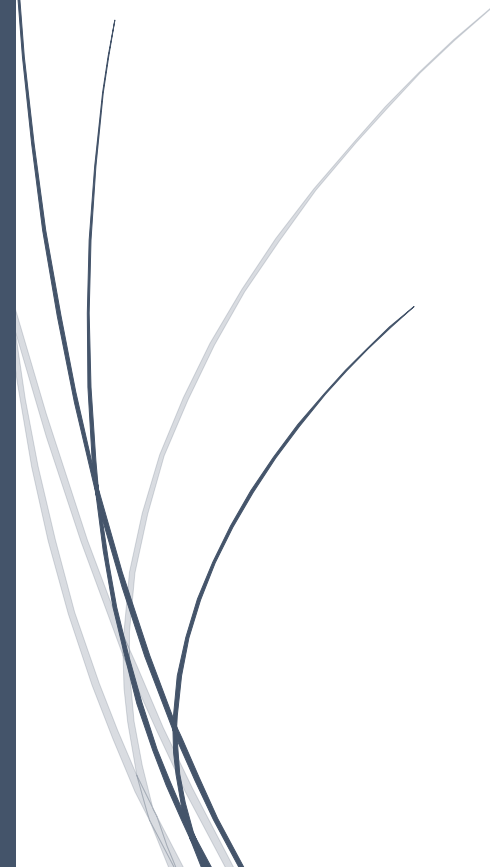


The logo for RADemics, featuring the text "RADemics" in white on a blue arrow-shaped background pointing to the right. The arrow is part of a larger blue graphic element on the left side of the page.

RADemics

AI-Based Climate Change Impact Assessment on Ecosystems and Human Health

A decorative graphic on the left side of the page consisting of several thin, curved lines in shades of blue and grey, resembling stylized grass or reeds.

Pradeep Kumar Tiwari, Sameer Sonawane
Dayanand Academy of Management Studies,
Bharati Vidyapeeth's Institute of Management

AI-Based Climate Change Impact Assessment on Ecosystems and Human Health

¹Pradeep Kumar Tiwari, Assistant Professor, Computer Applications, Dayanand Academy of Management Studies, Kanpur Nagar, Uttar Pradesh, India. Pradeeptripathi.iit@gmail.com

²Sameer Sonawane, Assistant Professor, Bharati Vidyapeeth's Institute of Management Studies & Research, Navi-Mumbai. sameersonawane@bvimsr.com

Abstract

The increasing impacts of climate change pose significant risks to ecosystems, human health, and global sustainability. This chapter explores the integration of Artificial Intelligence (AI) and Machine Learning (ML) techniques in assessing and predicting climate change impacts, with a focus on agricultural systems, public health, and extreme climate events. AI's ability to process vast, multi-source data allows for improved climate predictions, real-time monitoring, and the development of adaptive strategies that enhance resilience. By employing data fusion techniques, AI models can seamlessly integrate satellite imagery, sensor data, and historical records to forecast climate-induced disruptions with higher accuracy. Furthermore, these models are essential for assessing the cascading effects of climate variability on food security, disease spread, and ecosystem health. The chapter also highlights the potential of AI to optimize resource management and disaster response by identifying vulnerable regions and predicting future climate scenarios. As climate change continues to threaten global stability, AI-based predictive models emerge as a powerful tool for informed decision-making and effective climate adaptation.

Keywords: Artificial Intelligence, Machine Learning, Climate Change, Predictive Models, Data Fusion, Climate Resilience.

Introduction

Climate change has emerged as one of the most pressing challenges of the 21st century, with profound implications for ecosystems, human health, and global economic stability [1]. As the world continues to experience shifts in temperature, altered precipitation patterns [2], and the increasing frequency of extreme weather events, the need for accurate, timely, and actionable climate predictions has never been more urgent [3]. Traditional climate models, while valuable, often struggle to capture the complexity and dynamism of climate systems, which are influenced by numerous variables interacting across different spatial and temporal scales [4]. In this context, Artificial Intelligence (AI) and Machine Learning (ML) have emerged as critical tools for enhancing climate change impact assessments, offering powerful capabilities to process large-scale, heterogeneous data and uncover patterns that were previously difficult to detect [5].

AI and ML techniques enable the integration of diverse data sources, such as satellite imagery, weather station records, environmental sensors [6], and historical climate data, to develop more robust and dynamic predictive models [7]. These technologies are particularly useful in addressing the challenges posed by the complexity and interconnectedness of climate systems [8]. By utilizing

machine learning algorithms, researchers can analyze these vast datasets to uncover hidden relationships and make more accurate predictions about future climate scenarios. These predictions, in turn, support the development of proactive strategies for mitigating the effects of climate change on agriculture, public health, ecosystems, and infrastructure [9]. The ability of AI to continuously learn and refine its models based on new data is one of the key advantages of this approach, enabling better adaptation to the evolving nature of climate impacts [10].

One of the most significant applications of AI in climate change impact assessment is in the modeling and prediction of extreme climate events, such as heatwaves, hurricanes, and droughts [11]. These events have wide-ranging effects on both ecosystems and human populations, with consequences for food security, water availability, and public health [12]. By leveraging AI-driven predictive models, climate scientists can forecast the likelihood, intensity, and geographic distribution of such events with greater accuracy and lead time [13]. This enhanced predictive capability allows for better preparedness, enabling governments, organizations, and communities to take preventive measures and allocate resources more effectively [14]. AI can also simulate different climate scenarios, providing insights into how various climate variables such as rising temperatures or changes in precipitation patterns could impact the frequency and severity of extreme weather events in the future [15].