European Commission

JRC PESETA III Science for Policy Summary Series

THE JRC PESETA III PROJECT

By the end of the century, Europe's temperature is projected to increase by between 2.5 and 4.7°C. The JRC PESETA III project aims to better understand the biophysical and economic consequences of these changes. It does this by using projections of climate change for Europe from several climate models along with a set of climate change impact models. The project covers several sectors that are relevant to society and the natural environment, including: freshwater, agriculture, transportation, ecosystems, human health and coasts. Most of the assessments are based on the assumption that future climate change occurs in the present, affecting today's economy and population. The economic consequences of the projected impacts are assessed.

IMPACT MODELS

PESETA III uses state-of-the-art impact models to quantify the effects of climate change on several sectors across Europe (Figure 1).

Some of the models are used across multiple sectors because the projections from one impact model can be used as input to another model, e.g. the hydrological model projections are used to estimate the impact of climate change on river flooding, drought, transport infrastructure, and water availability; and the coastal flood risk model is used to quantify the number of people affected and economic damages from coastal flooding, as well as the impact on transport infrastructure.

CLIMATE MODELLING

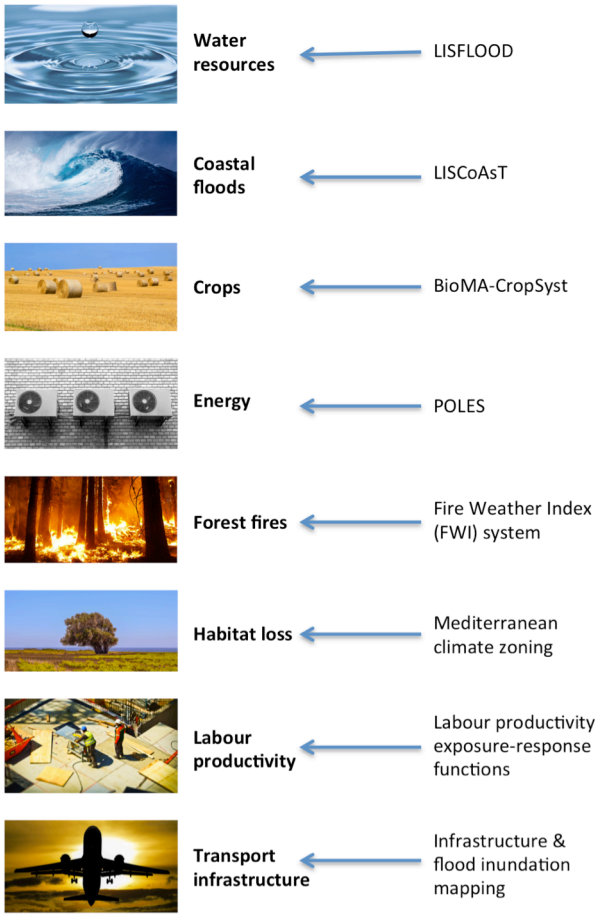
The climate models used in PESETA III simulate physical climate processes on a grid that covers the whole of Europe, i.e. including non-EU countries. The climate models used are known as regional climate models (RCMs), which mean that they produce climate projections at a relatively fine scale.

Simulations of the climate will differ between climate models, even when the forces that drive the climate, such as greenhouse gas emissions, are the same, and when all models are built in plausible ways. This is known as climate modelling uncertainty.

To account for this uncertainty, PESETA III started with an initial set of 12 climate models that took part in a large, on-going climate model inter-comparison project called EURO-CORDEX. From this 12, a high priority sub-set of 5 climate models were chosen because it can be computationally very demanding to use all 12 climate models. The 5 priority models were carefully selected to ensure that they represented the range in climate projections produced by the larger set of 12. All of the impact sectors in PESETA III used at least the smaller sub-set of 5 climate models.

Simulations of the past climate from climate models can differ from the real measured climate. Therefore climate model simulations are often corrected to account for such biases, through a statistical procedure known as “bias correction”. All of the climate model simulations used in PESETA III were bias corrected using an established method that has been extensively used in other studies.

Figure 1. The impact sectors investigated by PESETA III and the impact models used.



CLIMATE SCENARIOS

Two main climate change scenarios are used in PESETA III: a high warming scenario and a 2°C warming scenario. The high warming scenario is for the end of the century (2071-2100) with global mean surface temperature exceeding 3°C relative to pre-industrial temperatures. The 2°C warming scenario covers the period when global mean surface temperature is equal to 2°C above pre-industrial and approximately covers the period 2025-2055.

Impacts under the high warming scenario are compared with impacts under the 2°C warming scenario to show the benefits of climate change mitigation. The years when global temperature rise reaches 2°C are different for each climate model (Table 1) but they approximately cover the period 2025-2055. Both scenarios are also compared with nowadays (1981-2010).

