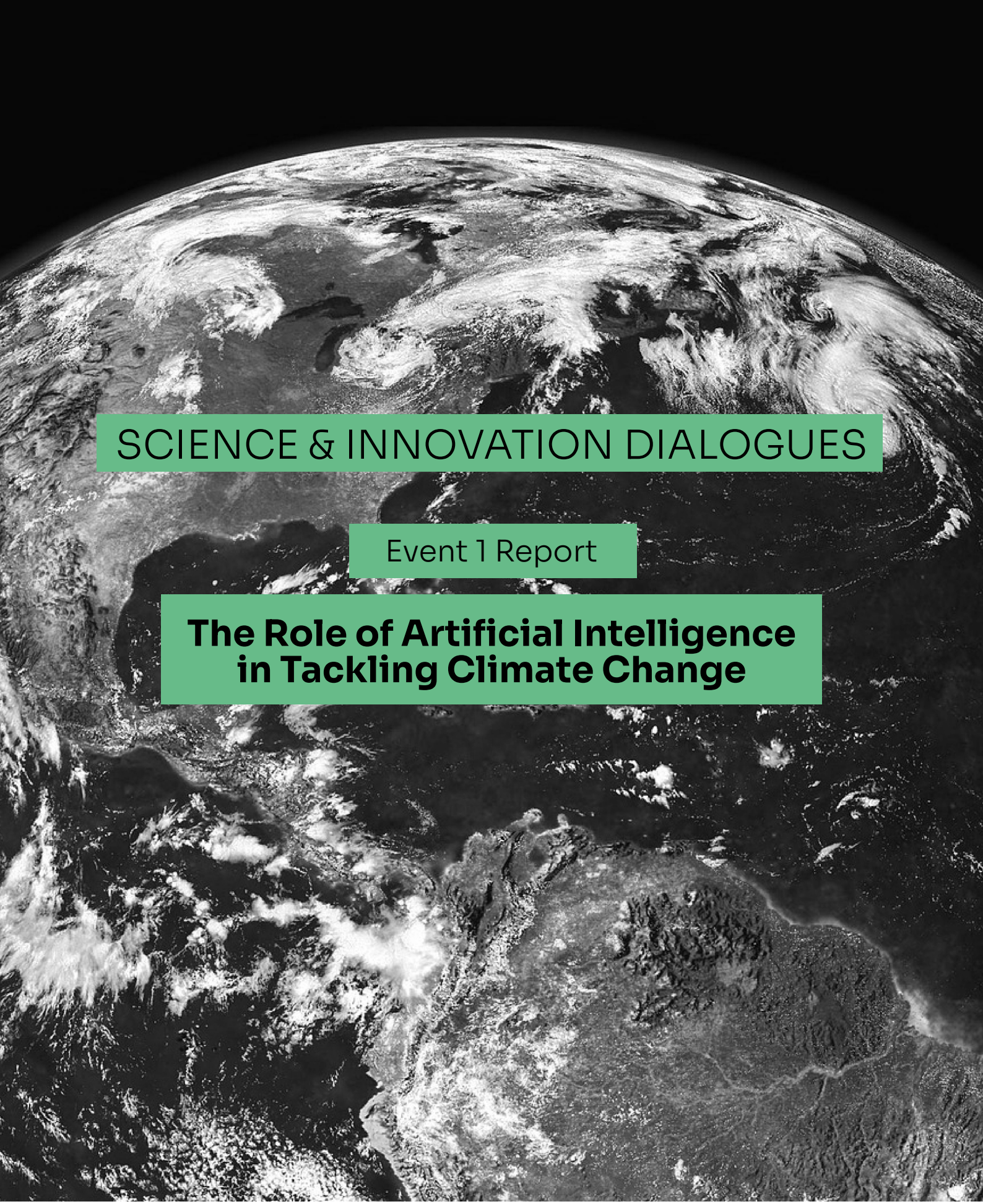

SCIENCE & INNOVATION DIALOGUES

Event 1 Report

The Role of Artificial Intelligence in Tackling Climate Change

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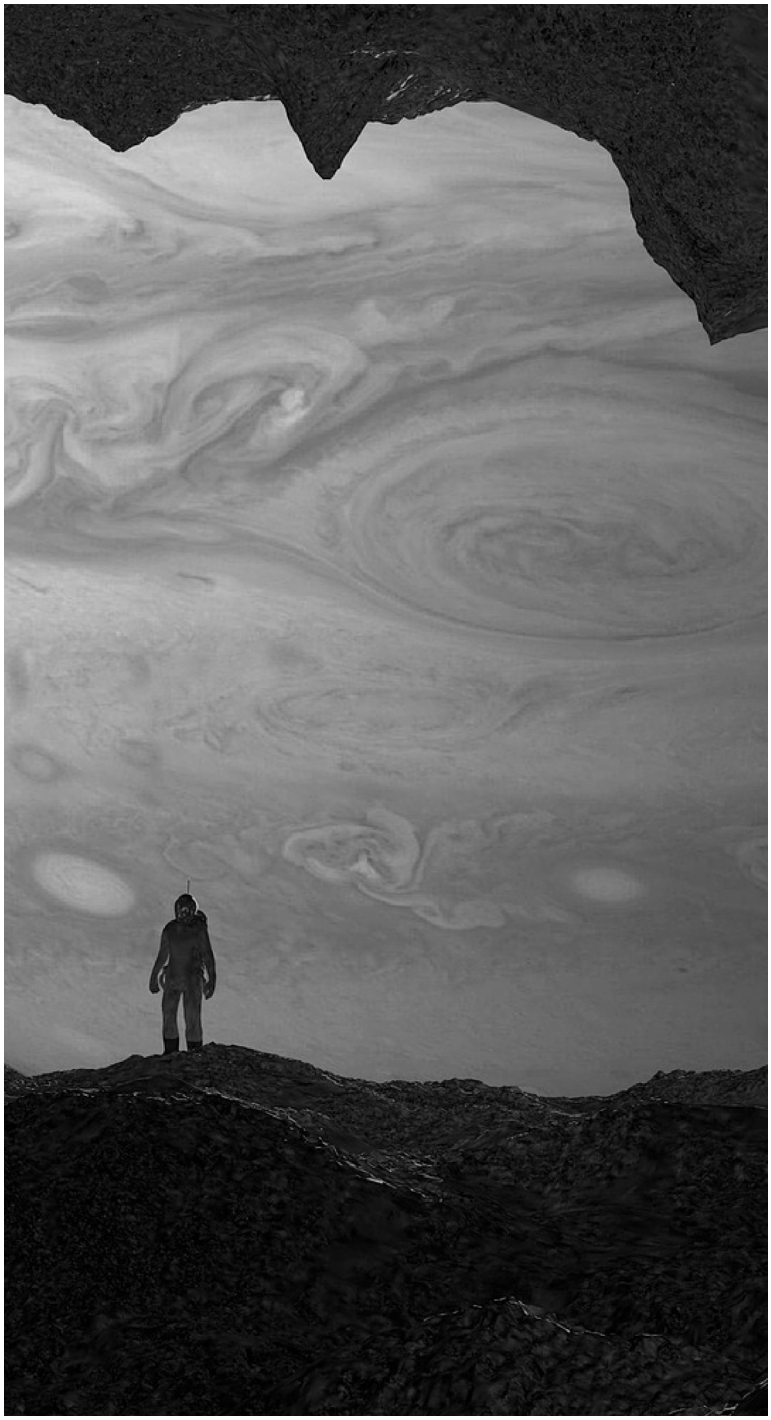
Report: The Role of Artificial Intelligence in Tackling Climate Change



18 January 2022
at 16:00 GMT (17:00 CET)

This event is part of Science & Innovation Dialogues, a plethora of online discussions facilitated by IRCAI, the British Council and the UK Science & Innovation Network. The aim is to highlight and stimulate scientific collaboration between the UK and Europe. This second series (early 2022) has been dedicated to Artificial Intelligence, specifically to the intersection of AI and climate, health, and education.

With the aim of highlighting UK leadership in AI, these dialogues also showcase science excellence in other European countries and bring out the importance of international research and academic collaboration. Dialogues also aim at facilitating exchange of best practice. Science & Innovation Dialogues bring together scientists from the UK and across ten countries in the Baltics, Central and Eastern, and Southern Europe.

Abstract

While we are striving to reduce social inequalities across the globe, climate change remains a serious impediment: People living in poverty, who emit the least greenhouse gas emissions, are often more likely to bear the brunt of climate change. Without sufficient action to restrain global warming to 1.5°C, many of the UN Sustainable Development Goals (SDGs) will not be reached.

