



European Commission

*Research in the environmental sciences is necessary for a better understanding of the underlying principles of climate change and its effects. But simply understanding how and why climate change is occurring is not enough. We also need to know its impacts and how to respond. The EU's Seventh Framework Programme supports research and innovation based solutions at transnational and international level.*

*Research and Innovation policy*



# EU research Climate Change



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# Climate change is now

*Research in the environmental sciences is necessary for a better understanding of the underlying principles of climate change and its effects. But simply understanding how and why climate change is occurring is not enough. We also need to know its impacts and how to respond.*

With environment at the top of the political agenda, climate change remains one of the most difficult challenges now confronting society. The primary implications of global temperature change include access to basic and essential resources – food, fresh water and energy.

Now also on the agenda are various mitigation and adaptation strategies. We need to know and to decide what to do about climate change. This phenomenon does not respect any borders and, therefore, it needs to be addressed from a global perspective in a sustainable way.

And of course, at the very core of the issue is how to minimise our own contribution to the problem. It is now widely accepted that human activity plays a key role in climate change. We are causing changes in the Earth's atmospheric composition in terms of greenhouse gases, aerosols, small particles and cloudiness. The most significant known human contribution comes from the burning of fossil fuels, which releases carbon dioxide gas (CO<sub>2</sub>) directly to the atmosphere.

Greenhouse gases and aerosols affect climate by altering incoming solar radiation and outgoing infrared (thermal) radiation that are part of Earth's energy balance. Increasing the atmospheric abundance or properties of these gases and particles leads to a warming of the climate system. Since the start of the industrial era, the

overall effect of human activities on climate has been a warming influence. This impact during this era greatly exceeds that due to the known influences of natural processes, such as solar changes and volcanic eruptions.

## Research Priorities

Developing a clear and consistent approach on how to deal with climate change is a subject of high-level concern for individual countries and for the European Union. Today the EU plays a leading role by contributing to the Intergovernmental Panel on Climate Change (IPCC) and the UN Framework Convention on Climate Change (UNFCCC).

The EU's Seventh Research Framework Programme (FP7) is funding advanced researched initiatives in a number of specific areas. First, to understand what is actually happening in our environment, research is being undertaken to assess the current state of our **oceans, atmosphere, and ecosystems**. Going a step further, **earth system modelling** allows scientists and policy makers to see in to the future, delivering actionable climate information over longer time scales.

Another key research area is assessing **impacts, vulnerabilities and** working out methods for **adapting to climate change**. Implementing an effective response to climate change is a tremendous challenge, particularly putting in place actions to avoid a rise in global temperature of more than 2°C. Finally, a fundamental restructuring of the way energy, land and water resources are managed is needed. Therefore, the **transition to low-carbon economies and societies** is also a key area of EU-supported research.





# Ocean, atmosphere, and ecosystems

*The environment is now under enormous pressure due to the release of harmful emissions and greenhouse gases from economic activity. Pollution, reduced availability of drinking water, and climate change all have enormous implications for ecosystems, human health and the economy around the globe.*

In order to understand exactly what is going on and the potential consequences for the future, we need to closely observe and understand key processes on land, in the air and in the oceans.

Identifying the causes and characteristics of climate change allows us to take timely and effective action to mitigate the impacts. Crucially, policy makers need good information about climate



## Understanding ocean circulation: THOR

*ThermoHaline Circulation (THC) is the large-scale ocean circulation created and driven by water density gradients, surface heat and freshwater fluxes. The Gulf Stream, which brings warm water up from the Caribbean into Europe's North Atlantic waters, is an important part of the global THC system and has a major impact on the European climate.*

*The EU-funded THOR project is looking at the implications of global warming on ocean circulation, including the Gulf Stream. Partners are working to establish an operational system that will monitor and forecast the development of the North Atlantic THC on decadal time scales, assessing its stability and the risk of a breakdown in a changing climate.*

change, so that they can make the best decisions about how to respond.

## The oceans and the atmosphere are changing

FP7 is funding a number of important research projects aimed at better understanding the possible results of changes in our oceans, in the atmosphere and in the earth's ecosystems.

