PRIMAVERA

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

Quality of climate models

Climate models are complex, but even so, they are still simplifications of reality. Therefore, there will be systematic differences between the results of simulations with climate models, and observations in the real world. Such differences are called the model bias. The smaller the bias, the higher the model skill to simulate the observed climate correctly. This skill is often used as a measure for quality. Climate models can be evaluated for many different aspects such as how they represent averages, extremes or variability. PRIMAVERA aims to improve the skill of climate models by increasing the spatial resolution.

What is a model bias?

Models are always a simplification of reality and, therefore, they will never represent reality exactly. A bias is a systematic deviation of climate model output (e.g. too high, too low or not in right location) compared to observations in the real world (Fig 1).

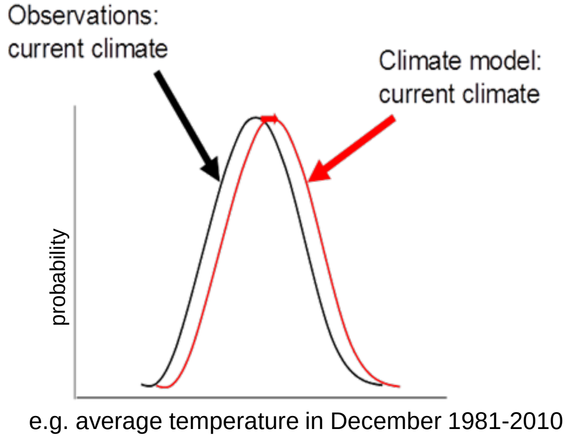

Fig 1. Schematic presentation of climate model bias: the systematic difference between model output and observations (Source: Bessembinder, 2015).

Climate model evaluation

The smaller the bias, the higher the model skill to simulate the observed climate correctly. This skill is often used as a measure of quality of a model.

To determine the skill of climate model output, the difference between the *statistics* of the observations for the reference period in the past (e.g. a period of 30 years) are compared with the statistics of the climate model simulation for the same period.

A climate model can be evaluated according to different aspects, e.g. annual and seasonal climatological averages for all relevant climate variables, probability of certain extremes, variability, trends (Fig. 2). Model evaluation can also focus on how well specific weather phenomena are represented.

Climate models produce area-average data, whereas many observations are point measurements. Climate variables for which large spatial differences are observed within a grid cell, may show large differences between area-average data and point data (e.g. precipitation). For this reason, the technique of “re-analysis”, which combines information from observations and models, is often used to explore model skill.

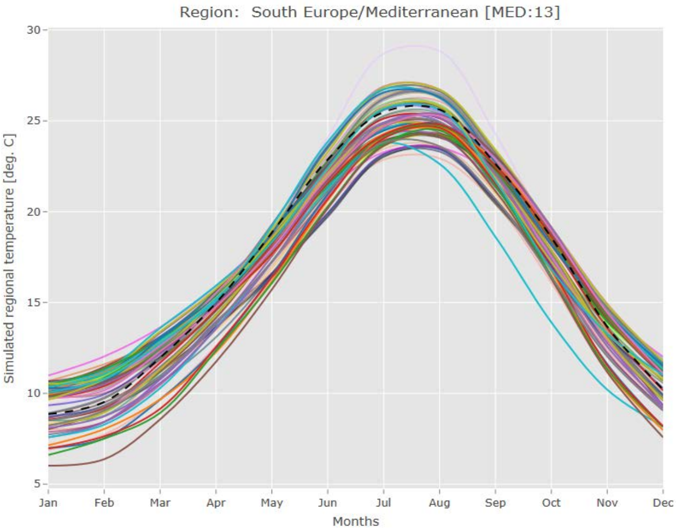

Fig 2. Annual cycle of average temperature for South Europe/Mediterranean in a large number of CMIP5 global climate models, compared with ERA-Interim reanalysis (black dashed line; Source: DECM)

Funding

Info

Media

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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.

www.primavera-h2020.eu

Watch the project video →

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Quality of future projections

The quality of climate model data for the future cannot be assessed in a direct way, since no observational data set is available for the future. It is generally assumed that the bias for the future is the same as for the current climate. When the skill is good for the current climate and for representing trends in the past, we generally have more confidence in the results for the future.

Example from PRIMAVERA

For some regions, high resolution models may have a better representation on how precipitation is distributed. Figure 3 shows the highest one day precipitation per year for a low and high spatial resolution model used in PRIMAVERA. In many places the high resolution model shows smaller differences (lower bias) with E-OBS data (based on observations) than the lower resolution model.

