PROJECT TITLE

Can upper stratospheric flow regimes improve weather prediction of the UK and Europe?

PROJECT DESCRIPTION

Weather hazards such as Storm Dennis and Ciara or "Beast from the East" occurred in the winter of 2019-2020 bring about strong winds and floods or heavy snow fall, causing major disruptions and economic damages to the UK. In a rapidly warming planet, extreme weather events like those are expected to occur more frequently globally but with distinct different regional drivers. Identifying the relevant drivers would benefit those decision makers whose planning and business activities involve weather forecasts and long-term climate projection. The storminess and coldness of the regional winter are largely affected by the passage of low-pressure systems from North Atlantic Ocean and occasional outbreaks of freezing winds from the Arctic. The relevant strength of the low-pressure systems and the cold Arctic outbreaks disturb the westerly jet stream that blow over the North Atlantic Ocean, which would normally bring in warm, moisture airs across the UK and Europe. The variability of this jet stream is often measured by a seesaw pattern between the North Atlantic and the Arctic, the so-called North Atlantic Oscillation (NAO). Recent research suggests that another strong jet stream sitting above in the stratosphere (15-50 km above the surface), which is termed as the stratospheric polar vortex, plays a crucial role in determining the NAO, thus the European climate variability during winter. The polar vortex varies in both strength and vertical structure. In some winters, the vortex starts being stronger and /or wider in the upper stratosphere and lower mesosphere (a layer between 45-65 km above the surface). In other winters, the vortex starts being weaker/narrower there. Different types of circulation anomalies near the surface are found to associate with these two type vortex profiles later in the winter. Such connections are important and exciting because of they may bring in much needed improvement of sub-seasonal to seasonal forecasting to the UK and the surrounding regions. In order to realize this potential, it is necessary check whether or not other reanalysis data sets and/or the state-of-art climate models can reliably reproduce the aforementioned results. The main objectives of this project are to:

1) check the robustness of the results using most reliable reanalysis data sets.

2) detect biases in model simulations by comparing model simulations against the patterns found in the reanalysis data sets.

1) involves using existing Matlab program developed at BAS by the main supervisor, applying these existing diagnostic tools to the ERA5 reanalysis data set, which is already in house at BAS.

2) involves using the same set of tools to analyze a subset of CMIP6 control simulations, i.e. UKESM, for the same period. The student will need to access JASMIN and CEDA services because all the CMIP6 data are stored there.

The project is designed to be flexible. The two objectives are independent and can be treated as separate projects by their own or as sub-modules of a single project depending on applicants and availability.

SUGGESTED LENGTH – project 1 is a 6-week project; project 2 is a 10-week project. Combined it is a 12- to 16-week project**.**

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

JOB DESCRIPTION

For 6 week project: the student will 1) apply and modify an existing suite of software written in Matlab to carry out data analysis using ERA5 monthly data sets using BAS's HPC; 2) evaluate the difference between the results from the ERA5 and those from previous published results; and 3) examine the robustness of the previously reported impact on the near surface weather.
For 10 week project: the student will 1) apply and modify an existing suite of software written in Matlab to carry out data analysis using a subset of CMIP6 model simulations available on JASMIN; 2) quantify the model bias in both the stratosphere and the troposphere; 3) explore the cause(s) of the bias; or 4) identify crucial processes that lead to the detected near surface responses.
For 12 week+ project: the student will carry out a module-based project and will tackle all the items listed above one-by-one.
Based at the British Antarctic Survey you will receive core supervision from Dr Hua LU with additional supervision from other colleagues within the AIC-PCAP team. There is opportunity to interact with polar meteorologists and other scientists specialising in atmospheric dynamics, polar ocean, sea ice, computer modelling, and analysis of big data. If results are publishable, the student will be guided through the process of preparing the results for publication. Also, the student will have the opportunity to present the research outcomes at the BAS Atmosphere and Ice-Climate seminar series.

WHAT ARE WE LOOKING FOR?

We seek an enthusiastic, proactive student with strong scientific interests and self□motivation, who holds or expects to gain an upper-second class undergraduate degree or above in atmospheric or oceanic sciences, applied mathematics, computer science, engineering, physics, statistics or a related field. Programming experience and ability to handle large data sets are advantageous. This project would most suit an applicant with a desire to become a dynamist, meteorologist, or polar scientist.

ADDITIONAL INFORMATION

The project requires that the candidate has access to relatively fast internet connection that can cope with BAS's high-end computing facilities including the HPC, other Unix systems for external connections, and the central Matlab license. Most of the work can be achieved remotely.
It is desirable that the candidate at least spend some time in Cambridge so that they have the opportunity to meet and work face-to-face with the supervisor allowing for better appreciation of the work environment of a polar research institute such as BAS and to resolve concerns in a timely fashion.