



Different Applications of Artificial Intelligence to Combat Climate Change Issues

Rakshit Jakhar¹, Garima Singh², Ravi Raj³, Kumkum Kumari⁴, Preeti Sachar⁵, P. Syam Prasad⁶

^{1,2}Department of Geography, University of Mumbai, Mumbai, India,
therakshit27@gmail.com, garimasinghmu@gmail.com

³Faculty of Computer Science, Electronics, and Telecommunications, AGH University of Science and Technology, Poland, Email- raj@agh.edu.pl

⁴Department of Botany, D. A. V. P. G. College (Siwan), Jai Prakash University, Chapra, India,
pandeykumkumraj715@gmail.com

⁵Department of Geography, University of Delhi, Delhi, India,
preetisachar18@gmail.com

⁶Department of Physics, National Institute of Technology (NIT), Warangal, Telangana, India
syamprasad@nitw.ac.in

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ABSTRACT

Artificial intelligence (AI) is the most famous technology in recent decades providing solutions to very complex issues facing human beings. From space exploration, transport, military, entertainment, healthcare, and governmental applications, AI is becoming a game-changer technique to overcome the problems that are related to our societies, especially with the emerging technologies such as processors of small-sized with high speed and high-speed communications. In recent decades climate change has become a major threat to our ecological system due to its bad effect on almost every part of the environment. Various environmental problems can be detected and overcome by AI applications. This paper discusses the several applications of AI technology to provide the solutions and monitors to protect the environment, management of wastewater, reduce air pollution, climate forecasting, and many more.

Key words: Artificial Intelligence, Climate Change, Earth System Models, Machine Learning, Pollution, Vulnerabilities.

1. INTRODUCTION

Artificial intelligence (AI) significantly impacts lives, facilitated by important enhancements in the availability of processors, cheap data storage, connectivity, and speed. AI is enhancing health and medical provision, systems of food supply, security support, transport delivery, and interaction with the internet are changing the structure of geopolitics. Human beings are approaching the era of accurate speech and

character recognition, self-driving vehicles, receiving the suggestions of tailored purchase, and helping medical practitioners by providing an accurate medical diagnosis. Simultaneously, advancing lifestyles should be obliged to interact cautiously with climate change. These climate change issues are very harmful for the power systems because it is the main reason behind Islanding incidents in the energy systems [1]. There is an enhancing realization that environmental change effects are not an individual threat, instead of requiring high responses of holistic alongside focusing on other societal problems. Climate change is a multifaceted and complex scientific problem, flexible to AI analysis, but normally, it has been not yet happened. Although, constraints of the architecture of computational and power of AI have blocked their implication, and mostly for problems as intensive of data as climate change.

Several technologies illustrate novel methods of computation, including Machine learning (ML), Deep learning (DL), AI, and big data. Big data is related to utilizing complex datasets, thus huge that general techniques of analysis are unsuitable. For weather and climate applications, a schematic characterization can be done by: step-1 big data as the crowdsource for analysis of earth system or meteorological related quantifications, and high temporal and spatial resolution outputs of the model of the earth system, step-2 ML as discovering or refining novel linkages between quantities, locations, and times in the datasets and step-3 AI as building on relations that discovered by ML, to give automatic warnings and assist to human beings to reaching extremes of weather.

Recent advancements in computer science allow us to build a better model for weather forecasting, with the

resolution of the grid at mostly kilometer scale. Although many procedures are still specified, such best grids allow precise estimation of the tracks of the storm, systems of mesoscale cloud, and events of deep convective. Earth system models (ESM) are mostly utilized as the models for weather forecasting, having a dynamical core. Various ESMs illustrate the carbon cycle at the global level, linking emissions in the known domain and future trends to atmospheric greenhouse gases levels, which are then treated as a diagnostic model. But unfortunately, computers are still not enough fast to run the operation of ESM at the resolution

of high order kilometers of weather forecasts to make so obstructs the timescales of the modeled century from accomplishing in a significant timeframe. Therefore, ESMs still maintain parameterization of crucial processes of sub-grid such as convection [2]. Figure 1 is providing a complete overview of applications of AI technologies in different ways to combat the problems of climate change. Climate change issues can be tackled by AI and ML techniques in several ways such as by ecological awareness, resilient infrastructures, social systems, and crisis readiness.

