INVESTIGATION OF FLOW AND SOLUTE TRANSPORT IN SATURATED POROUS MEDIA SUBJECTED TO VIOLATION TO THE CONTINUUM HYPOTHESIS

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An experimental and numerical work has been conducted to highlight the significance of violating the length scale constraints, which are required to correctly adopt the continuum hypothesis in porous media, on our ability to predict solute transport in such systems. In this system a gravel zone (50x50x60 cm) was constructed in a relatively large sand box (230x146x60 cm). The mean grain size of the gravel was 0.8 cm which suggests that the continuum hypothesis may be adopted in both the gravel and the sand zones. Dye was injected in the sand upgradient the gravel and samples were collected in the sand downgradient the gravel. The system was then allowed to violate length scale constraints in the gravel layer by successively decreasing its width. It has been found that when the system complies with all length scale constraints good match was generally observed between measurements and simulations. However, as the system begins to violate the upper limit length scale constraint (i.e., the dimension of the domain is relatively small compared with the size of the REV), large deviation between simulation based on the continuum approach and measurements were observed. This has been attributed to the effects of the interface boundary. When the system begins to violate the lower limit (i.e., the width of the gravel zone was on the order of magnitude of the gravel grains) better match was noticed. This has been attributed to the fact that the effect of the boundary becomes insignificant and the dispersion was able to spread solute across the domain.