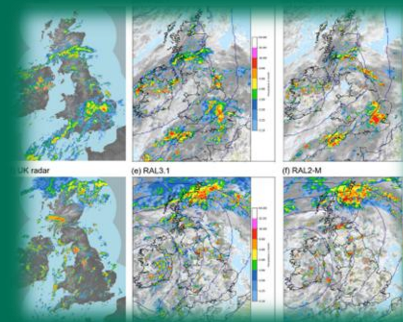
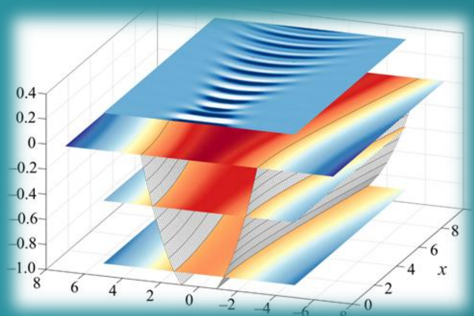
EPSRC CDT Fluid Dynamics *presents*

FLUIDS CDT SYMPOSIUM 2026

Simon Vosper, Met Office

Fluid Dynamics and Numerical Weather Prediction: Successes, challenges, and opportunities



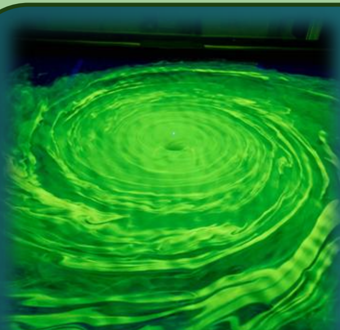


Phil Trinh, Univ. of Bath

The role of fluid dynamics and asymptotics in a changing climate: on hydrology, industry, and current fashions.

Allen Haddrell, Univ. of Bristol

Moving beyond Wells-Riley: Coupling next generation bioaerosol techniques with CFD modelling to better estimate airborne disease transmission risk



Silke Weinfurtner, Univ. of Manchester

The Hydrodynamic Universe: Exploring Black Holes and Cosmology with Fluids

Date: 12 June, 2026

Time: 10:00 – 16:00

Venue: Nexus Building, University of Leeds

SCHEDULE

9:30-10: Registration

10-11: Simon Vosper: Fluid Dynamics and Numerical Weather Prediction: Successes, challenges, and opportunities

11-11:20: Coffee break

11:20-12:20: Phil Trinh: The role of fluid dynamics and asymptotics in a changing climate: on hydrology, industry, and current fashions.

12:20-13:20: Lunch + Posters

13:20-14:20: Allen Haddrell: Moving beyond Wells-Riley: Coupling next generation bioaerosol techniques with CFD modelling to better estimate airborne disease transmission risk

14:20-14:30: Coffee break

14:30-15:30: Silke Weinfurtner: The Hydrodynamic Universe: Exploring Black Holes and Cosmology with Fluids

15:30-16:00: Acknowledgements + Poster winner

LIFD
Leeds Institute for Fluid Dynamics

Simon Vosper, Director of Research and Development, Met Office

Fluid Dynamics and Numerical Weather Prediction: Successes, challenges, and opportunities

Numerical Weather Prediction (NWP) underpins our ability to forecast the weather. This has advanced tremendously over the past few decades through improvements in observations of the atmosphere, in physics-based simulation models, and through increases in computational power. These physics-based models are computational fluid dynamics (CFD) models - numerical models which include parametrizations of important physical processes that represent the effect of both unresolved fluid motions and other complex processes, beyond those described by the equations of motion. Improvements in these parametrizations rely on fundamental scientific understanding of Earth system processes and are key to improving the accuracy of NWP and ultimately the weather forecasts needed to help people stay safe and thrive.

This talk will demonstrate how improvements in physical parametrizations have recently led to significant advances in the realism of NWP models and the accuracy of weather forecasts.

But there is a new kid on the block! The rapid rise of Artificial Intelligence and Machine Learning (AI/ML) is providing new opportunities to improve weather forecasts. These technologies rely on training ML neural networks on datasets of past weather, to infer future states. But there are challenges (and risks) with these approaches, and the future of NWP will likely be a hybrid one, where physics-based approaches are augmented by ML. There are many possible variants of this, and this talk will consider these and the challenges that must be overcome for these hybrid systems to provide physically consistent, accurate, reliable and trusted weather forecasts.

Simon leads the Science directorate with accountability for the Met Office's world-leading research in Foundation, Weather and Climate Science and for developing the scientific capability which underpins all the Met Office products and services.

He is responsible for the Next Generations Modelling Systems programme which aims to reformulate and redesign the whole of the Met Office weather and climate research and operational systems. Ultimately enabling the organisation to exploit future generations of supercomputers and remain at the forefront of weather and climate science and services.

