EDHEC-CLIRMAP:

EDHEC-CLimate-Induced Regional MAcroimpacts Projector—

How-To Guide[1]

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Abstract:

The EDHEC-CLIRMAP (EDHEC-CLimate-Induced Regional MAcroimpacts Projector) is a web-hosted tool developed by the EDHEC Climate Institute. It provides a user-friendly, educational platform for scientists, experts, professional investors and policymakers to visualize how climate change–induced shifts in average temperature are projected to affect gross regional economic product (GRP) over time and space, under a number of reference temperature models and warming scenarios. This note provides a How-To Guide of EDHEC-CLIRMAP. Companion documents *EDHEC-CLIRMAP--The Macroeconomic and Econometric Background* and *EDHEC-CLIRMAP--A High-Level View* are available as well.

1. Purpose of This Document

This document provides a How-To Guide of EDHEC-CLIRMAP. The purpose is to explain how inputs can be provided to the projector, and how to interpret the outputs. The tool can be accessed here: https://climateinstitute.edhec.edu/data-visualizations#edhec-clirmap

The reader is encouraged to consult two companion technical documents for further insight:

- ***EDHEC-CLIRMAP: The Macroeconomic and Econometric Background***[3] provides detailed information on the scientific background underpinning this tool, with emphasis on the macroeconomic framework, the climate econometric theory, and the *Delta* method elaborated to project future damages over time and space.
- ***EDHEC-CLIRMAP: A High-Level View***[4] offers a broad overview of the EDHEC-CLIRMAP, summarizing its conceptual approach, structure, objectives, and key features in an accessible format.

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[3]https://climateinstitute.edhec.edu/sites/default/files/2025-07/ECI_Macroeco_Econometric_Background_EDHEC-CLIRMAP.pdf
[4]https://climateinstitute.edhec.edu/sites/default/files/2025-07/ECI_High_Level_Note_EDHEC-CLIRMAP.pdf

2. Description of EDHEC-CLIRMAP Projector

The description of EDHEC-CLIRMAP to users is straightforward. EDHEC-CLIRMAP has one panel: a map, which is interactive (see Fig. 1).

