

Hunting for Flow Paths with Darcy

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In the first half of the nineteen hundreds, flood forecasting was the main concern of hydrologists. The goal was to predict the storm hydrograph correctly. Where the water originated in the landscape was of little concern at that time. After all, one drop of water is like any other drop of water in the watershed. This changed when water quality became a concern. A defining moment was the pollution with Aldicarb of the Long Island aquifer in the eastern USA in the early nineteen eighties. Early attempts to forecast both the spatially distributed pesticide concentration and the ground water contamination failed miserably. Although since then, there have been many attempts to predict ground water contamination, there is still no agreement what the best approach is to predict solute transport and what flow paths are followed.

The basic tools for predictions of solute transport are Darcy's law, the conservation of mass and a term that defines the interactions of the dissolved solute with the soil and air. So why is it that we cannot agree on predictions of solute transport? It is not that Darcy was wrong. After all, Darcy only predicted the amount of water flowing through a column under an imposed hydraulic gradient. Also, the mass conservation law is correct. Not knowing the spatial distribution of the water flux is a main limitation. In this talk we will show how different assumptions of the soils and scales lead to different solute transport approaches. We will see using Darcy's law that the depths of the restricting layers are one of the major determinants for flow path predictions at larger scales while at the smaller scales the pore processes become important. The structure of the soil plays also a role and is especially important for micro organism and chemicals that are toxic at very low concentrations.