

## 1. Background to my research – key generic problem

Hurricanes are annual events in the Caribbean and are associated with three hazards: storm surge, wind and rain effects that impact the islands in the Caribbean basin and mainland America. Low-lying areas are particularly susceptible to the effects of storm surges and flooding associated with hurricanes. Global data indicates a 30-year trend towards more frequent and intense hurricanes<sup>1</sup>. There is a continuing and strong scientific debate around whether the trends of increased frequency and magnitude in hurricane events are directly linked to trends in global warming or, whether the recent (decadal) trends in hurricanes are related to cyclic events throughout history<sup>2,3</sup>. In particular, it is unclear whether regions are more likely to experience more frequent and intense hurricane events in the future.

Hurricane prediction models typically utilise historical meteorological records that are often limited to <100 year. In order to understand the cyclicity of hurricane activity and inform hurricane prediction it is imperative that hurricane records be extended. An effective way of extending the historical record of hurricane events is to examine hurricane deposits. Hurricanes of category 3 or greater generate large storm surges that scour beach and shallow marine sediments then re-deposit the sediment landwards. The geomorphology of low-lying coastal lagoons provides an ideal setting for capturing hurricane-deposited sediment and consequently the ability to preserve a multi-millennial sedimentary archive of past hurricane activity. This has been effectively undertaken along Mainland America<sup>4,5,6,7</sup> and Puerto Rico in the Northern Caribbean<sup>8</sup> but not for the Main Development Region (MDR) of the Atlantic hurricane activity (between 10° and 20° N<sup>9</sup>).

## 2. Research project: aims and uses of the research

The proposed study **aims** to reconstruct the environmental history and past hurricane activity as recorded in coastal lagoons along the south coast of Jamaica. The project will provide a spatially detailed study of past hurricane activity as recorded in washover events in coastal lagoons, and will examine sedimentological characteristics of such events. The project will provide a well-constrained chronology of hurricane events along the south coast of Jamaica, and therefore provide important information in the understanding of hurricane frequency, magnitude and character within the Caribbean.

### *Preliminary findings and proposed fieldwork*

In collaboration with Dr Michael Burn (University of the West Indies, Mona Campus, Jamaica) sediment cores from one coastal lagoon were recovered in September 2010. The cores indicate that the lagoon infill is punctuated by marine washover deposits. The depositional history of the lagoon suggests spatial variation in the thickness and number of overwash events associated with proximity from the coastline and alongshore variations in the coastal geomorphology. The data collected to-date clearly highlights potential for the coastal lagoons along the south coast of Jamaica to provide long-term records for environmental reconstruction and paleotempestology. On the basis of this initial work it is proposed that a multi-site, multi-proxy project be developed. Initial surveys will identify suitable sites for sediment coring on the south coast of Jamaica. Sedimentological techniques (bioclast constituent analysis, fossil pollen, ostracod identification and charcoal remains) will be employed to identify washover deposits and distinguish between lacustrine and marine conditions. AMS radiocarbon dating will be carried out to provide a well-dated record of climate dynamics and ecosystem response to hurricane activity. Together sediment records will form the most detailed records of environmental reconstruction and paleotempestology in

Jamaica. Consequently, the potential exists to contribute to a deeper regional understanding of hurricane activity in the Caribbean.

### **3. Financial requirements**

It is intended to carry out the fieldwork over one month period (August-September 2011) to recover sediment cores from coastal lagoons. Funding for the preliminary fieldtrip in 2010 was provided partly by the Department of Geography and Development Studies and partly self-funded. The proposed research, part-funded by the BSRG Gill Harwood Fund, will thus: (1) provide an early career postdoctorate researcher the opportunity to gather new and original pertinent data in a contemporary and emerging area of research; (2) be the catalyst for longer-term collaboration with the University of West Indies; and (3) enable the development of a regional scale, interdisciplinary project. It is clear that this project has the potential to develop scientific knowledge and understanding into the magnitude and nature of historical hurricane events over geomorphic and geological timescales. The findings will have a more significant impact by contributing to the prediction, assessment and mitigation of hurricane-related coastal hazards for the Caribbean.

### **4. Main anticipated outputs and modes of dissemination of the project**

Over the course of the project it is anticipated that at least three peer-reviewed papers will be submitted for publication in relevant international journals. There will also be the opportunity for further publications by virtue of synergetic research with project collaborators. Results will be presented locally in Jamaica and internationally at conferences including the XXVII International Quaternary Association Congress in Bern, Switzerland, 20 – 27 July 2011. Conference grants have been submitted to through INQUA and the Quaternary Research Association (QRA) to facilitate attendance at the INQUA Annual Meeting, Bern, Switzerland (notification imminent).

1. Webster et al. (2005) Changes in tropical cyclone number, duration and intensity in a warming environment, *Science*, 309, 1844-1846.
2. Goldenberg, S.B. et al. (2001) The recent increase in hurricane activity: causes and implications, *Science*, 293, 474-479.
3. Knutson, T.R. et al. (2010) Tropical cyclones and climate change, *Nature Geoscience*, 3, 157-163.
4. Donnelly, J.P. et al. (2001) A 700-year sedimentary record of intense hurricane landfalls in southern New England, *Geological Society of America Bulletin*, 113, 714-727.
5. Donnelly, J.P. et al. (2004) A backbarrier overwash record of intense storms from Brigantine, New Jersey, *Geology*, 29, 615-618.
6. Liu, K.B. & Fearn, M.L. (1993) Lake sediment record of late Holocene hurricane activities from coastal Alabama, *Geology*, 21 (9) 793-996.
7. Liu, K.B. & Fearn, M.L. (2000) Reconstruction of prehistoric landfall frequencies of catastrophic hurricanes in north western Florida from lake sediment records, *Quaternary Research*, 54 (2) 238-245.
8. Donnelly, J.P. (2005) Evidence of past intense tropical cyclones from backbarrier Salt Pond sediments: A case study from Isla de Culebrita, Puerto Rico, USA, *Journal of Coastal Research*, Special Issue, 42, 201-210.
9. Nyberg, J. et al. (2007) Low Atlantic hurricane activity in the 1970s and 1980s compared to the past 270 years, *Nature*, 447, 698-702.

## Budget for fieldwork

The following budget covers fieldwork expenses to enable the recovery of sediment cores from coastal lagoons in Jamaica. The total requested funding from BSRG Gill Harwood Fund is **£500** to contribute towards the airfare costs. The balance of the costs is covered by the British Society for Geomorphology (BSG) Research Grant (£1300) which was awarded in November 2010.

| <b>Research trip August-September 2011</b>  | <b>Cost/item<br/>£</b>  | <b>Detail</b>                   | <b>Source of funding</b>             |
|---|-------------------------|---------------------------------|--------------------------------------|
| <b>Flights Manchester-Kingston, Jamaica</b> | <b>800</b>              | <i>British Airways</i>          | <b>Gill Harwood Fund / BSG Grant</b> |
| Accommodation                               | 0                       | <i>University accommodation</i> | N/A                                  |
| Boats/Fuel/Fieldwork supplies               | 400                     |                                 | <i>BSG Grant (awarded Nov 2010)</i>  |
| Core tubes and caps                         | 300                     |                                 | <i>BSG Grant (awarded Nov 2010)</i>  |
| Shipping of cores                           | 300                     |                                 | <i>BSG Grant (awarded Nov 2010)</i>  |
|   | <b><u>£1,800.00</u></b> |                                 |                                      |

**TOTAL REQUESTED - £500**