PRIMAVERA aims to improve the skill of climate models by increasing the spatial resolution. This can result in better representation of various extreme weather conditions and/or reducing the biases.

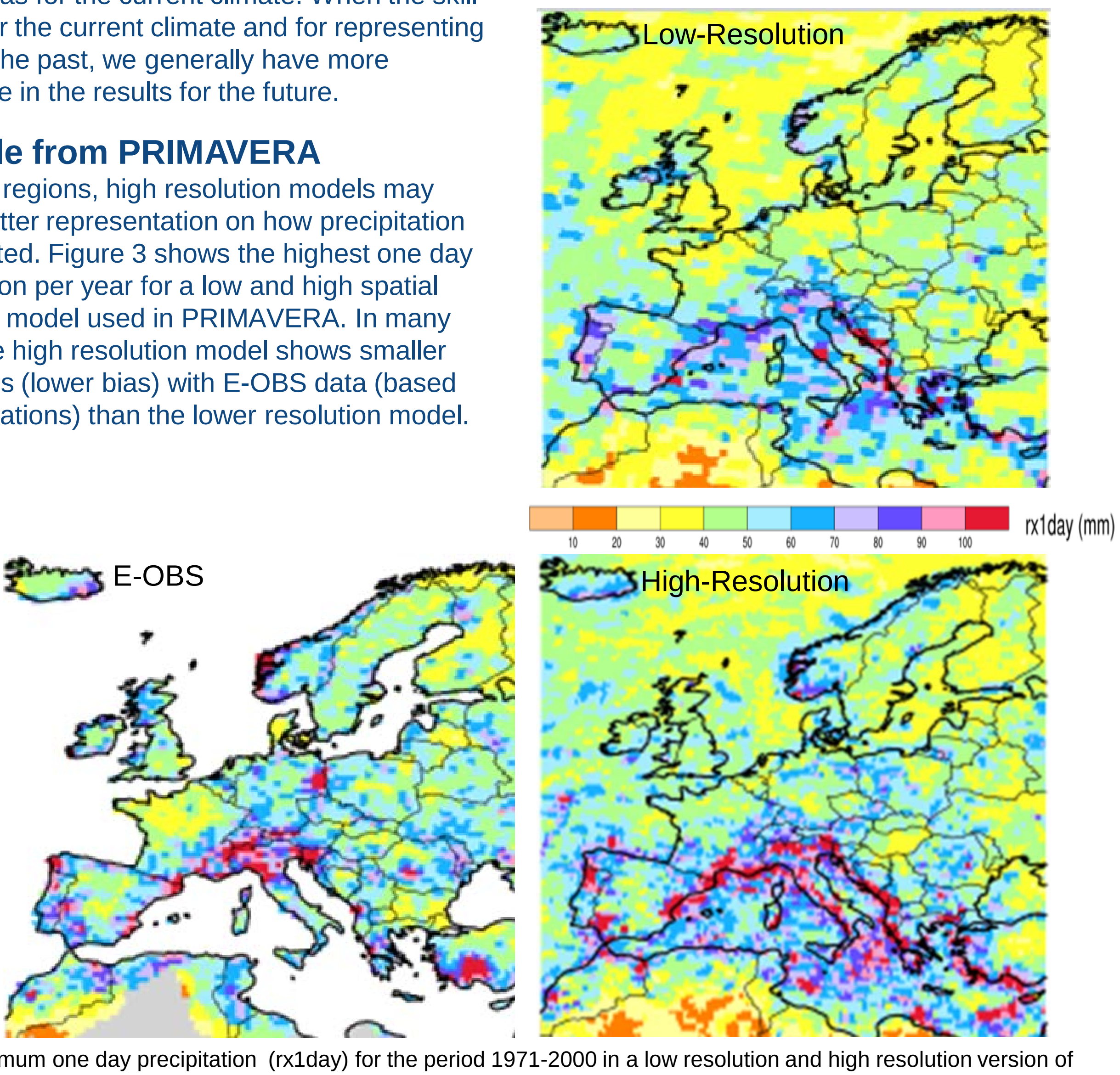

Fig 3. Maximum one day precipitation (rx1day) for the period 1971-2000 in a low resolution and high resolution version of the EC-Earth model, compared with E-OBS9.0 (Source: Strandberg et al., 2018).

References

Bessembinder, J., 2015. Guideline on the use of data for the current and future climate for road infrastructure. ROADAPT

DECM (Data Evaluation for Climate Models; C3S project): prototype version (figure made January 31, 2019)

Strandberg, G., et al., 2018. Comparison of statistics of selected meteorological events in CMIP5, CORDEX and in PRIMAVERA models. PRIMAVERA deliverable D10.2

Partners