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, BAMLS:

**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?

Science Highlight: 11-Year Solar Cycle’s Impact on NAO

- There has been much scepticism of the 11-year Solar Cycle’s impact on the North Atlantic Oscillation (NAO) due to weak signals that depend on the time period examined.
- A number of different sea level pressure datasets extending back to 1600 have been analysed using a multi-linear regression analysis.
- There is no clear signal at lag-zero (Figure 1), but a clear positive NAO response emerges at 3-4 year lags. The response over the Azores reaches ~3 hPa, a significant proportion of the variance.
- A mechanism for this lagged response has been proposed in terms of ocean-atmosphere coupling, involving the re-emergence of a sea surface temperature anomaly from beneath the mixed layer, which amplifies the signal from one winter to the next.

For further information see Gray et al. 2013 GB, Báziks et al. 2013 ERL, Andrews et al. 2015 JGR, Gory et al. 2015/00, Ali et al. 2015 ERL.

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**SCIENCE HIGHLIGHT:** 11 YEAR SOLAR CYCLE’S IMPACT ON NAO

**Figure 1:** Solar cycle signal in meridional wind in HadISST significant pressure (hPa) for 1974-2016 from a multi-linear regression analysis that includes indices for DMI, volcanic and solar radiative forcing. The 95% (99%) confidence limits are indicated in blue (yellow). Black dots arehppstatistically significant.

**Figure 2:** Linear correlation (Pearson) coefficient of the 11-year solar cycle index over the North Atlantic from 1600 to 2000 (left) and May 1870 to June 2016 (right).

**Figure 3:** Tmin in Atlantic Europe 1989-2016 (°C) with linear trend (°C decade−1).

**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 4).

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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The ACSIS project is a collaboration between NERC’s 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 Oceanography Centre. The wider project team is spread across the seven partner organisations, and is made up of about 90 scientists.

**Figure 4:** Recent changes in basin-wide sea surface temperature (°C) for the 1600-1870 period (left) and for the 1984-2016 period (right), with multi-linear regression analysis applied (°C decade−1). The Atlantic Ocean is colour shaded by the magnitude of the regression result (°C decade−1), which highlights a marked shift in the late 1990s.