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Presents

WEST HUB RESEARCH CAFÉ | CLIMATE CHANGE

Wednesday, 24th APRIL 2024

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RESEARCH

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WEST HUB RESEARCH CAFÉ

KEYNOTE

Professor Lord Martin Rees

Astronomer Royal

Co-founder of Centre for the Study of Existential Risk

Emer. Prof. of Cosmology & Astrophysics, Cambridge

Fellow and 38th Master of Trinity College, Cambridge

Author of 'If Science is to Save Us' and 10 other books

60th President of the Royal Society

Martin Rees (Lord Rees of Ludlow, OM FRS) is an astrophysicist and cosmologist, and the UK's Astronomer Royal. He is based at the University of Cambridge where he has been Professor of Astronomy and Director of the Institute of Astronomy. Martin is a Fellow, and was the former Master, of Trinity College, Cambridge.

Martin has been increasingly concerned in recent years about long-term global issues – the pressures that a growing and more demanding population are placing on environment, sustainability and biodiversity; and the impact of powerful new technologies. He is co-founder of the Centre for the Study of Existential Risk (CSER) at the University of Cambridge with a focus on these issues.

In addition to his research publications, which total over 500, Martin has written extensively for a general readership. His ten books include 'Just Six Numbers', 'Our Cosmic Habitat', 'Gravity's Fatal Attraction', and the recently-published, 'On the Future: Prospects for Humanity'. - Available at https://www.martinrees.uk.

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LIGHTNING TALKS

AI Apocalypse: How to Feed Robots Before They Cook the Climate Elizabeth Barsotti, MRC Laboratory of Molecular Biology

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Every day, we are met with terrifying and thrilling headlines about AI: it's going to take over the world; it's going to take our jobs; it's going to cure cancer; it's conscious; it's sentient; and it has feelings. These headlines are fantastic and exciting, but regardless of the cognitive capabilities of AI, there is one aspect of the human brain that it cannot replicate: energy efficiency. The human brain processes about 75 gigabytes of data per day on less energy than is required to operate a lightbulb. On the other hand, ChatGPT uses 500,000 kWh per day, more than 1.5 million times the energy needed for a human brain (0.3 kWh/day). Likewise, training a single AI model emits more than 620,000 pounds of CO2. And data centers, which are central to AI development and training, are already estimated to emit up to 3.7% of greenhouse gas, putting them on par with industries like aviation and shipping. How do we bridge the energy gap between human and machine cognition, and what can we do in the meantime to minimize the harmful impact of AI on the climate?

WEST HUB RESEARCH CAFÉ

LIGHTNING TALKS

Predictions of Future Ozone Exceedance Days in Europe under Climate Change

Xingpei Ye, Department of Chemistry

Surface ozone is a key component of air pollution, contributing to 254,000 deaths worldwide annually and causing approximately 100 million tons crop losses per year. Due to the positive correlation between ozone production mechanisms and temperature, ozone levels are expected to rise in a warming future, known as the ozone climate penalty.

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In this study, we built a machine learning (ML) model to quantify how often the future ozone will exceed the WHO air quality guideline (50 ppbv) across Europe. Using simulated future weather conditions from the UK Earth System Model (UKESM) as inputs, our ML model predicts an increase in ozone pollution days of 14-20 days by the mid-21st century and 15-57 days by the end of the 21st century, under different shared socio-economic pathways. The increase in temperature and the decrease in humidity are identified as the main driving factors.

It is important to note that such projections have significant uncertainties, depending on the climate models chosen. In fact, UKESM is one of the "hottest" models among current climate or earth system models. If a Russian model with the lowest climate sensitivity is used, the predicted increase in ozone exceedance days could be halved.

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LIGHTNING TALKS

Janus face: Just transition and the right to development

Dr Kennedy Mbeva, Centre for the Study of Existential Risk (CSER)

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The global challenge of aligning economic development with ambitious climate action has shifted from a perceived issue for developing countries, to a concern for all nations. This presentation, motivated by insights from the book "Africa's Right to Development in a Climate-Constrained World," emphasises the need for strategies that enable economic growth, particularly in regions like Africa, without forgoing the commitment to environmental sustainability. It stresses the importance of reconciling the right to development with ambitious climate action. The presentation will specifically focus on the tensions and solutions emerging from the proliferation and implementation of net-zero policies within the context of a just transition, serving as an illustrative example of integrating economic progress with climate ambitions. Importantly, the talk will use the book as a starting point but will broaden the discussion to encompass global perspectives. By calling for a paradigm shift towards this integrative approach, the presentation highlights the necessity of addressing the intertwined challenges of development and environmental stewardship worldwide, advocating for a cohesive global response. But doing so would require a critical reconsideration of, or even upending, long-held assumptions that are no longer fit-for-purpose in the emerging world order.

