Research Scientist: Tropical cyclones and air-sea coupling

Further Details

FASCINATE project

This post is part of the "Forecasting Air-Sea Coupled Interactions in Numerical weather prediction for Atmospheric Tropical Extremes" (FASCINATE) project. FASCINATE is one of several projects recently funded as part of the Weather and Climate Science for Service Partnership-Southeast Asia (WCSSP SE Asia), by the UK government department of Business, Energy and Industrial Strategy (BEIS), through the Newton Fund. The motivation behind these project is to increase strategic scientific collaborations between the UK and Southeast Asia, while maintaining an international-development remit. WCSSP SE Asia projects are administered by the UK Met Office and feature close collaboration with Met Office scientists, as well as scientists in Southeast Asia.

Tropical cyclones (TCs) are a considerable threat to lives and livelihoods throughout the western North Pacific (WNP). The Philippines Area Region (PAR) is particularly at risk from high-impact weather associated with TC landfalls, due to its location in a region of frequent and intense TC activity; its high population density, which increases vulnerability and hampers evacuation efforts; its steep inland topography, which enhances rainfall and the risk of landslides; and the long, narrow configuration of its islands, which places most of its population within a few dozen kilometres of the coast, increasing their susceptibility to storm surges. It is therefore imperative to understand and improve the ability of state-of-the-art numerical weather prediction (NWP) models and seasonal forecasting systems to predict TC activity in the WNP and PAR, to provide more accurate and longer-lead warnings of TC landfalls, to increase decision-makers' confidence in forecasting systems and ultimately to safeguard life and property.

The objectives of FASCINATE are to improve the understanding of the relationships between WNP TC activity and large-scale tropical phenomena, including the Madden-Julian Oscillation (MJO) and the El Nino Southern Oscillation (ENSO); to evaluate the ability of the Met Office NWP and seasonal prediction systems to represent those relationships; and to investigate whether NWP skill for WNP TCs could be improved by simulating local atmosphere-ocean feedbacks and/or by altering the treatment of sub-gridscale atmospheric convection. FASCINATE is led at the University of Reading by Principal Investigator Dr. Nicholas Klingaman, with Co-Investigators Prof. Pier Luigi Vidale and Dr. Kevin Hodges. Technical support for the Met Office forecast model will be provided by Ms. Rosalyn Hatcher.

Research plan

The post-holder will identify relationships between WNP TC activity and large-scale tropical phenomena, such as the MJO and the ENSO. This will involve using observations and reanalysis data, with TCs identified and tracked using a software package developed by Co-I Hodges. A particular focus of this work will be analysis of how these large-scale phenomena influence the environment in which TCs form and strengthen, for example through modifying patterns of sea-surface temperature

or atmospheric relative humidity. After establishing these relationships in observations and reanalysis and existing climate-model simulations, the post-holder will perform a similar analysis using past forecasts with the Met Office NWP and seasonal prediction systems. The goal of this research is to link biases in predictions of TC activity to biases in predictions of large-scale tropical phenomena and their teleconnections to the regional-scale environment in the WNP. For example, poor predictions of the MJO may cause poor predictions of MJO-related TC activity in the WNP; alternatively, the forecasts of the MJO itself may be accurate, but poor predictions of the teleconnection from the MJO and WNP SST may hamper WNP TC predictions.

The post-holder may contribute to the development and implementation of an atmosphere-ocean coupled configuration of the Met Office NWP system, as part of a project activity led by the PI with support from Ms. Hatcher. The PI has developed a many-column configuration of a one-dimensional mixed-layer ocean model, which he has successfully coupled to the Met Office climate model for process-based experiments of the effects of air-sea feedbacks on tropical variability. A key goal of FASCINATE is to deliver a similar coupled configuration of the Met Office global and regional NWP systems. Depending on the skills and initiative of the post-holder, the post-holder may contribute to the development and implementation of these models on high-performance computing systems in the UK and in the Philippines.

Regardless of the post-holder's involvement in the model-development work above, the post-holder will be responsible for performing re-forecasts of past TCs in the WNP and PAR with the global and regional air-sea coupled NWP models, with support from the PI and Ms. Hatcher. The post-holder will participate in the selection of case studies, in collaboration with scientists at the Met Office and the Philippines Atmospheric Geophysical and Astronomical Services Administration (PAGASA). The aim of these re-forecasts is to determine whether including atmosphere-ocean interactions in global or regional NWP systems affects the skill of TC predictions. Most NWP systems, including those of the UK Met Office, do not consider feedbacks from the atmosphere on the underlying ocean; instead, they prescribe the initial SST throughout the forecast. Since PAGASA uses the UK Met Office model for its operational TC forecasts, these experiments have direct relevance to improving real-world predictions of TC tracks and intensities, with the potential to mitigate the often-substantial humanitarian and economic consequences of TC landfalls in the Philippines.

Further re-forecast experiments will assess whether alterations to the treatment of sub-gridscale atmospheric convection – known to influence the skill of MJO predictions in the Met Office model – affects the skill of predictions of WNP TCs, potentially through an improved representation of the large-scale tropical environment in which those TCs form and strengthen.

FASCINATE is required to deliver periodic reports and scientific software to the Met Office and to the wider WCSSP SE Asia project. The post-holder will be expected to contribute strongly to these deliverables.

Work environment

The post-holder will be part of the Tropical Climate and High-Resolution Climate Modelling research groups within the National Centre for Atmospheric Science's Climate Directorate (NCAS-Climate), based within the Department of Meteorology at the University of Reading. NCAS-Climate comprises approximately 50 scientists at Reading, and provides a core-strategic programme and national capability in modelling and understanding the climate system. The Department of Meteorology is a thriving centre for atmospheric and ocean science with around 200 research and academic staff and 80 research students. In the most recent Research Excellence Framework results (REF 2014), 86% of our research was graded as world leading or internationally excellent.

The post-holder will develop strong collaborations with scientists at the Met Office and in the Philippines. The post-holder will make regular visits to the Met Office and annual visits to the Philippines (or elsewhere in SE Asia), for meetings with collaborators and regular WCSSP SE Asia workshops.

The University aspires to be an "Employer of Choice" and recognises that success is not simply determined by a competitive suite of terms and conditions of service, but by fostering a working environment that protects the physical and mental well-being of its staff. Full details of the University's Health and Well-being policy are available through the HR website. The University is committed to work-life balance and supportive of flexible working arrangements, and the School's website gives examples of excellent practices in respect of flexible work as well as for maternity/parental leave within the School. The University supports its staff in many other ways:

- its Centre for Quality Support and Development,
- its excellent Nursery facilities,
- its SportsPark,
- its membership of Childcare+.

The School of Mathematical and Physical Sciences was awarded an Athena SWAN Silver award in 2010, renewed in 2014, in recognition of its good employment practices in relation to women working in science, engineering and technology (SET). Please follow the link for more information.

The University is a Stonewall Diversity Champion and is participating in Stonewall's 2015 Workplace Equality Index.