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文獻來源	Linxian Huang, Lichun Wang , Yongyong Zhang, Liting Xing, Qichen Hao, Yong Xiao , Lizhi Yang and Henghua Zhu , Identification of Groundwater Pollution Sources by a SCE-UA Algorithm-Based Simulation/Optimization Model, (2018),A simple contaminant fate and transport modelling tool for management and risk assessment of groundwater pollution from contaminated sites , Water **2018**, 10, 193,*1-19*.
英文	Prevention and remediation strategies for groundwater pollution can be successfully carried out if the location, concentration, and release history of contaminants can be accurately identified. This, however, presents a challenge due to complex groundwater systems. To address this issue, a simulation-optimization (S/O) model by integrating MODFLOW and MT3DMS into a shuffled complex evolution (SCE-UA) optimization algorithm was proposed; this coupled model can identify the unknown groundwater pollution source characteristics. Moreover, the Grids Traversal algorithm was used for automatically searching all possible combinations of pollution source location. The performance of the proposed S/O model was tested by three hypothetical scenarios with various combinations of mixed situations (i.e., single and multiple pollution source locations, known and unknown pollution source locations, steady-state flow and transient flow). The field measurement errors was additionally considered and analyzed. Our results showed that this proposed S/O model performed reasonably well. The identified locations and concentrations of contaminants fairly matched with the imposed inputs with average normalized deviations less than 1% after sufficient generations. We further assessed the impact of generation number on the performance of the S/O model. The performance could be significantly improved by increasing generation number, which yet resulted in a heavy computational burden. Furthermore, the proposed S/O model performed more efficiently and robustly than the traditionally used artificial neural network (ANN)-based model. This is due to the internal linkage of numerical simulation in the S/O model that promotes the data exchange from external files to programming variables. This new model allows for solving the source-identification problems considering complex conditions, and thus for providing a platform for groundwater pollution prevention and management.
中文	地下水是中國華北地區寶貴的淡水供應來源。然而，在過去的幾十年中，因人口增長、非計畫中和規劃內的工業化以及農地灌溉活動影響，使得地下水受到人為污染。中國 90％城市的地下水已被污染，其中約 40％的城市地下水水質直接威脅到人們的健康。所以，地下水污染一直是中國環境上亟待解決問題。為了確保地下水可持續利用和開發，需要針對地下水提出預防、補救和管理策略。

對於準確判別污染源的工作，仍有許多尚未解決的問題，目前而言，這仍有待持續研究。如果可以準確地確定污染物的位置、濃度和流出歷史軌跡，地下水污染的預防和補救策略就可以成功。然而，由於複雜的地下水系統，這將會是極大的挑戰。

為了解決這個問題，本研究透過將 MODFLOW、MT3DMS 和 Grids Traversal Algorithm 三者，結合 SCE-UA 演算法組合成一個模擬優化模式。這個耦合模式可以辨識未知的地下水污染源。

本研究提出由Grids Traversal algorithm，自動搜索可能污染源位置的所有組合、MODFLOW模擬流場、MT3DMS模擬污染物傳輸、SCE-UA源頭位置及濃度評估的模擬優化識別模式。此模式假設三種情境，包括單一和多個污染源位置、已知和未知污染源位置以及穩態流和暫態流，經模擬誤差分析及判別源頭的誤差分析，以確定模擬優化模式獲得的結果是最佳的，整個研究成果顯示模式模擬結果良好。

除了模擬功能之外，也進一步評估了演算次數對模式功能的影響，證實可以透過增加演算次數使結果更為接近，但是相對的也增加計算量。

本研究所提出的模式演算，各功能模組的輸出入連結，從外部檔案到變量的數據交換都以數值方式處理連結，比傳統類神經網絡（ANN）的模式，更穩定，效率更高。研究結果表示這個新模式可以解決複雜條件下判別污染源頭的問題，從而提供地下水污染預防和管理的平台。