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Studying Vadose Zone Flow and Transport Processes: A Personal Look Back, ... and Forward (John Dalton Medal Lecture)

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In this presentation, to be given at the occasion of my receipt of the John Dalton Medal from the European Geophysical Union, I provide a personal look back of studying subsurface flow and transport processes. Looking back, it is clear that tremendous advances have been made from the time I first started as a student some 40 years ago. Actually, compared to the thousands of years during which humans tried to manipulate the earth's surface for improved agricultural and engineering practices, it is truly amazing that Darcy's law for saturated flow was first formulated only some 150 years ago, and the Richards equation for unsaturated flow less than 80 years ago. In this presentation I will focus especially on alternative formulations for modeling fluid flow and contaminant transport in the subsurface, including the use of dual-porosity and dual-permeability models for nonequilibrium transport. The various approaches are illustrated by means of a large number of examples, from transport through well-controlled laboratory soil columns to flow and contaminant transport at the larger field scale. Looking forward, I will also give a personal view of what I believe comes next, and the topics I would work on if I could somehow start now all over again.