PRIMAVERA

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

Extra-tropical cyclones factsheet

Extra-tropical cyclones, also known as European wind storms, can bring violent winds, intense rain and battering waves to Europe. They are capable of major disruption, causing damage to transport networks, energy infrastructure, and even loss of life.

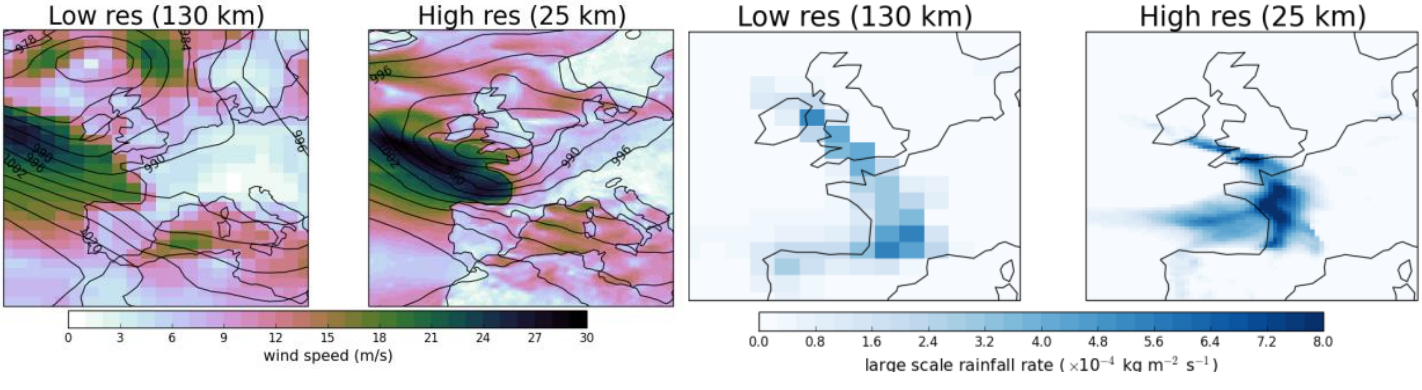
Because extreme storms at a particular location are relatively rare events, observational data is often insufficient to fully understand the risk that they pose. Some businesses and governments use climate models to provide additional information on storm statistics in the present day, as well as predicting any changes in the future.

This factsheet gives some examples of how PRIMAVERA high-resolution models will be able to improve our understanding of extra-tropical cyclone risk.

Impacts of extra-tropical cyclones include storm surge (left) and strong winds capable of bringing down trees (right).

Increased detail

The climate models used in the IPCC 5th Assessment Report, known as the CMIP5 models, have model grid box sizes ranging from 100 to 300 km, and are unable to capture the fine detail and extreme winds and rains associated with European wind storms, which often occur on smaller spatial scales. The climate models for PRIMAVERA have much smaller grid boxes (typically 25 km), giving much more detailed information on the modelled storms (see below).



Simulations of similar extra-tropical cyclones from a low-resolution (130 km) and high-resolution (25 km) climate model. The wind speed and mean sea-level pressure associated with the storms are shown in the panels on the left, and the rainfall in the panels on the right. Data are from the UPSCALE project (P. L. Vidale; Mizielinski et al., 2014).

Funding

This project has received funding from the European Union's Horizon 2020 Research & Innovation Programme under grant agreement no. 641727.

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

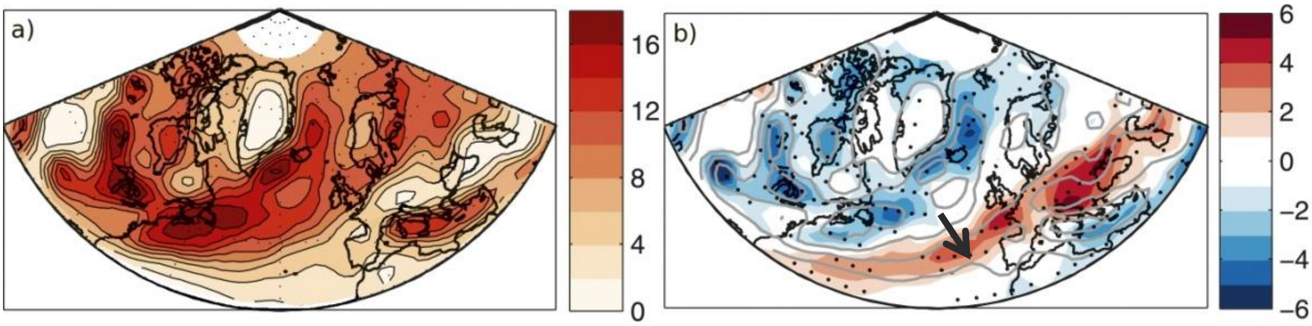
www.primavera-h2020.eu

Watch the project video →

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

High-resolution climate models give more realistic storm simulations

Extra-tropical cyclones usually form in the North Atlantic, and travel along the North Atlantic storm track to reach Europe. The observed storm track tilts from south-west to north-east across the Atlantic (above left), but Zappa et al. (2013) found that on average the CMIP5 climate models do not fully capture this tilt, leading to storms hitting Europe further south than observed (above right). However, some of the higher-resolution CMIP5 climate models have a better representation of the tilt, indicating that high resolution is important for an accurate representation of the storm track.



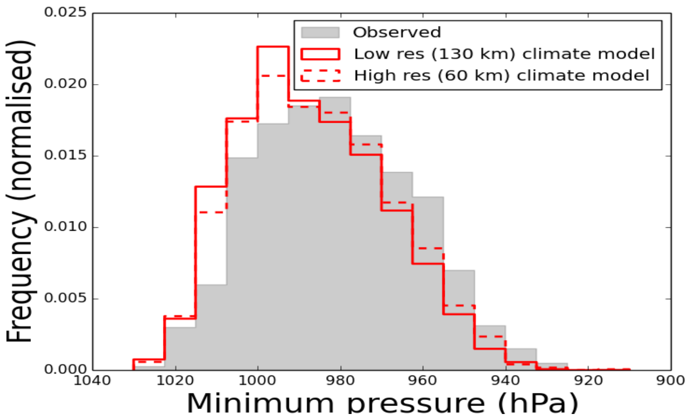
a) The observed North Atlantic winter storm track for the period 1980-2009, measured by number of cyclones per month derived from the ERA-Interim dataset (Dee et al., 2011).

b) The mean difference in cyclone numbers between observations and CMIP5 climate models. Grey contour lines mark the observed storm track and the arrow indicates the southward shift of the storm track in the CMIP5 models. Stippling shows where at least 80 % of the CMIP5 models agree in the sign of the difference.

(Figure adapted from Zappa et al., 2013; © 2013 American Meteorological Society; used with permission)

A recent study (Senior et al., 2016) also found that a lower-resolution climate model simulated more weaker storms and fewer intense storms than are observed, but increasing model resolution improved the intensity distribution (see histogram).

The state-of-the-art multi-model, high-resolution PRIMAVERA project will provide new capabilities for assessing European wind storm risk in the next three decades, and support the development of next-generation climate projections and models.



Histograms of the distribution of storm intensities, measured by minimum central pressure in observed data (ERA Interim; grey), in a climate model (low and high resolutions; red). Data are from the UPSCALE project (P. L. Vidale; Mizielinski et al., 2014).

References

Dee et al, 2011, doi:10.1002/qj.828

Mizielinski et al, 2014, doi:10.5194/gmd-7-1629-2014

Senior et al, 2016, doi:10.1002/2015MS000614

Zappa et al, 2013, doi:10.1175/JCLI-D-12-00501.1

Partners