One example is the newly launched **Ice2Sea** project, which looks at the contributions of glaciers, the Antarctic and Greenlandic ice-sheets on sea-level rise and the potential impacts on coastal areas. This could include increased rates of coastal erosion, accelerated destruction of natural sea defences and a higher incidence of flooding. Project partners believe their work can contribute to the development of policies to protect our coastlines, and to reduce the impact of climate change on the lives and livelihoods of EU citizens.

An area of longstanding concern closely linked to climate change is the effect of human activity on the ozone layer. The stratospheric ozone layer protects the surface of the earth, and those who live on it, from UV radiation. Human activities, primarily the release of chlorofluorocarbons (CFCs), used as solvents, refrigerants and as propellants in aerosol applications, have led to a thinning of this protective layer, in particular in polar regions.

The EU-funded **Reconcile** project is studying the depletion of ozone layer through dedicated laboratory and field measurements, working to improve model representations which can simulate and predict current and future Arctic stratospheric ozone loss.

# Earth system modelling

*The assessment of the impacts and risks related to climate change rely on the predictions of models that forecast changes in the most important variables such as sea level, precipitation or frequency of extreme events.*

The Global Framework on Climate Services (GFCS), initiated by the World Meteorological Organisation (WMO) in 2009, has expressed a clear need for actionable climate information, for periods from months up to several decades, for economic, industrial and political planning. Currently, climate change predictions are still subject to considerable uncertainties, caused by insufficient model resolution which has to do with computing limitations and the stochastic nature of the problem. Furthermore, lacking understanding of some of the key processes regulating the climate system such as convection and the interaction of aerosols, clouds and radiation, the complex exchange of energy and gases between the atmosphere, the solid earth, the oceans and all of their ecosystems add to the problem. These deficits call for an integrated programme to develop a new generation of Earth-system models and the application of sophisticated downscaling and calibration methods to accomplish reliable local climate predictions in Europe.

## The world as one

The EU has historically supported work in the area of Earth system modelling, funding important research initiatives going right back to the 1980s. Indeed, the progress made in Europe on climate modelling can be directly linked to the strong cooperation among all EU Member States, creating a critical mass of resources, tools and minds in a research area where no single country could accomplish as much by working on its own.

A number of current EU projects serve as good examples of how European researchers are addressing critical aspects of climate modelling. One of them is the **Euclipse** project which fo-

cusses on the modelling of clouds in the atmosphere.

The Euclipse project will provide new evaluation tools and climate simulation data for cloud research and will deliver vital analyses of climate simulations in support of the 5th Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Euclipse and many other EU-funded research projects serve to illustrate how and why Europe is now a world leader in earth system modelling, prime examples of strength in unity on the scientific front. Of course, earth system modelling is and will remain a global endeavour, and therefore Europe continues to work closely with key and longstanding international partners such as the USA and Japan, as well as emerging players such as Brazil, India and China.

## Towards more accurate climate predictions: Combine

*The EU-funded Combine project is an essential initiative that brings together research groups for better assessment of changes in the physical climate system and their impacts on the economy and society over the next few decades. Combine will look at a number of new components in Earth System modelling, including key physical and biogeochemical processes that will allow it to model more accurately the magnitude of climate change in the 21st century. Analyses will incorporate the carbon and nitrogen cycles, aerosols coupled to cloud microphysics and chemistry, for example, proper stratospheric dynamics and increased resolution, ice sheets and permafrost.*

# Impacts, vulnerabilities and adapting to climate change

*Assessing the impacts of and vulnerability to climate change and subsequently working out adaptation needs requires good quality information. If the capacity for assessing climate change is not there, countries are limited in their ability to plan adaptation measures and adapt effectively.*

Based on recent research, adaptation to climate change is now a necessity. Given the current levels of greenhouse gas emissions it is now inevitable that we will see a certain amount of climate change and its related impacts.