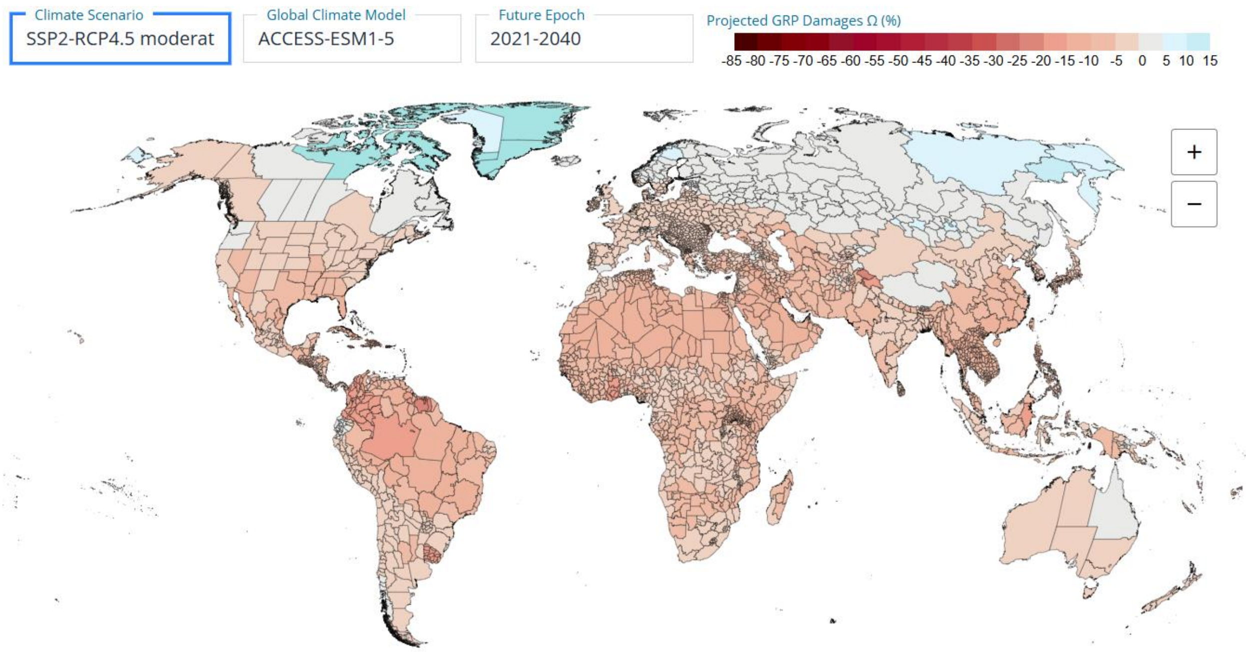

Fig. 1: Snapshot of EDHEC-CLIRMAP interactive tool.

Its geographic coverage is global. It shows 3,672 sub-national administrative provinces for which EDHEC-CLIRMAP offers predictions of future economic damage from climate-change-driven shifts in average temperature.

Configuration requirements for the user are minimal, but it is important to explain what each parameter means from a scientific viewpoint. **By order, the user will choose:**

> **(1) <u>Future Epoch</u> → the user picks a future epoch available on a decadal-frequency between 2040 and end-century.**
> **(2) <u>One Benchmark SSP-RCP Climate Scenario</u> → the user selects a moderate, intermediate or vigorous scenario of climate change based on GHG emission trajectories and radiative forcing.**
> **(3) <u>One Specific Global Climate Model</u> → the user selects from among state-of-the-art numerical models that simulate the Earth's climate system and its feedback response to atmospheric emissions.**

We explain these parameters more in details below.

Followingly, EDHEC-CLIRMAP will offer a spatial visualization of what the climatically induced change in GRP is expected to be.

By zooming in on the map, the user can point to specific areas of the world (e.g., the Alpes-Maritimes district or the West Midlands) and view summary statistics of expected climate change damages on regional economic output (see Fig. 2).

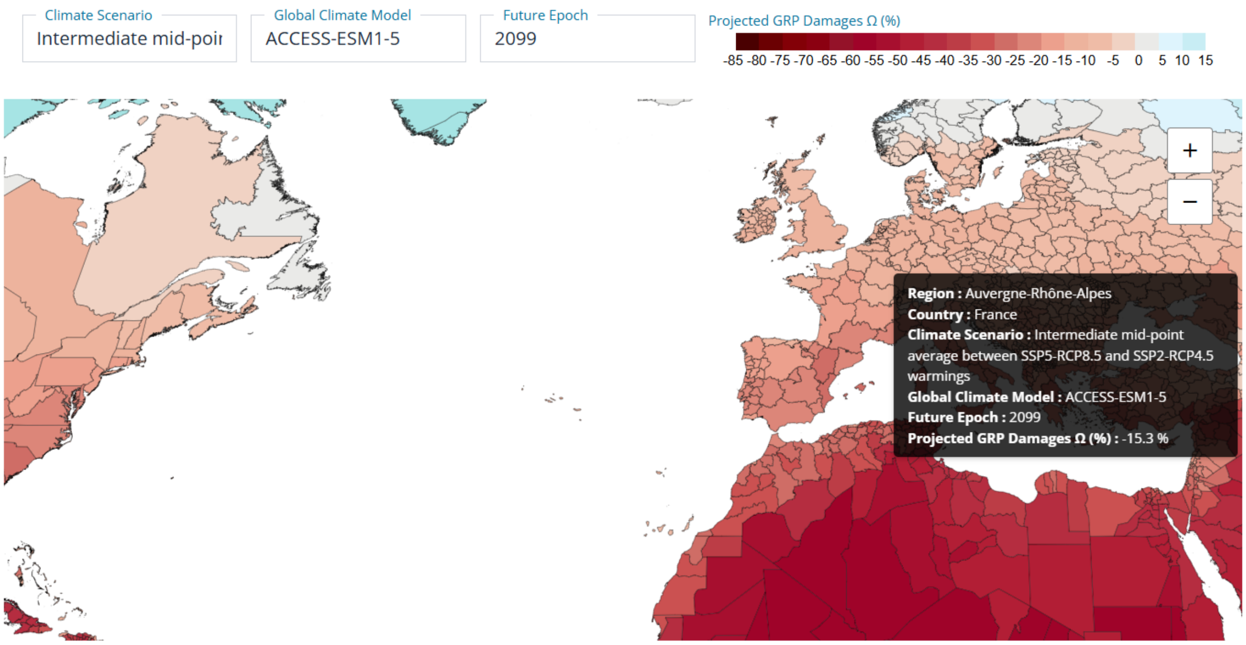

Fig. 2: Example of summary statistics on expected climate change-driven regional economic damages.

