$$\begin{cases} u_w = \dfrac{K K_{rw}(S)}{\mu_w} \nabla p \qquad \nabla p = \dfrac{\partial p}{\partial x} = \\ \qquad\qquad = p\text{-grad} \\ u_o = -\dfrac{K K_o(S)}{\mu_o} \nabla p \\ \dfrac{\partial (\varphi S_w)}{\partial t} + \operatorname{div}(u_w) = 0 \\ \dfrac{\partial (\varphi S_o)}{\partial t} + \operatorname{div}(u_o) = 0 \\ S_w + S_o = 1 \end{cases}$$