



# THE UNIVERSITY *of* EDINBURGH

## Job Description

**Internship Title:** NERC Research Experience Placement - Employ.ed on Campus - Evaluation of ERA5 near-surface wind speeds (variability and long-term) over Madagascar

<b>Department / School</b>	School of GeoSciences, University of Edinburgh
<b>Reports To</b>	Dr Massimo Bollasina, School of Geosciences, University of Edinburgh, <a href="mailto:Massimo.Bollasina@ed.ac.uk">Massimo.Bollasina@ed.ac.uk</a>

### Job Purpose

The objective of this summer placement project is to validate the wind speeds and wind gust speeds from the ERA reanalysis dataset over the island of Madagascar against in situ observations.

### Main responsibilities

- Extract ERA5 data over Madagascar. This requires knowledge of the (preferably) Python programming language or, alternatively, any other programming language.
- Manipulating climatic data (basically wind speed and wind gust wind data) from weather stations and organise them in an appropriate format for analysis. #
- Conduct various statistical analyses to validate the ability of the ERA5 reanalysis dataset at representing the mean and variability of wind speeds and wind gust speeds over Madagascar.
- Searching for relevant literature using Scopus, ScienceDirect and/or Web of Science and putting together a list of relevant journal articles and book chapters using the EndNote referencing software
- Ability to extract information relevant to the project objectives from the literature obtained above and to write an annotated bibliography.
- Make probability distributions of wind speeds and wind gust speeds using the ERA5 reanalysis dataset and calculate the 50-year return period. The latter return period is selected given its use in the country's building code.

### Knowledge Skills and Experience

#### Person specification

- Knowledge of a programming language (essential)
- Knowledge of Python (preferred) and R (preferred).
- Ability to search for scientific literature using library databases and to extract information relevant to the project objectives (essential).
- Interest in working as part of an interdisciplinary team of researchers working in climate science, engineering and social sciences (desirable).

## Key contacts

- Dr Massimo Bollasina, School of Geosciences, UoE;
- Dr Chris Beckett, School of Engineering, UoE and
- Dr Alexandre Gagnon, School of Biological and Environmental Science, Liverpool John Moores University

## Dimensions

This is a 7-week placement with flexible start date (between 14 June and 19 July).

**Closing date:** 19 May 2021

**Interview date:** to be determined by the supervisor

**Start date:** flexible start date between 14 June and 19 July

**Hours per week and preferred pattern/restrictions (if applicable):** 35 hours per week (part-time option available)

**Length of internship:** 7 weeks

## Additional Information

### Host and Project outline

Dr Massimo Bollasina from the School of Geosciences at the University of Edinburgh will be the host of this project, supported by Dr Chris Beckett and Dr Alexandre Gagnon from the School of Engineering at the University of Edinburgh and the School of Biological and Environmental Sciences at Liverpool John Moores University, respectively. The three academics are currently working together on a project titled: "The Resilience of Traditional Structures in Madagascar to Cyclones in a Changing Climate (RC3)" through funding from the Royal Society under the Global Challenges Research Fund. The summer student will be invited to attend the weekly project meetings and will thus benefit from working with an interdisciplinary team of researchers comprising climate scientists, engineers and geographers, thereby raising their awareness of the wider context of the work, as well as investigating a topic with practical societal applications.

Madagascar is a highly vulnerable country with regard to the impacts of climate change. The exposure of the country to cyclones contributes to this ranking while the limited resources that the country disposes constrain its capacity for adaptation. In March 2017, for instance, cyclone Enawo caused at least 81 deaths, destroyed 38,000 houses and left 250,000 people displaced. As the development of cyclones is related to Sea Surface Temperatures (SSTs), there is a risk that they will become more frequent and/or intense under climate change, thereby further increasing Madagascar's vulnerability to extreme events. The built environment is thus one sector particularly affected by cyclones. During cyclones, large proportions of the building stock of Madagascar collapse under the associated high wind loads and flood events.

Resilience is the ability of a system, or in the case of the project associated with this placement the traditional residential infrastructure of Madagascar, to withstand the severe winds associated with tropical cyclones and to anticipate and adapt in the face of change (UNISDR 2009)<sup>1</sup>. One key component of resilience is that it incorporates not only short-term disruption but also long-term trends, notably in maximum wind speeds and wind gust winds, in order to understand and anticipate potential future challenges. According to the United Nations, Madagascar belongs to the group of Least Developed Countries. In those countries, the lack of availability and completeness of the climatic data records makes it difficult to analyse long-term trends as one would expect in a resilience analysis. This is even more problematic for climatic variables other than the traditional temperature and precipitation measurements such as wind speed.

Reanalysis datasets such as ERA5, i.e., the fifth generation atmospheric reanalysis of the global climate of the European Centre for Medium Range Weather Forecasting (ECMWF) offers a potential alternative not only to the lack of complete data records of wind speed, but also to the scarcity of meteorological observations in certain regions. ERA5 is a reanalysis dataset combining ‘vast amounts of historical observations into global estimates using advanced modelling and data assimilation systems’<sup>2</sup>. Reanalysis datasets need to accurately reproduce local climate variability for their use in climate impact studies, notably to assess the resilience of infrastructure to cyclonic winds and temporal trends in their intensity. Wind speed data derived from reanalysis datasets have been used in the planning and design of infrastructure, notably for wind farms in China, but the quality of these data remains unknown in many parts of the world<sup>3</sup>, with the validation of such datasets revealing systematic underestimation of wind speeds and the need for bias correction for an adequate use of those data<sup>4</sup>.

The objective of this summer placement project is to validate the wind speeds and wind gust speeds from the ERA reanalysis dataset over the island of Madagascar against in situ observations. The validation will focus on reproducing the spatial distribution of the climatology, interannual variations and long-term trend of near-surface (10m above ground) wind speeds over Madagascar and estimate any potential bias between the two datasets using various statistical techniques, for instance the root mean square error, Pearson correlation, absolute error and relative bias. The probability distributions of wind speeds and wind gust speeds will also be determined and will contribute to the development of a baseline climatology of a 50-year return period of annual maximum wind speed, as the latter has been adopted in the country’s building code. The analysis will first focus on the 1979-2020 period and will then be expanded to the recently made available extension of the reanalysis dataset for the 1950-1979 period.

The same data extracted and formatted by the student will then be used by the project team in the autumn to compare the new Coupled Model Intercomparison Project Phase 6 (CMIP6) models’ simulations over the 40-year period extending between 1979 and 2014, with the objective of selecting the General Circulation Models (GCMs) that are best at simulating the past climate (according to a number of statistical measures). These selected GCMs will subsequently provide probabilistic distributions of wind speeds and wind gust speeds which will be used in a model developed as part of the project that determines the likelihood of failure of a building on the basis of a wind load applied to it.

## References

- 1 UNISDR 2009. Terminology on Disaster Risk Reduction. United Nations
- 2 <https://www.ecmwf.int/en/forecasts/datasets/reanalysis-datasets/era5>
- 3 Yu et al. 2019. Evaluation of Near-Surface Wind Speed Changes during 1979 to 2011 over China Based on Five Reanalysis Datasets. *Atmosphere*, 10.

4 Ramon J. et al. 2019. What global reanalysis best represents near-surface winds?. Quarterly Journal of the Royal Meteorological Society, 145(724).

### [Training](#)

Python programming language for model output extraction and mapping. R statistical package and scripting language for data analyses and the production of publication quality figures. Training can be provided on this, but the student will require knowledge of at least one programming language, preferably Python.

### [Location](#)

Pending Covid regulations the student will be based in the School of Geosciences at the University of Edinburgh. Note that given the desk-based nature of the project, it is possible to do all the project at home, as detailed under point L below. Meeting with Dr Beckett and his PDRA in Engineering will also take place in the lab for the student to understand the applications of the climatic data analyses that s/he is conducting for the Engineering side of the RC3 project.

### [Covid-19 contingency plan](#)

All the work described above can be done remotely. Both the Python programming language and the R software environment for statistical computing and graphics are free, open-source software and can thereby be downloaded by the student for home use. Meeting between the student and the supervisory team will take place regularly using either Skype or Microsoft Teams. It is anticipated that the student, being registered at the University of Edinburgh, will have either a desktop for home use or laptop. A standard computer will provide enough computer power for the data analyses required for this summer placement project. Even if the project is entirely online the student will still be integrated with the research team through attendance at the weekly project meetings and regular contacts with the supervisory team.

## [Programme Information](#)

Research Experience Placement is a summer placement scheme funded by NERC, aimed at undergraduate students to address demographic and diversity-related challenges in the environmental sciences as well as thematic skills gaps (e.g. quantitative skills).

**Please see the application instructions and selection process on the REP webpage:**  
[Research Experience Placements \(REPs\) | The University of Edinburgh](#)

[Employ.ed on Campus](#) is run by the Careers Service in collaboration with University departments and Schools. It offers exclusive summer internships at the University over the summer for 2nd year to penultimate year undergraduate students studying in an UK Higher Education institution.

As well as great work experience, the Careers Service provides supporting resources, this is combined with a framework to support the development of participants' employability and self-reflection with an [Edinburgh Award](#) as part of the internship.

## [Application Support](#)

For guidance on writing an effective application see our website: [CV, Applications and Interview Advice](#)

You can also make an appointment with a Careers Consultant using [MyCareerHub](#).

## Eligibility

Students are subject to eligibility criteria to be able to apply for NERC REPs and must:

- Be undertaking their first undergraduate degree studies (or integrated Masters)
- Be applying for a placement in a different department to their undergraduate degree
- Be eligible for subsequent NERC PhD funding, i.e. be either:
  - an UK citizen OR
  - an EU citizen with pre- or settled status under the EU Settlement Scheme OR
  - a non-EU citizen who have obtained the right to remain in the UK - known as 'indefinite leave to remain' (ILR) O
  - an International/EU student already studying in the UK and currently under a Tier 4 or Student Route Visa with validity until at least September 2021

**REPs do not meet the requirements for a visa request therefore non-UK students who are not currently living in the UK or who are without a suitable UK visa are not eligible to apply.**

Internships are ONLY open to 2nd year to penultimate year undergraduate students studying in an UK Higher Education institution and based in the UK. You cannot take part if you are a visiting student, or you have already taken part in the programme before.

## Privacy Statement

In addition to the University's HR data privacy statement, please read the [Student and Graduate Privacy Statement: Internships and work experience programmes](#) to understand how and why we will use the information you submit for the Employ.ed Programmes

## Health & Safety Requirements for the role

N/A

## Key Job hazard information specific to the role

N/A

If you require this document in an alternative format please contact Internships and Work Experience Team by email at [employ.ed@ed.ac.uk](mailto:employ.ed@ed.ac.uk)