3. Description of the Parameters

This Section describes each parameter the user must configure on EDHEC-CLIRMAP.

3.1. Future Epoch

Straightforwardly, the user must choose a future period (see Fig. 3). Epochs are available on a decade-frequency basis, starting in 2040 and ending in 2099 (a proxy for 2100, or end-century). The fact that target periods are not available on a yearly basis results from a methodological choice, rather than a technical preference.

In Climate Economics, accounting for uncertainty is crucial and cannot be avoided when dealing with climate projections. This applies to the future global temperature trajectories used in EDHEC-CLIRMAP. These were first simulated under the Coupled Model Intercomparison Phase VI (CMIP6—Eyring et al, 2016) exercise, before being biased-corrected and daily downscaled to a 0.25-degree grid by NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP-CMIP6—Trasher et al, 2022). Evidently, uncertainty propagates throughout resulting outputs and is mainly attributable to the model itself (see 3.3), as well as the downscaling and bias-correction methods (Lafferty and Sriver, 2023). Together, these potentially alter local climate projections in CMIP6.

One way to partially mitigate this uncertainty is by averaging scenario- and GCM-specific values over the 20-year period centered on each target year. For example, to project temperature impacts on regional productivity in 2040, EDHEC-CLIRMAP uses the average for 2031–2050, ensuring that the target year lies at the midpoint of the interval. Similarly, for 2050, we compute the average of the 2041-2060 interval, etc. Next, we can take the inter-epoch difference between historical and future epoch means and pursue with the 'Delta' method more exhaustively described in the companion document *EDHEC-CLIRMAP: The Macroeconomic and Econometric Background.*

