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Source: [AI for the planet BCG report July-2022](https://web-assets.bcg.com/ff/d7/90b70d9f405fa2b67c8498ed39f3/ai-for-the-planet-bcg-report-july-2022.pdf)

[Climate Change and AI](https://www.gpai.ai/projects/climate-change-and-ai.pdf)

[Role of AI in Climate Change](https://fermun.org/wp-content/uploads/2019/11/UNEP_1_ENGLISH.pdf)

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**Role of AI in Combatting Climate Change**

**Abstract:**

One of the most important worldwide issues of our day is climate change, which has profound effects on the economy, society, and ecology. Because artificial intelligence (AI) provides a potent instrument to address several elements of this complicated issue, its role in addressing climate change has garnered substantial attention in recent years. The purpose of this study is to investigate how artificial intelligence (AI) may be used to improve adaptation and resilience tactics while also reducing the consequences of climate change.

This research aims to present a thorough knowledge of how artificial intelligence (AI) may be utilized to address the many issues that climate change presents. To lower greenhouse gas emissions, increase energy efficiency, and promote sustainable behaviours, it aims to pinpoint and examine the main areas in which artificial intelligence might be useful. The study will also look at how AI may be used to predict and manage climate change's effects, such as severe weather, rising sea levels, and a decline in biodiversity.

The potential for this study to educate communities, corporations, and governments about the advantages and best practices for using AI in efforts to mitigate and adapt to climate change makes it significant. This study can help address one of the most important global concerns of our day by demonstrating the useful uses of AI in this field and helping to establish strategies and solutions that work.

**Introduction to Climate Change:**

Climate change is a long-term change in the average weather patterns that have come to define Earth’s local, regional, and global climates. These changes have a broad range of observed effects that are synonymous with the term. Changes observed in Earth’s climate since the mid-20th century are driven by human activities, particularly fossil fuel burning, which increases heat-trapping greenhouse gas levels in Earth’s atmosphere, raising Earth’s average surface temperature. Natural processes, which have been overwhelmed by human activities, can also contribute to climate change, including internal variability (e.g., cyclical ocean patterns like El Nino, La Nina, and the Pacific Decadal Oscillation) and external forcings (e.g., volcanic activity, changes in the Sun’s energy output, variations in Earth’s orbit).

Scientists use observations from the ground, air, and space, along with computer models, to monitor and study past, present, and future climate change. Climate data records provide evidence of climate change key indicators, such as global land and ocean temperature increases; rising sea levels; ice loss at Earth’s poles and in mountain glaciers; frequency and severity changes in extreme weather such as hurricanes, heatwaves, wildfires, droughts, floods, and precipitation; and cloud and vegetation cover changes.

**Introduction to AI:**

All computer algorithms generate forecasts, suggestions, or other types of choices based on a predetermined set of goals.10 AI techniques can be broadly categorized into two categories: statistical approaches, which rely on induction from data rather than deduction from rules, and symbolic approaches, which rely on established rules and logic to generate conclusions. Both strategies have their advantages depending on the situation, but machine learning (ML), a subset of statistical AI, has been substantially responsible for the current rise in the efficacy and acceptance of AI. The majority of AI methods discussed in this paper will be categorized as machine learning. An ML algorithm "learns" by recognizing patterns in the data, which may then be applied to forecast fresh data, rather than having the precise nature of the computations done known ahead of time. As a result, an ML system might be trained on thousands of labelled satellite images to determine which patterns make up trees. Then, given a fresh set of unlabelled satellite images, the algorithm could recognize the trees.

Certain types of issues can provide incredibly high performance from ML algorithms. These are typically data-rich situations where the solution entails identifying correlations between the solution and subtle patterns that exist in the data. Because of this, ML is effective in automating a variety of activities that humans would find simple (such as identifying the forested areas in a satellite image) and at resolving issues when there is more data than a human could comprehend. The use of machine learning (ML) and other AI algorithms has rapidly increased worldwide as a result of several advancements in these fields in recent years. AI is being widely used in several industries, including robotics, image tagging, healthcare, advertising, finance, and text correction and translation.

**Literature Review:**

Existing literature highlights the growing interest and potential of AI in combating climate change. Several studies have explored the use of AI for measuring and monitoring greenhouse gas emissions, optimizing energy systems, and supporting sustainable practices across various sectors (Rolnick et al., 2019; Kaack et al., 2021). One of the key areas where AI has shown promising applications is in the measurement and monitoring of emissions. Researchers have developed AI-based models to estimate carbon dioxide emissions from satellite imagery and other data sources (Climate TRACE, 2021). AI has also been used to monitor deforestation and changes in natural carbon sinks, contributing to our understanding of the carbon cycle (Pachama, 2022).

In the realm of mitigation, AI has been utilized to improve energy efficiency in various industries, such as optimizing supply chains, predicting demand for renewable energy sources, and controlling intelligent irrigation systems (BCG, 2022). Additionally, AI has been employed in research and development efforts for sustainable technologies, such as carbon capture and storage (Gentine et al., 2022). Regarding adaptation and resilience, AI has been applied in forecasting climate hazards, such as extreme weather events and sea-level rise (UNESCO, 2022). AI-based models have been developed to predict the impact of climate change on agricultural productivity, water resources, and biodiversity (IPCC, 2022).