Aiming to explore how to mitigate climate change, this dialogue highlights various AI applications to bring down emissions and adapt to a warmer world - without jeopardizing our net-zero goal. Moderated by **Susan Watts** (Science Communicator & Former Science Editor at BBC's *Newsnight*), the event starts with a keynote by **Aidan O'Sullivan** (Associate Professor in Energy and Artificial Intelligence at *UCL Energy Institute* & Co-Founder of *CarbonRe*). This is followed by a roundtable, in which Aidan is joined by a multi-disciplinary range of experts:

- **Prof. Gatis Bazbauers** (Professor at the Institute of Energy Systems and Environment at the Faculty of Electrical and Environmental Engineering at *Riga Technical University*)
- **Dr. Jan Červený** (Head of Domain of Adaptive and Innovative Techniques at the Department of Adaptive Biotechnologies at the *Global Change Research Institute of the Czech Academy of Sciences*)
- **Marcin Gnat** (Senior Communications and PR Manager at *Airly*)
- **Prof. Todor Stoilov** (Professor at the Institute of Information and Communication Technologies at the *Bulgarian Academy of Sciences*)

AI: A rapid and scalable solution to reduce carbon emissions

As observed by Aidan, the conversation has moved on in the last decade: "We are no longer focused on whether we should do something about it, but on what we can do about it". With reports repeatedly highlighting the ever-growing challenges posed by climate change, various sectors are examining how AI-based technologies can help us understand global warming.

"Over the past hundred years, the bulk of emissions would be from Europe, United States and other regions that have been industrial powerhouses for a long time", notes Aidan. However, these are not the regions that are hit the hardest by the repercussions of climate change. Therefore, it is of utmost importance to democratize the access to these climate technologies by making them "reproducible and scalable across the globe".

Meanwhile, AI is becoming increasingly ubiquitous in society. With a rising number of software technologies helping us make our daily decisions, machines are continuously learning new tasks day by day. Aidan posits that AI has the power to "solve problems in a more direct fashion": Instead of working with "brittle, rule-based systems", AI-based technologies can (when provided with sufficient input data) be trained to optimize processes, including those with a clear environmental impact. Aidan emphasizes that efficiency is the best fuel: "By doing more with less, you have made a big impact", he says, as he points to the potential of AI to provide a rapid and scalable solution to counter the cumulative effect of carbon emissions.

How can AI applications mitigate climate change? A cross-sectoral overview

AI for Energy

As brought forward by multiple panellists, AI has the scaling properties that allow us to have a large impact. Referring to the energy sector, which Aidan works with, he notes that the diffusion of software technologies like AI are remarkably efficient: "To get the same power output of a wind turbine, you need to build another wind turbine, whereas the cost of spinning up another iteration of the AI agent is absolutely minimal".

Thereby, Aidan emphasizes that AI can make an impact most of all in closed system setups, where one can easily define the region of operation where the efficiency is to be maximized. So, rather than trying to have a solution to improve the carbon footprint of every individual commuter on the streets, Aidan prefers focusing on a "single concentrated source of change", where an AI-run algorithm can make its mark at a significant scale. Therefore, Aidan's venture (CarbonRe) targets AI applications in the steel and cement industry, which are usually managed by single authorities.

While "plant operators are managing a huge degree of complexity", Aidan posits that AI applications in power plants can advise marginal operational improvements that can yield gigatonnes of emission savings. In his keynote, Aidan illustrates that the intensity of energy resources used in power grids vary enormously from day to day, whereby CarbonRe aims to minimize the surplus emissions on "bad days" by training AI agents to recommend the plant operators the key levers to save on emissions. After being asked by Marcin about his CarbonRe's biggest obstacle in achieving their carbon goals, Aidan points at the continuous difficulty to obtain the necessary (real-time) data on the industrial processes: Over time,

sensors can fail, be corrupted and must even be removed sometimes.

Gatis, who also studies the complexity of sustainable energy systems, notes that another persisting challenge is to internalize the social and institutional factors that come into play in energy transitions. Therefore, he persists on internalizing factors like "consumer behaviour" or "institutional capacity" in his research models based on system dynamics.

AI for Transport

The global transportation sector is a major polluter. In 2020, the sector accounted for 21% of the world's CO2 emissions. Meanwhile, many of our transportation practices remain highly inefficient: As for the EU, the average car is only occupied by 1.2-1.9 persons, while a fifth of all road freight journeys are performed by empty vehicles. As noted by Todor, a better management of the transport system could contribute to a substantial "decrease in air pollution levels for a positive impact on climate change".

The application of AI in transportation systems could, however, substantially increase the efficiency of passenger mobility and road freight transport: By obtaining data from cameras, inductive loops or satellites, Todor highlights that AI-based technologies can help estimate travel demands and deliver real-time information on journey times or the waiting times in critical traffic junctions. AI is therefore adequate to propose the most efficient routes or any options to share vehicles or optimize loads of road freight transport – as a way to minimize travelled distances and air pollution. As put forward by Todor, the application of autonomous control in transportation systems can effectively "predict future traffic behaviour and decrease the subjective decision making which hinders the minimization of travel times and the optimization of environmental indicators such as energy consumption, noise and particle pollution".

