

**Facing Climate Change Crisis: Interconnection between Artificial Intelligence and
Indigenous Knowledge**

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Introduction

The climate change crisis, a topic frequently addressed by scientists and governments, has expanded in scope with the advancements in technology. This critical issue has a history dating back to the early 19th century when scientists first began to suspect natural changes in paleoclimate and identify the natural greenhouse effect. Since then, people's understanding of climate change has undergone a significant transformation.

Nowadays more climate data is available than ever before, but how that data is accessed, interpreted, and acted on are crucial to combat the crisis. One technology that is good at it is Artificial Intelligence (AI) (United Nations Environment Program, 2022). AI works by building connections among massive data automatically. Exposing the data to AI models enables the algorithms to “play” with it and find statistical connections. The so-called ‘convolutional neural network algorithms used by AI have the potential to resolve climate change problems that vary in space and time (2019, European Space Agency).

However, despite new technology being a trend to help with climate change, the traditional knowledge from local people is still useful at present. Other than natural scientists, Native Americans are able to notice climate change the fastest. “Indigenous peoples have always been on the front lines,” says Nikki Cooley, who grew up without electricity or running water on the Navajo Nation reservation and now co-manages the Tribes and Climate Change Program for the Institute for Tribal Environmental Professionals (ITEP) in Flagstaff, Arizona. “Tribes have always been adapting to climate change. Now we have to adapt even faster.” (Jones, 2020) Native Americans are using their special ways to protect nature and eliminate the negative effects of climate change.

So it is worth investigating the way of combining AI and indigenous knowledge to overcome the climate change crisis.

Climate Change Crisis

The climate change crisis, together with the loss of biodiversity, is the greatest challenge facing our world. Global temperatures rose about 1.98° (1.1°C) from 1901 to 2020. Increased global average temperatures are having a profound effect on the environment and those effects will become more severe in the coming years. It also triggers sea level rise, drought and flooding, and more. Almost everything people rely on like water, energy, wildlife, agriculture, and ecosystems is experiencing the bad effects of the changing climate (National Centers for Environmental Information, 2021).

Human beings' food supply highly depends on climate and weather conditions. Although farmers and researchers may be able to adapt some agricultural techniques, the unstable climate can destroy all efforts. Increased temperatures, drought and water stress, diseases, and extreme weather make farmers and ranchers harder and harder to put food on tables.

Climate change impacts human health too. Heat is one of the most deadly weather phenomena which can lead to wildfires. As ocean temperatures rise, hurricanes are getting stronger and wetter, which can cause a huge amount of deaths. The spreading of diseases becomes easier due to more flooding.

AI Assists to Solve Climate Problems

AI can be utilized to tackle the challenges related to climate change by leveraging machine learning algorithms to process and analyze the massive datasets collected by Earth observation satellites. These datasets related to climate change can help researchers train the models to make accurate predictions about the future climate. The European Space Agency's

Climate Change Initiative (CCI) funds research teams to create accurate and long-term datasets which provide a comprehensive view of the Earth's climate change. Random forests and convolutional neural networks backed up by AI can improve detection rates of climate phenomena, such as making it easier to detect different land cover types or areas burned by wildfires (2019, European Space Agency).

By using AI, businesses can better understand, predict, and prepare for climate change and make more effective decisions to slow its pace and protect the environment. It is much easier to monitor and predict emissions, optimize energy production operations, and predict when equipment needs repair to reduce carbon-emitting failures. In agriculture-related companies, AI can also be used to monitor and protect crops, maximize yields, and conserve resources. (Gonzalez, 2022)

AI synthesizes predictions by analyzing trends, patterns, and the vast amounts of data collected. It means different things to different people. For scientists, AI is helpful to assist with research and allows them to develop more accurate climate models and predict future climate scenarios. While for policymakers, it provides a fast aisle to evaluate the costs and benefits of a possible policy or rule. For example, during urban planning, AI's comprehensive view set up a foundation for cities' design to be more livable. AI-supported "smart cities" can reduce resource waste by optimizing water and energy use, with such technology already rolling out in fast-growing cities in places such as Brazil and the Philippines.

