

	6 月
文獻來源	Luca Locatelli, Philip J. Binning, Xavier Sanchez-Vila, Gitte Lemming Søndergaard, Louise Rosenberg, Poul L. Bjerg , (2019), A simple contaminant fate and transport modelling tool for management and risk assessment of groundwater pollution from contaminated sites , <i>Journal of Contaminant Hydrology</i> 2019, 221, 35-49.
英文	<p>Contaminated sites pose a significant threat to groundwater resources. There sources that can be allocated by water regulators for site investigation and clean up are limited compared to the large number of contaminated sites. Numerical transport models of individual sites require large amounts of data and are labor intensive to set up, and thus they are likely to be too expensive to be useful in the management of thousands of contaminated sites. Therefore, simple tools based on analytical solutions of contaminant transport models are widely used to assess (at an early stage) whether a site might pose a threat to groundwater. We present a tool consisting of five different models, representing common geological settings, contaminant pathways, and transport processes. The tool employs a simplified approach for preliminary, conservative, fast and inexpensive estimation of the contamination level s of aquifers. This is useful for risk assessment applications or to select and prioritize the sites, which should be targeted for further investigation. The tool is based on steady-state semi-analytical models simulating different contaminant transport scenarios from the source to downstream groundwater, and includes both unsaturated and saturated transport processes. The models combine existing analytical solutions from the literature for vertical (from the source to the top of the aquifer) and horizontal(within the aquifer)transport. The effect of net recharge causing a downward migration and an increase of vertical dispersion and dilution of the plume is also considered. Finally, we illustrate the application of the tool for a preliminary assessment of two contaminated sites in Denmark and compare the model results with field data. The comparison shows that a first preliminary assessment with conservative, and often non-site specific parameter selection, is qualitatively consistent with broad trends in observations and provides a conservative estimate of contamination.</p>
中文	<p>本研究是以風險評估應用為前提，發展最初步及快速方式可以篩選評估的工具。因應初步的要求，利用少量地質類型、來源分布及流場等資料，模擬污染場址初步概況。由於污染場址對地下水資源會構成重大威脅，當地下水監測管理單位面對數量眾多的污染場址時，須將資源分配至現場調查及整治復育，事實上很難將資源做到良好的分配應用。若是直接應用數值模式模擬，則須提供詳細的地質及水文現地調查資料，在控制場址調查階段前期，初步尚未有明確調查資料之前，無法有詳細的污染場址資料可</p>

供使用。因此監管單位希望發展可應用於多數污染場地進行初步簡單的評估工具，既能獲得初步資訊供管理參考又可提高經費資源使用效益。

故本研究提供由五種不同模型組成的工具，代表常見的地質背景、污染物污染途徑及傳輸過程機制，包括平流、延散、降解、連續降解及氣相擴散，特別是從源頭到含水層頂部的垂直傳輸與含水層內的水平傳輸耦合運算。此外，以三維水平傳輸模擬結果，說明地下含水層污染物傳輸時，會導致往下遷移並且增加垂直方向擴散與水平方向的濃度稀釋。該工具以簡化的方式對污染程度進行初步、保守及快速的估算，大大降低調查時間並減少費用，評估的結果可作為進一步調查的依據。作者所採用的工具基於半穩態分析模型，模擬從源頭到地下水下游的不同污染物傳輸情景，包括不飽和及飽和傳輸過程，對含水層下游污染場址的污染物濃度和質量排放進行保守估算。

最後，作者以此方式應用在丹麥兩個污染場地的初步評估，並將模型結果與現場數據進行比較。由於觀測數據少或是不同年度和不同採樣數據被合併，初步評估採用比較保守的方式，不是以現場數據做為模式的設定條件，使得模擬與現地的比較變得困難，因此研究結果只能在定性上與觀測數據比較，顯示模擬結果與觀測數據大方向趨勢是一致的。

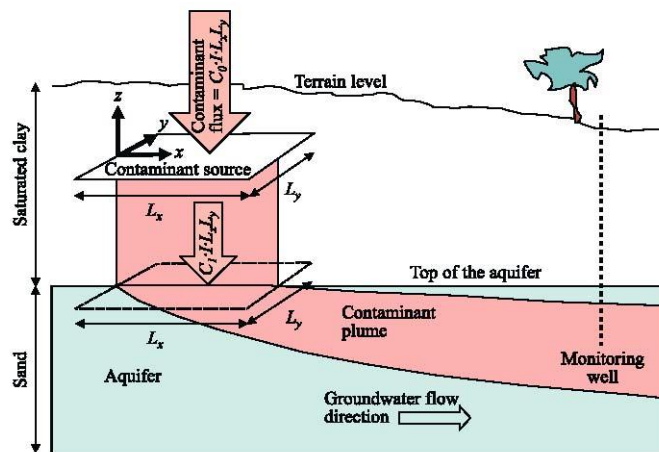


Fig. 1. Model I. Vertical contaminant transport from a source located in a homogeneous saturated clay, downward to the top of the aquifer and then horizontal transport in the aquifer.

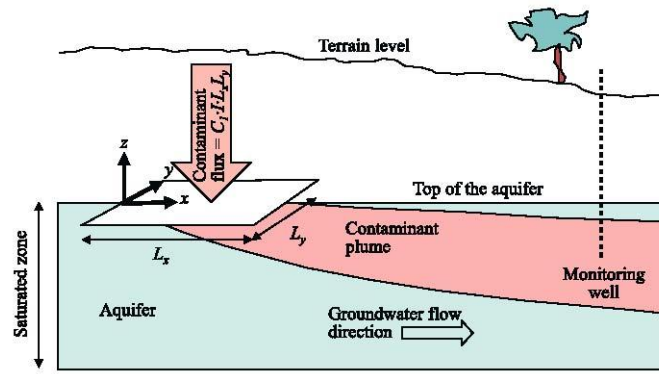


Fig. 5. Model V. Horizontal contaminant transport from a source located at the top of the aquifer.