

Chapter 6

Optimizing Flood Risk Management Through Geospatial AI and Remote Sensing

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ABSTRACT

Flooding presents an increasing threat to communities globally, intensified by climate change and urban expansion. Effective flood risk management requires precise and timely information to guide decision-making and planning. This chapter explores the use of geospatial artificial intelligence (AI) in combination with remote sensing to enhance flood risk management. Advanced AI techniques are applied to analyze satellite and aerial images, enabling more accurate identification of flood-prone areas and prediction of potential flood events. Machine learning is utilized to integrate historical and real-time data, improving flood prediction models and evaluating the effectiveness of various mitigation strategies. A decision-support system is developed

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to leverage this technology, providing valuable insights for policymakers, emergency responders, and urban planners. This chapter demonstrate that the integration of geospatial AI and remote sensing can significantly advance flood risk management, offering a more proactive and resilient approach to addressing this critical issue.

INTRODUCTION

Artificial intelligence (AI) involves the development of intelligent machines capable of performing tasks that typically require human intelligence. With the rapid advancements in machine learning (ML), a branch of AI focused on developing models that learn from data, there is growing interest in exploring how these technologies can help address climate change challenges. While recent discussions have emphasized the potential of ML techniques for improving weather and climate modeling, there is also significant value in applying AI/ML to assess the risks and impacts of climate change, particularly in relation to extreme events like floods, droughts, heatwaves, and wildfires. The scope of AI's application extends beyond long-term predictive assessments, which often span decades, to include shorter timescales of days to months. This is crucial for climate resilience planning across various sectors, such as energy distribution, logistics, agriculture, supply chain management, and infrastructure, where timely predictions can inform proactive decision-making and risk mitigation strategies. By leveraging AI, organizations can better anticipate and adapt to the impacts of climate variability and extreme weather events, enhancing their ability to cope with future challenges.

Floods rank among the most common and destructive natural disasters, leading to significant loss of life and widespread damage to infrastructure around the globe. The intensifying impacts of climate change are expected to increase the frequency and severity of extreme weather events, including flooding, thereby raising risk levels in already vulnerable regions. This growing threat highlights the urgent need for precise and reliable flood hazard modeling to aid disaster risk reduction efforts and promote sustainable development. The field of flood hazard modeling has seen remarkable progress due to advancements in geospatial technologies and computational methods. Machine learning, in particular, has emerged as a promising tool for flood modeling because of its capacity to manage the complex, nonlinear relationships between flooding events and their contributing factors. Despite these advancements, there remain substantial research challenges, such as limited model interpretability, the need for more rigorous validation, and insufficient sensitivity analysis concerning the conditioning factors used as model inputs.

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