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AI-ENHANCED, SATELLITE-BASED HYDROLOGICAL MODEL FOR WATER SECURITY

Abstract

Climate change and unsustainable water management practices threaten global water resources. This study addresses this urgent challenge by developing a novel hydrological modeling framework that seamlessly integrates satellite data, artificial intelligence (AI), and a specialized autonomous amphibious rover. We utilized Landsat and Sentinel satellites to gather historical and large-scale hydrological data, encompassing surface water extent, soil moisture, and vegetation health. Custom-designed machine learning algorithms analyzed this satellite data to reveal complex patterns and trends. In parallel, our autonomous amphibious rover collected targeted, high-resolution, real-time ground-level data on water quality, flow rates, and other localized hydrological factors. The integration of satellite-derived insights, AI-based analysis, and the rover's unique data enabled the creation of a highly refined hydrological model, termed WISE (Water Intelligence from Space and Earth).

This comprehensive approach significantly outperformed traditional hydrological modeling methods in accuracy, detail, and predictive capabilities. The unique combination of satellite imagery, AI, and amphibious rover data acquisition provided multi-dimensional insights into hydrological dynamics. These insights enabled the precise identification of areas vulnerable to water scarcity or quality degradation, facilitating proactive decision-making in water resource management.

Our findings underscore the immense potential of technological synergy for advanced hydrological modeling, addressing climate-driven hydrological changes, and ensuring water security. This innovative framework establishes a powerful precedent for collaborative problem-solving, highlighting the vital role of space technology, AI, and specialized robotics in achieving sustainable water resource practices and global development goals. Importantly, this work directly contributes to UN SDG 6 (Clean Water and Sanitation) and aligns with goals related to climate action (SDG 13) and sustainable ecosystems (SDGs 14 15).

Keywords: Hydrological Modeling, Water Resource Management, Artificial Intelligence, Robotics, Amphibious Rover, Landsat, Sentinel, Satellite Data, Integrated Applications, Sustainable Development Goals