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

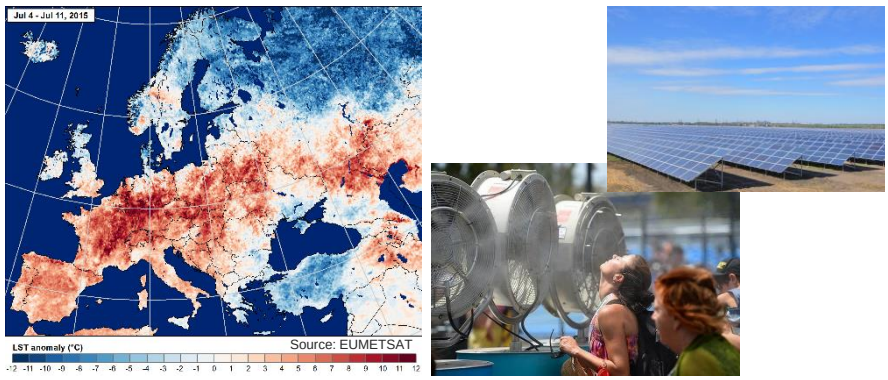
HEATWAVES AND ENERGY OVER EUROPE

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.

Heatwaves are an extreme event that significantly affects the energy sector. Future projections from previous generations of climate models suggest an increase in the severity and frequency of heatwaves over Europe. Further insight into the evolution of heatwaves and their inherent impacts are of utmost relevance for climate risk management in the energy sector.

What are heatwaves?

Heatwaves are typically perceived as persistent periods of abnormally warm conditions. During such extreme events, high temperatures, cloud-free skies and low precipitation can occur for several days and pose a threat to health, comfort and the energy system.



Heatwaves over Europe have direct impacts on the energy system. Source: EUMETSAT & Flickr/Creative Commons.

Impacts

There are several ways in which heatwaves impact the energy system:

- **Increased air temperature**
  - increases electricity demand for air conditioning, but also decreases efficiency of natural gas plants, turbines and boilers.
  - affects power transmission → decreased transformers capacity and increased lines resistance
- **Increased water temperature**
  - constraints for cooling some power plants (powered by fossil fuels, geothermal, biomass and nuclear) → decreased efficiency and security issues.
  - cooling water too hot to release back to source due to environmental impact → management constraints
- **Increased evaporation and risk of drought** → limits hydropower generation and causes difficulties in the waterborne transport of raw fuel to inland power stations
- **Increased solar radiation** → increases solar photovoltaic generation, but it is of reduced efficiency due to high temperatures

Funding

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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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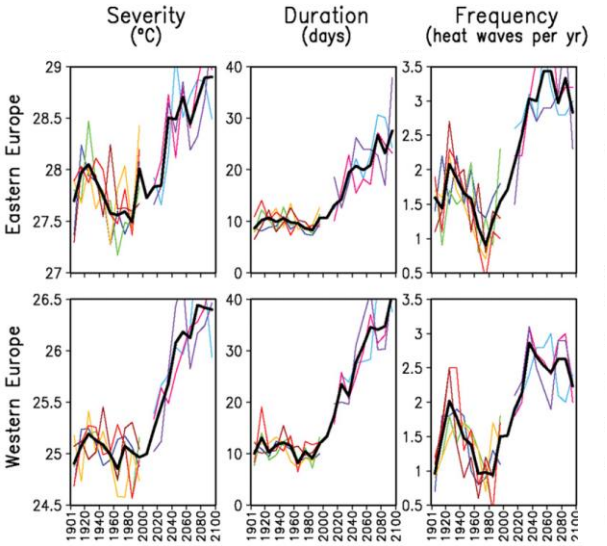
Projections and drivers

Climate projections consistently show a worsening in heatwave conditions over Europe by the end of the 21st Century. Results from previous generations of climate models have shown significant increases in heatwave properties such as duration, severity and frequency over most of Europe (see figure).

Heatwaves over Europe most often result from persistent upper-level high pressure systems (or 'blocking' conditions), which are connected to the northward displacement of travelling cyclones and anticyclones. High-resolution PRIMAVERA runs are fundamental for a correct representation of these interactions between climate and weather systems and therefore to the generation of reliable projections that can help the energy sector adapt to future challenges.



Time series of simulated changes in heatwave properties using a mid-resolution model. Adapted from Lau & Nath (2014).

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 global models, which will allow to identify and characterize robustly the physical processes controlling current and future climate over Europe and those associated with climate risk.

References

Aivalioti (2015) doi:10.7916/D8D799MC
European Commission (2014) 2030 climate & energy framework
Lau and Nath (2014) doi:10.1175/JCLI-D-13-00284.1

Partners