



Science for Climate Action

EU research contribution to IPCC
Working Group II on Impacts,
Adaptation and Vulnerability

*Providing solutions,
enabling resilient development*



*Research and
Innovation*

Science for Climate Action: EU research contribution to IPCC Working Group II on Impacts, Adaptation and Vulnerability

European Commission
Directorate-General for Research and Innovation
Directorate B — Healthy Planet
Unit B.3 — Climate & Planetary Boundaries

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Science for Climate Action

EU research contribution to IPCC Working Group II
on Impacts, Adaptation and Vulnerability

edited by Onélia Andrade, Alfonso Acosta Gonçalves and Katarzyna Drabicka

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INTRODUCTION

Climate change is one of the greatest threats facing humanity, with potentially devastating impacts on people and the natural environment – this realisation is becoming clearer and more concrete every day as new climate extremes manifest themselves around the globe. To respond to this challenge, the European Union has made climate action its top priority through the European Green Deal. The overarching goal is reaching climate neutrality by 2050, while at the same time making the continent climate resilient.

While mitigating emissions is at the heart of climate action and constitutes a pre-condition for avoiding the worst climate impacts, increased focus on climate adaptation has never been more urgent. This message transpires from the latest scientific assessment by the **Intergovernmental Panel on Climate Change (IPCC)**, the most authoritative source of knowledge about the changing climate. The IPCC **Working Group II report Climate Change 2022: Impacts, Adaptation and Vulnerability** warns that the world faces unavoidable, multiple climate hazards over the next two decades, and risks for society and nature are set to increase. And indeed, it is very worrying to see three of the four main risks identified by the IPCC: 1) extreme heat over land and at sea, 2) water scarcity and 3) the negative effects on food production, already materialising across Europe this summer and challenging our adaptation capacities. Beyond 2040 and depending on the level of global warming, impacts could be up to multiple times higher than currently observed. Paraphrasing Darwin, humanity might soon find itself facing the “adapt or die” choice. Against this background, the scientific community cautions that the window to act and secure a liveable future is closing fast.

As more and more intense climate impacts are already being felt, the world needs to urgently step-up action and re-balance the focus between adaptation and mitigation to allow countries to better respond to climate change impacts. Globally, the momentum on adaptation is indeed building up, reflecting the increased understanding that climate resilience is central to smart policy making – it is not only a moral and ethical imperative towards the most vulnerable, but it also makes economic sense.

At COP26, the Glasgow Climate Pact set the path forward to the Global Goal on Adaptation, and all parties were urged to further integrate adaptation actions into local, regional, and national planning. In Europe, the new **EU Strategy on adaptation to climate change**¹ was adopted in early 2021 and sets out how the EU can adapt to the unavoidable climate impacts and become climate resilient by 2050. As the key implementing vector of the Strategy, the EU Mission for Adaptation to Climate Change² seeks to support at least 150 European regions and communities towards climate resilience by 2030. It will strengthen the scientific understanding of climate-related risks and possible adaptation responses at a local level, pilot solutions across sectors,

1. COM(2021) 82 final

2. [EU Mission: Adaptation to Climate Change](#)

build capacity, mobilise stakeholders and, crucially, engage citizens to upscale and accelerate transformational adaptation towards a climate-resilient society. To maximise the effectiveness and impact of adaptation responses, it is imperative that they rest upon the best available climate science. This is clearly acknowledged in the EU Adaptation Strategy, which asserts that anchoring decisions in the latest science can facilitate decision-making. In this regard, the IPCC assessments play a special role as they constitute the ultimate source of knowledge on climate change. They not only build consensus around key scientific questions, and inform policies, but also provide an important guidance for the strategic programming of EU-funded research, helping to focus on the most pressing knowledge gaps and policy-relevant research. The year 2022 is key for the Panel and climate science as it brings about the finalisation of IPCC milestone reports.

The Intergovernmental Panel on Climate Change (IPCC), consisting of the world's leading climate scientists, plays a unique role within climate science and in informing policy decisions. First convened in 1988 by the United Nations and the World Meteorological Organisation, the IPCC is tasked to provide policymakers with regular, comprehensive, and authoritative scientific assessments on climate science knowledge, building on the work of hundreds of scientists worldwide.

