PROJECT TITLE: Waves and Warmings

DTP Research Theme(s): Changing Planet

Lead Institution: University of Bath

Lead Supervisor: Corwin Wright, University of Bath, Department of Electronic Engineering
Co-Supervisor: Daniel Mitchell, University of Bristol, School of Geographical Sciences

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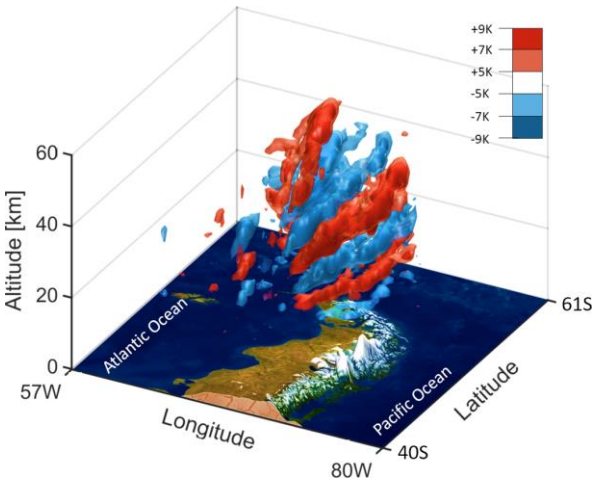

Figure 1: Gravity wave observed over the Andes mountains in May 2008. Red and blue show air heated and cooled by the wave respectively.

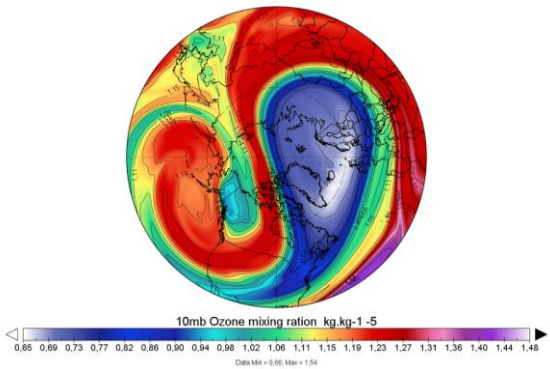

Figure 2: Distribution of ozone in the mid stratosphere showing the stratospheric polar vortex. Image shows a single day in winter.

Project Background

Sudden stratospheric warmings (SSWs) are one of the most dramatic events in the atmosphere. Over only a few days, stratospheric temperatures can shoot up 30-50°C, while the high altitude jet stream stops and sometimes even reverses. However, SSWs are hard to predict. This is a problem because they affect surface weather over the following weeks, making them important for accurate weather forecasting.

"Waves and Warmings" will investigate the role of small-scale atmospheric waves in SSWs. These waves, generated near the ground, significantly affect how SSWs form and develop. New measurement techniques will allow us for the first time to measure key wave properties which determine how this happens, including their speeds and direction. We will measure these properties, then determine if they are represented in models to understand more about the mechanisms. The ultimate goal is to improve our theoretical understanding of SSWs and hence to improve predictability.

This collaborative/interdisciplinary project combines expertise in observational atmospheric science from the lead supervisor at Bath with the modelling and atmospheric dynamics skills of the co-supervisor at Bristol, allowing the student to pursue post-graduation opportunities across the full range of the atmospheric sciences.

Project Aims and Methods

Aim:

To improve the forecasting of sudden stratospheric warmings, by:

i. Measuring atmospheric gravity and planetary waves in the polar troposphere, stratosphere and mesosphere to produce the definitive climatology of wave properties in polar region with current technology (at Bath).

ii. Using these measurements to improve how these waves are simulated in polar winter (at Bristol).
iii. Assessing the response in model performance as a result of implementing these changes (using the experience gained from both institutions in the relevant theoretical science and use of observational constraints).

Methods

The project will use an unusually wide range of methods, giving the student the chance to develop a broad skillset and giving them extensive options for their post-graduation career.

On the observational side, world-leading new measurement techniques developed by the supervisory team for the analysis of satellite observations and radar data will be used and, if time permits, extended upon. This will include the use of high-performance computing resources at Bath.

On the modelling side, the student will use the one of the worlds most advanced global climate models, HadGEM3 (also known as the Unified Model), to simulation SSWs, analyse and understand model output, and quantify any improvements in how the model performs so that we can further understand the stratosphere-troposphere connection.

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

The student will receive training from the supervisory team on analysis and interpretation of atmospheric measurement data from a range of sources (from the Bath supervisor), on the operation and modification of the Unified Model (from the Bristol supervisor), and in the use of high-performance computing resources (for both parts of the project). This combination of observational and modelling approaches will prepare them for post-graduation opportunities across the full range of atmospheric science careers.

Depending on student interests, they would 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.

References / Background reading list

Wright et al (Atmos. Chem. Phys. 2017) - http://doi.org/10.5194/acp-17-8553-2017
Ern et al (Atmos. Chem. Phys. 2016) - http://doi.org/10.5194/acp-16-9983-2016
Mitchell et al (J. Clim. 2013) - http://doi.org/10.1175/JCLI-D-12-00030.1
Wright et al (J. Geophys. Res. 2010) - http://doi.org/10.1029/2009JD011858

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 1600 hours GMT Monday 7 January 2019 and interviews will take place between 4 and 15 February 2019. For more information about the NERC GW4+ DTP, please visit https://nercgw4plus.ac.uk.