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LIGHTNING TALKS

Integrating Emerging Technologies with Traditional Industries for Climate Change Mitigation: A System Analysis Approach Zhimian Hao, Department of Chemical Engineering and Biotechnology

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Climate change mitigation necessitates the coupled feedstock and energy transition. New carbon sources (e.g., CO2 and biomass) can be explored to produce low-carbon fuels and high-value bio-derived materials. This can be achieved by the system integration of emerging technologies with traditional (existing) industries. However, some emerging technologies capable of transforming CO2 may come with the trade-off of increased energy consumption, which may potentially cause more emissions. To address these challenges, we have developed a system analysis tool, which combines process modelling, Artificant intelligence (AI), and lifecycle assessment (LCA). This tool facilitates quantitative analysis of integrated process systems and supports decision-making by (1) by avoiding aggressive decisions in carbon reduction; (2) tackling the challenges of integrating mult-sector within a large system, thereby enabling the layout of multi-sector industrial parks and supply chains. We will illustrate the efficacy of this approach through two case studies: (1) integrating carbon capture and utilization with thermal power plants; (2) using green technologies to upgrade paper and pulp mills.

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LIGHTNING TALKS

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Spray mechanism development for marine cloud brightening Dante McGrath, Department of Engineering

Arctic sea ice plays a vital role in the Earth's energy balance, regulating global temperatures by reflecting solar radiation back into space. This natural defence is in a perilous state of decline due to global warming, such that an ice-free end-of-summer appears imminent. The melting of Arctic sea ice has a cascade effect on the Earth's climate, contributing to rising sea levels, adverse ocean and air currents, and thawing permafrost, which have severe impacts on lives and livelihoods. In spite of efforts to reduce greenhouse gas emissions, the immediacy of these risks has motivated the study of climate intervention. A technique of climate intervention that has received growing attention is marine cloud brightening (MCB). MCB involves spraying microscale seawater droplets into the atmosphere to deliver nanoscale salt crystals to low-lying clouds; these crystals trigger cloud droplet formation, which can enhance cloud reflectivity, thereby contributing to localised cooling. Although theory and computational models have furthered understanding of MCB and its impacts, a paucity of information exists as to its practical feasibility, especially concerning the generation of optimal sprays. Our work aims to develop an energy-efficient and scalable spray generation system that provides salt crystals of optimal size and quantity for MCB. In this presentation, we compare various approaches undergoing experimental and computational investigation. For each, we outline benefits, limitations, and technical challenges of laboratory and field experimentation.

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LIGHTNING TALKS

Complexity in action: An exploration of domestic building Energy Performance Certificates data for London from a complexity science lens Cuicheng Zhang, Department of Architecture

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Energy Performance Certificates (EPCs) critically assess UK building energy efficiency. This research addresses the complexity of EPC data by exploring the relationship between energy performance, geolocations, environmental impacts and building characteristics- including form, type, and age- across all 33 councils in London. Utilising a comprehensive dataset and rigorous data processing, this study maps energy efficiency against environmental impact and will discern trends and outline spatial disparities. The methodology of this study combines descriptive analysis with the consideration of different spatial contexts. It will identify areas where energy efficiency retrofits are most needed. Key findings will highlight the variance in energy performance across property types and the challenge of aligning energy efficiency with environmental goals. The research will illustrate the urgent need to retrofit London's older properties to achieve a minimum 'C' EPC rating. It will highlight significant future steps including modelling to quantify the impact of individual factors and integrating socio-demographic data. Thus, this analysis will inform a roadmap towards energy-efficient, sustainable housing with socio-economic considerations.

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LIGHTNING TALKS

Using deep-sea mud to extend the instrumental record of the Atlantic Meridional Overturning Circulation Dr Aidan Starr, Department of Geography

The Atlantic Meridional Overturning Circulation (AMOC) is a system of ocean currents which dominate the transfer of momentum, heat, and tracers such as carbon around the global ocean. Climate models predict that under anthropogenic warming, the AMOC could weaken substantially by the end of the century, potentially resulting in significant adverse climate effects across Europe and the Northern Hemisphere. However, direct measurements of AMOC strength only began in the early 2000s, and the longer records needed to differentiate natural variability from a forced weakening require indirect proxy reconstructions. In this study, we present a 1000-year long record of ocean circulation in the upper North Atlantic based on geochemical and microfossil measurements of a rapidly accumulating sediment core from the Norwegian Sea. Our results, which span the years 900CE to 1970CE, provide insights into 1) AMOC conditions during anomalously warm/cold historical intervals, and 2) the recent natural range of AMOC variability in comparison to forced changes since the Industrial Revolution.