AI serves as a valuable tool that not only uncovers insights into the uncertainties surrounding climate change but also enhances understanding of model outputs. This contributes to the development of better observation programs, model improvements, and the incorporation of AI into the modeling system itself.

Influence by Interactive AI models

Interactive AI is designed to engage in dynamic, two-way interactions with humans. This type of AI is good at understanding natural language and respond in a way that mimics human conversation, with the goal of providing useful information or assistance to the user (Mustafa Mert Çelikok; Peltola, Tomi; Dae, Pedram and Kaski, Samuel, 2019). Interactive AI is a rapidly evolving field, and it is undergoing continuous growth and advancing in recent years. It has many different types of systems and applications being developed, including chatbots. The chatbot, simulating and processing human conversation, allowing humans to interact with digital devices as if they were communicating with a real person, is becoming increasingly popular in 2023.

Currently, ChatGPT is the most popular application of chatbots widely used by people which is not only limited to addressing the climate change crisis. It is a natural language processing tool driven by AI technology that allows people to have human-like conversations and much more with the chatbot. The language model can answer questions and assist people with tasks like composing emails, essays, and code (Hao, 2023).

While facing the climate change crisis, ChatGPT shows its great potential for sorting data and giving out detailed responses in a second. It largely increases the efficiency for scientists or normal people to quickly learn a specific point of climate change. And for organizations in the climate area, ChatGPT offers a quick tool to revise advocacy materials, such as op-eds and flyers.

Some scientists also express concerns about new interactive AI like ChatGPT. The lack of transparency forms an outstanding issue. Although the chatbot might appear “open” to nontechnical users based on the free public access, the actual model behind it remains

closed-source, for the company provides little information about the process behind it. Without access to the inner workings of an AI model, it can be difficult to understand how the model processes information, makes decisions or arrives at specific outputs. It can also inadvertently perpetuate biases present in the training data, leading to unfair or discriminatory outcomes. Imagine there is a strong AI model to help all countries process environmental policy. If it's trained from biased datasets, it probably would choose to transfer the pollution from the wealthy countries to the poor ones which are not acceptable.

Training strong interactive AI models also costs a large amount of energy. A model from OpenAI used in ChatGPT, GPT-3 was estimated to produce about 500 metric tons of carbon dioxide while being trained—the equivalent of roughly 610 one-way direct flights from New York City to Paris.

Challenges for AI

The use of AI also brings new challenges for people.

One of the challenges is to begin to truly comprehend the complexities of the living part of our ecosystem, particularly the ocean. If people want to collect complete data on the ocean such as the number of volcanoes, the largely increasing time and expense will be hardly acceptable for most institutes. Without the complete data, it can be difficult for AI to provide correct predictions. So in order to solve this problem, scientists need to improve AI to better adapt to all kinds of datasets.

At the same time, the increasing use of AI also raised concerns about the enormous computational power it consumes, potentially making the climate change problem worse. Complex AI models require vast amounts of data processing and training. This energy consumption can lead to increased greenhouse gas emissions. So efforts should be made to

optimize algorithms, improve energy efficiency, and promote the use of renewable energy sources to mitigate the negative consequences associated with the increasing demand for computational power in the AI domain (Ekin, 2019).

Lack of access to high-quality data is also a critical challenge for AI in addressing climate change. Because a useful AI model needs to be trained with reliable and accurate data. High-quality data on climate change may come from a variety of sources, including remote sensing satellites, weather stations, oceanographic instruments, and socioeconomic databases. Data sharing and collaboration between international organizations, government agencies, research institutions, and private companies are crucial for obtaining and maintaining comprehensive, up-to-date datasets. However, plenty of organizations and countries don't want to share their data about climate due to the consideration of security. Getting access to the most climate data is necessary for AI's development to reach its full potential in combating climate change (Younanzadeh, 2022).

Integration of Indigenous Knowledge and AI

Indigenous knowledge plays a crucial role in mitigating the impacts of climate change. Local communities have developed their knowledge and practices over centuries of living in harmony with the natural environment. Integrating indigenous knowledge into climate decision-making can help scientists find a better solution for climate change problems.

