The North Atlantic Climate System Integrated Study

ACSIS aims to detect, explain and predict changes in the North Atlantic

Changes in the North Atlantic directly affect the UK’s climate, weather and air quality, with major economic impacts on agriculture, fisheries, water, energy, transport and health. The North Atlantic also has global importance, since changes here drive changes in climate, hazardous weather and air quality in North America, Africa and Asia.

ACSIS focuses on understanding recent and often rapid changes in the North Atlantic’s highly coupled ocean, atmosphere (including composition) and cryosphere. By understanding how these changes relate to external drivers of climate, such as human activity or natural variability, ACSIS will improve our capability to detect, explain and predict changes in the North Atlantic climate system.

For further information see Sutton et al. (2017), *Atlantic Multidecadal Variability and the U.K. ACSIS Program*, BAM:

**ATMOSPHERE & CLIMATE ATMOSPHERIC COMPOSITION**

This theme focuses on atmospheric and coupled processes and their role in the climate system over the Atlantic, using a combination of data and modelling studies.

Research Questions:
1. How have natural variability and radiative forcing combined to shape multi-year trends in the North Atlantic physical climate system?
2. To what extent are these changes predictable on multi-year timescales?

**Ocean & Ice**

This theme focuses on why the North Atlantic ocean heat content (OHC), sea surface temperature (SST), sea ice and ice sheets undergo long-term changes with associated impacts on climate.

Research Questions:
1. What are the causes of Arctic sea-ice decline, and how does it impact on the North Atlantic?
2. What is the cause of multi-year trends in ocean conditions, focusing on (a) the ocean heat budget, and (b) causes and consequences of Atlantic Meridional Overturning Circulation (AMOC) variability?

Science Highlight: Ocean Heat Content

- The North Atlantic Subpolar Gyre (SPG) contributed significantly to global ocean heat uptake during the recent global surface warming slowdown (aka hiatus).
- We have quantified the impact of the Labrador Sea (right panel, Figure 3) on SPG heat content via downward and southward propagation of temperature anomalies on decadal timescales.
- Oceanic deep convection does not dominate the transfer of temperature anomalies from the surface to depth. Instead, shallow convection, boundary mixing and recirculation are implicated (left panel, Figure 4), which shows that density-compensated (spice) anomalies dominate the downward propagation.
- In contrast, deep convection creates temperature anomalies which are not density-compensated (brave). These anomalies are weaker, more short-lived, and penetrate less deeply (Figure 5).

For further information see Drijfhout et al., 2016, and de Vries et al., 2018, submitted

**SYNTHESIS**

ACSIS has compiled a review of “Recent observed changes in the North Atlantic with a focus on 2006-2015”, which in particular highlights recent changes in variables that span the breadth North Atlantic Climate System (see Figure 8).

ACSIS has developed the Atlantic Climate System Indicators (ACSI), which are observation-based measures that track the past and present conditions, and important trends, in the North Atlantic climate system for key variables.

Visit the ACSIS website to find out more about the ACSI.

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ACSIS is a UK-funded Centre of Excellence in Atmospheric Research, underpinning national and international research in the climate system. It is also a key part of the UK Met Office’s National Centre for Atmospheric Science (NCAS). For information about the NCAS, visit www.ncas.ac.uk.

The ACSIS project is a collaboration between NERC research centres and the Met Office, and has been funded for five years (2016-2021) to tackle major scientific and societal challenges associated with changes occurring across the North Atlantic. ACSIS is led by a small team from the National Centre for Atmospheric Science and the National Oceanographic Centre. The wider project team is spread across the seven partner organisations, and is made up of about 40 scientists.