Charles Powell

PhD Student in Atmosphere-Ocean Fluid Dynamics, DAMTP

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PhD Research

University of Cambridge   *2021 - Present*

Supervisors: Prof. Peter Haynes & Prof. John Taylor

Thesis: *On convective penetration of a buoyant plume into a stably stratified layer*

- Research motivated by the need to understand water vapour transport into the middle atmosphere by tropical thunderstorms. Study the fluid dynamics of a buoyant plume penetrating into a stably stratified layer using numerical simulations, as an idealised model of the geophysical flow. This problem has relevance to many processes in the atmosphere and ocean.

- Developed a novel method for diagnosing tracer transport and analysing turbulent mixing in complex flows. Application of this method yielded new understanding of the mixing process in convective penetration of a stably stratified layer, published in the Journal of Fluid Mechanics.

- Collaborated with *Bruce Sutherland* (University of Alberta) on the generation of internal gravity waves by convective penetration. Identified a gap in current understanding of this generation mechanism and highlighted avenues for future research in the field via application of an emerging data-driven analysis method.

- Developed a minimal dynamical model of moisture coupled to a flow which represents key atmospheric processes. Understanding competition between various processes improves our understanding of a key process in stratosphere-troposphere coupling.

Education

University of Cambridge	*2017 – 2021*	**Exeter Mathematics School**	*2015 – 2017*
MMath, BA. Honours Pass with Distinction, top 16%		A-Levels, 4 A*	

Publications

PUBLISHED

Charles Powell, Peter Haynes, John Taylor. 2024. *Diagnosing Tracer Transport in Convective Penetration of a Stably Stratified Layer*
    Journal of Fluid Mechanics (accepted)

Charles Powell. 2019. *Automated Spectrogram Analysis for Meteor Head Echoes*
    WGN, Journal of the International Meteor Organization, 47, 2, pp. 55–65

Charles Powell. 2017. *Modelling & Analysis of Diurnal Variation in Meteor Flux*
    WGN, Journal of the International Meteor Organization, 45, 2, pp. 32–37

Charles Powell, Kristina Veljkovic. 2017. *Temporal and Spatial Variation of Meteor Flux in Radio Data*
    WGN, Journal of the International Meteor Organization, 45, 4, pp. 73–81

IN PREPARATION

Charles Powell, Peter Haynes, John Taylor. In preparation. *Review: the influence of convective overshooting on moisture in the Tropical Tropopause Layer*
    Weather

Charles Powell, Bruce Sutherland, Peter Haynes, John Taylor. To be submitted late 2024. *Internal Waves Generated by a Plume Impinging on a Stratified Fluid*
    Journal of Fluid Mechanics, Rapids

Scholarships & Awards

2024	**RMets Early Career & Student Conference,**	Oral Presentation Prize
2023-24	**Royal Meteorological Society,**	Legacies Fund Grant (Nov 2023, Jun 2024)
2023	**DAMTP,**	Rayleigh-Knight & Smith-Knight Essay Prize
2022	**Cambridge Philosophical Society,**	Fellow
2021	**Emmanuel College,**	Bachelor Scholarship
2018	**Devon Cambridge Society,**	Long Vacation Research Grant
2017	**Royal Astronomical Society,**	Elected Fellow

Research in Astronomy

Astrophysics group, University of Exeter _Exeter_

Radio Astronomy Research Engineer _Jul 2014, Jul - Aug 2017, Aug- Sep 2019_

- **2019:** invited to work with Dr. Chris Brunt to determine the viability of a novel technique of measuring atmospheric refractivity using a combination of radio interferometry and ADS-B transmissions from commercial aircraft. Worked with the Met Office to test the technique at an observation station, producing promising results that led to further development by a PhD student towards active deployment by the Met Office.
- **2017:** design & development of a small and affordable radio telescope in collaboration with Dr. Chris Brunt & Master's student. Worked independently on back-end software development using GNUradio to process radio signals and detect pulsars.
- **2014:** work experience placement with Dr. Jennifer Hatchell. Developed skills in data analysis, using TOPCAT for numerical investigation of young stellar objects in infrared observations of the Serpens South cluster.

Norman Lockyer Observatory _Sidmouth_

Research Software Engineer _2012 - 2018_

- Member of the Lockyer Technology Group, one of the first and most active citizen science radio observation stations in the UK. Assisted in development of hardware for detecting meteors using reflected radio signals.
- Primary role was development of software to analyse spectrogram observations by categorising the RMS error; the method is now in use across the UK Meteor Observation Network.
- During A-Levels, carried out independent research on global variation of observed meteor rates and automated analysis techniques, leading to three peer-reviewed publications (two solo authored).

Teaching Experience

2024-present	**Mentor**, A-Level research projects.	_Cambridge Maths School_
2023-present	**CATAM Feedback Sessions**, Part IB Mathematics computational project.	_DAMTP_
2022-present	**Admissions Interviews**, Undergraduate Mathematics	_Emmanuel College_
2022-present	**Research Project Feedback Sessions**, A-Level research project reports.	_Exeter Maths School_
2021-present	**Supervisions**, IA Mathematics: 12 students in two courses.	_Emmanuel College_
2021-22	**Tutoring**, GCSE Mathematics: weekly sessions with 1 student.	_Freelance_

Interests & Responsibilities

2024-present	**Steering Committee Member**, Representing DAMTP.	_Cambridge Centre for Climate Science_
2023-24	**Seminar Organiser**, Weekly talks for the GK Batchelor Lab research group.	_DAMTP_
2023-24	**Seminar Organiser**, Weekly talks for the Atmosphere-Ocean group.	_DAMTP_
2021-22	**Committee Member**, MCR Computer Officer	_Emmanuel College_
2018-present	**Committee Member**, Lower Boats' Captain (2018-19), Men's Captain & Captain of Boats (2019-20), Secretary (2020-23), Junior Treasurer (2023-present)	_Emmanuel Boat Club_
2018	**Editor**, Preparation of 2017 conference proceedings.	_International Meteor Organisation_
2017-present	**Rower**, First VIII Blades in May Bumps 2018 and Lent Bumps 2024.	_Emmanuel Boat Club_