So far, the Panel has produced five Assessment Reports and its work has been instrumental in creating a broad, evidence-based consensus, not only on the link between human activity and climate change, but also on the associated impacts, future risks, and options for adaptation and mitigation. The consecutive reports have seen an increased confidence on the findings, based on continuous progress in climate science and modelling, and have reinforced the warnings and calls for action. The IPCC reports thus represent an essential source of information for the implementation of the Paris Agreement.

The latest IPCC 6th Assessment Report (AR6), consists of three parts: the first instalment, on the physical science of climate change³, was published in August 2021, delivering the starkest warning so far, described by the UN Secretary-General António Guterres as a “code red for humanity”. The second part, approved in February 2022 and focusing on impacts, adaptation and vulnerability⁴ does not paint a much brighter picture — it warns that any further delay in climate action “will miss a brief and rapidly closing window of opportunity to secure a liveable and sustainable future for all”. The third report⁵ that came out in April 2022 is centred on mitigation and highlights how the world must take deep and rapid cuts in emissions to keep global warming in check.

The European Union, through its successive Framework Programmes for Research and Innovation (R&I), is among the top funders of the evidence base underpinning the IPCC reports. Our recent

3. <https://www.ipcc.ch/report/ar6/wg1/>

4. <https://www.ipcc.ch/report/ar6/wg2/>

5. <https://www.ipcc.ch/report/ar6/wg3/>

analysis covering a sample of IPCC reports concludes that publications to which EU funding has contributed account for approximately 12% of all references cited⁶. By filling critical knowledge gaps, EU funded research contributes to increasing the robustness of research findings. This way, EU-funded projects contribute to improving the effectiveness of both national and international climate policies and processes, including those underpinning the implementation of the Paris Agreement. They also play an important role in increasing public support for more ambitious climate action through a variety of outreach activities.

To celebrate the publication of the IPCC Working Group II report on Impacts, Adaptation and Vulnerability, this brochure highlights the contribution of EU-funded projects to developing science and solutions for climate adaptation. The projects featured in this publication showcase some of the outstanding EU-funded research on topics that range from improved understanding of physical climate impacts at global-to-local scales, tipping points in Earth systems, extreme weather events and their cascading effects on the economy and society; to customised adaptation measures that build resilience through climate services, nature-based solutions and other innovations. The results are invaluable in paving the way towards a climate-resilient development.

6. [Contribution of the Framework Programmes \(FP7 and H2020\) to the knowledge base of recent IPCC reports based on openly available data](#)



HORIZON EUROPE

THE EU RESEARCH & INNOVATION PROGRAMME

IMPACTS AND RISKS



REGIONAL



EXTREME
EVENTS



ECONOMY



CASCADING

ADAPTATION MEASURES



CROSS-SECTORIAL



DISASTER RISK
REDUCTION



WATER
MANAGEMENT



ECOSYSTEMS &
NATURE-BASED SOLUTIONS



HUMAN HEALTH
& WELLBEING



CRITICAL
INFRASTRUCTURE



RESILIENT CITIES



LAND USE &
FOOD SYSTEMS

UNDERSTANDING THE IMPACTS and RISKS OF CLIMATE CHANGE

REGIONAL and LOCAL IMPACTS

When it comes to adaptation to climate change there is no room for applying the “one size fits all” strategy. Good adaptation requires customised solutions, tailored to specific local needs. This is because the physical impacts of climate change and their associated socio-economic consequences differ significantly not only from country to country, but within countries themselves depending on geographical conditions, socio-economic characteristics and adaptive capacity. For example, some regions of Europe are already experiencing and will continue to experience more rapid changes than others and each region will be faced with different types of extreme weather events. In addition, within the same location, the same climate change impacts can be experienced very differently across sectors and social groups, with the most vulnerable often hit the hardest.

This makes adaptation responses complex and context-dependent, putting local actors on the frontline of action. To implement successful adaptation responses, they need to understand well the risks, impacts and options that are specific to them. While modern climate science provides robust projections of future changes in the climate, based on socioeconomic development scenarios, the uptake of this information is hindered by the frequent mismatch in spatial and temporal scales between data produced by global and regional climate models and data relevant for local decision making. This is one of the key challenges that the EU Mission on Adaptation to Climate Change aims to tackle.

