

使用數值模型評估含水層儲存和回收的可行性和 地理空間分析：在路易斯安那州的應用

Olivia aHaye, mad . abib, amid Vahdat-Aboueshagh, rank T.-C. Tsai, and avid orrok

報告者：李柏峯

指導教授：陳瑞昇 老師

共同指導教授：梁菁萍 老師

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摘要

含水層儲存和恢復 (ASR) 是針對地下水短缺地區的解決方案，但在路易斯安那州等潮濕地區尚未開發，該地區正在以驚人的速度透支含水層。在這些低梯度環境中，地表蓄水庫是不可行的，因此 ASR 可以提供一種替代方案來緩解地下水壓力並防止沉降和鹽水入侵。本研究的目的是評估 ASR 在路易斯安那州西南部 Chicot 含水層的可行性。該研究基於區域地下水模型，並結合對地表水和地下水資源的數量和質量以及土地利用的地理空間分析。使用統計分佈對每個標準進行評級，並將它們組合成一個適用性指數 (SI)，該指數定義了每個流域的可行性，考慮了由用戶對 ASR 的目的和數據可用性確定的標準組合。SI 被制定為一個混合加法乘乘函數，以便在指定被認為最限制 ASR 可行性的標準時提供靈活性。分析確定了 Chicot 含水層的中東部地區，該地區正因農業灌溉而遭受大量地下水壓力，最適合 ASR 作業。除了水資源可用性和含水層特徵的標準外，地表水的質量和土地利用因素也是限制可行流域的關鍵因素。



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Assessment of Aquifer Storage and Recovery Feasibility Using Numerical Modeling and Geospatial Analysis: Application in Louisiana

Olivia LaHaye, Emad H. Habib, Hamid Vahdat-Aboueshagh, Frank T.-C. Tsai, and David Borrok

Research Impact Statement: Our new hybrid function index integrates land use, water quality and quantity, and modeled aquifer parameters to identify the most promising areas for implementing aquifer storage and recovery.

ABSTRACT: Aquifer storage and recovery (ASR) is a solution for regions experiencing groundwater shortages, but is unexplored in wet regions such as Louisiana, which is experiencing aquifer overdrafting at alarming rates. Surface storage reservoirs are infeasible in these low-gradient environments, so ASR can provide an alternative to alleviate groundwater stress and prevent subsidence and saltwater intrusion. The purpose of this study was to assess the feasibility of ASR in the Chicot Aquifer in Southwest Louisiana. The study is based on a regional groundwater model combined with a geospatial analysis of the quantity and quality of surface water and groundwater resources and land use. A statistical distribution was used to rate each criterion and combine them into a suitability index (SI) that defines each watershed's feasibility considering combinations of criteria determined by the user's purpose for ASR and the availability of data. The SI was formulated as a hybrid additive-multiplicative function to provide flexibility in specifying criteria that are deemed most constraining for ASR feasibility. The analysis identified the east-central zone of the Chicot Aquifer, which is experiencing substantial groundwater stress from agricultural irrigation, as most suited for ASR operations. Besides the criteria on water availability and aquifer characteristics, the quality of the surface water and land-use considerations were key factors in constraining the feasible watersheds.