While the 2°C target, if reached, may keep 'catastrophic change' in check, a 2°C increase is certainly not negligible. Indeed, it is quite significant. Furthermore, this figure is only meant to represent an average – while some regions may see a 2°C change, others may see very little change, while still other regions would see greater tem-



## Impact2C

*The EU-funded Impact2C project will ensure that both individual and cross-sector assessments are aligned to the 2°C scenario. For example, impact assessments and response strategies for the agriculture sector should not be in conflict with the same assessments and strategies in the forestry or tourism sectors.*

*Impact2C integrates the expertise of top climate scientists, impact specialists with both scientific and economic backgrounds, and local specialists from specific regions under study. All are working to deliver maximum support on the development of sectoral and cross-sectoral, pan-European strategies for adapting to a 2°C global temperature rise.*

perature rises. Temperature increases of about 3°C are estimated for parts of Europe under this scenario. Meanwhile, consequences, such as sea level rise, will be global in nature, regardless of the specific temperature change in any given area, and will therefore be felt equally by everyone in all parts of the world. Hence, all countries, no matter where they are, need to face up to the challenge of adapting to climate change.

## First things first

The first concern, naturally, is to have good data about what is really happening. Unfortunately, a sufficiently detailed and complete picture of the form and dimensions of adaptation, and its costs, is not yet available for Europe and other parts of the world. This is because adaptation measures are highly dependent on specific, geographical and climate risk factors, as well as institutional, political and financial constraints, and all of these require a great amount of time and effort to be worked through. Work on climate change adaptation, currently funded by FP7, include the **Climsave** project. This is developing a user-friendly, interactive web-based tool that will allow government and local authorities to assess climate change impacts and vulnerabilities for a range of sectors, including agriculture, forests, biodiversity, coasts, water resources, urban development and tourism.

Another remarkable initiative is the **Responses** project which is trying to develop a new global scenario for very low greenhouse gas emissions, which would achieve the EU's 2°C target. In developing this scenario, it contributes directly to EU policy and to the work of the Intergovernmental Panel on Climate Change (IPCC) on future climate projections.

# Transition to low-carbon economies and societies

*Implementing an effective response to climate change is going to require a fundamental restructuring of the way energy and land are managed. At the same time, this transition will open up new opportunities and deliver wider benefits to society.*

Today, levels of CO<sub>2</sub> in the atmosphere are increasing, rising faster than ever and, in fact, the longer this goes on, the more drastic will be the cuts required to meet our desired targets. As things stand now, meeting the 2°C target and thus avoiding the worst impacts of climate change will require developed countries to cut greenhouse gas emissions such as CO<sub>2</sub> by 80-95% by 2050 compared to 1990 levels.

This will imply major transformations for both EU and non-EU developed economies, but it will also require significant efforts from emerging economies like China who is now the first world emitter. All will need to be encompassed by effective mitigation policies and long-term low-carbon growth strategies.

However, identifying and implementing effective mitigation strategies presents multiple challenges. There are many uncertainties that will determine future emission levels, for example the economic, technical and political feasibility of different mitigation options, alternative socio-economic scenarios, and so forth, all of which must feed into the policy making process.

Better information is needed about the costs and benefits of different approaches, including low-carbon technologies, as well as economic, regulatory and legislative tools to drive innovation and reduce greenhouse gasses.

## Staring climate change in the face

Key EU research initiatives aimed at addressing the challenges of a low-carbon future include the **LIMITS** project, investigating global-level mitigation strategies, including feasibility, cost-effectiveness and technological implications of

alternative scenarios. Crucially, Limits wants to know how Europe can jump start investments and innovation into clean energy technologies.

Another very interesting EU project is **AMPERE**. Here, researchers are analysing mitigation pathways and associated costs by carrying out a series of comparisons of different state-of-the-art energy/economy/climate models.



## Reaching both development and climate objectives: POEM

*The EU-funded POEM project looks at options for sustaining both development and a stable future for climate in emerging economies such as India and China. Under test is the hypothesis that it is in fact possible to achieve both objectives. A combination of policies and measures encompassing both international and national-level emission reduction scenarios will be analysed, as well as innovative energy tools and technologies.*

# Project List

**ACCENT-PLUS** – Atmospheric Composition Change: the European Network-Policy Support and Science  
[www.accent-network.org](http://www.accent-network.org)

**AQCWA** – Assessment of Climatic change and impacts on the Quantity and quality of Water  
[www.aqwa.ch](http://www.aqwa.ch)

