PRocess-based climate sIMulation: AdVances in high-resolution modelling and European climate Risk Assessment

ATMOSPHERIC BLOCKINGS AND THE EUROPEAN ENERGY SYSTEM

Almost all aspects of national and global energy systems are exposed to some form of climate risk attributable to scales ranging from extreme weather to long term climate change. The impact of climate is further exacerbated with the growing use of weather-dependent renewable generation, the output from which cannot be directly controlled in the same way as traditional power stations.

Blocking events – where the usual eastward wind from the Atlantic into Europe is paused or reversed – have significant regional weather impacts throughout the year, affecting European temperature, wind, and precipitation; and thus energy production and demand.

Some climate models project a reduced frequency of blocks over the Atlantic and Europe, but significant uncertainties remain. New high-resolution PRIMAVERA simulations offer new opportunities to explore this important phenomenon.

What is an atmospheric blocking?

Atmospheric blocks are persistent periods in which the typical westerly flow of the mid-latitudes (i.e., blowing from west to east) is interrupted, becoming 'meridional' (i.e., north-south) or reversed (i.e., easterly). These disruptions in the flow are associated with persistent high pressure weather patterns that impede the normal easterly propagation of cyclonic weather systems (or 'storms').

The resulting patterns of wind and pressure have a strong impact on the regional weather over Europe, and are often associated with the occurrence of extreme temperatures (heat waves in summer, cold-spells in winter), droughts, and persistent low surface wind speeds.

Typical blocking patterns in the Euro-Atlantic sector

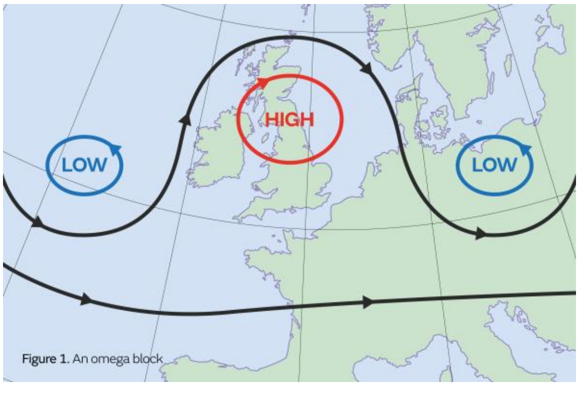

Figure 1. An omega block

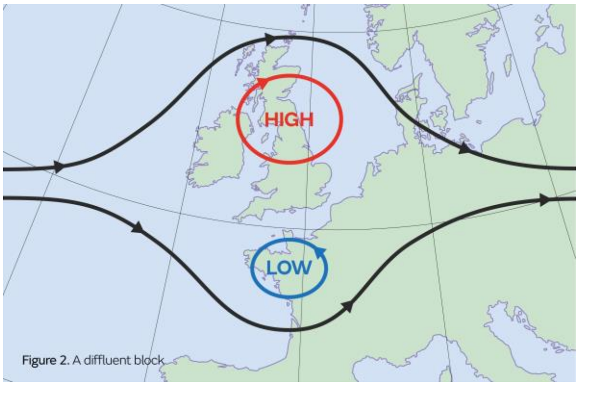

Figure 2. A diffluent block

The typical atmospheric blocking patterns in the Euro-Atlantic sector are represented above as they affect the UK sector. . The left panel shows an 'omega' block and the right panel a 'diffluent' or 'dipole' block. Source: Met Office, UK

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Info

PRIMAVERA is a collaboration between 19 leading European research and technology organisations with complementary expertise in climate science, climate change modelling, and high performance computing.

The project is led by the Met Office and the University of Reading.

Media

www.primavera-h2020.eu

Watch the project video →

PRIMAVERA

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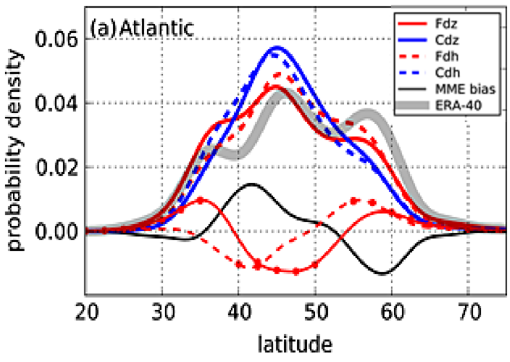
Likely impacts of atmospheric blockings on the European energy sector

As atmospheric blocking is characterized by persistent patterns of unusual pressure, wind and temperature over Europe, they have potentially significant consequences for the energy sector. For example:

- Less precipitation than average in central and northern Europe □ decreased hydropower generation
- Significant winter cold spells that affect vast areas over Europe □ increased energy demand for heating
- Summer heatwaves over Northern Europe → increased energy demand for cooling
- Disruption of typical wind patterns and ‘wind drought’ events → decreased wind power generation
- Persistent clear skies in regions affected by high pressures → increased solar PV generation



Previous climate model simulations (CMIP5) show that higher horizontal (Fdh) and vertical (Fdz) model resolutions tend to be associated with a better characterisation of blocking over the Atlantic sector. Source: Adapted from Anstey et al. 2013. Source: Adapted from Anstey et al. 2013.

How can the PRIMAVERA project help?

The PRIMAVERA project is developing a new generation of advanced high-resolution global climate models, capable of simulating and predicting regional climate with unprecedented fidelity.

The increased model resolution of the PRIMAVERA models (typically around 25km) has the advantage of allowing a better global representation of large-scale physical processes. Since these large-scale phenomena have significant local impacts, the PRIMAVERA models have the potential to generate a much better representation of regional climates, that are less reliant on the mathematical formulations used to represent physical processes occurring within each grid-box (e.g., clouds).

Furthermore, PRIMAVERA constitutes the first inter-comparison project between high-resolution models, which will allow to identify and characterize robustly the physical processes controlling current and future climate over Europe and those processes associated with climate risk.

References

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