結合 GEMPY 與 FLOPY 開源模式
模擬沿海地區中海淡水相互作用

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摘要

水資源缺少已成為世界上的重大問題，而在沿海地區的地下水資源也可能被用作替代缺口的潛在水資源，但在沿海地區不可避免地會遇到海淡水共存的問題，因此需要透過觀測資料與數值模型了解海淡水的交界分布範圍，以及其受潮汐影響所造成的變化。水文地質數值模式模擬工作首重地質概念模型之建立，建構符合現地條件之地質模型可有效降低推估結果之不確定性，並提升水資源計算與評估之精準度。本研究研究旨在開發一個結合 GemPy 和 FloPy 的開源模式，並以國立中央大學 TaiCOAST 臨海工作站為目標用於模擬沿海含水層中的海淡水相互作用。GemPy 是一個基於隱式插值方法的地質建模套件，用於構建沿海含水層的三維地質模型。FloPy 是用於模擬 MODFLOW 和含水層系統的相關套件。本研究進行水文地質調查工作以獲取現場特定資料，包括岩心鑽探與地質材料判識、地下水位觀測、水文地質特徵參數等。地質模型使用從岩心樣本中獲得的數據來繪製沿海含水層的地層分佈圖。然後根據現場的長期觀察對地下水流模型進行了校準和驗證。系統地評估了現場的海底地下水的流向，並討論參數異質性引起的不確定性。

關鍵詞：沿海含水層、不確定性、開源軟體、海淡水相互作用、地質模型。

Integration of GemPy and FloPy packages for modeling seawater and freshwater interactions in coastal aquifers

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Abstract

Coastal groundwater resource is a potential alternative water resource to bridge the gap of increasing water demands. An accurate hydrogeological model could reduce the uncertainty of the flow and transport estimations in coastal aquifers. The study aims to develop a framework that integrates the open-source GemPy and FloPy for modeling seawater and freshwater interactions in the coastal aquifer in Taoyuan, Taiwan. The GemPy is a geological modeling suite based on implicit interpolation algorithms and is employed to build the 3D geological model for the coastal aquifer. The FloPy allows the users to simulate MODFLOW and the relevant modeling packages for aquifer systems. In the study, a series of field works were conducted to acquire site-specific information, including core drilling and identification of geological materials, groundwater level observation, and hydraulic tests. The geological model uses data obtained from the core samples to map the stratigraphic distribution of the coastal aquifer. The groundwater flow model was then calibrated and validated based on long-term observation at the site. The submarine groundwater discharge at the site was systematically assessed and the parameter heterogeneous induced uncertainty was evaluated.

Keyword: Coastal aquifer, uncertainty, open-source, seawater and freshwater interaction, geological model.