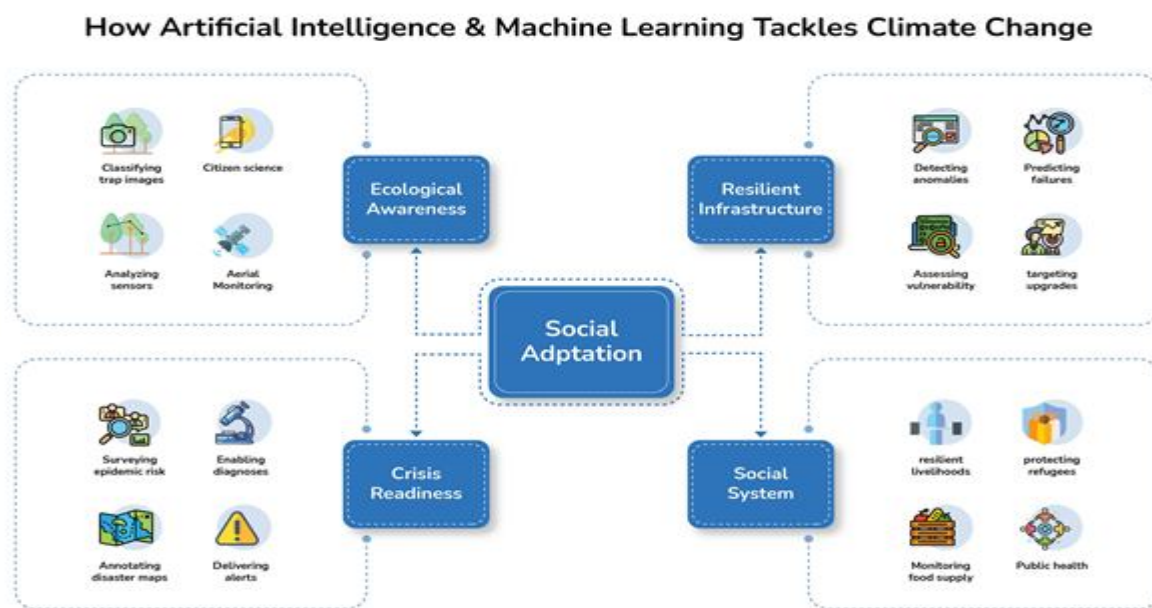


Figure 1: Different applications of AI and ML to combat Climate Change [3]

2. PREVIOUS WORK

In recent years, environmental and computer scientists are working together to combat the climate change problems associated with lives. S. Dewitte *et al.* [4] study the AI applications for weather forecasting, monitoring of climate, and decadal prediction. This article illustrates that AI implications can forward simultaneously to (1) An increased quality of forecast, (2) reduction of development of human effort, and (3) better efficient utilization of computing resources. Finally, AI must become a vital player in future climate and weather modeling and observation systems. B. Bochenek *et al.* [5] analyze the 500-most recent articles published since 2018, related to ML techniques in weather and climate prediction using the search engine Google scholar. By doing extensive literature surveys this article can predict the future research direction of AI application to tackle climate change problems. T. R. V. Anandharajan *et al.* [6] develop an intelligent module for the prediction of weather. This technique is intended to estimate the measurement of minimum temperature, maximum temperature, and rainfall by utilizing sampled period. This article analyzes intelligent prediction by the application of

ML techniques. These predictions and analyses are depending on linear regressions which can provide the weather forecasting for the next few days. A. McGovern *et al.* [7] discuss the AI application for the prediction of severe wind, classification of precipitation, storm wind, renewable energy forecast, severe hail, aviation turbulence, and storm duration. This article also illustrates the process of AI techniques through big data providing deeper insights into phenomena of high-impact weather. J. Y. Seo *et al.* [8] discuss a technique to develop two predictive models of deep learning by using remote sensing-based datasets, LSTM (Long short-term memory), and CNN (convolutional neural networks)-LSTM models. These models will be used for regular monitoring and optimal storage of spatiotemporal groundwater variations predictions that can aid sustainable increasement and efficient management of groundwater resources. E. Felsche *et al.* [9] discuss predicting the drought occurrence with the help of Artificial neural networks (ANN) in two European domains of contrast, Lisbon, and Munich, with a timeframe of one month. This article shows that seasonality mostly impacts the drought prediction performance, mainly focusing on the Lisbon domain. Explainable AI techniques such as Shapley additive

explanations (SHAP) are implied to acknowledge the better-trained algorithms. S. Scher [10] presents a technique to make operational forecasting for the weather. This article proves that it is realistic to utilize deep neural networks to estimate the total dynamics of a model of general simplified circulation, providing both better forecasts of the several state days ahead of models as well as fixed time-series for the long-term climate. Also, this paper illustrates that neural networks can learn the impact of slowly changing outer forcings on the system dynamics, but just provide wide regimes of forcing.

