CHPATER 12

Impact Trends of Artificial Intelligence on Climate Change within the context of Globalization

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ABSTRACT

While artificial intelligence (AI) offers innovative tools for addressing the global climate crisis, the existing literature lacks a comprehensive evaluation of its real-world implementation challenges and regulatory governance frameworks. To address this critical research gap, this study employs a comparative qualitative methodology, systematically analyzing diverse international case studies to evaluate both the environmental footprints and macro-level forecasting capabilities of widespread AI deployment. It is hypothetically considered that establishing flexible, well-structured national governance strategies can successfully mitigate the ecological costs of computational power while simultaneously maximizing predictive accuracy for complex climate trends. The research findings reveal that current AI initiatives significantly improve predictive precision in environmental modelling, yet they urgently require harmonized policy frameworks to offset their substantial energy consumption. Ultimately, this study provides actionable strategic recommendations for global policymakers to optimize AI integration within broader sustainable development agendas. This study also investigates the environmental impact of AI implementation projects based on international experience.

Introduction

The global climate crisis represents one of the most defining socio-economic and ontological challenges facing contemporary society. Anthropogenic greenhouse gas emissions have accelerated environmental degradation, leading to extreme weather events, rising sea levels, and severe disruptions to global food systems and water security[1]. In modern society, addressing climate change goes beyond ecosystem protection; it is directly tied to human survival, public health, economic security, and the safeguarding of vulnerable populations. As traditional mitigation approaches struggle to keep pace with the rapidly changing environment, the integration of advanced digital technologies has become imperative. In this context, artificial intelligence (AI) is creating new pathways to address climate change, offering a fresh perspective on this multifarious global crisis. Through leveraging machine learning, neural networks, and big data analytics, AI serves as a catalytic catalyst, bridging the divide between raw environmental data and actionable societal resilience and radically altering how human civilization perceives and responds to ecological instability. Being able to predict the possible impacts of climate change in advance and reduce their effects is especially important for safeguarding vulnerable communities, which often bear the brunt of environmental disasters despite contributing the least to global emissions. Data driven by AI plays a key role in producing highly accurate climate forecasts and guiding macro-level decision-making processes across public and private sectors. For instance, empirical research and framework documentation from the World Economic Forum suggests that AI could become an effective means of tackling catastrophic wildfires worldwide[2]. By continuously utilizing high-resolution satellite imagery, remote sensing infrastructure, and real-time meteorological data, it is possible to design more efficient systems for early detection, monitoring, and control of hazardous fires. Furthermore, advanced machine learning algorithms can accurately predict how these fires might spread across diverse topographies, enabling emergency response teams to refine resource allocation and execute timely evacuations. To make these disaster mitigation efforts truly effective, an integrated smart framework is urgently needed to combine all these disparate computational systems and generate dynamic wildfire risk maps through interactive modelling. Those frameworks allow for

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[1] IPCC 2023. "Climate Change 2023." Intergovernmental Panel on Climate Change (IPCC). https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf

[2] WEF. 2024. "Global Risks Report 2024."World Economic Forum. https://www.weforum.org/publications/global-risks-report-2024/.

the synchronization of multi-layered environmental parameters, transforming static historical data into predictive, real-time intelligence. However, the rapidly expanding use of AI also raises profound moral issues and may contribute to a larger digital carbon footprint due to the massive computational resources required to train sophisticated deep learning models[3]. For this reason, such powerful technologies must be managed carefully, transparently, and responsibly in accordance with comprehensive international standards. The institutional recognition of this technology's potential is already widespread among global industrial and political leaders. According to the 2022 BCG Climate AI Survey, 87% of private and public sector leaders responsible for artificial intelligence or climate change initiatives in their organizations believe that this technology is an important, necessary tool in addressing climate change[4]. This overwhelming consensus highlights a calculated shift in which artificial intelligence is increasingly central to the global climate agenda, transitioning from a niche computational novelty to a core pillar of sustainable macroeconomics.

This central role, however, creates a dual-faced technological paradox that calls for meticulous professional analysis. On the one hand, AI consumes vast amounts of electrical energy and requires a rapidly growing number of hyperscale data centres worldwide, which considerably increase area energy demand and threaten to overburden existing electrical grids[5]. On the other hand, when properly optimized, AI has the potential to revolutionize the transition to a low-carbon economy, improve industrial energy efficiency, enhance supply chains, and help businesses manage their

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[3] Cowls, Josh, Tsamados, Andreas, Taddeo, Mariarosaria, and Floridi, Luciano. 2023. "The AI Gambit: Leveraging Artificial Intelligence to Combat Climate Change—Opportunities, Challenges, and Recommendations." *AI & Society*, 38: 791–807. https://link.springer.com/article/10.1007/s00146-021-01294-x

[4] Dannouni, Amane, Deutscher, Stefan A., Dezzaz, Ghita, Elman, Adam, Gawel, Antonia, Hanna, Marsden, Hyland, Andrew, Kharij, Amjad, Maher, Hamid, Patterson, David, Jones, Edmond Rhys, Rothenberg, Juliet, Tber, Hamzam, Texier, Maud, and Ziat, Ali . 2022. "How AI Can Speed Climate Action." BCG. https://web-assets.bcg.com/72/cf/b609ac3d4ac6829bae6fa88b8329/bcg-accelerating-climate-action-with-ai-nov-2023-rev.pdf

[5] Cowls, Josh, Tsamados, Andreas, Taddeo, Mariarosaria, and Floridi, Luciano. 2023. "The AI Gambit: Leveraging Artificial Intelligence to Combat Climate Change—Opportunities, Challenges, and Recommendations." *AI & Society*, 38: 791–807. https://link.springer.com/article/10.1007/s00146-021-01294-x