PROJECT TITLE:	**Connections between tropical and polar climate change**
Lead Institution:	**University of Exeter**
Lead Supervisor:	**Prof James Screen, University of Exeter, Mathematics**
Co-Supervisor:	**Dr Thomas Bracegirdle, British Antarctic Survey**
Co-Supervisor:	**Dr Doug Smith, Met Office, Hadley Centre**
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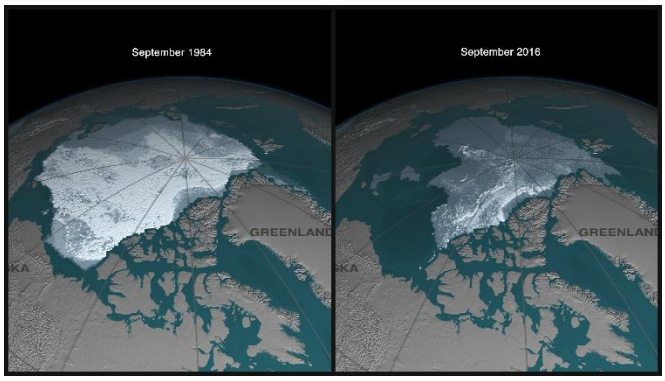
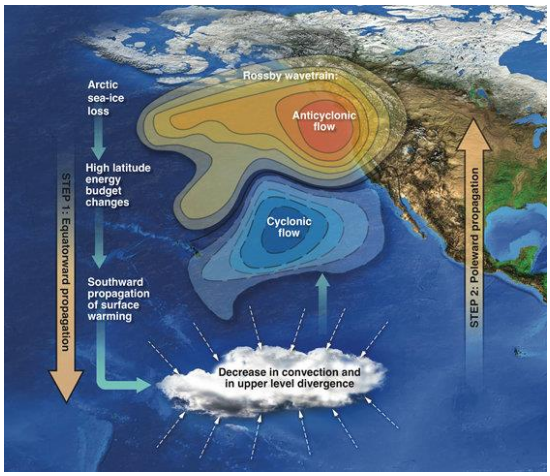


Arctic sea ice has declined rapidly in recent decades, in large part due to manmade global warming. These two images visualise the summer sea ice cover in 1984 and 2016, obtained from satellite observations. The thickest ice is coloured whitest. This dramatic loss of sea ice may trigger further climatic changes across the planet, as far away as the tropics.



California drought has been linked to Arctic sea-ice loss. Arctic sea-ice loss induces changes in the global energy balance, effecting tropical rainfall. Decreased tropical convection then drives a northward propagating Rossby wave-train, forming a ridge in the North Pacific, which steers wet tropical air masses away from California.

Project Background

Despite being thousands of kilometres apart, climatic changes in the tropical and polar regions of the planet are highly interconnected. In recent decades, the Arctic has warmed more than twice as fast as the global average – a phenomenon known as Arctic amplification. Emerging evidence suggests that a substantial portion of Arctic warming may be driven remotely from the tropics. Yet, the atmospheric and oceanic processes through which the tropics influence the Arctic are not fully understood. There is also increasing recognition that the effects of Arctic warming are not limited to the Arctic: what happens in the Arctic doesn't stay in the Arctic (see this explainer video: https://bit.ly/2Csj1Yg). State-of-the-art climate model experiments suggest that Arctic sea-ice loss can trigger climate changes as far away as the tropics. But again, a detailed understanding of such connections is lacking. Lying in between the tropics and the poles are the mid-latitudes, where a vast number of people live. Weather patterns in mid-latitudes are affected by both tropical and polar influences, but separating out one regions' influence on another is not an easy task. Recently there has been much speculation about a possible link between Arctic warming and increased extreme weather in mid-latitudes. This exciting and cutting-edge project will explore these connections between climate changes in the tropics, mid-latitudes and polar regions.

Project Aims and Methods

To make progress in these important research areas, the student will make heavy use of output from a new international climate modelling activity: the Polar Amplification Model Intercomparison Project (PAMIP). PAMIP includes novel model experiments to help elucidate both the causes and consequences of Arctic amplification. With support from the supervisors, the candidate will have the opportunity to shape the project design to focus on aspects of the problem of most interest to them. It is anticipated that the project will involve a mix of analysis of observed climate records and climate model output, and potentially, opportunities for the candidate to learn how to conduct their own climate model simulations as part of the PAMIP. This studentship comes with a generous budget for travel and training (£15k), with additional CASE support (£1k per year) from the UK Met Office.

Candidate Requirements

The candidate must have achieved, or be expected to achieve, a first class or 2:1 degree in Meteorology, Oceanography, Mathematics, Physics, Environmental Science, or related field. A Master's level qualification with previous experience of conducting independent research is desirable. Knowledge of scientific programming languages (e.g., Matlab, Python, IDL, R) would be advantageous, but is not essential.

CASE or Collaborative Partner

This project is in collaboration with the Met Office Hadley Centre (MOHC) for Climate Science and Services. The MOHC is a globally recognised centre for climate modelling and is a leading partner in the PAMIP. The candidate will benefit from regular visits to the MOHC, located nearby in Exeter, gaining exposure to a non-University research environment. The candidate will be able to participate in student training courses and networking/social events held by the Met Office.

Training

The candidate will gain experience of cutting-edge climate science, learning skills in data analysis, scientific figure and paper preparation, and climate modelling. As part of international project, the PhD candidate will have the opportunity to travel to overseas partners for collaboration, and to contribute to the wider scientific goals of the PAMIP.

References / Background reading list

Screen et al., 2018: Consistency and discrepancy in the atmospheric response to Arctic sea ice loss across climate models, *Nature Geoscience*, 11, 153-163.
Vavrus, 2018: The influence of Arctic Amplification on mid-latitude weather and climate, *Current Climate Change Reports*, 4, 238-249.
Coumou et al., 2018: The influence of Arctic amplification on mid-latitude summer circulation. *Nature Communications*, 9, 2959.
Cohen et al., 2014: Recent Arctic amplification and extreme mid-latitude weather. *Nature Geoscience*, 7, 627-637.
Smith et al., 2018: The Polar Amplification Model Intercomparison Project (PAMIP) contribution to CMIP6: investigating the causes and consequences of polar amplification. *Geoscientific Model Development Discussions*, in review.

Useful links

The application deadline is 1600 hours GMT Monday 7 January 2019 and interviews will take place between 4 and 15 February 2019. For more information about the NERC GW4+ DTP, please visit https://nercgw4plus.ac.uk.