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LIGHTNING TALKS

Computational modelling to explore socio-economic processes in sustainable food system adoption

Simon Carrignon, McDonald Institute for Archaeological Research

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Transitioning to sustainable food systems is crucial in light of the pressure climate change exert on the world. Food production is a major contributor of this pressure: agriculture accounts for 70% of global freshwater use and 21-37% of total GHG emissions. Shifting to plant based diets would greatly reduce these emissions while improving health and addressing inequality. This has led a growing advocacy toward reducing meat consumption and multiple market projections are predicting significant growth in plant based food market.

But market projections often ignore local socio-economic and cultural factors and can't explain underlying causal processes. The adoption of new food systems is influenced by complex interactions at various scales, leading to hardly predictable outcomes. Micro-level decisions, shaped by a myriad of factors, influence larger economic processes that transform local environments and in turn impact future micro level decisions. Understanding these dynamics requires tools that can capture such retro-active loops and interactions.

Continue

This project tackle this by applying Cultural Evolution to study the adoption of new food habits. Combining data collection, analysis, and computational modeling, it will investigate the drivers behind shifts to more sustainable food practices accounting for regional specificities and local socio-cultural backgrounds.

This will not only demonstrate how combining empirical evidence with computer simulations can help understand the complexity behind changes in foods habits, but will also provide insights for policymakers and the food industry to support the much needed transition to sustainable food systems.

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RESEARCH POSTERS

Predicting future environmental suitability of reefs via machine learning to optimise long-term efficacy of conservation efforts Orlando Timmerman, Department of Earth Sciences

Current levels of atmospheric greenhouse gases will result in significant geographic shifts in the regions that can support tropical coral species. Present-day resource-intensive reef conservation projects, such as coral outplanting, may therefore be ineffective in the long term if focused on areas in which environmental conditions will become increasingly unsuitable for coral survival. To address this, we need robust tools which can identify areas where future environmental conditions will be conducive to long-term coral survival. These tools could be used to guide where to focus reef restoration efforts, as well as implement complementary conservation techniques such as assisted migration, placement of genetically-altered corals, and static or mobile marine protected areas.

This work explores the application of multimodal machine learning to predict the present global distributions of shallow-water coral reefs using historic environmental data. The machine learning techniques improve on traditional species distribution modelling by combining ground truth presence-absence datasets, and by using entire environmental variable time series rather than relying on statistical parameterisations. In addition, input data is downsampled to scales relevant to ongoing conservation initiatives. Further work will predict future environmental suitability for reefs using forecasted environmental data.

The project aims to be directly applicable to the optimisation of coral reef conservation initiatives: providing a necessary tool for the long-term preservation of the rich biodiversity and invaluable ecosystem services of shallow-water coral reefs.

Health Impact of Climate Change: A Case Study of Karamoja in Eastern Uganda Ronnie Aisu, Mariestopes Uganda

This abstract explores the health implications of climate change in the context of Karamoja, a region in Eastern Uganda. Climate change poses significant challenges to the health and well-being of communities in Karamoja, exacerbating existing vulnerabilities and contributing to a range of health issues.

B

Rising temperatures, erratic rainfall patterns, and prolonged droughts have led to decreased agricultural productivity, food insecurity, and malnutrition, particularly among vulnerable populations such as children and pregnant women. Water scarcity and contamination have also increased, leading to a higher prevalence of waterborne diseases such as diarrhea and cholera.

Furthermore, climate-related events, such as floods and landslides, pose immediate risks to public health, causing injuries, displacement, and the spread of infectious diseases in overcrowded shelters. Additionally, changes in vector ecology have expanded the transmission range of diseases such as malaria and dengue fever, further burdening already strained healthcare systems.

Continue

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RESEARCH POSTERS

Addressing the health impacts of climate change in Karamoja requires a comprehensive and multi-sectoral approach. This includes strengthening healthcare infrastructure, improving access to clean water and sanitation facilities, and enhancing disease surveillance and response mechanisms to mitigate the spread of infectious diseases.

Community-based adaptation strategies, such as promoting climate-resilient agriculture and enhancing early warning systems, can build resilience and empower communities to cope with climate-related health risks. Furthermore, collaboration between government agencies, non-governmental organizations, and international partners is essential to mobilize resources and implement effective interventions tailored to the specific needs of Karamoja.

