Introduction

• Time lag = intrinsic delay between remediation measures and improvements in water quality.
• Understanding time lag helps policymakers set realistic water quality targets.
• Time lag includes both groundwater (t<sub>g</sub>) and unsaturated zone (t<sub>u</sub>) components (Fig. 1).
• In situ measurement of t<sub>u</sub> can be prohibitively expensive and slow.
• Numerical models estimate t<sub>u</sub> based on soil and met. data.
• Estimates of t<sub>u</sub> coupled with groundwater travel times give a holistic appraisal of watershed time lag.

Model Input Data

• Meteorological data at hourly and daily resolution.
• Soil hydraulic parameters determined by:
  A. Generic textural data incorporated in the model.
  B. Pedotransfer functions based on detailed textural analysis.
  C. Measurement of the soil water characteristic curve (SWCC) and fitting of the Van Genuchten Mualem (VGM) equation.
  D. The VGM equation fitted to a partial SWCC (excluding the -15 bar pressure step).

Results

• Daily meteorological data underestimated t<sub>u</sub> (>0.47 years) compared to hourly resolution – hourly data were consequently used for soil parameter analysis.
• Typically small standard deviation in initial and peak breakthrough using various methods of parameter estimation (<0.10 years and <0.28 years, respectively).
• Regarding centre of mass and solute exit, standard deviation ranged between 0.03 and 0.24 years, and 0.14 and 0.70 years, respectively.
• Saturated assumptions dramatically underestimate t<sub>u</sub> compared to simulations.

Methods

• Conservative solute movement was simulated.
• Hourly vs. Daily meteorological resolution – 12 textural classes.
• Simple to complex soil data (Fig. 2) – nine real soil profiles.

Conclusions

• Hourly meteorological data are preferable.
• For initial or peak breakthrough, generic soil data are sufficient, precluding the need for SWCC construction.
• For centre of mass (indicating the bulk effect of measures) or total solute exit, the SWCC should be measured.
• The challenging -15 bar pressure step can be excluded from the SWCC with minimal effect on t<sub>u</sub> estimates – improving the speed and ease of analysis.
• These results should enable the judicious use of resources in calculating t<sub>u</sub> using Hydrus 1D.
• Validation of these estimates against in situ tracer tests in two vulnerable watersheds is in progress.

References

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