

AI: Climate Change and Disaster Management

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Abstract

This compilation examines the transformative role of *Artificial Intelligence* (AI) in climate change and disaster management. It covers AI applications across prediction, adaptation, and risk reduction, utilizing machine learning and deep learning for forecasting extreme weather, droughts, floods, and wildfires. AI enhances climate modeling, early warning systems, and resource optimization. The data highlights AI's contribution to urban resilience and public health preparedness against climate impacts. While acknowledging AI's potential for improved accuracy and efficiency, challenges related to data quality, interpretability, and ethics are also discussed.

Keywords

Artificial Intelligence (AI); Climate Change; Disaster Management; Machine Learning; Deep Learning; Drought Prediction; Flood Forecasting; Wildfire Management; Early Warning Systems; Climate Modeling; Explainable AI (XAI); Public Health

Introduction

This paper systematically reviews the application of Artificial Intelligence (AI) in predicting climate change and managing disasters. It highlights how various AI techniques, including machine learning and deep learning, are utilized for forecasting extreme weather events, assessing risks, and supporting decision-making during disaster response and recovery. The review emphasizes AI's potential to improve accuracy and efficiency in these critical areas, while also addressing inherent challenges like data availability, model interpretability, and ethical considerations [1].

This systematic review explores the role of Artificial Intelligence across all stages of disaster risk reduction, encompassing pre-

vention, preparedness, response, and recovery. It identifies common AI techniques, such as machine learning, deep learning, and natural language processing, deployed for early warning systems, damage assessment, resource allocation, and public communication during disasters. The authors underscore AI's capacity to boost disaster management efficiency and effectiveness, alongside discussing challenges related to data quality, ethical implications, and the necessity for interdisciplinary collaboration [2].

This review paper examines the increasing significance of Artificial Intelligence in climate change adaptation strategies. It covers applications ranging from predictive modeling of climate impacts to optimizing resource management for enhanced resilience. The discussion highlights how AI technologies can deepen our understanding of complex climate systems, improve early warning capabilities, and support effective decision-making across vital sectors like agriculture, water resources, and urban planning. The article also addresses challenges associated with data quality, model interpretability, and ethical considerations in deploying AI for climate adaptation [5].

This review synthesizes recent advancements and outlines fu-

ture directions in applying Artificial Intelligence to climate modeling. It covers how AI techniques are improving the accuracy and efficiency of climate simulations, from forecasting global temperature shifts to regional weather patterns. The paper underscores AI's ability to process extensive climate datasets, identify intricate relationships, and enhance our capability to project future climate scenarios, which is crucial for long-term climate action and resilience planning [8].

This review investigates the use of Machine Learning techniques in developing early warning systems for various climate-related hazards, including floods, droughts, and heatwaves. It thoroughly explains how ML models analyze vast datasets to predict hazard occurrences with greater accuracy and extended lead times, facilitating prompt preparedness and response actions. The paper underscores the potential of these systems to mitigate disaster impacts and bolster community resilience through proactive risk management [6].

This review offers a comprehensive overview of Artificial Intelligence applications in flood prediction and management, with a specific focus on their contribution to urban resilience. It details how AI techniques, particularly machine learning and deep learning, are employed for real-time flood forecasting, inundation mapping, and optimizing flood control strategies. The paper highlights AI's capacity to improve the responsiveness of urban infrastructure and communities to flood events, thereby minimizing damage and supporting quicker recovery [7].

This review concentrates on the application of Artificial Intelligence in advancing wildfire prediction and management strategies. It outlines how AI algorithms, including machine learning and deep learning, are used to forecast wildfire occurrence, spread, and intensity by analyzing environmental data, satellite imagery, and weather patterns. The paper highlights AI's role in developing more effective early warning systems and optimizing resource allocation for firefighting and post-disaster recovery, thereby strengthening resilience against wildfires [9].

This research introduces and evaluates Artificial Intelligence-based hybrid machine learning algorithms for meteorological drought prediction in the Middle East, utilizing climate time series data. The study effectively demonstrates these advanced models' ability to capture complex non-linear patterns within climate variables, leading to more accurate drought predictions. Improved drought forecasting is vital for enhancing water resource management and agricultural planning, directly contributing to regional climate resilience [3].

This study investigates advancements in drought prediction through Machine Learning and Explainable AI (XAI) from a global viewpoint. It clarifies how these technologies boost the accuracy and transparency of drought forecasting models by pinpointing crucial climatic drivers and their interactions. Integrating XAI offers insights into model decisions, which is essential for developing effective early warning systems and implementing targeted interventions to build drought resilience in vulnerable regions worldwide [4].

This paper reviews the current applications and future directions of Artificial Intelligence in tackling the interconnected challenges of climate change and public health. It explores how AI can assist in predicting climate-sensitive health outcomes, monitoring environmental health risks, and developing targeted interventions for vulnerable populations. The integration of AI tools aims to bolster health systems' resilience against climate-related diseases and extreme weather events, ensuring improved public health preparedness and response [10].

Description

This paper systematically reviews the application of Artificial Intelligence (AI) in predicting climate change and managing disasters. It highlights how various AI techniques, including machine learning and deep learning, are utilized for forecasting extreme weather events, assessing risks, and supporting decision-making during disaster response and recovery. The review emphasizes AI's potential to improve accuracy and efficiency in these critical areas, while also addressing inherent challenges like data availability, model interpretability, and ethical considerations [1]. This systematic review explores the role of Artificial Intelligence across all stages of disaster risk reduction, encompassing prevention, preparedness, response, and recovery. It identifies common AI techniques, such as machine learning, deep learning, and natural language processing, deployed for early warning systems, damage assessment, resource allocation, and public communication during disasters. The authors underscore AI's capacity to boost disaster management efficiency and effectiveness, alongside discussing challenges related to data quality, ethical implications, and the necessity for interdisciplinary collaboration [2]. These initial reviews establish the broad application of AI, encompassing prevention, preparedness, response, and recovery stages of disaster risk reduction. The recurring challenges include data availability, model interpretability, and ethical considerations in deploying AI solutions [1, 2].