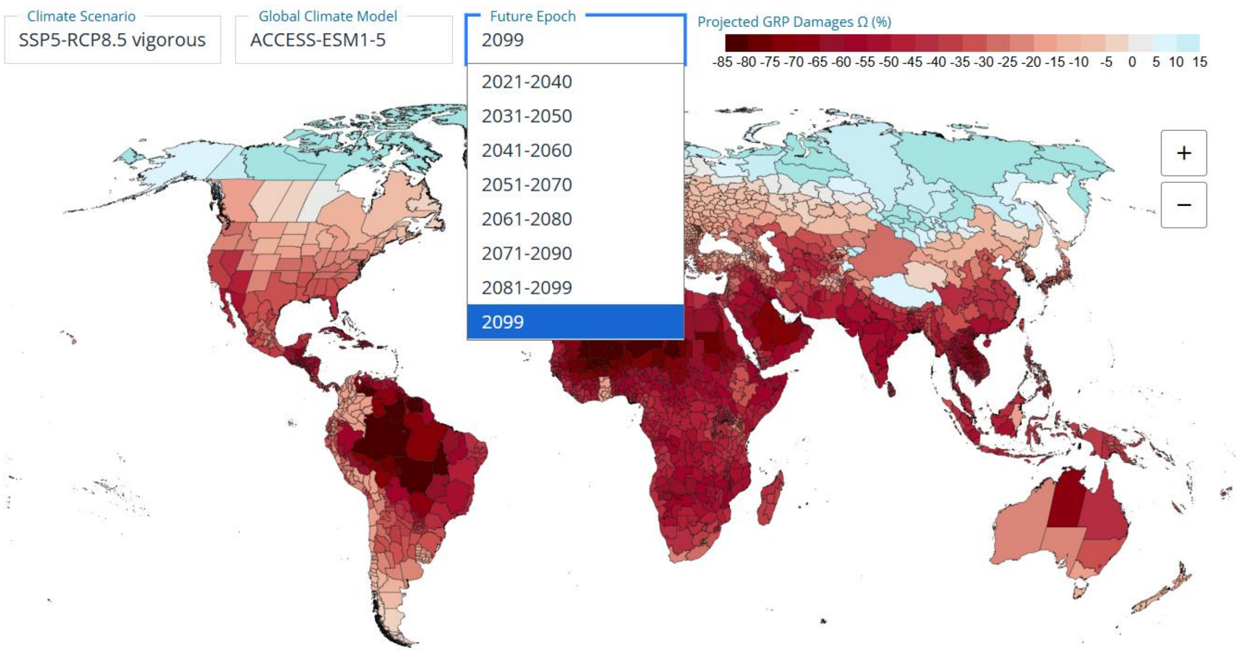

Fig. 3: Choice of Future Epoch on the configuration panel.

3.2. Benchmark SSP-RCP Climate Scenarios

The Shared Socioeconomic Pathways (SSPs) and Representative Concentration Pathways (RCPs) are complementary. SSPs are scenarios of projected global socioeconomic developments through 2100, as defined in the IPCC's Sixth Assessment Report (2021). SSPs provide narrative pathways describing potential trends in demographics, economic growth, education, and technology, but they do not include climate projections. To simulate future climate conditions, SSPs are, by construction, to be paired with RCPs scenarios. These latter specify greenhouse gas concentration trajectories and radiative forcing levels (in W/m²) by 2100. These SSP-RCP combined scenarios—such as those used in EDHEC-CLIRMAP—allow for integrated climate-socioeconomic modeling.

There are classic combinations, which users in EDHEC-CLIRMAP can choose amongst: SSP2-RCP4.5 moderate warming, intermediate warming, and SSP5-RCP8.5 vigorous warming scenarios (see Fig. 4). Although they differ in terms of economic trajectories and climate stringency forecasts (see narratives and definitions below), both sets of climate models predict vigorous warming to cause substantially more extreme high temperature circa-2050.

Note that the selection of SSP2-RCP4.5 versus SSP5-RCP8.5 climate scenarios results from probabilistic considerations, rather than subjective preferences. These, according to EDHEC studies (Rebonato et al, 2025) are the emission pathways most likely to occur. Note that the intermediate scenario has an illustrative purpose. It is computed directly at the source as the midpoint average between the SSP5-8.5 and SSP2-4.5 future temperature trajectories and is therefore *not equivalent* to RCP6.0.