While the existing literature highlights the potential of AI in addressing climate change, some gaps and areas need further exploration. Most of the current research has focused on developed countries, with limited attention given to the specific challenges and priorities of developing regions, which are often more vulnerable to the impacts of climate change (Radwan, 2023). Additionally, there is a need for more research on the ethical and responsible development and deployment of AI solutions in the context of climate change (Microsoft & BCG, 2022). This research aims to address these gaps by investigating how AI can be applied to solve the unique climate change challenges faced by developing regions, particularly in the Global South. It will also explore the ethical and responsible development and application of AI solutions in the context of climate change mitigation and adaptation. Furthermore, the study will examine how AI can support collaborative efforts and knowledge-sharing among various stakeholders, such as corporations, communities, academics, and policymakers, to enhance the effectiveness of climate change efforts.

**Major areas where AI can support climate action:**

AI is in a unique position to assist in managing these intricate problems as a tool. According to 87% of public and commercial sector climate and AI leaders surveyed globally by BCG ([Boston Consulting Group](https://www.bcg.com/)) in May 2022, AI is a useful tool in the battle against climate change. Additionally, 43% of leaders expressed interest in utilizing AI for their company's climate change initiatives, demonstrating a high degree of enthusiasm for the technology's potential to bring about positive change among these individuals. AI can be used to assist all stakeholders in adopting a more knowledgeable and data-driven approach to reducing carbon emissions and fostering a greener society because of its exceptional ability to collect, compile, and interpret large, complex data sets on emissions, climate impact, and more. Additionally, it can assist in reallocating global climate efforts to the most vulnerable areas.

**There are several key themes for how AI can accelerate climate action:**

1. Transforming raw data into knowledge that can be used: Large volumes of unstructured data can include valuable information that AI can find, frequently by scaling up annotations that people could more laboriously offer. Artificial intelligence (AI) can analyze satellite images to detect deforestation or designate city areas that are susceptible to coastal flooding. It can also screen through extensive databases of corporate financial statements to find information related to climate change.
2. Enhancing forecasts: AI is capable of forecasting future events based on historical data and, on occasion, additional information. AI, for instance, may estimate solar power generation at the minute level to assist in balancing the electrical grid or predict agricultural produce when extreme weather poses a threat to food security.
3. Improving complex systems. When faced with a complex system that has numerous variables that can be adjusted at once, AI techniques excel at optimizing for a particular goal. AI can be utilized, for instance, to improve freight transportation schedules or lower the amount of energy required to heat and cool a building.
4. Speeding up scientific research and modeling. AI has the potential to speed up scientific discovery by combining approximations gleaned from data with known physics-based limits. AI, for instance, can expedite testing by suggesting potential candidate materials for batteries and catalysts and can swiftly replicate parts of climate and weather models to make them more computationally tractable.

**Research Questions / Objectives:**

1. How may artificial intelligence be used to effectively address the particular climate change issues that developing nations—particularly those in the Global South—face?

Objective: Identify and evaluate the unique climate change vulnerabilities and requirements that developing countries have, and look into how artificial intelligence may be tailored to effectively address these problems.

In response, the source PDF emphasizes that wealthy nations have received the majority of the attention in the current research on AI applications for climate change, with emerging regions—particularly those in the Global South—getting less attention and facing different issues. These areas are frequently more susceptible to climate change's effects, including severe weather, rising sea levels, and disruptions to agriculture.

To address this gap, the research will aim to:

* Recognise and evaluate the particular demands and vulnerabilities posed by climate change for poor nations in the Global South, including the dangers associated with droughts, floods, and sea level rise.
* Examine how AI-based solutions, utilizing methods like machine learning, data analysis, and predictive modeling, might be tailored and adjusted to tackle these region-specific problems.
* Examine how artificial intelligence (AI) may help design resource management plans, infrastructure planning, and early warning systems that are specific to the needs of developing countries.
* Make sure that equitable and inclusive AI solutions for climate change are developed and implemented in the Global South, taking into account the needs of marginalized groups.

1. What are the ethical concerns and best practices for the responsible development and implementation of AI solutions in the context of mitigating and adapting to climate change?

Objective: The goal of this research is to provide a paradigm for morally and responsibly handling AI in climate change-related applications. The framework will take into account several issues, such as accountability, openness, prejudice, and data privacy.

In response, the source PDF notes that further study is necessary to fully understand how to develop and implement AI solutions ethically and responsibly in light of climate change (Microsoft & BCG, 2022). It is imperative to make sure that these solutions are created and implemented ethically and responsibly, given the substantial influence that AI-based choices and actions may have on tackling climate change.

