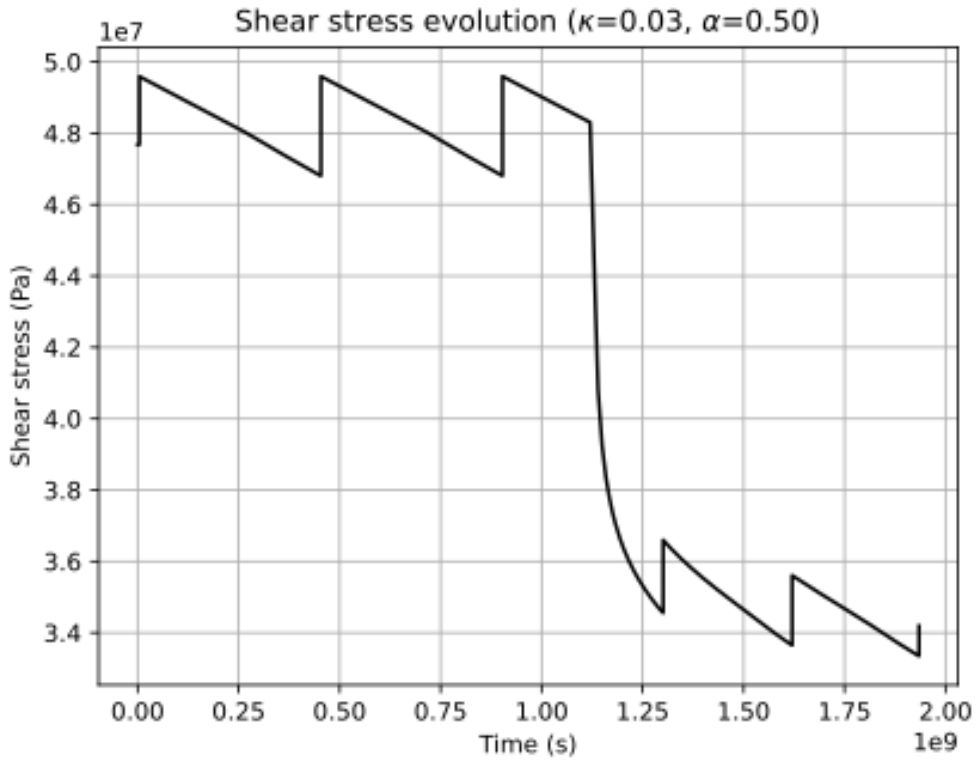


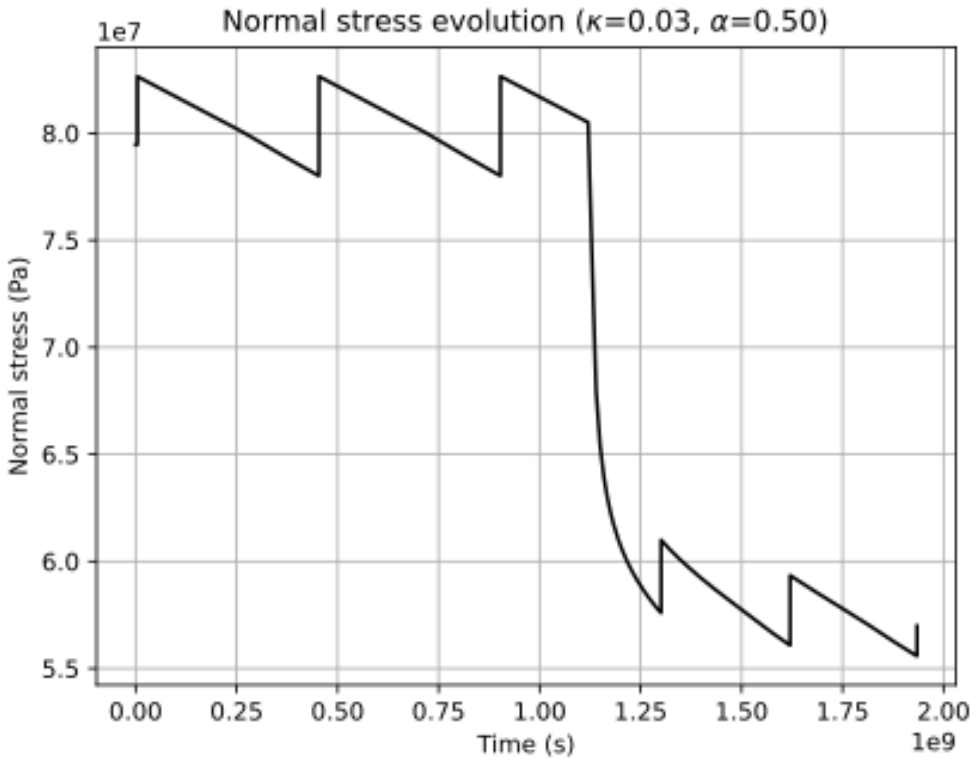


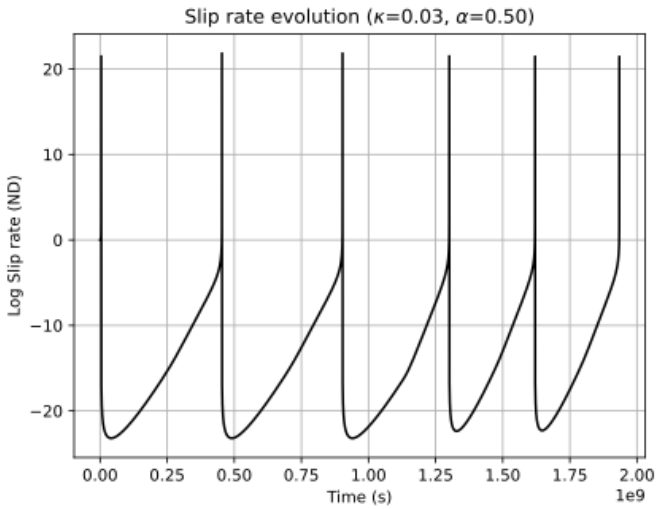
Ajout d’un délai

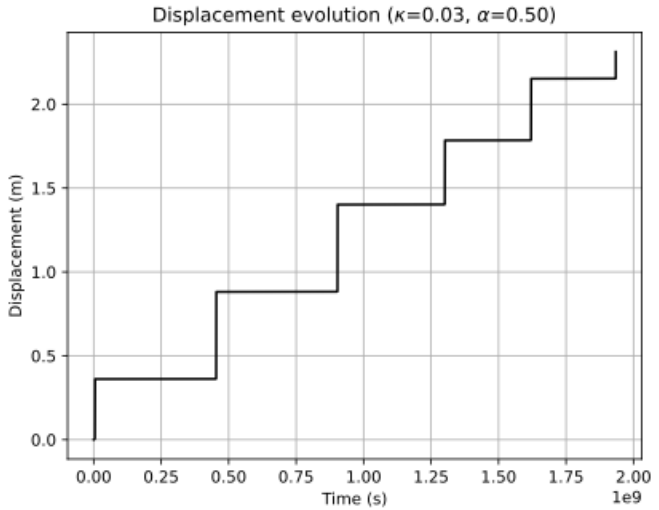


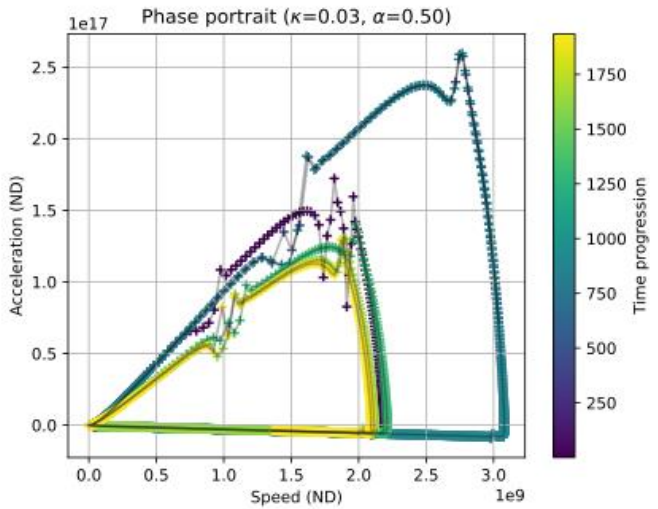
$$\left(\phi = \frac{\pi}{4}\right)$$

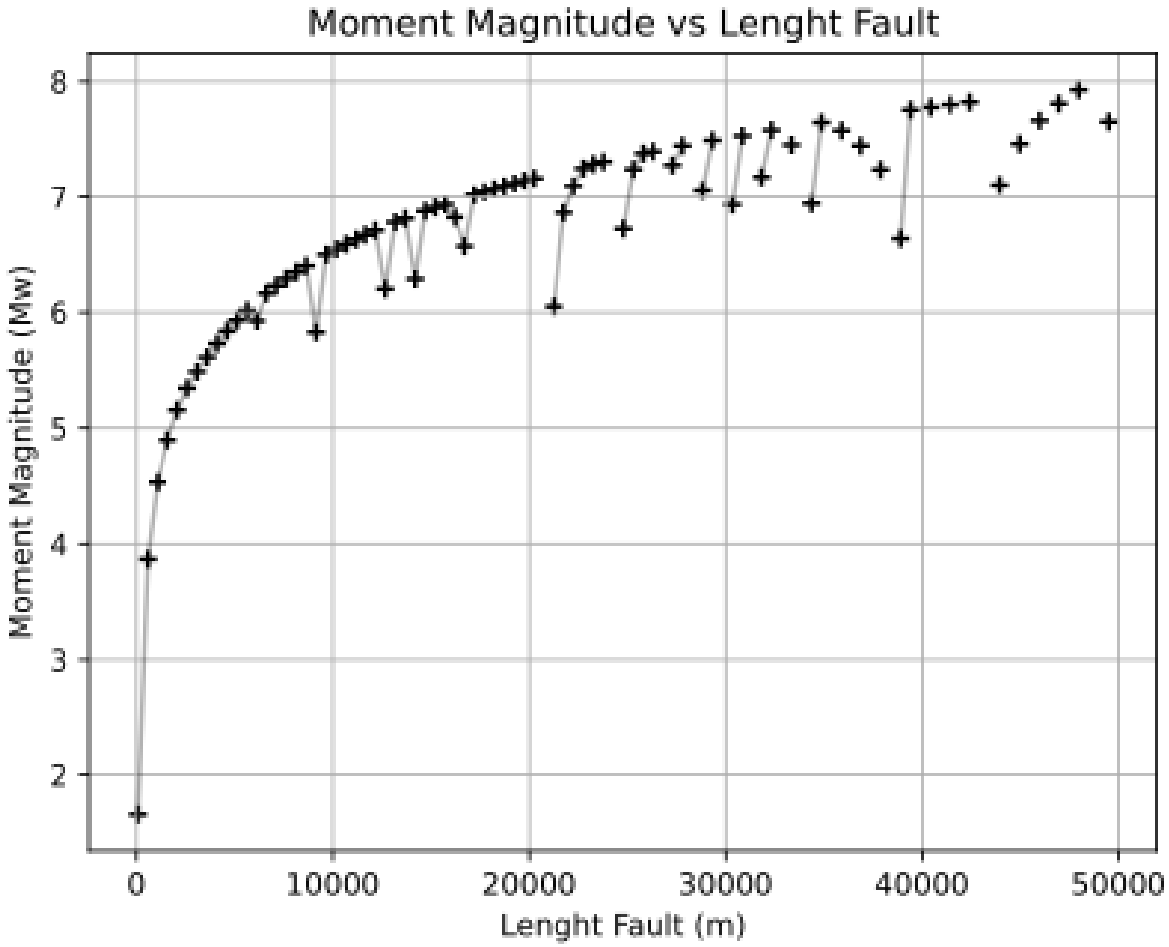


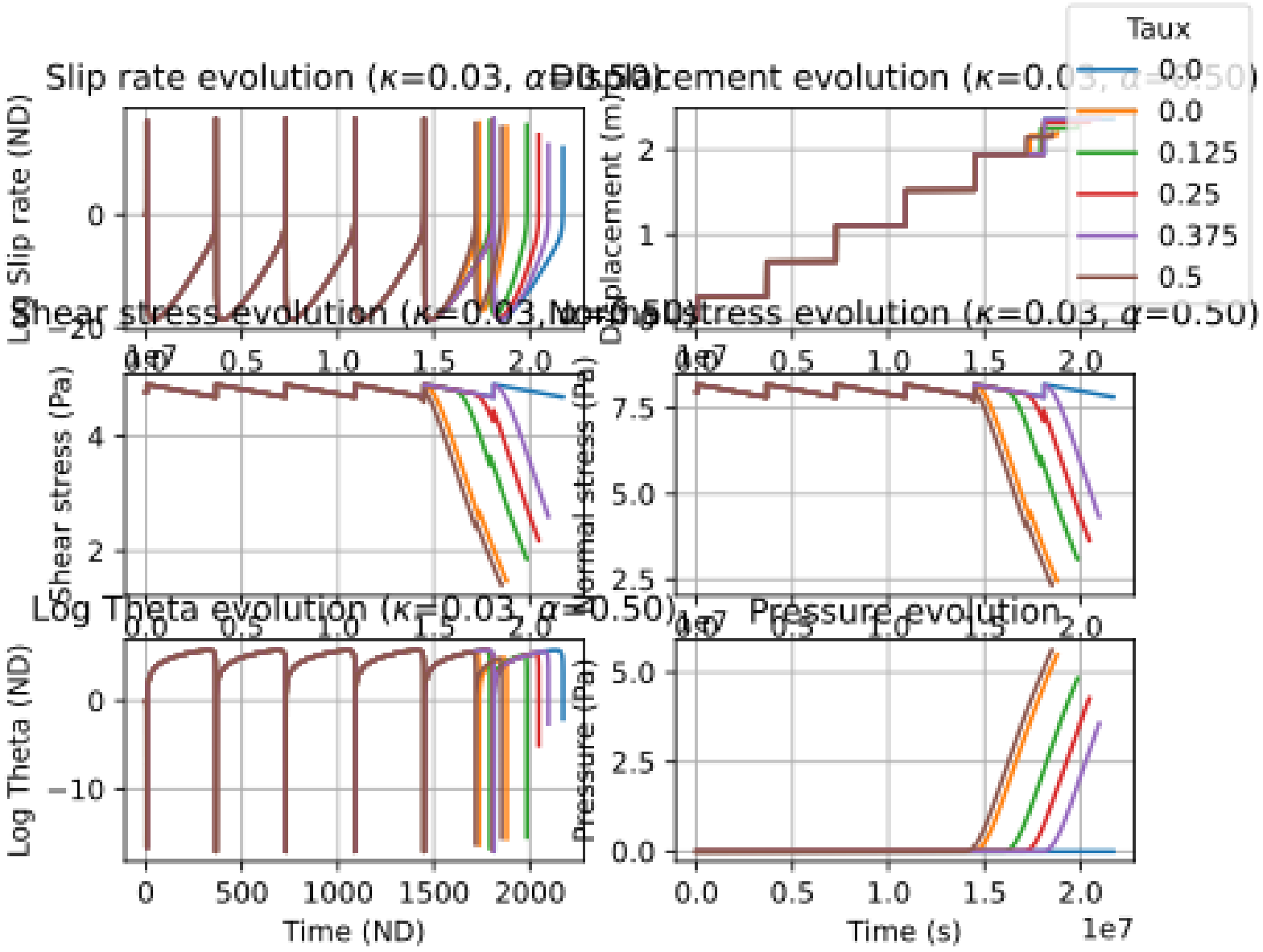