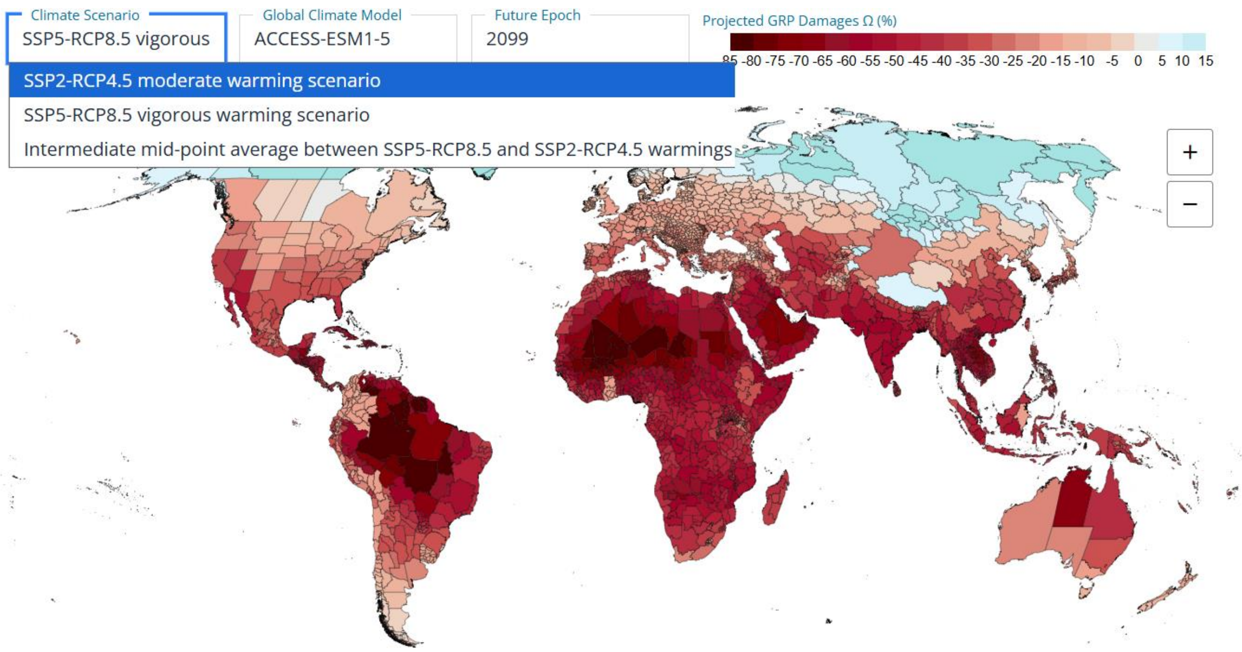

Fig. 4: Choice of Climate Scenario on the configuration panel.

The *narrative* of SSPs are described in Annex. The *definition* of RCPs scenarios is as follows:

RCP8.5: *High Emissions Scenario*

- Definition: RCP8.5 is a high greenhouse gas emissions scenario that leads to radiative forcing of 8.5 W/m² by 2100.
- Emissions Path: GHG emissions continue to rise throughout the 21st century, with no major climate policies to limit fossil fuel use.
- CO_2 concentration: Reaches ~936 ppm by 2100.

- Global warming: Likely leads to ~4.3°C warming above preindustrial levels by 2100.
- Assumptions: High population growth, slow technological change, energy-intensive economies, and strong reliance on coal and other fossil fuels.

RCP4.5: *Stabilization Scenario*

- Definition: RCP4.5 is a medium stabilization scenario in which radiative forcing levels off at 4.5 W/m² above preindustrial levels by 2100.
- Emissions Path: Greenhouse gas (GHG) emissions peak around 2040 and then decline due to climate policies and technological change.
- CO_2 concentration: Stabilizes around 650 ppm by 2100.
- Global warming: Likely leads to ~2.0–2.5°C warming above preindustrial levels by 2100.
- Assumptions: Moderate mitigation efforts, adoption of low-carbon technologies, improved energy efficiency, and afforestation.

Table 1: Summary information on RCPs.

Characteristics	**RCP4.5**	**RCP8.5**
Radiative Forcing	4.5 W/m² by 2100	8.5 W/m² by 2100
Emissions Trend	Peak ~2040, then decline	Rise throughout the century
Climate Policy	Moderate mitigation	No mitigation
Warming by 2100	~2–2.5°C	~4–4.5°C
CO_2 ppm (2100)	~650 ppm	~936 ppm

Source: Our elaboration from IPCC (2021).

Consequently, when a user selects SSP5–RCP8.5 on EDHEC-CLIRMAP, user chooses a high-emissions, high-warming scenario that combines:

- **SSP5** (*Shared Socioeconomic Pathway 5*): A socioeconomic pathway describing rapid economic growth fueled by fossil energy.
- **RCP8.5** (*Representative Concentration Pathway 8.5*): A climate forcing pathway where greenhouse gas emissions rise throughout the 21st century, reaching 8.5 W/m² of radiative forcing by 2100.

Alternatively, when a user selects **SSP2–RCP4.5** in EDHEC-CLIRMAP, this refers to a middle-of-the-road climate-socioeconomic scenario that combines:

- **SSP2** (*Shared Socioeconomic Pathway 2*): A moderate socioeconomic development pathway.
- **RCP4.5** (*Representative Concentration Pathway 4.5*): A climate pathway that leads to stabilization of radiative forcing at 4.5 W/m² by 2100 through moderate mitigation.

3.3. Global Climate Model (GCM)

In EDHEC-CLIRMAP, for each climate scenarios (RCP4.5, RCP8.5, or an intermediate mid-point between the two), the outputs of an ensemble of 29 Global Climate Models (GCMs) are available (see Fig. 5).