B

In conclusion, understanding the health impacts of climate change in Karamoja is crucial for developing targeted interventions to protect vulnerable populations and build resilient health systems. By prioritizing adaptation and mitigation measures, we can safeguard the health and well-being of communities in the face of a changing climate.

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RESEARCH POSTERS

Assessing the Impact of Societal Perception on Controversial CDR Technologies: Insights from the DICE Model Haiming Luo, Department of Earth Sciences

This study investigates how societal attitudes influence the effectiveness and acceptance of controversial Carbon Dioxide Removal (CDR) methods, with a focus on Ocean-based approaches. The urgent need to address escalating greenhouse gas levels requires innovative solutions to curb atmospheric carbon dioxide. Despite ongoing debates regarding their efficiency, Ocean CDR methods leverage the ocean's natural carbon sequestration capacity. By integrating societal perceptions into the Dynamic Integrated model of Climate and the Economy (DICE), renowned for its comprehensive approach, we aim to understand how public opinion shapes Ocean CDR strategies. Our methodology initially establishes reference scenarios demonstrating the economic viability of Ocean CDR in achieving a 1.5°C temperature target, disregarding societal impacts. We further analyze carbon sequestration process using Ocean Iron Fertilization (OIF) as a case study. Preliminary findings suggest the substantial potential of Ocean CDR technologies for climate mitigation. However, uncertainties surrounding OIF deployment costs and effectiveness necessitate further investigation to align carbon capture targets with recent IPCC reports. Future steps involve integrating societal perceptions into the DICE model for a more comprehensive analysis.

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RESEARCH POSTERS

Low Carbon Public Procurement in the Asia Pacific Region

Jellie Molino, Center for Climate Change Engagement

The Paris Agreement recognizes the important role of sustainable patterns of consumption and production (SCP) in addressing climate change. Target 12.7 of Goal 12 on SCP specifically calls for the promotion of public procurement practices that are sustainable. In this context, the concept of low carbon procurement (LCP) has emerged as a particular approach to sustainable public procurement (SPP), more particularly to green public procurement GPP). LCP is a process whereby organizations procure goods, services, works and utilities with a reduced carbon footprint throughout their life cycle.

The main focus for this research was the policies and programmes in introducing low-carbon criteria and/or energy efficiency criteria in every stage of the public procurement cycle. The scope is both global and regional. Analysis of global examples and practices was included, albeit limited on data derived from literature review and interview with focal persons from 8 targeted countries. The existing policies and programmes aimed at addressing climate change through public procurement, including tools and guidelines with specific low-carbon criteria in the 15 countries in the Asia Pacific Region were then examined and recorded in the appended country factsheets. The results are a recommendation on strategies to facilitate increased uptake of LCP in the region.

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RESEARCH POSTERS

Developing Tools to Expedite Soybean Breeding Chiara Di Dio, Crop Science Centre - Department of Plant Sciences

Soybean is a globally significant legume, renowned for its versatile applications in food, feed, and various industrial products. As a high- oil and protein crop, it plays a critical role in addressing nutritional needs and in promoting sustainable agricultural systems worldwide. However, the full genetic potential of soybean remains untapped, primarily due to the constraints of crossover that underpin traditional breeding methods, which are inadequate to handle the unforeseen climate changes ahead. During meiosis, a specialized cell division in sexually reproducing eukaryotes that result in gametes (eggs and sperm), parental chromosomes exchange parts in the form of crossover. This process leads to novel combinations of agronomically valuable traits that can be selected by breeders to enhance crop varieties. However, the low frequency and uneven distribution of crossover events make most soybean traits inaccessible to breeders. In the last decades, fundamental breakthroughs in the field of crossover have paved the way to overcoming these limitations. Our overarching aim is to beneficially transform soybean breeding by developing technologies that enable translation of the fundamental knowledge of crossover control into soybean. To achieve this, we are developing genetic tools that will enable us to manipulate and monitor soybean meiotic progression and fertility, and establishing a pipeline for mapping and measure crossovers. By innovating soybean breeding techniques, our research is committed not only to advancing our understanding of crossover control but also significantly expediting the development of improved soybean varieties, directly contributing to global food security and the agricultural industry's resilience against climate changes.

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RESEARCH POSTERS

How can cities develop holistic physical infrastructure interventions to reduce climate-health risks? Maria Ikonomova, Department of Engineering

Climate-related hazards such as heatwaves and flooding pose a threat to public health. While existing climate and health research studies highlight that physical infrastructure interventions can help to reduce climate-health risks, these studies have advocated for the development of standalone infrastructure measures. Yet, infrastructure decision-makers can also develop holistic interventions across multiple physical infrastructure systems to protect public health from climate-related hazards.

