Thermodynamically Constrained Averaging Theory for Porous Media Flow: Why Bother?

William G. Gray
Environmental Sciences and Engineering, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599

Abstract. The thermodynamically constrained averaging theory (TCAT) has been proposed as a method for changing the scale at which flow and transport in porous media is modeled. The procedure consists of integrating both conservation equations and thermodynamic relations over regions of the scale of interest and then closing the equations making use of an entropy inequality. As this method has evolved it has made use of rather elaborate notation and very long derivations that are alleged to provide insight for describing single-phase flow, multiphase flow, heat transport, mass transport, and behavior of elastic solids. So the question arises as to whether this is just mathematical exercise or a tool that actually provides improved descriptions of the physical processes involved. Here we will cut through the mathematics and discuss some of the novel results of the TCAT approach that are useful for describing problems and assuring consistent transfer of information between scales.