Table 1. The priority sub-set of 5 climate models used in PESETA III, and the year when 2°C is reached.

	Climate model full name	2°C
H1	CNRM-CERFACS-CNRM-CM5_r1i1p1_CLMcom-CCLM4-8-17	2044
H2	ICHEC-EC-EARTH_r12i1p1_CLMcom-CCLM4-8-17	2041
H3	IPSL-IPSL-CM5A-MR_r1i1p1_IPSL-INERIS-WRF331F	2035
H4	MOHC-HadGEM2-ES_r1i1p1_SMHI-RCA4	2030
H5	MPI-M-MPI-ESM-LR_r1i1p1_SMHI-RCA4	2044

SOCIO-ECONOMIC SCENARIOS

PESETA III aims to assess impacts as if future climate change occurs in the present, affecting today's economy and population. Therefore most of the sectors assume that current levels of population and gross domestic product (GPD) do not change in the future.

However, in some cases, it is interesting to understand the sensitivity of impacts to future socio-economic change. To this end, impacts under different assumptions of future socio-economic change are also estimated under the high warming scenario (but not the 2°C warming scenario), for energy, coastal floods, river floods and agricultural economics.

In those cases where the sensitivity of impacts to socio-economic change are assessed, three scenarios are considered. Two are from a well-known set of scenarios used in the international context, known as the "Shared Socio-economic Pathways" (SSPs). The SSPs used (called SSP3 and SSP5) are consistent with the high warming scenario used in PESETA III.

SSP3 assumes that there is slow to moderate economic development and increased international fragmentation due to countries focussing on achieving their own energy and food security goals at the expense of broader-based development. Slow technological change and large regional inequalities mean that there are challenges to both mitigating and adapting to climate change.

SSP5 assumes that there is rapid globalisation and economic development. This occurs at the expense of global environmental concern, however, because in the absence of climate policies, energy demand is high and most of this demand is met with carbon-based fuels. Nonetheless, rapid economic development means that challenges to adaptation are lower than in the SSP3, but there are still challenges to mitigation because of the reliance on carbon-based fuels.

The third scenario is from an EU Ageing Report and is based on detailed analyses of the determinants of long-term growth in Europe, notably demographics, labour market and planned legislation measures.

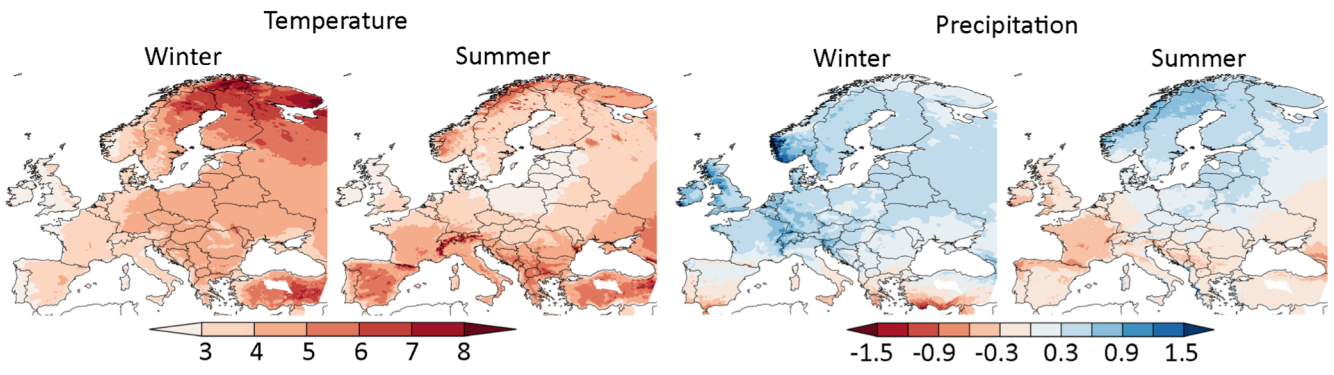
CLIMATE PROJECTIONS UNDER THE HIGH WARMING SCENARIO

Under the high warming scenario the average daily temperature in Europe is projected to increase significantly (Figure 2):

- in winter, between 2.5°C over the UK and 4.8°C over Scandinavia; and
- in summer, between 2.5°C over the UK and 4.7°C over the Iberian Peninsula.

Average daily precipitation is projected to increase over most of central and northern Europe in winter (Figure 2). In summer, a general reduction in precipitation is projected for all regions except Scandinavia and Eastern Europe. The southern regions of several Mediterranean countries see declines in precipitation in both seasons.

Figure 2. Changes in average daily temperature (°C) and average daily precipitation (mm/day) respectively, in winter and summer, by the end of the century under the high warming scenario.



Read more

PESETA III Task 1: Climate change projections, bias-adjustment, and selection of model runs; and Task 2: Socioeconomic scenarios dataset. Available on our website https://ec.europa.eu/jrc/en/peseta