

**ESM2025**

# **KEY MESSAGES**

For each target group

The project goal of ESM2025 is to **advance the understanding of the Earth system and its response to human activities.**

The project aims to develop the next generation of European Earth System Models including **a more comprehensive representation of the Earth's response to anthropogenic emissions and human land-use change.**

The improved models will help to enhance the consistency of climate and mitigation-relevant processes across Earth System and Integrated Assessment models and **provide valuable scientific insights to support successful implementation of the Paris Agreement.**

Results from coordinated simulations with the new models will also **provide more robust guidance on future global environmental risks**, supporting policies targeting adaptation to global change.



## THE SCIENTIFIC COMMUNITY

The ESM2025 project aims to **enhance our understanding of the Earth system** and its response to human activities related to climate change. To achieve this goal, the following objectives have been developed:

### 1.

Development **five new-generation European Earth System Models (ESMs), an Integrated Assessment Model (IAM)** with an improved representation of Earth system variability, **an open-source reduced-complexity Earth system model**, and an **improved set of diagnostics** through ESMValTool, specifically **designed to address key policy questions** related to climate change mitigation and adaptation.

### 2.

**Improvement of key physical, biogeochemical, biophysical, and aerosol processes** to increase the realism of atmosphere, land, ocean, and cryosphere modelling within ESMs.

### 3.

**Enhancement of the coupling between existing and new ESM components** for carbon, methane, reactive nitrogen, nitrous oxide, and ice sheets, to capture the full range of climate-relevant interactions across the Earth system.

### 4.

Development of **emission-driven ESMs** for key greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O).

### 5.

**Reduction of process uncertainty** through the optimal calibration of ESM components, incorporating computationally efficient model configurations and novel machine learning approaches that assimilate observations.

### 6.

Development of a **new interdisciplinary framework** that unifies the representation of climate and land-use change interactions across ESMs and IAMs.

### 7.

Provision of open access publications and open data to support **open research**.

ESM2025 science should also serve society. To achieve this goal, ESM2025 promotes **strong stakeholder engagement** with research throughout the project, developing specific activities, resources and communication targeting policymakers, the education sector and the general public.



## DECISION AND POLICYMAKERS

ESM2025 is building the next generation of Earth System Models and Integrated Assessment Models **tailored to inform mitigation strategies in support of achieving the goals of the Paris Agreement.**

### 1.

ESM2025 models will provide tools to **project future climate change and its impacts more accurately** and integrated models to **identify robust responses**, contributing to the evidence base for important assessments by the IPCC, IPBES, and UNEP.

### 2.

ESM2025 models will deliver **more reliable estimates of allowable carbon and methane emissions** to stay below different global warming levels.

### 3.

The new models will provide more reliable information on the impact of different **CO<sub>2</sub>-based and non-CO<sub>2</sub>-based mitigation strategies and their co-benefits** for air quality and food security.

### 4.

The new models will provide a more comprehensive understanding of the **risk of major tipping points and complex climate hazards** such as ice sheet and permafrost thaw, forest loss, and wildfires.

### 5.

ESM2025 is enhancing the representation of **land-use and land-based mitigation strategies** in Earth System and Integrated Assessment Models, improving the tools for climate projections and analysis related to these topics.

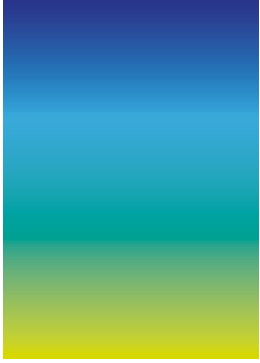
### 6.

ESM2025 will provide a suite of tools, models and diagnostics **openly available** to the global research community.

### 7.

ESM2025 develops **innovative climate education** for European students and citizens, providing pedagogical resources and professional development for teachers across Europe.

ESM2025 will **foster a science-policy knowledge exchange** to inform the implementation of the Paris Agreement and contribute to the advancement of European leadership in climate science.



## EDUCATION SECTOR

ESM2025 is committed to providing European students and citizens with **innovative climate education opportunities**. This includes:

### 1.

Hosting **two Climate Education Summer Universities for European teachers**, featuring hands-on workshops with ESM2025 researchers and pedagogical experts from the Office for Climate Education.

### 2.

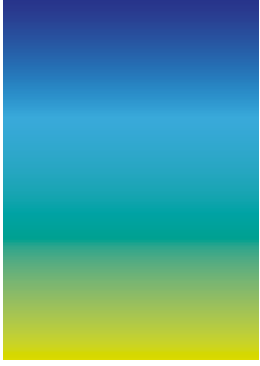
Developing a **teacher's handbook** with turnkey lessons on climate modelling and climate change for students from 9 to 15 years old.

### 3.

Creating a series of short **educational videos** on various topics related to climate modelling and climate change, also aimed at 9 to 15 years old students.

### 4.

Designing a **simplified climate model** that can serve as an educational tool for 9 to 15-year-old students, allowing them to manipulate key climate concepts at an actionable scale.



## GENERAL PUBLIC, ONGS AND THE MEDIA

ESM2025 is a European research project aimed at **improving our understanding of our planet and how it responds to disturbances by human activities**, particularly related to climate change.

### 1.

ESM2025 is building **a new generation of sophisticated computer models** that describe the laws of physics, chemistry and biology of our planet. These new models are known as Earth System Models, or ESMs, and aim **to provide more accurate and robust projections of future climate change and its impacts** than is currently the case.

### 2.

In ESM2025, **scientists partner with society and policy makers** to support the implementation of the Paris Agreement on climate change.

### 3.

To foster broader understanding of the science of climate change and possible solutions, ESM2025 will provide **innovative climate education opportunities and communication resources** for European students and citizens.