GCMs are state-of-the-art numerical models that simulate the Earth's climate system — including the interaction between the atmospheric temperature precipitation and winds, ocean currents and heat uptake land surface, ice and snow cover — based on physical laws. In the most recent CMIP6 exercise, GCMs are used to produce standardized climate projections under different SSP-RCP scenarios, historical reconstructions and sensitivity studies. CMIP6 GCMs, which include representations of clouds, aerosols, greenhouse gases, and feedback processes as well, are run by modeling centers (e.g., NASA, ECMWF, MPI, NCAR, IPSL) using a common set of experiments.

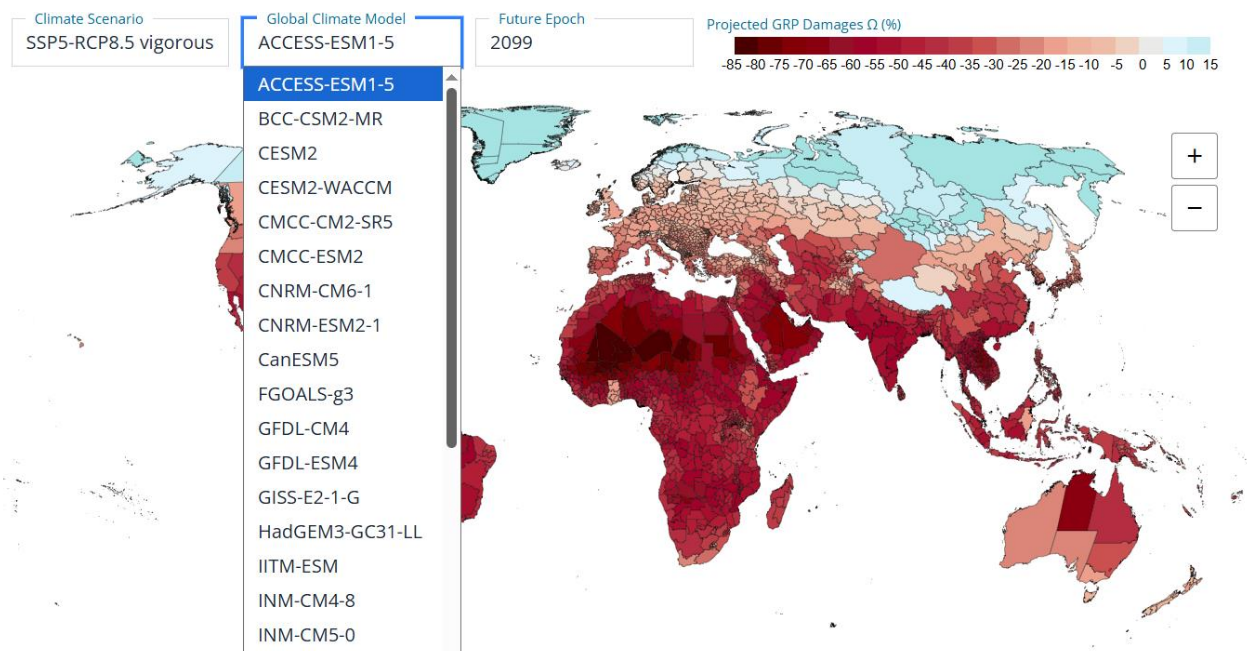

Fig. 5: Choice of Global Climate Model (GCM) on the configuration panel.

Burke et al (2015) pointed out that estimates of the economic effects of climate change are GCM-sensitive. Hence, EDHEC-CLIRMAP enables users to more holistically look at projected regional damages from an exhaustive list of 29 individual CMIP6 GCMs.

A concern is that a subset of CMIP6 GCMs may be ‘*too hot*’[5], with representations of cloud feedback in some models associated with higher-than-consensus global surface temperature

[5]For a more exhaustive review of this topic, see Hausfather et al (2022).

response to doubled atmospheric CO_2 concentrations–equilibrium climate sensitivity (ECS)[6] and global warming after 70 years of a 1% per annum increase in CO_2–transient climate response (TCR) (Sherwood et al, 2020; Tokarska et al, 2020; Zelinka et al, 2020). To mitigate the threat of bias potentially introduced by this phenomenon, we follow Hausfather et al's (2022) recommended procedure of labelling models with TCR and ECS outside 'likely' ranges (1.4-2.2◦C, 66% likelihood, and 2.5-4◦C, 90% likelihood, respectively). This leaves us with 15 'likely' GCMs, which users can directly compare against the outcomes of the 'not-likely' models on EDHEC-CLIRMAP.