Slip rate evolution (κ=0.03, α=0.50)
Log Slip rate (ND)
Time (s)
1e9


Displacement evolution (κ=0.03, α=0.50)
Displacement (m)
Time (s)
1e9


Phase portrait (κ=0.03, α=0.50)
1e17
Acceleration (ND)
Speed (ND)
1e9
Time progression


Moment Magnitude vs Lenght Fault
Moment Magnitude (Mw)
Lenght Fault (m)
8
7
6
5
4
3
2
0
10000
20000
30000
40000
50000


Slip rate evolution (κ=0.03, α=0.50)
Log Slip rate (ND)
Displacement evolution (κ=0.03, α=0.50)
Displacement (m)
Taux
0.0
0.0
0.125
0.25
0.375
0.5
Shear stress evolution (κ=0.03, Normal stress evolution (κ=0.03, α=0.50)
Shear stress (Pa)
Normal stress (Pa)
1e7
Log Theta evolution (κ=0.03, α=0.50)
Pressure evolution
Log Theta (ND)
Pressure (Pa)
Time (ND)
Time (s)
1e7

Prise en compte de la poro-élasticité

$$\eta \frac{dv}{dt} = -k(v \sin(\phi) - v_p)\sin(\phi) - \left(\frac{df}{dt}\left(\sigma(t) + \sigma_{pe}^{(y)}(t) - P(t)\right) + \frac{d(\sigma + \sigma_{pe}^{(y)} - P)}{dt} f(t) \right) + \frac{d\sigma_{pe}^{(x)}}{dt}$$