**ADVANCE** – Advanced Model Development and Validation for Improved Analysis of Costs and Impacts of Mitigation Policies

**AFRICAN CLIMATE** – Uptake of Climate related Research Results through Knowledge Platforms with African Collaboration Partners  
[www.africanclimate.net](http://www.africanclimate.net)

**AMAZALERT** – Raising the alert about critical feedbacks between climate and long-term land use change in the Amazon  
[www.eu-amazalert.org](http://www.eu-amazalert.org)

**AMPERE** – Assessment of Climate Change Mitigation Pathways and Evaluation of the Robustness of Mitigation Cost Estimates  
[www.ampere-project.eu](http://www.ampere-project.eu)

**APPRAISAL** – Air Pollution Policies for Assessment of Integrated Strategies At regional and Local scales  
[www.appraisal-fp7.eu](http://www.appraisal-fp7.eu)

**ARIMMORA** – Advanced Research on Interaction Mechanisms of electroMagnetic exposures with Organisms for Risk Assessment  
[www.arimmora-fp7.eu](http://www.arimmora-fp7.eu)

**ArcRisk** – Arctic Health Risks: Impacts on health in the Arctic and Europe owing to climate-induced changes in contaminant cycling  
[www.arcrisk.eu](http://www.arcrisk.eu)

**ATP** – Arctic Tipping Points  
[www.eu-atp.org](http://www.eu-atp.org)

**BASE** – Bottom-up Climate Adaptation Strategies towards a Sustainable Europe

**CARBOCHANGE** - Changes in carbon uptake and emissions by oceans in a changing climate  
[www.carbochange.buib.no](http://www.carbochange.buib.no)

**CARBO-Extreme** - The terrestrial Carbon cycle under Climate Variability and Extremes - a Pan-European synthesis  
[www.carbo-extreme.eu](http://www.carbo-extreme.eu)

**CCTAME** – Climate Change - Terrestrial Adaptation and Mitigation in Europe  
[www.cctame.eu](http://www.cctame.eu)

**CECILIA2050** – Choosing Efficient Combinations of Policy Instruments for Low-carbon development and Innovation to Achieve Europe's 2050 climate targets

**CIRCLE-2** – Climate Impact Research & Response Coordination for a Larger Europe - 2nd Generation ERA-Net -Science meets Policy  
[www.circle-era.eu](http://www.circle-era.eu)

**CITYZEN** – megaCITY - zoom for the Environment  
<https://wiki.met.no/cityzen/start>

**CLAMER** – Climate Change and Marine Ecosystem Research Results  
[www.clamer.eu](http://www.clamer.eu)

**CLARIS LPB** – A Europe-South America Network for Climate Change Assessment and Impact Studies in the La Plata Basin  
[www.claris-eu.org](http://www.claris-eu.org)

**CLEAR** – Climate change, Environmental contaminants and Reproductive health  
[www.inuendo.dk/clear](http://www.inuendo.dk/clear)

**CLIMAFRICA** – Climate change predictions in Sub-Saharan Africa: impacts and adaptations  
[www.climafrika.net](http://www.climafrika.net)

**ClimateWater** – Bridging the gap between adaptation strategies of climate change impacts and European water policies  
[www.climatewater.org](http://www.climatewater.org)

**CLIMB** – Climate Induced Changes on the Hydrology of Mediterranean Basins: Reducing Uncertainty and Quantifying Risk through an Integrated Monitoring and Modeling System  
[www.climb-fp7.eu](http://www.climb-fp7.eu)

**CLIM-RUN** – Climate Local Information in the Mediterranean region: Responding to User Needs  
[www.climsave.eu](http://www.climsave.eu)

**CLIMSAVE** – Climate change integrated assessment methodology for cross-sectoral adaptation and vulnerability in Europe  
[www.climsave.eu](http://www.climsave.eu)

**CLIMATE FOR CULTURE** – Damage risk assessment, macroeconomic impact and mitigation strategies for sustainable preservation of cultural heritage in the times of climate change  
[www.climateforculture.eu](http://www.climateforculture.eu)