EU-funded projects play an important role in overcoming these problems by generating knowledge and data that serve the needs of local adaptation practitioners and decision-makers. They boost the availability, reliability and accessibility of climate information at high spatial resolution, while reducing the uncertainty of the projections. In their work, the projects deploy cutting-edge digital technologies such as artificial intelligence, high-performance computing and smart sensors. The findings form a basis for identifying adaptation options, selecting priorities and formulating strategies to build resilience across communities and sectors, and are therefore an essential input to the efforts of the EU Mission on Adaptation to Climate Change.

“ Good adaptation requires customised solutions, tailored to specific local needs. ”



PROTECT

Project Name:

PROjecting sEa-level rise: from iCe sheets to local implicaTions

Description:

PROTECT is assessing and projecting changes in the land-based cryosphere to produce robust global, regional, and local projections of sea-level rise on decadal to multi-centennial timescales across all relevant spatial and temporal scales: from today's coastal management decisions (decadal), through infrastructure planning (centennial), to the long-term viability of coastal cities, small islands, and low-lying states (multi-centennial).

The project aims at co-designing and co-constructing sea-level projections together with users and stakeholders to tailor outputs to their specific needs and contexts — in terms of exposed assets, levels of risk aversion, or stakeholder objectives. PROTECT will lay the foundation for innovative and fit-for-purpose coastal climate services to support adaptation to future flood risks in Europe. Scientific publications from the project contributed to the IPCC assessment, and several scientists were lead or contributing authors to the IPCC reports.

Project coordinator & participating countries:

Centre National de la Recherche Scientifique (France)
Netherlands, United Kingdom, Denmark, Germany, Belgium, Switzerland, Greenland, Maldives

Total investment / EU contribution:

EUR 9 996 661 / EUR 9 996 661

Start & End dates (Duration):

September 2020 to August 2024 (4 years)

Website:

<https://protect-slr.eu>



COACCH

Project Name:

CO-designing the Assessment of Climate Change costs

Description:

COACCH produced a new set of high spatial resolution climate change damage estimates in the EU, highlighting the possibility of macro-economic losses larger than previously estimated. Losses are estimated per region, sector, and impact type identifying where and when major vulnerabilities are expected.

COACCH advanced the analysis of climatic and socio-economic tipping points, showing that many EU regions could already meet these highly damaging events by mid-century. It also demonstrated impact variability across alternative climate and socio-economic scenarios. Further, the project investigated attitudes toward climate risk by EU citizens and developed assessments of cost-benefit and policy effectiveness.

The project elaborated a new generation of climate change damage functions that are now freely available to the scientific community for the validation and use. It also developed a comprehensive and transparent description and quantification of scenario and model uncertainty, as well as best practices for co-design and co-production of research that can guide similar exercises in the future.

Project coordinator & participating countries:

Fondazione Centro Euro-Mediterraneo sui Cambiamenti Climatici (Italy)
Germany, Austria, United Kingdom,
Netherlands, Czechia, Spain

Total investment / EU contribution:

EUR 4 999 843 / EUR 4 999 843

Start & End dates (Duration):

December 2017 to November 2021 (4 years)

Website:

<https://www.coacch.eu/>



EUCP

Project Name:

EUropean Climate Prediction system

Description:

EUCP is examining a number of adaptation issues and addressing the challenges raised in the IPCC Working Group II report, including how to improve decadal predictions and simulations of future local extreme weather, providing examples of how to use these improvements to inform resilience building and adaptation efforts.

Data and methods developed during EUCP, in particular the improved decadal forecasting, will play an important role in addressing the needs for improved adaptation planning and implementation. The very high resolution convective-permitting models will enable improved simulation of present and future extreme events over Europe — an essential component of organizational, regional, and national risk assessments. The intercomparison of methods to constrain projections will better inform planners on the likely range of temperatures and rainfall over Europe, helping them to avoid either over- or under-adaptation.

The project publications contributed to the IPCC Working Group II report, and a number of EUCP scientists directly participated as contributing authors.

