## AI-Driven Solutions for Groundwater Management and Subsidence Mitigation in Texas

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## ABSTRACT

Groundwater management issues arising from increased water scarcity stress due to shifting weather and climate conditions are vital drivers for resource managers in the 21<sup>st</sup> century. Land subsidence linked to groundwater abstraction is a key marker of unsustainable use of groundwater resources and is prevalent globally, particularly in Texas, USA. This research explores how AI tools, when combined with insights from subject matter experts, can significantly enhance understanding around possible options to improve groundwater management strategies. To prepare the basis for a robust information system tailored for subsidence in Texas, this study evaluates a multi-modal collection of subsidence data. The approach was designed to facilitate implementation of a reusable workflow capable of supporting geoscientists and decision-making organizations by providing AI-enhanced approaches to identify groundwater management techniques. The methodology includes Python-based topic analysis and large language model training and response testing to extract meaningful insights from video, text, geospatial data, state reports, and peer reviewed literature. Initial testing demonstrated workflow efficiency for topic analysis of large video and text libraries. The results outline a workflow that integrates AI tools to analyze collections of professional discourse and observed data, providing actionable information for subsidence district managers and geoscience researchers. Additionally, a levelized basis of understanding for stakeholders with varying levels of expertise makes subsidence knowledge more accessible. The resulting topic analyses facilitates deeper comprehension of the subsidence information landscape in Texas laying the groundwork for a state-wide subsidence information system project. AI-enhanced decision support systems show promise with positive implications for expansion of AI in natural resource management.

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