RESEARCHER JOB DETAILS

Civil Engineering and Geosciences

Research Associate (INTENSE II) Grade: F Vacancy Ref: D1637R

Main Duties and Responsibilities

A successful candidate would be expected to:

1. Attend GEWEX/GHP meetings to contribute to the GEWEX/GHP sub-daily rainfall initiative/cross-cut which Prof Fowler leads.
2. Examine the dependence of daily and sub-daily precipitation annual/seasonal maxima on global near-surface temperature by developing non-stationary GEV models using the new precipitation dataset.
3. Examine the dependence of daily and sub-daily extreme precipitation on local temperature and humidity and work with colleagues to compare results to model data where appropriate.
4. Examine the role of the large scale atmosphere in modulating the local-scale dependencies working with Post 3 PDRA.
5. Work closely with Geert Lenderink (KNMI, Netherlands) on this analysis which will involve short visits to KNMI.

Additional information

Based at Newcastle University, you will carry out research on the project “INTENSE: INTElligent use of climate models for adaptatioN to non-Stationary hydrological Extremes”. You will be responsible for work in WP2 of the INTENSE project, in particular to examine the influence of local thermodynamics (temperature, humidity etc.) on sub-daily and daily precipitation extremes around the globe using a new global sub-daily precipitation dataset being collected as part of the project. This will involve working with Dr Geert Lenderink and his team at KNMI, Netherlands. A 3-month funded international research visit is included as part of the role (negotiable). You should have a PhD or equivalent, with a proven record of achievement in a relevant research area and a creative approach to solving problems with an appropriate level of mathematical ability and prior use and knowledge of statistics. Experience in handing and manipulation of large datasets and computer programming skills are essential as are excellent written and oral communication skills and the ability to work both independently and as part of a team. It is desirable that you also have experience with precipitation datasets.

This is one of three posts being advertised to work on the INTENSE project. The post is tenable for 36 months from 1st December 2014 or as soon as possible thereafter. For further information and informal discussion of the role please contact Professor Hayley Fowler at h.j.fowler@ncl.ac.uk (0191 208 7113).

You will be employed by Newcastle University for the 3-year (36-month) post under the day-to-day supervision of Prof. Hayley Fowler. You will be responsible for work in WP2 of the INTENSE project, in particular examining the influence of local thermodynamics on sub-daily precipitation extremes around the globe.

Clausius-Clapeyron (CC) suggests that total atmospheric water vapour will increase at a rate of 7% per °C of surface warming in the absence of large changes to circulation (Pall et al., 2007), causing comparable rises in precipitation extremes (Trenberth et al., 2003). Westra et al. (2012) confirmed the median intensity of daily annual maximum precipitation changes with global mean temperature at a rate of 5.9% to 7.7% per °C. However, recent results indicate that sub-daily extreme precipitation will intensify more than theory suggests (e.g. USA: Mishra et al., 2012; Shaw et al., 2011; Brazil: Maeda et al., 2012; Netherlands, Belgium, Switzerland: Lenderink and van Meijgaard, 2008, 2010; Hong Kong: Lenderink et al., 2011; Germany: Berg et al., 2013; China: Yu and Li, 2012). Many of these studies have found evidence of super-CC dependence (~2 x CC) for hourly extremes from ~12°C to ~23°C and thereafter reductions, but it is still unclear how this is related to event duration, moisture availability and local scale thermodynamics in clouds. INTENSE will analyse new and existing precipitation and temperature datasets to quantify the scaling relationship between extreme precipitation and temperature for different climate regimes and seasons, then extending this to examine the effects of atmospheric humidity on precipitation extremes. Separate seasonal analyses will remove some ambiguity introduced by atmospheric circulation conditions, particularly over moisture- limited regions and for the summer season. This will be the first global study linking temperature and atmospheric humidity to precipitation extremes at different time-scales

The Project

The post is funded by a European Research Council funded project led by Professor Hayley Fowler, INTENSE: INTElligent use of climate models for adaptatioN to non-Stationary hydrological Extremes. The project is large and exciting – with a number of research staff working together on different aspects based at both Newcastle University and our main project partner, the UK Met Office Hadley Centre Regional Climate Modelling team led by Dr. Elizabeth Kendon. The project also has many international project partners including Princeton University, NCAR and Washington State University (US), KNMI (Netherlands), SMHI (Sweden), CSIRO, UNSW, Adelaide University (Australia) and Reading University (UK) and funding is available for extended stays to work with international research teams within the project budget.

The key challenges to the climate change impacts community with regards to precipitation extremes are: (i) a paucity of studies on sub-daily extremes and the lack of a comprehensive global assessment of changes; (ii) an incomplete understanding of the relationship between atmospheric temperature and moisture and extreme precipitation; (iii) an incomplete understanding of how large-scale atmospheric and oceanic modes and local thermodynamics influence extreme precipitation; (iv) statistical and climate modelling approaches that fail to represent the key features, non-stationarities and continuum nature of precipitation extremes, features that are likely essential in adequately representing the response to global and local change.

