Questions

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We have three equations that we want to solve.

$$u = -\frac{k}{\mu_c}\nabla p,$$

$$\mu_c = \left(\frac{c}{mu_o^{\frac{1}{4}}} + \frac{1-c}{mu_s^{\frac{1}{4}}}\right)^{-4}$$

and,

$$\varphi\frac{\delta c}{\delta t} + \nabla(uc) = \nabla(\kappa\nabla c)$$

I am trying to understand how these equations are encoded in uw3.
I believe I understand how the Darcy velocity equation is encoded and solved. You define a Darcy model that takes velocity u and pressure p. You give this model a constitutive equation in the form $q + D\frac{d}{dx}(\phi) = 0$. Somehow, and I'm not sure where in the code this is, but q gets set to the velocity u, and the flux term ϕ, gets set to p. You then give D to be $\frac{k}{\mu_c}$. This encodes our Darcy flow equation in uw3.
Now, I am trying to understand how you specify the advection diffusion equation. You give the advection diffusion solver the material, velocity and something called u_Star_fn, which I think is some sort of history variable for the material. You then give it a diffusion equation constituative model. This is again of the form

$$q = D\frac{d\phi}{dx}, \tag{1}$$

where ϕ is some flux term. How is ϕ specified, where can I find this in the code, and how should D be defined?