* To accomplish this goal, create a thorough framework that takes into account important values like these to ensure the moral and responsible application of AI in efforts to mitigate and adapt to climate change.
* Data security and privacy: Making sure that private information on emissions, the effects of climate change, and vulnerable groups is safeguarded.
* Algorithmic fairness and bias: Recognising and reducing potential biases in AI models and their implementation, particularly when it comes to groups and areas that are disproportionately impacted.
* Transparency and accountability: Creating distinct channels of accountability and encouraging transparency in the decision-making processes of AI-powered systems.
* Human monitoring and control: Encouraging proper human participation and decision-making power when using AI technologies to address climate change.
* Using current frameworks and industry standards as a reference, provide best practices and recommendations for the ethical development, testing, and deployment of AI applications in climate change initiatives.
* Examine procedures including public-private collaborations, third-party audits, and multi-stakeholder governance that guarantee the moral and responsible application of AI.

1. How can the obstacles and difficulties preventing the broad acceptance and application of AI solutions for climate change be overcome?

Objective: To pinpoint the institutional, financial, and technological barriers preventing the uptake and scalability of AI solutions and to provide solutions.

The source PDF highlights several key obstacles and challenges that are preventing the widespread adoption and scaling of AI solutions for climate change, based on the findings of the BCG Climate AI survey:

* Lack of AI experience: A key hurdle mentioned by 78% of executives in the public and commercial sectors was a lack of AI expertise either inside or outside their company.
* Limited availability of AI solutions: 77% of respondents cited a shortage of goods and solutions for AI as a barrier.
* Lack of trust in AI data and analysis: Of those surveyed, 67% said they had little faith in the information and analysis that AI systems had to provide.
* The research will: Identify the specific institutional, financial, and technological barriers that are impeding the uptake and scalability of AI solutions, drawing insights from case studies, expert interviews, and survey results. • To address these barriers and facilitate the wider acceptance and application of AI solutions for climate change.
* Suggest tactics and measures to get beyond these obstacles, such as capacity-building initiatives to teach and retrain professionals, government employees, and other stakeholders in the appropriate application and interpretation of AI solutions.
* Techniques to make it easier to get funds and capital investments to close the gap between scholarly research and large-scale implementation.
* Methods to improve the openness, dependability, and credibility of climate solutions driven by AI, such as responsible AI procedures and quality control checks.
* Suggestions for cross-sectoral cooperation and public-private partnerships to speed up the creation, testing, and broad implementation of AI solutions.
* Techniques to encourage AI systems' interoperability and integration with current infrastructure and technologies, hence lowering vendor lock-in and facilitating simpler adoption.

**Potential Implications / Contributions:**

* Mitigation: AI can assist in reducing emissions and the impacts of greenhouse gases, measuring and tracking emissions at both the macro and micro levels, and removing current emissions from the environment. When used internationally, it can help cut greenhouse gas emissions by a quantity comparable to 5% to 10% of an organization's carbon footprint, or 2.6 to 5.3 gigatons of carbon dioxide equivalent (CO2e).
* Adaptation and Resilience: Artificial intelligence (AI) may be used to increase the capacity for adaptation and resilience, partly by enhancing hazard estimates of localized long-term consequences (like sea level rise) or catastrophic occurrences (like hurricanes or droughts). The management of exposure and vulnerability is another aspect of these efforts, and it involves building infrastructure that reduces the effect of climate risks, among other things.
* Basics: Artificial intelligence (AI) may support climate research and modeling, climate financing and analytics, and behaviour modification through teaching and nudging (e.g., by suggesting ecologically good products).
* Capacity Building: Retraining and training may guarantee that leaders in the corporate sector, government employees, and other stakeholders use and understand AI solutions in crucial situations. Customers must be ready to overcome vendor lock-in to guarantee the large-scale deployment of viable solutions.
* Resources and Networks: Links to business executives and policymakers may assist increase awareness and acceptance, while financial support can help close the gap between academic research and at-scale application. By exchanging information on potential applications and best practices, we can make sure that our solutions are prepared for business and government deployment at scale.
* Confidence and Trust: Leaders must have faith in AI users due to the technology's complexity and the potential for prejudice or immoral conduct, whether deliberate or inadvertent. They should concentrate on important aspects like the underlying data's quality and granularity and the analysis's interpretability to achieve this.
* Responsible AI: AI teams and their algorithms should go through frequent compliance assessments to guarantee the technology is used responsibly. AI teams should also follow best practices for privacy, fairness, human control, and other areas, as well as consult with domain experts and potentially impacted groups.

**Conclusion:**

The use of AI in the battle against climate change has several potential benefits. Stakeholders may make a substantial contribution to activities aimed at resilience, adaptation, and mitigation by utilizing AI technology. AI has the potential to be extremely helpful in monitoring, cutting, and eliminating greenhouse gas impacts and emissions, which will help to fulfill the objectives outlined in the Paris Agreement. According to the paper, AI has the potential to significantly lower global greenhouse gas emissions by as much as 2.6 to 5.3 gigatons of CO2e. the vital necessity of developing cooperative ecosystems and international collaboration to successfully address climate concerns. The statement underscores the significance of promoting climate-positive habits, streamlining procedures, and employing artificial intelligence to tackle transient climate pollutants.

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