Speaker Abstracts and Biographies

Morning Session

Rossby Waves in the Quarterly Journal
Tim Woollings, University of Oxford

*Abstract: Rossby waves are one of the fundamental building blocks of atmospheric circulation. Despite being well studied for decades, they are still a key focus of current work to understand persistent extreme events in a changing climate. This talk will focus on Rossby's 1940 paper in the Quarterly Journal, one of a series of papers laying out observational and theoretical evidence for what Rossby called his 'planetary waves'. This paper considered waves growing on narrow zonal currents and derived some now well-loved results on the propagation of these waves. Some highlights of this paper will be presented along with a perspective on its place within the wider history of research on atmospheric circulation***.**

Tim Woollings is Professor of Physical Climate Science in the Dept of Physics, University of Oxford. His research focuses on atmospheric circulation and its role in predictability and climate change. He authored the popular science book 'Jet Stream; A journey through our changing climate', but is secretly as much of a fan of Rossby waves as jet streams.

Data Assimilation: A fusion of knowledge and the rise of the machines
Dr Anthony McNally, Head of Earth System Assimilation, ECMWF

Abstract: Over recent years data assimilation systems have evolved a long way from simply providing initial conditions for forecast models, now underpinning a huge variety of exciting Earth system science applications. In this talk we will explore some of the pivotal developments (that have been documented in QJRMS) such as variational techniques, Earth system coupling and the exploitation of satellites, which have driven the rapid expansion of data assimilation. We will also look at some of the novel areas in which these techniques have been applied. More recently, state of the art data assimilation systems generate the "big data" which has fuelled the extraordinary progress of machine learning approaches to Earth system science. The talk will conclude by exploring some of the wider implications of these highly advanced and potentially disruptive technologies, challenging as well as enhancing data assimilation, and asking the question: could the established scientific literature (exemplified by QJRMS) play a stronger role in guiding the future as well as documenting the past?

Tony McNally is the Head of Earth System Assimilation and a Principal Scientist at ECMWF. He is responsible for strategic planning and leading research activities related to the exploitation of observations and development of the centre's advanced data assimilation systems. His main area of expertise is the exploitation of satellite radiation measurements to support Numerical Weather Prediction (NWP), climate reanalyses and the monitoring of atmospheric composition.

Numerical Weather Prediction: The quest for accurate rainfall forecasts

Prof. Brian Golding, OBE (he/him), Fellow in Weather Impacts, Met Office

Abstract: The basis of Numerical Weather Prediction (NWP) was laid in 19th century work on atmospheric thermodynamics, but as recognised by Wilhelm Bjerknes, successful NWP also requires an initial state and fast computation, conditions that were not met until the mid-20th Century. From then, NWP developed rapidly and is one of the great scientific achievements of the past century. In my talk, I shall focus on developments in the UK, where the focus was, naturally, on rainfall. A key step was the development of the 10-level model, which was overtly designed to forecast frontal rainfall, as described in Bushby and Timpson's Quarterly Journal paper of 1967. The subsequent evolution to mesoscale and km-scale prediction has similarly been driven by the desire for more accurate rainfall forecasts. Yet major challenges remain in all of the aspects of NWP so clearly laid out in Bengtson's QJ review of 1991.

After studying mathematics at Leeds University, Brian joined the Met Office in 1972, working initially on diabatic forcing in quasi-geostrophy, which led to his PhD on Lagrangian analysis of baroclinic instability, awarded by Reading University. Brian then led the development of mesoscale NWP and its applications. After a sabbatical in Australia, Brian became responsible for forecast automation, building teams to develop tools to support the shift of human input from forecaster towards interpreter and communicator. Merging of NWP with radar extrapolation led to extensive collaboration with flood hydrologists. From 2005-12, Brian directed Met Office weather forecasting R&D, setting the strategy towards km-scale coupled, ensemble-based, environmental prediction.

Since 2015, he has co-chaired the WMO High Impact Weather (HIWeather) project, focused on the application of physical and social science to weather-related warnings. He was awarded the OBE for services to weather prediction and is currently an honorary professor at Bristol University.

Influence of Entrainment and Mixing on the Evolution of Cloud and Rain Drops in Cumulus Clouds

Alan Blyth, Professor, National Centre for Atmospheric Science (NCAS), University of Leeds, Steven Böing (he/him), Research Fellow, University of Leeds

Abstract: It is a very interesting time to be considering the importance of small-scale microphysics processes. How can processes that may occur on scales as small as a

micrometre be important for climate scales of 10's of kms? There is little doubt that they are -- there are currently two NERC-funded programmes on this topic. The interactions between dynamics and cloud microphysics was very much at the heart of the work introduced by Baker et al in the paper "The Influence of entrainment on the evolution of cloud droplet spectra: I. A model of inhomogeneous mixing." It was an exciting and lively time in cloud physics, probably because there were key observations that could not be explained with models.

The talk will discuss the background that led to the paper, including the Malkus, 1952 paper, and why inhomogeneous mixing was thought to be a breakthrough. Some disagreed. The ideas have been used in models in the last 40 years to explain the spatial and temporal distribution of cloud drops and the production of warm rain. New developments in modelling, such as the Elliptical Parcel-in-Cell model, now provide an opportunity to test the two-way coupling of inhomogeneous mixing and the dynamics at the cloud scale. The representation of cloud microphysics in Numerical Weather Prediction and Global Climate models remains an active area of research. These points, and the links between the two papers and current and future research will be discussed.

Steven Böing is a research fellow at the University of Leeds. He has been working on convective clouds since 2009, and holds a PhD from Delft University of Technology. His publications have focused on the dynamics of cumulus clouds and the associated downdraughts, often using a Lagrangian perspective. His work has stressed the importance of cloud size and atmospheric relative humidity to mixing processes in these clouds. Dr Böing has also contributed to the development of the parcel-following Elliptical Parcel-in-Cell method for simulating clouds. He is part of the University of Leeds/Met Office strategic research group.

Professor Alan Blyth is a Senior Scientist in the National Centre for Atmospheric Science (NCAS), University of Leeds, UK. His expertise is in problems associated with convective clouds, including microphysics, dynamics, entrainment, and convective initiation. A particular focus is on explaining the interacting physical processes involved in the development of the particles in the clouds using novel observations and high-resolution modelling. He has led several large international research projects using research aircraft and ground-based facilities and instruments, including recently EUREC4A-UK and DCMEX. DCMEX, in particular, involves observations and modelling of deep convective clouds, including their anvils. He began his career studying the influence of entrainment and mixing on the evolution of cloud drops and the development of warm rain. His supervisor, John Latham, introduced him to inhomogeneous mixing describing the cloud-air interfaces like Norwegian coastlines, which was a novel concept at the time.

Panel Session

Fran Morris, Post Doctoral Researcher Assistant, University of Oxford

Fran has, at the time of writing, nearly finished a PhD in tropical meteorology at the University of Leeds, studying the interactions between organised convection and larger-scale circulations over West Africa. She has recently started a postdoctoral job in convective-scale climate modelling at the University of Oxford, where she is currently trying to run high-resolution simulations over Southern Africa to study the Southern African Monsoon. Over the past few years Fran has been involved in running two RMetS Student & Early Career conferences, and has recently joined RMetS' events committee. She enjoys thunderstorms, teaching, and finding ways to make conference attendees complete weird tasks (don't worry, you're safe at this one).

Paul Trevorrow, Publisher, Wiley

Anna Ghelli, Chair of Scientific Publishing Committee and Former Meteorological Applications Associate Editor, Royal Meteorological Society

Dr Anna Ghelli is the Chair of Scientific Publishing Committee at the RMetS. The committee oversees the Society portfolio of journals and helps to shape and develop the future direction of the Society, working closely with the publisher.

Anna spent some years as a member of the editorial board of Meteorological Applications contributing to the publication of a number of Special Issues on forecast verification. She holds a PhD in Meteorology from the Eidgenössische Technische Hochschule Zürich (CH). She has more than 20 years' experience in NWP, with particular focus on training and operational services.

Dr Alison Brown, Head of Publishing and Scientific Engagement, Royal Meteorological Society

Alison joined the Society in May 2018 and has overall responsibility for the business management of the Society's publishing programme. She works closely with our Journal Editors and our publishing partner on initiatives to improve our services to authors, readers and subscribers, as well as identifying new publishing and partnership opportunities which can support the needs of individuals globally with an interest in weather and climate. Prior to joining the Society, she obtained a PhD in Agricultural Ecology and then went on to various publishing and marketing roles at Wiley and SpringerNature.

Andrew Ross, Co-Editor in Chief, Quarterly Journal

Afternoon Session

Advances in Climate Science through the Pages of the QJ
Joanna D. Haigh (she/her), Emeritus Professor of Atmospheric Physics, Imperial College London

Abstract: I will discuss how developments in climate science have been presented in the QJ over the past 150 years. Spoiled for choice I will focus on radiative processes, looking at the physics of the greenhouse effect and how radiative heating is represented in global models of climate and climate change. I will describe how QJ authors have enhanced understanding of radiative forcing, climate feedback factors and climate sensitivity and thus provided robust support for international action on climate change.

Joanna Haigh is a Distinguished Research Fellow at Imperial College London. For five years before her retirement in 2019 she was co-Director of the Grantham Institute on Climate Change and the Environment at Imperial and previously Head of the Physics Department. She has published widely on radiative processes in the atmosphere, climate modelling and radiative forcing of climate change, especially as a result of solar variability, and has been a Lead Author for the UN Intergovernmental Panel on Climate Change. She is a Fellow of the Royal Society, the Institute of Physics and the City & Guilds Institute and an Honorary Fellow of Somerville College, Oxford and of the Royal Meteorological Society of which she is also a past-President.

The Stratosphere
Mark P Baldwin, Professor of Climate Science, University of Exeter

Abstract: The stratosphere was not discovered until 1902, but in the following decades our knowledge grew as more observations of the stratosphere were made. The ozone layer was discovered, followed by a first basic idea of a stratospheric general circulation. Since the 1950s our knowledge of the stratosphere has expanded rapidly. With more observations, several new stratospheric phenomena were observed: the quasi-biennial oscillation, sudden stratospheric warmings, the Southern Hemisphere ozone hole and surface weather impacts of stratospheric variability. In the 1970s and 1980s, dynamical theory made great leaps forward. Since ~2000, better representations of the stratosphere have been included in climate and weather forecasting models: inclusion of the stratosphere in forecasts models leads to better forecasts. As Earth's surface warms, the stratosphere is observed to cool, giving some of the clearest evidence of climate change. However, beyond temperature, future changes to stratospheric phenomena are very difficult to predict.

Mark Baldwin is Professor of Climate Science at the University of Exeter. He received his PhD from the University of Washington in Atmospheric Sciences, and throughout his career has focused his research on the stratosphere and how the stratosphere affects surface climate and weather.

RMetS
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The Sea, The Sea – a fine tradition of oceanographic research in the Quarterly Journal
Bablu Sinha (he/him), Senior Scientist, National Oceanography Centre

Abstract: I discuss three highly influential papers from the Quarterly Journal's archives: John Green's 1970 paper on transfer properties of large-scale eddies; Zhengyu Liu's 1999 paper on planetary wave modes in the thermocline; and Richard Seager's 2002 paper on the Gulf Stream and European weather. Green's insights led to today's understanding of how mesoscale ocean eddies influence large scale ocean circulation. Liu's paper underpins our knowledge of ocean adjustment to changes in forcing and potentially provides the mechanism behind Atlantic Multidecadal Variability. Seager's work galvanized a generation of oceanographers to demonstrate that the ocean is not simply a passive recipient of atmospheric forcing, but actively participates in maintaining the mean climate and contributes to climate variability. I trace the influence of these classic papers on oceanographic research to the present day and show how they will continue to be relevant to the oceanographic and climate research challenges of the future.

Bablu studied Natural Sciences, at Churchill College, Cambridge, graduating in 1988. He obtained a Ph. D. in Oceanography whilst working as a research assistant at Southampton University under Dr Kelvin Richards on the Fine Resolution Antarctic Model (FRAM) project. Between 1992 and 2000, Bablu worked at Plymouth Marine Laboratory under Professor Robin Pingree, modelling UK tides, measuring the European Continental Slope current, studying the Azores Current and tracking ocean eddies. In 2000 Bablu joined the Southampton Oceanography Centre (now the National Oceanography Centre) where he has worked until the present day on the ocean's role in the climate system, in particular the variability and predictability of the Atlantic Meridional Overturning Circulation. He has participated in several internationally important climate research programmes such as the Coupled Ocean-Atmosphere Processes and European Climate (COAPEC) Programme, 2000-2006, and the recent Atlantic Climate System Integrated Study (ACSIS), 2016-2022.

Looking ahead Towards Celebrating 150 years of Remote Sensing Observations
Dr Thorwald Stein (he/him), Associate Professor in Clouds, Department of Meteorology, University of Reading

Abstract: Remote sensing only became more prominent in the latter half of QJ's 150-year history with the advance of radar technology and the launch of satellites. Since then, remote sensing observations have had major impacts on our understanding of weather and climate, especially the skill of our models through data assimilation. We will take a look at the importance of remote sensing in supporting the findings of some key papers in the QJ anniversary collection. Following that, we look ahead towards celebrating 150 years of remote sensing itself, the challenges ahead and some of the future missions in the pipeline.

Thorwald joined the Department of Meteorology in Reading in 2008 as a postdoc on the Cascade project and continued on the DYMECS project. Both projects were in close collaboration with the Met Office, developing and evaluating their (then novel) km-scale and later sub-km scale model configurations. His research focuses on the analysis of microphysical and dynamical processes in clouds and convection using satellite and ground-based radar observations for the verification of weather and climate models. Thorwald is currently Associate Professor in Clouds in Reading and has just completed the WesCon-WOEST campaign, during which he led coordinated observations of convective storms in southern England between ground-based radars and the FAAM research aircraft.

Poster Session

Past L F Richardson Winners

An Overview of Weak Signal-to-Noise Ratios in Climate Predictions
Dr Steven Hardiman (he/him), Senior Scientist, Met Office

Abstract: The signal-to-noise paradox that climate models are better at predicting the real world than their own ensemble forecast members highlights a serious and currently unresolved model error, adversely affecting climate predictions and introducing uncertainty into climate projections. This poster gives a brief overview of the signal-to-noise paradox, explaining what it is, why we care, and the current proposed mechanisms for its cause. We show that current seasonal forecast systems underestimate the eddy feedback between transient eddies and large-scale flow anomalies and suggest that this deficiency is linked to weak atmospheric teleconnections and weak signal-to-noise ratios in ensemble mean predictions.

Steven completed a PhD in “Stratosphere-Troposphere coupling” at the University of Cambridge, and a postdoc at the University of Toronto, before joining the Met Office in 2008. There he worked on global scale stratospheric dynamics for 8 years before joining the seasonal-to-decadal prediction team where he works on atmospheric dynamics and teleconnections on sub-seasonal to decadal time scales.

LFRic: Developing a model fit for the next 150 years!
Ian Boutle, Science Fellow, Met Office

Abstract: The LFRic atmospheric model is being developed as a replacement for the Unified Model, and comprises the LFRic infrastructure, the Gungho dynamical core, and many pre-existing physical parametrizations. Targeted for operational implementation as an NWP system in 2026, this poster gives an overview of the reasons for replacing the UM and the current status of where global and high-resolution development has got to. We also give some examples of improvements delivered by the new dynamical core, and potential future developments which have only been made possible by LFRic.

Ian is a Science Fellow at the Met Office, leading a team working on physics-dynamics coupling and the implementation of the new Momentum modelling system to replace the Unified Model. Ian completed a PhD at Reading University on boundary-layer processes in mid-latitude cyclones, and subsequently spent 10 years working on the development of cloud, microphysics and turbulence parametrizations at the Met Office. He spent a year working at NIWA in New Zealand in 2019-20, and also holds a position as an honorary Professor in Astrophysics at the University of Exeter, where he has collaborated on exoplanet modelling since 2016.

Urban-Scale Modelling for the WesCon Field Campaign
Kirsty Hanley, Senior Scientist, Met Office

Abstract: The Wessex Convection Experiment (WesCon) was a UK field campaign conducted during summer 2023 concentrating on understanding dynamical aspects of convection to provide observational data to develop next generation kilometre-scale and urban-scale models. During the campaign, extended evaluation of a variable resolution 300 m Wessex Model (the "WMV") was conducted, running as an ensemble nested inside the operational MOGREPS-UK 2.2km ensemble. Overall, the WMV looks promising for high-impact convective events as it is better able to represent the organisation of convection into lines or larger storms whereas MOGREPS-UK tends to simulate isolated, circular storms. This often leads to more reliable probabilities of heavy rainfall in the WMV ensemble compared to MOGREPS-UK. However, there is still an issue with the WMV producing too many small precipitating showers in situations where there should only be shallow clouds. This is thought to be a result of shallow clouds getting too deep in the model and precipitating erroneously.

Kirsty works in the Urban-scale Modelling group at MetOffice@Reading based at the University of Reading. Kirsty's work is focused on the representation of convection in convective-scale versions of the Unified Model. The aim of this work is to determine the best configuration for future operational models. An important aspect of this work is validating the Unified Model against observations obtained during field campaigns such as WesCon. Kirsty joined the Met Office in March 2013. Prior to this Kirsty completed her PhD in ocean waves and air-sea interactions at the University of Reading in 2008. Kirsty then went on to do post-doctoral work at the University of Reading, focusing on the initiation of convection over orography in convective-scale ensembles.

Representing Orographic Processes across Resolutions
Annelize van Niekerk (she/her), European Centre for Medium-Range Weather Forecasts

Abstract: Since the late 80s, the importance of accounting for small-scale mountains for the fidelity of numerical weather prediction and climate models has been recognized. From their ability to act as a barrier to near-surface flow, to their remote impacts on the stratosphere through vertically propagating gravity waves, they are a key ingredient in the large-scale circulation. Global models are not able to represent the full variability of the Earth's surface due to their horizontal resolutions, even when they approach km-scales. This has led to a wealth of theoretical, numerical, and observational investigations into the impacts of small-scale

orography on model evolution and how best to represent this in models through parametrizations. Over the last decade or so, new methods of diagnosing missing orographic drag, using analysis increments or high resolution numerical simulations, and more advanced parametrizations, including more 'scale-aware' parametrizations, have been developed. We discuss here some of these advances, many of which have been published in the QJRMS.

Annelize completed her PhD in Meteorology from the University of Reading in 2017, where she worked on the representation of orographic drag in models and their impact on large-scale circulation. After which, she worked in the Atmospheric Processes and Parametrizations team at the Met Office, until joining the Physical Processes team at the European Centre for Medium-range Weather Forecasts in 2022. Currently, Annelize is working on the impacts of turbulence, drag and orographic processes on the circulation across resolutions, with a focus on model errors in stable boundary layers and the representation of orography in km-scale simulations. Her background is in Astrophysics and Mathematics.

Early Career and Student Conference Prize Winners 2023

Stochastic Data Adapted AMOC Box Models: Tipping in a simple AMOC model
Ruth Chapman, PhD Student, University of Exeter and Met Office

Abstract: The Atlantic Meridional Overturning Circulation is responsible for the comparatively temperate climate found in Western Europe. This is a system that has multiple stable states- referred to as 'on' when the circulation is strong as in the current climate, and 'off' when it is much weaker. Tipping points occur between these states when a rapid shift in dynamics happens in response to a small change in a parameter. Making future projections of AMOC response to the climate is essential for avoiding any anthropogenic caused tipping, but it is computationally expensive to calculate the full hysteresis for different scenarios. This work looks at a conceptual five box model of the AMOC which is easy to understand and cheap to implement. Previous work has considered bifurcation and rate-dependent tipping. This current work looks to estimate a realistic amount of noise from various GCM data sets and apply this to the model.

Ruth is in the last year of her PhD in the dynamical systems group at the University of Exeter. She also collaborates with Oceanography colleagues at the Met Office, as her work focuses on tipping points in an ocean box model. She also helps lead the Women in Climate network which is joint between Exeter University and the Met Office. She has spent the last week at the British Science Festival, helping with a pop-up climate exhibit presented by Exeter Science Centre, explaining tipping points to the public.

Three Weeks More Summer? How Crowdsourced Observations Could Enhance Urban Climatology

Matthew Fry, Scientist – Observation Network Design, Met Office

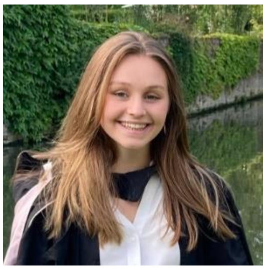
Abstract: Crowdsourced observation networks are typically much denser than those maintained by National Meteorological Services, and sample a much wider range of local climates. This offers an opportunity to build observed climatologies that are more representative of lived experience, particularly in cities. This study provides a worked example to show their potential for improving operational climate services, and to identify the challenges to realising that potential. To demonstrate the concept, data from personal weather stations, obtained through citizen science, are used to build an observed record of daily maximum temperatures in 2020 in Manchester (UK). This record is compared to the standard baseline used in a current climate service, showing a substantial increase in the estimated heat hazard.

Matthew is a Scientist in the Met Office's Observation Network Design team, which he joined in September 2021 following an MPhys Physics degree at the University of Exeter. His primary focus has been on evaluating the quality and reliability of observations from networks operated by citizens or external organisations, such as WOW, Davis, and Netatmo, to assess their potential contribution to the composite observing network. Most recently, he has been working to improve the representation of urban climatologies using crowdsourced observations.

Climate Modelling the Atmospheric and Environmental Effects of Hydrogen

Hannah Bryant, PhD Student, University of Edinburgh

Abstract: A shift in energy production is crucial in the control of global warming. Renewable hydrogen represents an alternative source of energy but can leak into the atmosphere during transportation and use. Understanding the fate of leaked hydrogen is vital to quantify the implications of this transition. This work uses the atmospheric component of the UK Earth System Model to assess the effects of increased atmospheric hydrogen concentrations by analysing its atmospheric budget and the chemical and radiative effects that it has. We find that in-situ atmospheric chemical production accounts for over two thirds of the total hydrogen source, with the dominating reaction being formaldehyde photolysis. Hydrogen generates radiative effects due to its interaction with methane, ozone, and water vapour. These atmospheric effects are potentially important, particularly if a large fraction of hydrogen leaks, and require suitable quantification to understand the net climate consequences of a transition to a hydrogen economy.



I am an atmospheric chemist, interested in understanding how the choices we make with our future energy system landscape can impact upon our climate and air pollution. I have an MSci in Natural Sciences from the University of Cambridge and am currently doing my PhD in Atmospheric and Environmental Science at the University of Edinburgh. My research looks at the atmospheric effects of emissions of hydrogen, an increasingly important chemical in our atmosphere as hydrogen becomes a larger component of our energy network. I am also on the Early Career Scientific Steering Committee for the International Global Atmospheric Chemistry

(IGAC) group which aims to support and promote collaboration between ECRs within the community and have led workshops in secondary schools around Edinburgh for the Scottish School's Hydrogen Challenge, allowing students to design and test hydrogen fuel cell vehicles in the classroom.

Backwards Ray-Tracing Satellite Observations of Atmospheric Gravity Waves
Phoebe Noble, PhD Student, University of Bath, British Antarctic Survey

Abstract: Analogous to ocean waves, there are waves in our atmosphere called gravity waves. Although small-scale, these waves are key drivers of atmospheric circulation, transporting momentum across the atmosphere. Understanding their sources and propagation is key to improving weather and climate models.

Gravity waves have a huge variety of sources including wind flow over mountains, convection, and jet stream instabilities. Yet when working with observations of gravity waves we can only make informed guesses of their sources. In this work we combine satellite observations of gravity waves, re-analysis and a ray tracing model to trace observations of gravity waves in the stratosphere back to their sources.

We show how some gravity waves are ray-traced to the surface, to mountainous regions suggesting an orographic source, and others are ray-traced to the tropopause, indicating non-orographic sources.

This work aims to answer the question: "Where do gravity waves observed in the stratosphere come from?"

I am currently completing my PhD in Atmospheric Dynamics at the University of Bath and British Antarctic Survey. Having graduated from a BA in Mathematics at Oxford University and an MSc in Engineering Mathematics at Bristol university, I am all about applying my technical background to observations of to reveal new understanding. I work with satellite observations of atmospheric gravity waves. These waves might be small, but they have far reaching impacts on the larger scale dynamics in our atmosphere!

I aspire to by a broad atmospheric scientist, bringing different ideas together through collaboration and science communication.

Outside the office, I am a keen explorer, I love being outdoors and finding new hills to climb and new places to swim. I love our natural environment and it is exciting to be a part of the collaborative science effort to understand it better.

Rapid Road Weather Hazard Forecasting Using Machine Learning
Alice Lake, Post-processing Applications Scientists, Met Office

Not submitted at time of print.

Using Expired Weather Forecasts to Supply up to 10 000 years of Data

Petr Dolezal, PhD candidate, AI for the research of Environmental Risk (AI4ER), University of Cambridge

Abstract: When modelling possible future renewable electricity systems, a strong focus needs to be directed to the input weather variables driving any such system. Since we cannot know the exact weather in any slightly distant future, a probabilistic approach is usually chosen, modelling the system over many possible scenarios, typically all of the past recorded weather data available. However, this narrows the range of situations considered to about 40 years, placing fundamental limits on the analysis, e.g. of rare, extreme scenarios.

In my work, I explore the possibility of using past expired ensemble forecasts from the ECMWF [1] to drastically increase the number of scenarios considered to up to 10 000 years of data. These ensemble forecasts are physical models that are regularly initialized from the same slightly perturbed snapshot, but due to the chaotic nature of weather, their predictions diverge from each other. The later stages of their predictions are thus entirely independent predictions of what the weather could have been, including the correct spatial correlations. I analyze the data from the operational archive of ECMWF to assess their suitability for modelling renewable systems of the future and demonstrate how this wealth of additional weather scenarios can enable the utilization of otherwise heavily data-dependent machine learning techniques in energy modelling.

[1] European Centre for Medium-Range Weather Forecasts (ECMWF) Atmospheric Model Ensemble extended forecast https://www.ecmwf.int/en/forecasts/datasets/set-vi

Petr Dolezal is a PhD student at the University of Cambridge, where he is a part of the AI for Environmental Risk research (AI4ER) Centre for Doctoral Training, which aims to develop the next generation of experts in the application of AI and machine learning to environmental science. He has a background in physics and is now working under the supervision of Prof Srinivasan Keshav and Prof Emily Shuckburgh at the Department of Computer Science and Technology.

His current research focuses on the modelling of renewable electricity systems, large continental-scale power grids, with a specific emphasis on the input weather variables that drive these systems. He aims to address the limitations of probabilistic modelling, which relies on historical weather data and is thus limited to a narrow range of scenarios.