台灣屏東平原地下水與地表水相互作用耦合三維模型用於海水入侵管理

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摘要

研究區域：發展了一個連接地下流動和地表流體動力學的耦合框架，並將其應用於東亞台灣西南部屏東沿海含水層的實際案例研究。研究重點：採用FEFLOW 建立平均海平面（MSL）以下 250 m 的屏東淺層含水層的 3D 變密度與瞬態地下水模型。 此模型透過 IFM MIKE 11 耦合介面使用 MIKE 11 與一維河流網路模型（由主要河流及其兩條支流組成）耦合。此模型能夠分析降雨量、地表水和地下水補給滯後時間之間的關係。此外，對潛在河流淹沒和最大河流流量的分析使該模型能夠選擇最佳位置進行人工補給作為管理方案，以減輕海水的影響入侵（SWI）。 據作者所知，所發展的耦合模型是第一個分析地表水和地下水相互作用的詳細綜合框架，能夠為河網的恢復、恢復和管理做出貢獻。該地區的新水文見解：與台灣其他地區相比，該平原的雨季與旱季降雨量比顯著。此外，台灣南部是海河相互作用最大的地區，而高屏溪則扮演內陸海水入侵的通道角色。

關鍵字：耦合模型、地下水、地表水、海水入侵、台灣、有限元素地下流動系統(FEFLOW)

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Coupled three-dimensional modelling of groundwater-surface water interactions for management of seawater intrusion in Pingtung Plain, Taiwan

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ABSTRACT

Study region: A coupled framework, linking subsurface flow and surface hydrodynamics, is developed and applied to a real-world case study of Pingtung coastal aquifer in southwest of Taiwan, in East Asia.

Study focus: FEFLOW is adopted to develop a 3-D variable density and transient groundwater model of the Pingtung shallow aquifer lying 250 m below mean sea level (MSL). This model is coupled with a 1-D river network model, comprised of the main river and its two tributaries, using MIKE 11 through the IFM MIKE 11 coupling interface. The model is capable of analysing the relationship between rainfall, surface water and groundwater recharge lag time. Also, the analysis of potential river inundation and maximum river discharge enable the model to choose the best location to apply artificial recharge as a management scenario to mitigate the effect of seawater intrusion (SWI). To the authors' knowledge, the developed coupled model is the first detailed integrated framework analysing the interaction of surface and subsurface water, with the capability to contribute to the restoration, rehabilitation, and management of the river network.

New hydrological insights for the region: The rainfall ratio in the wet season to dry season is significant in this plain comparing with the rest of Taiwan. Also, southern Taiwan experiences the largest sea and river interaction, while Kaoping River playing as a pathway role for inland lead of seawater intrusion.