Simon gained a BSc in Maths from the University of Leeds in 1991 and then went on to study for a PhD in the Applied Maths department. He is expert in atmospheric science, in particular model development and in orographic processes - the effect that hills and mountains have on the weather. His work has led to improved understanding of a range of hazardous atmospheric phenomena such as mountain waves, rotors and to better models and practical tools for their prediction.

Simon joined the Met Office in 2001 as a research scientist and has been involved in many exciting projects, including working with the Facility for Airborne Atmospheric Measurements (FAAM) research aircraft, studying rotors over the Sierra Nevada mountains in California as a Principal Investigator for the international T-REX programme.

He has retained very strong links with the University of Leeds and has a visiting Professorship position at the School of Earth and Environment.

He enjoys spending time on Dartmoor and the beautiful beaches of South Devon, is a keen angler and a lifelong Liverpool FC fan.

Phil Trinh, Department of Mathematical Sciences, University of Bath

The role of fluid dynamics and asymptotics in a changing climate: on hydrology, industry, and current fashions

In this talk, I want to describe some of the interesting problems and collaborations I've enjoyed as a mathematical fluid dynamicist interacting with the hydrological sciences and flood-risk industry. I will talk about the challenges of knowledge exchange between mathematics, where exactitude and rigour are supreme, to hydrology, where even the role of acceptable governing equations remains contentious. Are there powerful insights that theoretical fluid dynamics can bring to hydrology and industry? And how can these be communicated to practitioners and policy-makers? I shall use as an example the application of ideas of scaling, model reduction, and asymptotic analysis in this area.

Perhaps more widely, I want to talk about the evolution of doctoral training and British Fluid Dynamics, as I've seen it, and what that might mean for you as the next generation of mathematicians, analysts, scientists, and engineers in academia or industry. At the end of your doctoral degree, how will you market your abilities and strengths in the uncertain landscape of the future?

Before my current position with the University of Bath, I was a lecturer with the Industrially Focused Mathematical Modelling (InFoMM) group at the University of Oxford. I was a Darby Fellow at Lincoln College from 2012-2016, and a research associate and lecturer (2010-2012) joint between Princeton University's Program in Computational and Applied Mathematics (PACM) and the Complex Fluids Group of the Department of Mechanical and Aerospace Engineering.

I completed my doctorate as a Clarendon scholar from 2007-2010 with the Oxford Centre for Industrial and Applied Mathematics, and as a graduate student with Balliol College. Before that, I did my undergraduate and Master's degrees in Canada. I grew up in Ottawa, Ontario.

My research is motivated by a range of physical applications in fluid and solid mechanics, from classical hydrodynamics and wave-structure interactions, to thin film flow and elastocapillary systems. My primary area of expertise concerns the study of problems that involve a breakdown of traditional techniques in perturbation theory. Many of these problems involve the study of nonlinear differential equations and require the development of specialized methodologies and techniques, such as exponential asymptotics or asymptotics beyond-all-orders

Allen Haddrell, School of Chemistry, University of Bristol

Moving beyond Wells-Riley: Coupling next generation bioaerosol techniques with CFD modelling to better estimate airborne disease transmission risk

Prior to the 1950s, it was largely thought that diseases such as tuberculosis and measles were not transmitted through the air. Pioneering research by Richard Riley, and William and Midred Wells disproved these theories. Their work led to the development of the Wells-Riley model to estimate airborne transmission rates. Against the modern challenges of a 21st century pandemic, the fundamental limitations to the 20th century Wells-Riley model for estimating the risk of transmission became clear.

Prior to 2019, the length of time a microbe remained viable in the air was measured using systems only capable of measuring long term inactivation. Consequently, half-lives of multiple hours being commonly reported. Since 2019, transformative technological advancements have been made in the study of aerosolized microbes. What has become clear is that the inactivation dynamics of aerosolized viruses and bacteria are complex, where we see significant changes in microbe viability on the order of seconds to minutes, as opposed to hours. For this reason, there is a need for more robust models to apply our improved understanding of airborne microbial inactivation to better estimate risk and design effective mitigation strategies.

Allen E. Haddrell (AEH) is a Research Fellow at the University of Bristol. His research interests include aerosols, aerosol toxicity and pharmacology, atmospheric chemistry, proteomics, and instrumentation development. He has over 40 publications in peer-reviewed journals (2021) and has delivered 12 invited presentations at international conferences and institutions.

