In order to solve for the solute concentration of species i, c_i, the solute mass sorbed to solids $c_{P,i}$ and dissolved in the gas-phase $c_{G,i}$ are assumed to be functions of c_i. Expanding the time-dependent terms gives

$$\frac{\partial}{\partial t}(\theta c_i) + \frac{\partial}{\partial t}(\rho_b c_{P,i}) + \frac{\partial}{\partial t}(a_v c_{G,i}) = \\ (\theta + \rho_b k_{P,i} + a_v k_{G,i})\frac{\partial c_i}{\partial t} + (1 - k_{G,i})c_i\frac{\partial \theta}{\partial t} - (\rho_P c_{P,i} - k_{G,i}c_i)\frac{\partial \varepsilon}{\partial t} \tag{3-106}$$

where $k_{P,i} = \partial c_{P,i}/\partial c_i$ is the adsorption isotherm and $k_{G,i} = \partial c_{G,i}/\partial c_i$ is the linear volatilization. Equation 3-106 can then be written as

$$(\theta + \rho_b k_{P,i} + a_v k_{G,i})\frac{\partial c_i}{\partial t} + (1 - k_{G,i})c_i\frac{\partial \theta}{\partial t} - (\rho_P c_{P,i} - k_{G,i}c_i)\frac{\partial \varepsilon}{\partial t} + \nabla \cdot (c_i \mathbf{u}) \\ = \nabla \cdot [(D_D + D_e)\nabla c_i] + R_i + S_i$$

Saturated Porous Media

In the case of transport in saturated porous media, the governing equations are:

$$(\varepsilon + \rho_b k_{P,i})\frac{\partial c_i}{\partial t} + (c_i - \rho_P c_{P,i})\frac{\partial \varepsilon}{\partial t} + \nabla \cdot (c_i \mathbf{u}) = \\ \nabla \cdot [(D_{D,i} + \theta \tau_{F,i} D_{F,i})\nabla c_i] + R_i + S_i \tag{3-107}$$

Convection

Convection describes the movement of a species, such as a pollutant, with the bulk fluid velocity. In this interface you provide the velocities, $\mathbf{u}$, which correspond to superficial volume averages over a unit volume of the medium, including both pores and matrix. These velocities are sometimes called Darcy velocities, and defined as volume flow rates per unit cross section of the medium. This definition makes the velocity field continuous across the boundaries between porous regions and regions with free flow. The velocity field to be used in the Model Inputs section can for example be prescribed using the velocity field from a Darcy's Law or a Brinkman Equations interface.

The average linear fluid velocities $\mathbf{u}_a$, provides an estimate of the fluid velocity within the pores: