Project title: The impact of global warming on hurricane-induced storm-surges in the Caribbean

Supervisors: Rory Bingham and Dann Mitchell (University of Bristol), Michael Taylor (University of West Indies)

Background
The islands of the Caribbean are particularly vulnerable to hurricanes, seen most recently during the 2017 hurricane season. Over the last 500 years, hurricanes have caused an estimated 300,000–500,000 deaths in North America and the Caribbean, predominantly in the Small Island Developing States (SIDS) of the Caribbean. As well as the loss of life, the economic impact is huge. After a hurricane strikes an island, not only are there the direct costs of rebuilding, which often far exceed a SIDS’s annual GDP, but economic growth is severely limited during the recovery period. For a major hurricane, this often exceeds six years, even for the richer of the Caribbean Islands. Given these impacts, it is crucial that we understand how North Atlantic hurricanes and their associated risks for Caribbean Islands are likely to change with global warming. There are reasons to believe that rising global temperatures and warming oceans will lead to more intense and/or frequent hurricanes. However, the changing nature of North Atlantic hurricanes and their impacts on the Caribbean Islands have yet to be properly quantified. This ignorance limits our ability to effectively target resources that will enable communities to develop resilience in the face future threats.

Project Aims and Methods
In addition to the direct impact of intense winds, much of the loss of life and damage to property and infrastructure due to hurricanes results from coastal storm surges. Therefore, the over-arching aim of this project is to quantify the changing risk associated with hurricane-driven storm-surges in the Caribbean under global warming. This will be achieved through a combination of numerical modelling and statistical analysis. Parameterisations of the North Atlantic hurricane field will be obtained from climate models run under a range of warming scenarios. These parameterisations will be used to drive both physically-comprehensive and statistically-approximated storm-surge models, that will be developed as part of the project. Climate model and observational data will be used to consistently account for the influence of sea level rise due to thermal expansion, melting land-ice and ocean dynamics. Together, this will enable realistic, detailed and uncertainty-bounded projections of future storm-surge return periods for the coastlines of the Caribbean to be produced and provided for the benefit of local communities. The project will be conducted in collaboration with colleagues from the University of West Indices.

Candidate requirements
This project would suit someone with a strong quantitative background and an interest in ocean/atmosphere dynamics and climate change. You should enjoy computer programming (eg Python, R, Matlab, Fortran).

Training
You will develop skills in ocean modelling, the statistical analysis of large datasets, high-performance computing and programming. You will learn how to present complex ideas, both in written and verbal form, to a wide range of audiences. You will have the opportunity to attend summer schools in climate and ocean dynamics and can attend relevant university courses.