The presentation will provide examples from two case study cities (Ottawa and London) that show the multiple infrastructure interventions that these cities have implemented to protect public health from climate-related hazards. For example, how these cities have developed cool spaces, projects to cool transport networks, green infrastructure schemes, housing retrofit projects, and urban planning and maintenance policies to reduce heat-health risks. The research findings show existing best practices of how cities can develop holistic infrastructure measures to protect public health in a changing climate that go beyond the scope of measures identified in existing research studies.

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RESEARCH POSTERS

IMitigating risk of credit reversal in nature-based climate solutions by optimally anticipating carbon release E-Ping Rau, Department of Plant Sciences

Nature-based climate solutions supply carbon credits generated from net carbon drawdown in exchange for project funding, but their credibility is challenged by the inherent variability and impermanence of drawdown. By evaluating drawdown benefits from a social cost of carbon perspective, project developers can enhance credibility and estimate impermanence by conservatively anticipating drawdowns to be eventually released following a release schedule, issuing additional credits when actual release is less severe than anticipated. We demonstrate how we can use ex post observations of drawdowns to construct optimal release schedules that limit the risk of credit reversals (when net drawdown is negative). We simulate both theoretical and real-life projects to examine how this approach balances the trade-off between generating credits evaluated as more permanent and limiting reversal risk. We discuss how this approach incentivises project performance and provides a pragmatic solution to challenges facing larger-scale implementation of nature-based climate solutions.

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RESEARCH POSTERS

Germplasm screening for enhancing heat tolerance in model and crop plants Lovely Mae Lawas, Crop Science Centre - Department of Plant Sciences

Plant productivity is negatively impacted by climate change-induced heat stress, which is predicted to continue in the future. There is therefore a clear need to study how plants respond and adapt to heat stress, particularly during the sensitive reproductive stage. To help fill this knowledge gap, we are using both model and crop plants and existing natural and induced genetic variation to investigate the underlying molecular mechanisms of reproductive stage heat tolerance. Here I will highlight our work on cowpea, an important legume food crop in sub-Saharan Africa that is sensitive to high night temperatures. A collection of diverse 300 cowpea accessions will be grown in controlled growth chambers and exposed to 36°C/27°C day/night temperatures with a 12h photoperiod during the early reproductive stage (i.e. meiosis). Production and viability of pollen from heat-stressed and non-stressed (28°C/20°C day/night) plants will be compared, as well as grain yield. Further analysis will be conducted to identify genes associated with heat response under short days. Results from this study will aid in identifying more accessions that are resilient under predicted higher temperatures, and in developing more heat-tolerant cowpeas through advanced breeding techniques. Enhancing reproductive heat tolerance of this important economic crop will help farmers in developing countries in coping with cowpea production under future climates. Additionally, I will give an overview of our work on the model plant Arabidopsis, where we aim to identify heat tolerance genes and explore possible solutions for increasing tolerance to heat stress through genetic engineering.

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Location & Contacts

Address: West Hub, JJ Thomson Avenue, Cambridge, CB3 0US

Event location: West Hub, 1st Floor, East 1 room.
Direction will be available upon arrival.

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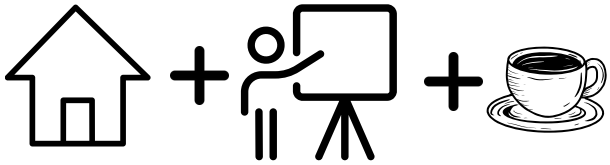
EVENT ITINERARY

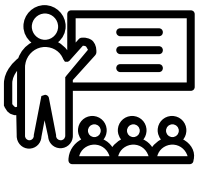
11:30 RECEPTION & POSTERS

Welcome & Exploring



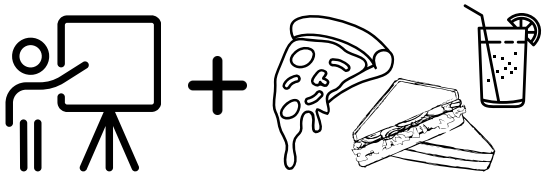
12:00 TALKS

Keynote & Lightning Talks



13:30 POSTERS & LUNCH

Lunch & Posters



14:00 PRIZES & SOCIAL

Prize Draw & Social Tea Break

CLIMATE CHANGE

WEDNESDAY, 24TH APRIL 2024

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