Quantification of Uncertainty for Transport-based Well Vulnerability Criteria

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Motivation
According to current Water Safety Plans, water suppliers and all other water actors should ensure safe drinking water supply by controlling the risk from catchment to tap through a preventive risk management concept. The most common concept to control the risk of drinking water contamination is the delineation of advection-based well-head protection zones. In 2006 Frind et. al extended this concept by introducing four intrinsic transport-based well vulnerability criteria. Our approach quantifies the uncertainty of well catchments and protection zones based on these advective-dispersive vulnerability criteria within a probabilistic framework, allowing water actors to take informed risk-based decisions in order to better control and manage the risk within their well catchment.

Approach
Four intrinsic transport-based well vulnerability criteria (Frind et. al, 2006): (a) Time $t_{\text{peak}}$ between a spill and arrival of peak concentration at the well, (b) Level of peak concentration $c_{\text{peak}}$ relative to the spill concentration, (c) Time $t_{\text{crit}}$ to breach a given drinking-water standard and (d) Time of exposure $t_{\text{exp}}$ (exceeding the water standard).

Discussion & Future Work
- Vulnerability isopercentile (VIP) maps are easy to understand
- VIPs support catchment managers with indispensable information
- Zones of higher and lower well vulnerability are displayed
- Allows prioritization of contamination sites
- Approach is independent of dimensionality and boundary conditions
- Conditioning method can be arbitrarily chosen (e.g. GLUE, EnKF)
- Computational savings and information gain justify model reduction

Future Work will be:
- Data assimilation by Bayesian GLUE
- Application to Copenhagen aquifer in cooperation with DTU
- Transfer to DuMuX, a flow and transport simulation platform
- Adopting the approach to a fracture-matrix system
- Application to a fractured system in cooperation with LW

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