# New research identifies the role of the Indian Summer Monsoon on global climate change

A study led by researchers at The Open University (OU) with contributions from the British Geological Survey (BGS) has revealed new insights to help understand the historical importance of the Indian Summer Monsoon. Newly generated records of the Indian Summer Monsoon in put into context with published climate data, identified how the monsoon helped propagate warmth and moisture between the southern hemisphere with the northern hemisphere and thereby promoted global deglaciation.

The Indian Summer Monsoon represents one of Earth's most dynamic interactions of ocean-atmosphere-terrestrial processes affecting some of the most densely populated regions. The economy and livelihoods of people living in these regions are greatly influenced by the rains of the Indian Summer Monsoon during the months of June to September; extreme rainfall events can lead to flooding and infrastructure damage whilst dry periods can result in drought and food and water insecurity. Understanding the response of the Indian Summer Monsoon to human induced climate change remains unknown. Therefore, it is critical to gain a comprehensive understanding of how the Indian Monsoon responded to climatic changes in the geologic past in order to better inform climate models used for predicting its future response.

The study, led by the OU's Dr Pallavi Anand and PhD student Katrina Nilsson-Kerr, is the first to be published following an International Ocean Drilling Programme (IODP) voyage to the Bay of Bengal in 2014 to better understand past variability of the Indian Monsoon. The paper, Role of Asian summer monsoon subsystems in the inter-hemispheric progression of deglaciation, is published in Nature Geoscience (18$^{th}$ March 2019). Professor Melanie Leng from the BGS undertook the very challenging analysis of the oxygen isotope composite of the tiny microfossils (foraminifera) preserved in the marine sediment, the data from which was used to calculate the amount of freshwaters entering the ocean from rivers.

Their study has reconstructed how the Indian Summer Monsoon responded to a change from cold, glacial period to warm, interglacial period around 140 to 128 thousand years ago from sediments recovered from the northern Bay of Bengal, proximal to river runoff sourced from the Ganges-Brahmaputra river system. During the summer monsoon, rainfall feeds the rivers draining into the Bay of Bengal promoting freshening of seawaters and delivery of continental material, therefore samples from this study (the foraminifera) were ideally situated to capture past changes in the strength of the monsoon. Their study revealed the potential for certain chemical elements preserved in the shell of the foraminifera to reconstruct the strength of river runoff in the past. Their study was also unique as it provides a high temporal resolution (i.e. each sample representing 250 years in contrast to 1,000 years as has been done previously) snapshot of how the monsoon responded to warming during the penultimate deglaciation. The material for the research was collected on an international research project (IODP Expedition 353) that set off in 2014 to retrieve deep-sea sediments capturing monsoon variability by drilling the seabed of the Bay of Bengal. This expedition was made possible due to Indian's involvement in the IODP, allowing the first international drilling to occur north of 9$^{o}$ and in locations close to river runoff, ideal for investigating past monsoon rainfall.

The samples were carefully selected – which Katrina embarked on examining in the OU's and BGS geochemistry labs during the course of her PhD. This project also included collaboration from the OU (Drs S Hammond and P.F. Sexton), British Geological Survey (Prof. M. Leng), Brown University (Prof. S. C. Clemens) and Indian Institute of Science, India (Dr. S. Misra).

PhD student Katrina said: *"Examining this sediment is so important because when we want to look at the future behaviour of the monsoon, in terms of how human induced climate change will affect it, we look at historical patterns to get an underpinning of how our understanding from the past could help inform us regarding its future behaviour"*