Table 2: List of CMIP6 GCMs available in EDHEC-CLIRMAP and classification according to Hausfather et al (2022)'s hot model problem

GCM	ID	Model Classification
ACCESS-ESM1-5	1	likely
BCC-CSM2-MR	2	likely
CESM2	3	not-likely
CESM2-WACCM	4	not-likely
CMCC-CM2-SR5	5	likely
CMCC-ESM2	6	likely
CNRM-CM6-1	7	not-likely
CNRM-ESM2-1	8	not-likely
CanESM5	9	not-likely
EC-Earth3	10	none
EC-Earth3-Veg-LR	11	not-likely
FGOALS-g3	12	likely
GFDL-CM4	13	likely
GFDL-ESM4	14	likely
HadGEM3-GC31-LL	15	not-likely
IITM-ESM	15	none
INM-CM4-8	16	likely
INM-CM5-0	17	none
IPSL-CM6A-LR	18	likely
KACE-1-0-G	19	none
KIOST-ESM	20	none
MIROC6	21	likely

[6]The equilibrium climate sensitivity (ECS) is the global temperature increase after an instantaneous doubling of the CO_2 concentration; the TCR (Transient Climate Response) is the global warming after 70 years of a 1% per annum increase in CO_2.

GCM	ID	Model Classification
MIROC-ES2L	22	likely
MPI-ESM1-2-HR	23	likely
MPI-ESM1-2-LR	24	likely
MRI-ESM2-0	25	likely
NorESM2-LM	26	likely
NorESM2-MM	27	none
TaiESM1	28	likely
UKESM1-0-LL	29	not-likely

Source: our elaboration.

4. Output Interpretation and Concluding Remarks

This document has explained how inputs (i.e., future epoch, benchmark SSP-RCP combined climate scenarios, and GCMs) can be provided to the projector. We now detail how to interpret the outputs.

The EDHEC-CLIRMAP web module could but does not provide a graphical summary of model responses in the form of globally aggregated percentage damages. The reason is that global averages are less reliable for investors seeking regional solutions. Estimates of global damages have granular origins that EDHEC-CLIRMAP chooses to exploit. We hence look more holistically at the spatial, temporal, climate model, and scenario distribution of projected GRP changes. Ultimately, delivering information on subnational economic damages predicted over time is both the explicit aim and the competitive edge of the EDHEC-CLIRMAP tool.

Outputs in EDHEC-CLIRMAP are thus shown in the form of a spatial distribution presenting the model impacts at future epoch e, from a given GCM g simulated under a given SSP-RCP realization s. Damages, or induced changes (%), are expressed relative to a baseline period – here, constant historical 1985-2004 temperature means. Conceptually, this is equivalent to projecting the current economic system into a warmer future e simulated by given GCM $g \times$ climate scenario s.

To conclude, the EDHEC-CLIRMAP module provides a basis for making more regionally localized projections of climatically induced economic damages from shift in average temperature. However, this projector is not without caveats, which are reviewed in Section 7 of the companion document *EDHEC-CLIRMAP: The Macroeconomic and Econometric Background.*

Annex

The narratives of SSPs are described as follows:

SSP5: *Fossil-fuelled Development – Taking the Highway* (High challenges to mitigation, low challenges to adaptation)

- Significant global development predicated on more competitive markets, innovation and greater investment in human and social capital. Global markets are increasingly integrated.
- Predicated on the exploitation of abundant fossil fuel resources and adoption of resource intensive lifestyles worldwide.
- All these factors lead to rapid growth of the global economy, while global population peaks and declines in the 21st century. Local environmental problems like air pollution are successfully managed. There is faith in the ability to effectively manage social and ecological systems, including by geo-engineering if necessary.

SSP2: *Middle of the Road* (Medium challenges to mitigation and adaptation)

- Social, economic, and technological trends do not shift markedly from historical patterns. Development and income growth proceeds unevenly, with some countries making progress while others do not.
- Global / national institutions make slow progress in achieving sustainable development goals.
- Intensity of resource and energy use declines but environmental systems experience degradation.
- Global population growth is moderate and levels off in the second half of the century.

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