3. APPLICATIONS OF ARTIFICIAL INTELLIGENCE FOR ENVIRONMENT PROTECTION

With the recent developments of AI experiences, a wider challenge is to follow human-friendly AI and to get AI-Earth-friendly. As the requirement to respond to health, economic, and social impacts at scale enhances, AI might change the issue of our declining conditions of environments. There is the possibility to transform the systems of legacy and general techniques to focus on key problems such as natural food and shortages of water, climate change, insufficient urban planning, loss of biodiversity, and direct attention to the welfare of overall humanity. Figure 2 demonstrates the various areas of environments where AI technology must be implemented to overcome the several climate change problems.

3.1. Climate Change: Use of AI to optimize power generation and consumption in real-time; higher quality of power grid systems having enhanced efficiency and enhanced predictability, and utilization of renewable energy. Intelligent meters and sensors can be implied within buildings to gather

data and analyze monitoring and optimize power usage in buildings.

3.2. Biodiversity and Conservation: AI integration with satellite imagery can easily predict changes in the use of land, forest cover, vegetation, and the reduction of natural disasters. Predictive software has been implied to assist the unit's plan of anti-poaching their patrol routes.

3.3. Ocean Health: AI can collect datasets from locations of the ocean that are impossible or strong to reach and thus, aid protect habitats and species. AI is also helpful to track illegal fishing. Nowadays, AI integrated robot has been deployed to monitor the ocean problems such as Ph, temperature, and levels of pollution.

3.4. Security of Water: AI is extensively utilized by water scientists to predict usage of water in a significant geographical domain and make forecasts of weather to decide policy. Satellite integrated with AI technique can help to forecast soil, weather, and subsurface water problems and predicts droughts.

3.5. Quality of Air: Simulations having AI- technology can provide warnings to human beings living in big cities areas about the levels of pollution of their areas. There is several AI-integrated tool which can predict the level of pollution accurately and quickly. Also, utilizing data from radar sensors, cameras, and vehicles can help to improve the level of air pollution.

3.6. Disaster and Weather Resilience: Advanced sensors, drones, and similar tools having inbuilt AI technology can monitor windstorms, changes in sea level, tremors, floods, and other natural problems.



Figure 2: Different Areas of Environment Which needs more focus on AI technology to Overcome Climate Change [11]

4. FUTURE RESEARCH TRENDS

AI technology will play a vital role in the future to predict the changes in climate and later overcome the issues associated with the environment. Some technologists say AI and ML offer important promising techniques to respond to the impacts of changes in climate. AI can perform more rapidly than a human, might further forecast in the upcoming time, has a very low rate of error, and has 24/7 working potential [12]. Thus, it permits a higher prediction rate for extreme weather, natural disasters, flooding, and many more problems related to climate change. AI and ML utilize combinations of simulations, historical data, and real-time observations of satellites to monitor climate patterns much speedier than a human being. This technology might better monitor future incidents, including inherently forecasting the place of the next wildfire or utilizing previous data to enhance the production of food through soil information and weather tracking. Thus, in the future AI is going to play a major role to prevent disasters, management of wastewater, creating safer environments, predicting climate, reduction of air pollution, and warning human beings of impending dangers.

5. CONCLUSION

This article provides an overview of the various applications of artificial intelligence and machine learning techniques for the purpose of monitoring and combating climate change problems. Many scientific areas promote routine adoption of AI and ML technologies, which will have a variable rate of success. We hope that the application of AI to the predictions and they are after resolving the climate change issues are the better choice. This paper provides an overview of the early-stage researchers in this field of study. Furthermore, extensive research can be carried out by taking this article as the base. For the general policy of climate, embracing AI will mostly help the step-change required to create refined instruction about the states of climate change.

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