This review paper examines the increasing significance of Arti-

ficial Intelligence in climate change adaptation strategies. It covers applications ranging from predictive modeling of climate impacts to optimizing resource management for enhanced resilience. The discussion highlights how AI technologies can deepen our understanding of complex climate systems, improve early warning capabilities, and support effective decision-making across vital sectors like agriculture, water resources, and urban planning. The article also addresses challenges associated with data quality, model interpretability, and ethical considerations in deploying AI for climate adaptation [5]. This review synthesizes recent advancements and outlines future directions in applying Artificial Intelligence to climate modeling. It covers how AI techniques are improving the accuracy and efficiency of climate simulations, from forecasting global temperature shifts to regional weather patterns. The paper underscores AI's ability to process extensive climate datasets, identify intricate relationships, and enhance our capability to project future climate scenarios, which is crucial for long-term climate action and resilience planning [8]. This review investigates the use of Machine Learning techniques in developing early warning systems for various climate-related hazards, including floods, droughts, and heatwaves. It thoroughly explains how ML models analyze vast datasets to predict hazard occurrences with greater accuracy and extended lead times, facilitating prompt preparedness and response actions. The paper underscores the potential of these systems to mitigate disaster impacts and bolster community resilience through proactive risk management [6]. These collective efforts deepen understanding of complex climate systems and enhance our capability to project future climate scenarios, which is crucial for long-term climate action and resilience planning [5, 6, 8].

This research introduces and evaluates Artificial Intelligence-based hybrid machine learning algorithms for meteorological drought prediction in the Middle East, utilizing climate time series data. The study effectively demonstrates these advanced models' ability to capture complex non-linear patterns within climate variables, leading to more accurate drought predictions. Improved drought forecasting is vital for enhancing water resource management and agricultural planning, directly contributing to regional climate resilience [3]. This study investigates advancements in drought prediction through Machine Learning and Explainable AI (XAI) from a global viewpoint. It clarifies how these technologies boost the accuracy and transparency of drought forecasting models by pinpointing crucial climatic drivers and their interactions. Integrating XAI offers insights into model decisions, which is essential for developing effective early warning systems and implementing targeted interventions to build drought resilience in vulnerable regions worldwide [4]. Together, these studies highlight the advanced

capabilities of AI in capturing complex non-linear patterns within climate variables, leading to more accurate and transparent drought predictions essential for water resource management and agricultural planning [3, 4].

This review offers a comprehensive overview of Artificial Intelligence applications in flood prediction and management, with a specific focus on their contribution to urban resilience. It details how AI techniques, particularly machine learning and deep learning, are employed for real-time flood forecasting, inundation mapping, and optimizing flood control strategies. The paper highlights AI's capacity to improve the responsiveness of urban infrastructure and communities to flood events, thereby minimizing damage and supporting quicker recovery [7]. This review concentrates on the application of Artificial Intelligence in advancing wildfire prediction and management strategies. It outlines how AI algorithms, including machine learning and deep learning, are used to forecast wildfire occurrence, spread, and intensity by analyzing environmental data, satellite imagery, and weather patterns. The paper highlights AI's role in developing more effective early warning systems and optimizing resource allocation for firefighting and post-disaster recovery, thereby strengthening resilience against wildfires [9]. These applications demonstrate AI's capacity to significantly improve responsiveness, minimize damage, and support quicker recovery efforts for specific climate hazards [7, 9].

This paper reviews the current applications and future directions of Artificial Intelligence in tackling the interconnected challenges of climate change and public health. It explores how AI can assist in predicting climate-sensitive health outcomes, monitoring environmental health risks, and developing targeted interventions for vulnerable populations. The integration of AI tools aims to bolster health systems' resilience against climate-related diseases and extreme weather events, ensuring improved public health preparedness and response [10].

Conclusion

Artificial Intelligence (AI) plays a pivotal role in addressing climate change and disaster management. Reviews highlight AI's application in predicting climate change, managing disasters, and enhancing climate adaptation strategies. Machine learning and deep learning techniques are fundamental for forecasting extreme weather events, assessing risks, and supporting decision-making during disaster response and recovery. AI's potential to improve accuracy and efficiency in these critical areas is consistently emphasized. Specific applications include meteorological drought prediction, utiliz-

ing hybrid machine learning algorithms to capture complex non-linear patterns for more accurate forecasts. Explainable AI (XAI) further boosts the transparency and accuracy of drought forecasting by pinpointing crucial climatic drivers. AI is also critical for developing early warning systems for various climate-related hazards, like floods, droughts, and heatwaves. These systems analyze vast datasets to predict hazard occurrences with greater accuracy and extended lead times, facilitating prompt preparedness and bolstering community resilience. Furthermore, AI contributes to urban resilience by improving real-time flood forecasting, inundation mapping, and optimizing flood control strategies. In climate modeling, AI enhances the accuracy and efficiency of simulations, processing extensive climate datasets to project future scenarios relevant for long-term action. AI algorithms are applied to advance wildfire prediction and management, forecasting occurrence, spread, and intensity, and optimizing resource allocation for firefighting and post-disaster recovery. The intersection of climate change and public health also benefits from AI, which helps predict climate-sensitive health outcomes and monitor environmental health risks, strengthening health systems against climate-related diseases. Despite its vast potential, common challenges discussed across these papers include data availability, data quality, model interpretability, and ethical considerations, underscoring the necessity for interdisciplinary collaboration in deploying AI solutions.

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