Understanding the influence of Anthropogenic Aerosols on Atlantic Multi-decadal Variability

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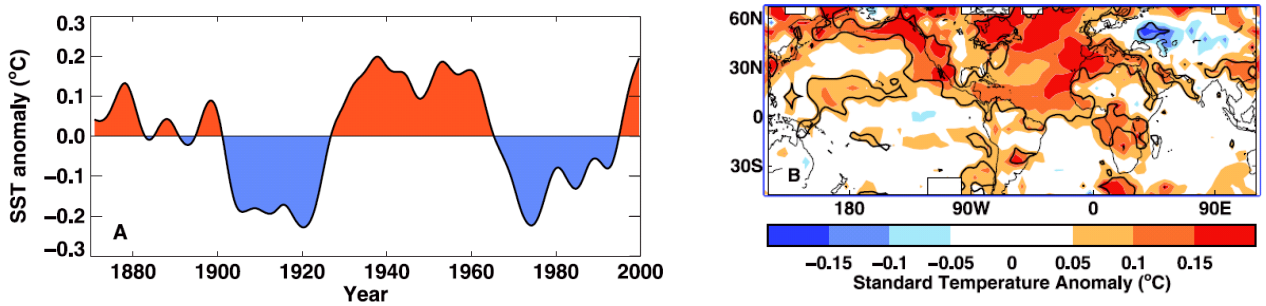
The surface temperatures of the North Atlantic Ocean have fluctuated between periods, many decades long, of relative warmth and cold (see figure below). These changes in the have been linked to extreme weather such as the extreme droughts across Africa and changes in the number of destructive Atlantic hurricanes.

It has long been thought that changes in the strength of the Atlantic Overturning Circulation, a vast ocean current that moves warm water into the North Atlantic, has been responsible these for multi-decadal swings in temperature in the North Atlantic. However, recent work at the UK Met Office has suggested that human activity, through the emission of tiny particulate matter – known as aerosols – from industry in North America and Europe, may have contributed to the observed changes in the North Atlantic. Since some of the aerosol particles act to reflect sunlight, particularly by changing the properties of marine cloud, changes in the rate of their emission have the potential to affect Atlantic temperatures. The aerosol pollution is also expected to effect the strength of the ocean currents, in particular the Atlantic Overturning Circulation.



The left figure shows how the temperature of the North Atlantic Ocean has changed over the past 150 years. The figure on the right shows the temperature anomalies that are observed when the North Atlantic is anomalously warm.

Therefore, it is possible that humans have largely been responsible for the past modulation of Atlantic temperatures and, hence, the high-impact weather events that have been associated with changes in Atlantic temperature. Such a conclusion would have important implications on climate prediction and on international climate policy. However, the extent to whether this is true, or the relative importance of different processes, is not well understood and further understanding is needed.

This project will seek to better understand the way in which human emissions of aerosols can affect Atlantic Multi-decadal Variability by using the latest state-of-the-art climate model from the Met Office, which offers an improved simulation of the climate of the North Atlantic and the important aerosol-cloud interactions. By altering the amount of aerosol pollution emitted by humans within the model, the student will characterize the impact of humans on the multi-decadal changes in Atlantic Ocean temperatures and also understand any impact on the atmospheric and ocean circulation. The student will also have the opportunity to design further sensitivity experiments in order to test specific hypotheses developed through the project.

Training opportunities:
There will be opportunities for extended visits and placements to the Met Office in Exeter during the project.

Student profile:
This project would be suitable for students with a good degree in physics, mathematics or a closely related environmental or physical science and a keen interest in understanding what drives our climate.

Funding particulars:
The project will have CASE funding from the Met Office.

References:

Sutton, et al (2017) *Atlantic Multi-decadal Variability and the UK ACSIS Programme.* Bulletin of the American Meteorological Society. ISSN 1520-0477 doi: 10.1175/BAMS-D-16-0266.1

Zhang, et al (2013) *Have aerosols caused the observed Atlantic multidecadal variability?* Journal of the Atmospheric Sciences, 70 (4). pp. 1135-1144. ISSN 1520-0469 doi: 10.1175/JAS-D-12-0331.1

Booth, et al (2012): *Aerosols implicated as a prime driver of twentieth-century North Atlantic climate variability. Nature*, **484**, 228–232. doi:10.1038/nature10946