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1D interpretation of chloride transport at field-scale: the effect of the transport volume on the local-scale and field-scale solute transport mechanism

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Understanding field–scale solute transport is a complex task because of heterogeneities at various scales inducing spatial and temporal variations in water flow velocities, converging or diverging flow trajectories, transverse dispersion. In these cases, 2D or even 3D transport models should be used for predictions. Nevertheless, transport of areawide surface applied chemicals is generally predicted using a 1D transport model, assuming that, on average, the transport process is one-dimensional and occurring in the vertical direction and the lateral solute transport can be neglected.

An effective method of assessing the lateral variability of solute movement is to analyze the spatial distribution of the so called solute transport volume, which can be defined as the volume fraction of the wetted pore-space which is active in the solute movement.

A steady state field tracer experiment was conducted on a tile-drained "Terra Rossa" plot located in Valenzano (Bari – Italy), to test whether TDR BTCs measured 1 m a part along a transect of 38 m can be used for prediction of field-scale BTC. A Generalized Transfer Function (GTF) (Zhang, 2000) was fitted to the observed concentration at three depths for each site along the transect to identify the transfer function parameters. At each of the 111 sampling positions, the transport volume was determined from the observed solute concentrations. The field scale transport volume is equivalent to the depth averaged volumetric water content if the average solute velocity is equal to the average pore water velocity.

The lateral variability of the solute movement at any depth was found greater than the vertical variability at any site. Also, the local transport volumes defined by the breakthrough curves were found to be much greater than the steady-state depth-averaged volumetric water content.