**CLIMATECOST** – Full Costs of Climate Change  
<http://www.climatecost.cc/>

**COCOS** – Coordination Action Carbon Observation System  
[www.cocos-carbon.org](http://www.cocos-carbon.org)

**COMBINE** – Comprehensive Modelling of the Earth system for better climate prediction and projection  
[www.combine-project.eu](http://www.combine-project.eu)

**COMPLEX** – Knowledge Based Climate Mitigation Systems for a Low Carbon Economy

**COPHES** – European coordination action on human biomonitoring  
[www.eu-hbm.info](http://www.eu-hbm.info)

**ECLAIRE** – Effects of Climate Change on Air Pollution Impacts and Response Strategies for European Ecosystems  
[www.eclairer-fp7.eu](http://www.eclairer-fp7.eu)

**ECLIPSE** – Evaluating the Climate and Air Quality Impacts of Short-Lived Pollutants  
<http://eclipse.nilu.no/>

**ECLISE** – Enabling CLimate Information Services for Europe  
[www.eclise-project.eu](http://www.eclise-project.eu)

**EMBRACE** – Earth system Model Bias Reduction and assessing Abrupt Climate change

**ENCI-LowCarb** – European Network engaging Civil society in Low Carbon scenarios  
[www.enci-lowcarb.eu/](http://www.enci-lowcarb.eu/)

**ENFIRO** – Life Cycle Assessment of Environment-Compatible Flame Retardants (Prototypical case study)  
[www.enfiro.eu](http://www.enfiro.eu)

**ENTRACTE** – Economic INsTRuments to Achieve Climate Targets in Europe  
<http://www.zew.de/en/forschung/projekte.php?action=detail&nr=1219>

**EPOCA** – European Project on Ocean Acidification  
[www.epoca-project.eu](http://www.epoca-project.eu)

**EUCLIPSE** - EU Cloud Intercomparison, Process Study and Evaluation Project  
[www.euclipse.eu](http://www.euclipse.eu)

**EUPORIAS** – EUropean Provision Of Regional Impact Assessment on a Seasonal-to-decadal timescale  
[www.euporias.eu](http://www.euporias.eu)

**EUTRACE** – European Trans-disciplinary Assessment of Climate Engineering  
[www.eutrace.org](http://www.eutrace.org)

**FoResTTrac** – Forest ecosystem genomics research: supporting Transatlantic Cooperation  
[www.foresttrac.eu](http://www.foresttrac.eu)

**FUME** – Forest fires under climate, social and economic changes in Europe, the Mediterranean and other fire-affected areas of the world  
[www.fumeproject.eu](http://www.fumeproject.eu)

**GHG EUROPE** – Greenhouse gas management in European land use systems  
[www.ghg-europe.eu](http://www.ghg-europe.eu)

**HighNoon** – HighNoon: adaptation to changing water resources availability in northern India with Himalayan glacier retreat and changing monsoon pattern  
[www.eu-highnoon.org](http://www.eu-highnoon.org)

# Project List

**Ice2sea** – Estimating the future contribution of continental ice to sea-level rise  
[www.ice2sea.eu](http://www.ice2sea.eu)

**IcePure** – The impact of climatic and environmental factors on personal ultraviolet radiation exposure and human health  
<http://www.icepure.eu/>

**IMPACT2C** – Quantifying projected impacts under 2°C warming  
[www.hzg.de/mw/impact2c](http://www.hzg.de/mw/impact2c)

**IMPLICC** – Implications and risks of engineering solar radiation to limit climate change  
<http://implycc.zmaw.de/>

**IPCCARS** – Support in Preparation of the IPCC 5th Assessment Report

**I-REDD+** – Impacts of Reducing Emissions from Deforestation and Forest Degradation and Enhancing Carbon Stocks  
[www.i-redd.eu](http://www.i-redd.eu)

**LIMITS** – Low climate Impact scenarios and the Implications of required Tight emission control Strategies  
[www.feem-project.net/limits](http://www.feem-project.net/limits)

**MEDIATION** – Methodology for Effective Decision-making on Impacts and AdaptATION  
[www.mediation-project.eu](http://www.mediation-project.eu)

**MEDSEA** – MEDiterranean Sea Acidification in a changing climate  
[www.medsea-project.eu/home](http://www.medsea-project.eu/home)