In North America, some indigenous groups are striving to cope with climate change by focusing on the economic opportunities that it may create. For example, the increased demand for renewable energy using wind and solar power could make tribal lands an important resource for such energy, replacing fossil fuel-derived energy and limiting greenhouse gas emissions. The Great Plains could provide a tremendous wind resource and its development could help to reduce

greenhouse gas emissions as well as alleviate the management problem of the Missouri River hydropower, helping to maintain water levels for power generation, navigation, and recreation. These experiences are helpful data that can be used for training AI models.

Indigenous knowledge can help train AI models to understand things in a long-term vision. This helps when suggestions are given for the climate change problem by AI. Indigenous languages are rooted in an oral tradition that provides a different perspective different from the way English, which relies on the alphabet, develops AI systems in a more humane way. Indigenous cultures also value the "seventh generation stewardship" principle, which urges current generations to work for the benefit of the seventh generation into the future. The Great Law of the Iroquois pushes people to consider whether the decisions they make today would benefit children in the future. This principle could also be applied to the development of AI, forcing people to reflect on how they should treat AI as it becomes more sophisticated and intelligent. Ultimately, integrating Indigenous perspectives into the development of AI could lead to a more humane way of developing AI (Kesserwan, 2018).

Local communities have a unique relationship with the environment, and they view the natural world as a living entity that must be respected and protected. They have developed indigenous knowledge that provides them with information on how to tackle climate change.

The indigenous wisdom to restore degraded ecosystems, manage forests sustainably, and adapt to changing weather patterns is valuable for AI training. Incorporating indigenous knowledge into climate change strategies can also help promote cultural integrity and provide different views. For instance, tribes in Minnesota use controlled burns to promote healthier forests. These prescribed burns not only help remove forest waste but also encourage

biodiversity by preventing any single species of plant or tree from dominating an ecosystem (Wagle & Marohn, 2022).

To enhance the impact of Indigenous knowledge on climate change, it is crucial to train the AI models with the indigenous datasets. In this way, climate change policy can be co-developed by indigenous communities' wisdom (Samala, 2021).

Preserve Indigenous Knowledge by AI

With the assistance of AI, indigenous people protect biodiversity by monitoring the environment through the analysis of sound data from at-risk ecosystems. Specifically, advanced deep-learning neural networks can quickly analyze sound data and open up a window of time for critical intervention, especially in places plagued by illegal logging and mining. For instance, AI technology can detect the sounds of chainsaws or drills and send alerts to action-ready patrols on the ground. The partnership between Indigenous peoples and AI can also be useful in monitoring deforestation and tracking illegal fishing (Dimock, 2022)

The local language is the foundation of indigenous knowledge. There are about 250 different languages in Native American tribes and half of them are near extinction. So preserving the local language becomes an important task. AI is able to save languages by facilitating language documentation, learning, and accessibility. For example, a platform called First Voices by the First Peoples' Cultural Council (FPCC) archives linguistic data and produces teaching programs and apps for indigenous languages. Their latest innovation, the FirstVoices Keyboard App, allows users to type in over 100 Indigenous languages on their mobile devices (Ibaraki, 2018).

Indigenous languages are sacred to Native Americans' communities, and preserving their culture and speech is really important. But their reservations often lack basic resources like

electricity or the internet, and Indigenous people must be given sovereignty in any data collection or AI development process to ensure that the technology really will serve the people.

Conclusion

The integration of AI and Indigenous knowledge offers a special way to overcome the complex challenges brought on by the climate change crisis. AI has the great potential to collect and sort data, make quick responses, and view a problem in a more comprehensive view. However, people must also try to overcome the challenges AI has, such as energy consumption, data accessibility, and model transparency. And Indigenous knowledge provides valuable insights based on indigenous people's harmonious living style with nature. By incorporating Indigenous knowledge into AI models' training, people can make AI generate more sustainable and long-term solutions to combat the climate change crisis.

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