Sea surface temperature pattern influence on monsoon variability and change

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Climate change will likely increase monsoon rainfall around the world but lead to greater variability and extremes. However, global climate models (GCMs) disagree on the pattern of warming of tropical sea surface temperatures (SSTs) as well as the regional changes in monsoon rainfall. GCMs also tend to have large biases in monsoon winds and rainfall in the present climate, which leads to some doubt in their climate projections for the future, although they largely capture relative differences in the strength of the monsoons in different continents. In order to interpret projections from climate models, we need a physically based understanding of how monsoons respond to different SST patterns. Part of this understanding will come from experiments with traditional GCMs, but we will also use state-of-the-art global models with very high resolution (5 km grid spacing) that resolve key rainstorm processes better than those GCMs.

The main research questions are:

1. How do zonal SST asymmetries affect the relative strength of monsoons in different regions and continents?
2. What implications do different patterns of SST warming in climate projections have for potential regional monsoon changes?
3. Can we use observed patterns of 20th-century SST change to inform or constrain future projections of regional monsoons?

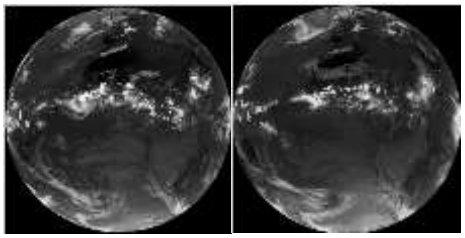

Figure: Observed brightness temperature (left) with whiter colour showing stronger and higher West African monsoon cloud tops from 10 July 2010, and the same field simulated by a 5-km global Met Office model with explicitly resolved rainstorm updraughts. Taken from Tomassini, L. and coauthors, submitted to JAMES 2022.

For this PhD project, the student will undertake work leading to improvements in our understanding of how monsoon rainfall interacts with moisture sources and how monsoons might change in the future. The work will involve performing and analysing global climate model experiments, including state-of-the-art of high-resolution process model simulations as well as observations and coarser-resolution simulations. The student will work closely with scientists at the Met Office in Exeter, both remotely and during in-person visits.

Training opportunities:
The student will run and analyse high-resolution K-SCALE global model experiments and visit the Met Office in Exeter to interact with modelling experts. Through this project the student will develop strong programming skills and the ability to process and visualise large datasets, supported by bespoke training courses provided by NCAS. The project will give the student the chance to discuss and present their work to a wider audience and presents the opportunity to engage with a leading employer of PhD graduates. The student will have the opportunity to undertake further training offered by NCAS in their Introduction to Atmospheric Science course and Climate Modelling Summer School. The student will have all the usual opportunities associated with a SCENARIO PhD such as developing presentation skills, networking at national and international conferences.

Student profile:
This project would be suitable for students with a degree in physics, mathematics or a closely related environmental or physical science. Knowledge of Python or a similar programming language is desirable.
https://research.reading.ac.uk/scenario/