After completing his PhD at Simon Fraser University (SFU, Canada) in 2007, AEH was recruited by Dr. Andre Nel (Director of the UC Center for the Environmental Impact of Nanotechnology (CEIN), Director of the Center for Nanobiology + Predictive Toxicology, and Co-Director of the UCLA Nanomachine Center) to work at University of California Los Angeles (UCLA, USA) as a research fellow to study the toxicity of particulate air pollution. The work undertaken while in UCLA was funded by the National Science and Engineering Research Council of Canada (NSERC) through the award of a prestigious fellowship to AEH. In 2009 AEH moved to the University of Bristol (UB, UK) as a research assistant to work on aerosol dynamics and drug delivery to the lungs at the Bristol Aerosol Research Centre (BARC). Since 2013 AEH has held an Elizabeth Blackwell Institute for Health Research (EBI) Early Career Fellowship.

AEH's research career has centred on aerosol science, with a specific interest in the development of methodology and instrumentation, involving numerous particle levitation techniques. Research undertaken by AEH has explored the tropospheric processing of particulate air pollution, the complex interaction between aerosol composition/size and human health, and the behaviour of suspended microorganisms.

Silke Weinfurtner, Mathematical Sciences, University of Nottingham

The Hydrodynamic Universe: Exploring Black Holes and Cosmology with Fluids

Fluid flows provide a powerful and versatile platform for investigating wave propagation on inhomogeneous, moving, and time-dependent media. Under suitable conditions, the dynamics of waves on such flows can be described in terms of an effective geometry, establishing a direct correspondence between wave propagation in fluids and fields evolving in curved spacetime.

This connection has opened an experimental route to exploring phenomena traditionally associated with black holes and the early universe. Effects such as Hawking's prediction of black hole evaporation, Penrose's mechanism for rotational energy extraction, and particle production processes analogous to cosmological preheating can be mapped onto wave dynamics in carefully engineered fluid systems. While direct astrophysical observation of these processes remains extremely challenging, analogue experiments allow us to probe their underlying mechanisms in controlled laboratory settings.

In this talk, I will present recent advances using both classical and quantum fluids to realise effective horizons, rotating geometries, and time-dependent backgrounds. These experiments sit at the intersection of fluid dynamics, nonlinear wave physics, and quantum field theory, and provide insight not only into gravitational phenomena but also into the rich and often unexpected behaviour of waves in dispersive and strongly interacting media.

My research is at the interface between quantum technology and fundamental physics. I am interested in the dynamics of the early universe and black holes arising of the interplay between general relativity and quantum fields. I am exploring these effects in laboratory experiments employing analogue gravity systems. My team and I are developing novel optical detection schemes for studying the dynamics of free fluid interfaces at room and ultra-cold temperatures. One led to a patent application (in review) for a High speed 3D air-fluid interface sensor with EnShape GmbH (Jena, Germany).

Posters

James Dunstan: Investigating the Dynamics of Borneo Vortices

Tao Yang: Collective Dynamics of Complex Multiple Flames: Phenomenal Observation, Mode Identification, and Reduced-order Modelling

Andrea Sendula: The structure of fracture fields in viscoelastic solids

Zecai Zhou: Extreme Events in Bubble-induced Turbulence

Chris Jackson: Modelling 3D printing of rheologically complex materials using OpenFOAM

Girindra Ramgobin: Multiscale and Multiphysics design optimisation of heat exchangers for sustainable aircraft

Ellen Bartle: Spin-up and Spin-down Flow Instabilities in Cylinders

Shufan Yang: Patient-Specific FSI Simulation of Cerebral Vasculature

Danny Blundell: How are Pathogens Distributed in Respiratory Emissions?

Benjamin Dalby-McCusker: Differentiable machine learning: Towards fast and accurate surrogates for fluid dynamics

Domantas Dilys: Vortex Ring Topological Analysis and Visualization in Large-Scale Convective Cloud Simulations

Girindra Ramgobin: Multiscale and Multiphysics design optimisation of heat exchangers for sustainable aircraft

Luke Barratt: Developing Numerical Tools to Improve the Diagnosis of Peripheral Artery Disease

Grasiele Romanzini-Bezerra: Machine Learning representation of El Niño stratospheric teleconnection to the polar vortex

Jade Spinks: Investigating the linear stability of magnetohydrodynamic waves in rotating fluids

Aniruddha Bose: Secondary currents in different pipe systems

Sonny: Instabilities in Radiative Zones of Stars

Krishna Kumar: Kink-unstable highly magnetized AGN jets and their interaction with winds from accretion disks

Jo Kershaw: The effect of boundary conditions on convection in a rotating cylinder

Xuan Zhao: Augmented Lagrangian Preconditioner for 3D Incompressible Flow with Moving Boundaries in PETSc

Gulana Anwar: Physical mechanisms of bubble-induced removal of surface-adhered particles

Ben Durnford: The Dynamics of Fluid-Supported Dense Granular Flow