However, Gatis emphasizes that innovations in the transportation sector can also have adverse effects. For example, by reducing traffic jams, the number of cars on the roads can increase. One must therefore also focus on how to steer the road users' behaviour as well. He points out that AI could come in handy to collect more evidence on what would happen under certain policies.

Aidan perceives AI also a solution for more personalized road fee schemes. Introduced in 2003, the congestion charge scheme in London charges most motor vehicles being driven within its designated Congestion Charge Zone between 7am and 10pm, seven days a week. By providing data on the road users' personal circumstances, however, Aidan believes that policymakers could be provided with a more data-driven approach to tackle the social implications that came with the introduction of the scheme.

AI for Biotechnology

Microorganisms are vital to life on earth. While they have the ability to ferment foods or treat sewage, some kinds can also produce various renewable energy sources. Capable of performing photosynthesis, microalgae (which are typically found in freshwater or marine systems), for example, also produce half of the world's atmospheric oxygen. Under specific environmental conditions, microalgae can very efficiently "sequestrate carbon emissions, tackle eutrophication, or even remove marine water residues such as microplastics", says Jan, who specializes in microalgal biotechnologies.

In his research at the Global Change Research Institute, Jan regularly avails himself with AI for predictive control and the real-time optimization of high-value products, which are produced by microalgae. By making use of laboratory cultivators, he tests microalgae for a very broad spectrum of environmental conditions, aiming to find out under which conditions the microalgae can best realize their potential. The tested environmental conditions include light composure, temperature, acidity levels, nutrients, and

another whole lot of indicators along these lines.

Jan applies various AI techniques, including convolutional neural networks and evolutionary algorithms. While such AI applications are "still far away from the industry scale", the technology serves as a highly efficient tool to categorize and identify the set of environmental conditions that can truly realize the potential of microalgae to tackle climate change.

AI for Air Quality

Be it from the local power grid, the local commuters going to work by car or the lack of photosynthetic microorganisms in the area – air pollution poses a serious threat to many parts of the world. According to UNEP, air pollution is the "most important environmental health risk of our time", causing 1 in 9 deaths.

Marcin's employer (Airly) aims to keep track of air pollution by monitoring it. Providing a (cost-effective) air quality monitoring platform, it serves as a guiding platform for governments and businesses to take action to reduce emissions and mitigate climate change. Deploying a dense network of air quality sensors, Airly provides hyperlocal, real-time data on air pollution in various parts of the globe. Having developed an algorithm based on neural networks (NN), Airly can predict air quality for the upcoming 24 hours - with a 95% verifiability. Thereby, ML also serves the purpose of interpolating data for locations in areas that are not in the proximity of any sensors.

All hands on deck: The importance of interdisciplinary collaboration for a positive impact

As emphasized by Gatis, we must strive for more "interdisciplinary collaboration research in order to create better models". Therefore, to find the points of mutual synergy, stakeholders must collaborate to face the common challenges posed by climate change. Aidan adds: "This is not just about making computer scientists apply these cases. It is also about training people with domain use as well as skills needed to have impact and really understand the problem".

However, Aidan notes that various institutions in Europe provide a key cornerstone for collaboration between different fields of knowledge for research in the field, as well as for regulation between policymakers. Meanwhile, Marcin observes that - while some policymakers are still hesitant to account for and shape the relationship of AI and climate change - new initiatives arise every day and are taken seriously in other parts of the policy world. Thereby, initiatives like IRCAI's Global Top 100 can play an important role in making the voice of AI application developers heard across the globe.

The recording of the full panel discussion can be found **here**.

A transcript of the full panel discussion can be found **here**.

Quotes

"We want speed and scale. AI embodies these characteristics by virtue of being a software technology"

Dr Aidan O'Sullivan, University College London

"In order to reach our climate targets, we need a massive change of our way of living. We must understand the decisions and behaviour of society and try to steer."

Prof Gatis Bazbauers, Riga Technical University

"Many tasks can be resolved through control of transportation systems by applying different solutions, which include AI approaches"

Prof Todor Stoilov, Institute of ICT, Bulgarian Academy of Sciences

"These problems can be tackled by constructing novel organisms that can better survive and profit in a changing environment"

Dr Jan Červený, Global Change Research Institute on the potential of microorganism-based biotechnology to mitigate climate change

"We are providing hyperlocal real-time data about air pollution by building a dense network of sensors. From the very beginning, we were confident that we need to use AI solutions to make our solution complete."

Marcin Gnat, Airly

"There are tons of other impactful applications, and it would be difficult for me to enumerate them. Fortunately, IRCAI has recently run a challenge to capture and promote some of the best projects around the world."

Dr Aidan O'Sullivan, University College London