INTENSE will use a novel and fully-integrated data-modelling approach to provide a step- change in our understanding of the nature and drivers of global precipitation extremes and change on societally relevant timescales. Extreme precipitation is increasing globally and theory suggests it will continue to increase with global warming: however, results based on opportunistic datasets indicate that sub- daily precipitation extremes will intensify more than is anticipated based upon theoretical considerations. Determining the precise response of precipitation extremes is hampered by coarse climate models which cannot adequately resolve cloud-scale processes and a lack of sub-daily observations which are vital in advancing the theoretical knowledge necessary for improved regional prediction. INTENSE will comprehensively analyse the response of precipitation extremes to global warming by constructing the first global sub-daily precipitation dataset, enabling substantial advances to be made in observing current and past changes and in providing the physical understanding of processes relating to precipitation extremes necessary for improved regional prediction. This will be used together with other new observational datasets and high-resolution climate modelling to quantify the nature and drivers of global precipitation extremes and their response to natural variability and forcing across multiple timescales. Specifically the project will examine the influence of local thermodynamics and large-scale circulation modes on observed precipitation extremes using new statistical methods which recognise the non-stationary nature of precipitation, and use these to identify climate model deficiencies in the representation of precipitation extremes. The recurrence of extreme hydrological events is notoriously hard to predict, yet successful climate adaptation will need reliable information which better quantifies projected changes. INTENSE will provide a new synergy between data, models and theory with which to tackle the problem using a process-based framework; isolating the precursors for extreme precipitation and intelligently using detailed modelling as a tool to understand how these extremes will respond to a warming world and the implications for adaptation strategy. This is hoped that this approach will provide improved projections of precipitation extremes.

This will be based around six key research questions:

i) How has sub-daily maximum precipitation changed over the last century, across continents, climate regimes and seasons?

ii) How does precipitation at different time-scales vary with atmospheric temperature and atmospheric moisture as the atmosphere warms?

iii) How do large-scale atmospheric and oceanic features influence or modulate the observed changes in precipitation extremes, the clustering of extremes and the variability between ‘drought’ and ‘flood’ periods, in different climate regimes and seasons?

iv) What is the influence of climate model resolution and structure on the simulation of precipitation extremes for different climate regimes and seasons?

v) What is likely the response to warming of precipitation and precipitation extremes at different time- scales across different climate regimes?

vi) How can we use information from both high-resolution and coarse-resolution climate models in a more intelligent way to inform climate change adaptation decision making to better manage extreme hydrological events?

The research questions outlined above will be addressed through 5 work-packages which each have a research associate working on them who will also work together as a larger project team. Additionally, Dr. Geert Lenderink from KNMI, Netherlands will work 20% FTE on WP2 during the project lifetime. Posts are advertised for PDRA’s to work on WP1, WP2 and WP3 of the project.

WP1: Sub-daily precipitation data collection and trend analysis: collect sub-daily precipitation data over four continents, quality check, analyse the global climatology of sub-daily precipitation and extremes (including the diurnal cycle), process to extract indices and quantify recent regional and global trends.

WP2: Influence of local thermodynamics: global analysis of precipitation (extremes) and temperature and humidity scaling for sub-daily data from WP1 and existing global daily datasets: exploring the influence of local environment, storm dynamics and cloud-process feedbacks using observed datasets.

WP3: Influence of large-scale atmosphere-ocean modes: regional analyses of precipitation (extremes) and temperature or humidity datasets linking changes/cycles to clearly defined atmosphere-ocean modes of natural variability, i.e. NAO, ENSO using non-stationary statistical methods.

WP4: Influence of climate model resolution and structure: global analysis, using case-studies of nested RCMs and high-resolution GCMs, to explore model inadequacies in simulation of local thermodynamics and the influence of large-scale atmosphere-ocean modes on extreme precipitation for different climate regimes.

WP5: Intelligent, process-based, downscaling: developing new downscaling methods accounting for non- stationarity in precipitation extremes from natural climate oscillations and global warming, using observed process-understanding from WP2-3 and better understanding of model inadequacies from WP4; explore how this alters the projected response of precipitation and precipitation extremes to global warming.

Research Role Profile

As part of our commitment to career development for research staff, the University has developed 3 levels of research role profiles. These profiles set out firstly the generic competences and responsibilities expected of role holders at each level and secondly the general qualifications and experiences needed for entry at a particular level. It is unlikely that any single member of staff will be applying all these competences at any one time but he or she would be expected to display most of them over a period of time.

Please follow this link to our Research Role Profiles

Person Specification

Knowledge (inc. qualifications)

Essential

- A good degree (2.1 or above) in mathematics, statistics, climate or atmospheric sciences, engineering, physics or related subject
- A PhD (or almost completed PhD or equivalent research experience) in a relevant physical science
- Appropriate level of mathematical ability and prior use and knowledge of statistics

Skills (professional, technical, managerial, practical)

Essential

- Excellent written and oral communication skills
- Ability to work both independently and as part of a team
- Ability to work to deadlines and manage competing priorities
- High level of analytical and problem solving capability

- Ability to co-ordinate own work with that of others, deal with problems which may affect the achievement of research objectives and contribute to the planning of the project

Desirable

- Detailed subject knowledge in the area of research

Experience and Achievements (paid or unpaid)

Essential

- Good knowledge of high level programming languages such as C or Fortran, IDL, R, Python etc.
- Experience in handling, manipulation and analysis of large datasets
- Published high quality research papers commensurate with level of experience
- Presenting research findings at conferences

Desirable

- Experience of extreme value statistics
- An appreciation of the wider issues related to climate impacts analysis and decision-making
- Contributed to/written research proposals

For additional details about this vacancy and essential information on how to apply, visit our Job Vacancies web page at http://www.ncl.ac.uk/vacancies/