**MEECE** – Marine Ecosystem Evolution in a Changing Environment  
[www.meece.eu](http://www.meece.eu)

**MEGAPOLI** – Megacities: emissions, urban, regional and Global Atmospheric pollution and climate effects and integrated tools for assessment and mitigation  
<http://megapoli.info/>

**NACLIM** – North Atlantic Climate: Predictability of the climate in the North Atlantic/European sector related to North Atlantic/Arctic sea surface temperature and sea ice variability and change  
<http://naclim.zmaw.de/>

**QWeCI** – Quantifying Weather and Climate Impacts on Health in Developing Countries  
[www.liv.ac.uk/qweci](http://www.liv.ac.uk/qweci)

**PACHELBEL** – Policy addressing climate change and learning about consumer behaviour and everyday life  
[www.pachelbel.eu](http://www.pachelbel.eu)

**PAGE21** – Changing Permafrost in the Arctic and its Global Effects in the 21st Century  
<http://page21.arcticportal.org/>



# Project List

**PAST4FUTURE** – Climate change - Learning from the past climate  
[www.past4future.eu](http://www.past4future.eu)

**PEGASOS** – Pan-European Gas-AeroSol-climate interaction Study  
<http://pegasos.iceht.forth.gr/>

**POEM** – Policy Options to engage Emerging Asian economies in a post-Kyoto regime

**PROMITHEAS-4** – Knowledge transfer and research needs for preparing mitigation/adaptation policy portfolios  
[www.promitheasnet.kepa.uoa.gr/Promitheas4](http://www.promitheasnet.kepa.uoa.gr/Promitheas4)

**RAMSES** – Reconciling Adaptation, Mitigation and Sustainable Development for Cities

**REAKT** – Strategies and tools for Real Time EArthquake RiSk ReducTion

**RECONCILE** – Reconciliation of essential process parameters for an enhanced predictability of arctic stratospheric ozone loss and its climate interactions  
[www.fp7-reconcile.eu](http://www.fp7-reconcile.eu)

**REDD-ALERT** – Reducing Emissions from Deforestation and Degradation through Alternative Landuses in Rainforests of the Tropics  
[www.redd-alert.eu](http://www.redd-alert.eu)

**RESPONSES** – European responses to climate change: deep emissions reductions and mainstreaming of mitigation and adaptation  
[www.responsesproject.eu](http://www.responsesproject.eu)

**Safe Land** – Living with landslide risk in Europe: Assessment, effects of global change, and risk management strategies  
[www.safeland-fp7.eu](http://www.safeland-fp7.eu)

**SHIVA** – Stratospheric Ozone: Halogen Impacts in a Varying Atmosphere  
<http://shiva.iup.uni-heidelberg.de/index.html>

**SPECS** – Seasonal-to-decadal climate Prediction for the improvement of European Climate Services

**SustainableRIO** – Sustainable development reflexive inputs to world organisation  
[www.iddri.org/Themes/Gouvernance/SustainableRIO](http://www.iddri.org/Themes/Gouvernance/SustainableRIO)

**THOR** – Therohaline Overturning - at Risk?  
[www.eu-thor.eu](http://www.eu-thor.eu)

**TopDad** – Tool-supported policy-development for regional adaptation

**TRANSPHORM** – Transport related Air Pollution and Health impacts - Integrated Methodologies for Assessing Particulate Matter  
[www.tmleuven.be/project/transphorm/home.htm](http://www.tmleuven.be/project/transphorm/home.htm)

**Twin2Go** – Coordinating Twinning partnerships towards more adaptive Governance in river basins  
[www.twin2go.uos.de](http://www.twin2go.uos.de)

**URGENCE** – Urban Reduction of GHG Emissions in China and Europe  
[www.urgence.eu](http://www.urgence.eu)

**VIROCLIME** – Impact of climate change on the transport, fate and risk management of viral pathogens in water  
[www.viroclimate.org](http://www.viroclimate.org)

**WASSERMED** – Water Availability and Security in Southern EuRoPe and the Mediterranean  
[www.wassersed.eu](http://www.wassersed.eu)