PROJECT TITLE: Waves and Winds at the Edge of Space

DTP Research Theme(s): Changing Planet

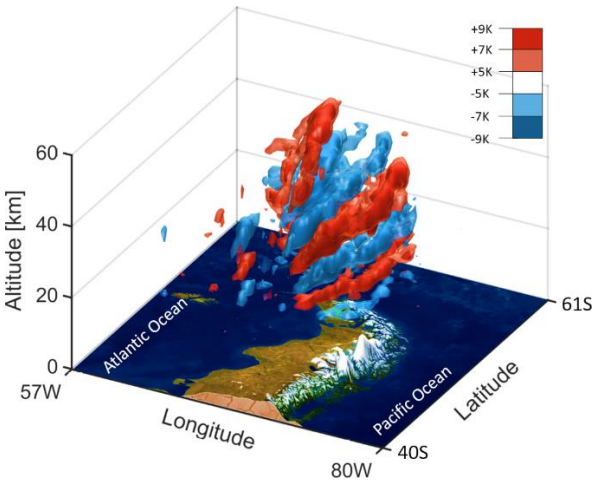
Lead Institution: University of Bath

Lead Supervisor: Dr Corwin Wright, University of Bath, Centre for Space, Atmospheric and Oceanic Science

Co-Supervisor: Dr Tracy Moffat-Griffin, British Antarctic Survey, Atmosphere, Ice and Climate Team

Project Enquiries: c.wright@bath.ac.uk

Project keywords: atmosphere, Antarctica, ionosphere, radar, airglow, satellites



Gravity wave observed over the Andes mountains in May 2008. Red and blue show air heated and cooled by the wave respectively.

Atmospheric airglow (orange layer), viewed from the International Space Station

Project Background

Radio signals, GPS measurements and the paths of low-orbiting satellites can all be interfered with by small-scale disturbances in the charged upper atmosphere, a region we call the ionosphere. However, the causes of these disruptions are poorly understood. We know that some disruptions have local causes, while some are forced by signals from the "neutral" atmosphere below and from space above, but the relative mix is unknown and the controlling physics poorly-understood. Understanding and quantifying the causes of and mechanisms underlying these disruptions has important implications for fields as diverse as self-driving transport, over-the-horizon radar and humanitarian emergency communications.

In this project, you will quantify the role of small-scale "gravity waves" generated in the lower atmosphere in driving these ionospheric disturbances. We know that these waves can travel upwards to the ionosphere, where they couple the air below with the charged gases above. However, we know very little about how this coupling works and how often and how intensely it occurs. You will focus in particular on detailed measurements taken from Halley VI station in Antarctica, using new imaging and radar hardware deployed by Bath and the British Antarctic Survey which will let us measure this coupling in unprecedented detail. You will also use satellite measurements and data from other research stations across Antarctica and beyond to both contextualise our results and understand how typical they are of other locations.

This interdisciplinary project combines expertise in observational lower-atmospheric science from the lead supervisor at Bath with the upper-atmospheric and Antarctic expertise of the co-supervisor at BAS. This broad mix of training and skillsets will provide the scientific underpinning needed for you to pursue post-graduation opportunities in both research and beyond, across the full range of atmospheric science.

Project Aims and Methods

The project aim is to understand wave-driven connections between the neutral lower atmosphere and charged ionosphere over Antarctica. You will use ground-based hardware, satellites, and novel software.

In the first year, you will use the VIIRS, AIRS, IASI and SABER satellites to study the atmospheric dynamics of the region. This will give you a detailed understanding of the relevant atmospheric science, and the skills needed to apply for post-PhD careers in science, weather forecasting, and the commercial satellite sector.

In the second and later years, you will use combined data from an airglow imager and a meteor radar deployed to Halley VI in winter 2021/22 (or, if there are problems with deployment, similar archival data from other locations). You will combine these data with the satellite information to study the whole spectrum of gravity waves. This will provide new information for developing space weather forecasting models and for guiding improvements to long-distance communications and GPS systems.

Candidate requirements

The project would suit a student with a background in a mathematical or physical science, with an interest in the atmosphere or weather in general and in developing skills in both observational data analysis and weather/climate modelling. Prior atmospheric-science knowledge is beneficial but not necessary.

Training

You will receive training from the supervisory team on analysis and interpretation of atmospheric measurement data from a range of sources, on the behaviour and dynamics of the Antarctic upper atmosphere, and in the use of high-performance computing resources. This combination will prepare them for post-graduation opportunities across a range of atmospheric science careers.

Depending on your interests, you will also have the opportunity to participate in external training courses including the European Research Course on Atmospheres, the NCAS Atmospheric Measurement Summer School and NCAS Introductory courses in Atmospheric Science and the Unified Model.

Background reading

What is Airglow?
AuroraWatch UK, https://wp.lancs.ac.uk/aurorawatchuk/2016/11/04/what-is-airglow/
Core Concept: To improve weather and climate models, researchers are chasing atmospheric gravity waves
Adam Mann, PNAS, https://www.pnas.org/content/116/39/19218
First tsunami gravity wave detection in ionospheric radio occultation data
Coisson et al, 2014 https://agupubs.onlinelibrary.wiley.com/doi/pdf/10.1002/2014EA000054

Useful links

Enquiries relating to the project should be directed to the lead supervisor (see email address above for Project Enquiries). Enquiries relating to the application process should be directed to doctoraladmissions@bath.ac.uk

In order to apply, you should select the relevant University of Bath PhD online application form found here: https://www.bath.ac.uk/study/pg/applications.pl. When completing the form, please state in the 'Finance' section that you wish to be considered for GW4+ DTP funding and quote the project title and lead supervisor's name in the 'Your research interests' section.

Further information about the application process may be found here: http://www.bath.ac.uk/topics/postgraduate-research/

The application deadline is Friday 8 January 2021 at 2359 GMT. Interviews will take place from 8th to 19th February 2021. For more information about the NERC GW4+ Doctoral Training Partnership please visit https://www.nercgw4plus.ac.uk.