Project coordinator & participating countries:

Met Office (UK)

France, Netherlands, Germany, Sweden, Italy, Switzerland, Spain, Denmark

Total investment / EU contribution:

EUR 12 999 515 / EUR 12 999 515

Start & End dates (Duration):

Dec 2017 to May 2022 (4 years & 6 months)

Website:

<http://eucp-project.eu>



EXHAUSTION

Project Name:

Exposure to heat and air pollution in Europe: cardiopulmonary impacts and benefits of mitigation and adaptation

Description:

The EXHAUSTION project has five overarching goals in support of the IPCC process:

- a. study the quantitative relationship between ambient temperature and cardiopulmonary mortality and morbidity in European populations;
- b. study to what extent air-pollution exposure modifies the relationship between temperature and health;
- c. project the health burden due to extreme heat and air pollution (including from wildfires);
- d. calculate the associated socioeconomic consequences of the health burden;
- e. identify effective strategies for minimizing adverse impacts.

The project has contributed to the IPCC Working Group II report in several ways, including by providing global datasets on climate extreme indices and heat stress indicators, estimates of the mortality burden associated with non-optimum temperatures (like the burden attributable to climate change), estimates of the economic costs of heat-induced reductions in worker productivity, or an assessment of the importance of air conditioning in reducing sensitivity to heat stress.

Project coordinator & participating countries:

CICERO Center for International Climate Research (Norway)
Denmark, Germany, Portugal, Romania, Greece, UK, Luxembourg, Italy, Finland

Total investment / EU contribution:

EUR 6 573 508 / EUR 6 573 508

Start & End dates (Duration):

June 2019 to May 2023 (4 years)

Website:

<http://www.exhaustion.eu>

COMPOUND, CASCADING IMPACTS and RISKS

In its latest reports, the IPCC warns that the impacts and risks of climate change are becoming increasingly complex and more difficult to manage. The Panel also emphasises that with rising temperatures multiple climate hazards will occur simultaneously, and different (climatic and non-climatic) risks will interact, exacerbating the overall risk and leading to risks cascading across sectors and regions. Some interventions to address climate change will also result in new impacts and risks, highlighting the need to carefully design and evaluate available options and policy responses.

Resonating with these messages, there is increasing scientific evidence on Europe's sensitivity to remote climate hazards: tropical cyclones are disrupting industrial production and supply chains, droughts are putting pressure on our food and feed security, and natural disasters are harming workforce in developing countries, on which we depend. Due to their intrinsic complexity, the costs associated with these risks have been systematically underestimated. Whereas the COVID-19 pandemic has painfully exposed some of Europe's vulnerabilities associated with globalisation, it has also provided lessons that enable the continent to rethink how to prepare for global, high-impact cascading disruptions triggered by climate change.

“The IPCC warns that the impacts and risks of climate change are becoming increasingly complex and more difficult to manage.”

The science is clear: we need to treat climate change as a systemic risk, threat multiplier and continue to improve our understanding of not only its direct environmental impacts, but also of the potential spillover effects, including macro-fiscal ones, that might not always be obvious. The EU is funding R&I projects developing new tools, assessments, and projections that play an important role in increasing the awareness about the significance and implications of climate-related hazards, in helping to account for them more holistically in various thematic policies and in promoting climate resilient development. Their findings are an important source of information to mainstream climate resilience considerations across EU thematic and sectorial policies that deal with economic and financial stability, civil protection and humanitarian aid, external development and other important policy areas. In this way, the projects act as enablers of a more systemic approach to climate adaptation, which is one of the key pillars of the EU Adaptation Strategy.



CASCADES

Project Name:

CAScading Climate risks: towards ADaptive and resilient European Societies

Description:

CASCADES generated knowledge on cross-border and cross-sectoral climate impacts that propagate through trade, political, and financial channels, and that have the potential to alter Europe's risk exposure. The project contributed work on cross-sectoral exposure to climatic hazards at different levels of warming, and how these may affect future generations. CASCADES also focused on quantifying climate impacts on ice roads in permafrost areas for which no multi-model-based projections existed so far. The project developed a conceptual framework to help describe and analyse the impacts, and to inform adaptation policies.

Due to their extreme complexity, these cross-impacts have not been widely studied in scientific literature, which instead has focused on direct climate impacts — a knowledge gap recognised by the IPCC. CASCADES filled in this gap, producing research papers in support of IPCC 6th Assessment Report and contributing to the Working Group II report.

Project coordinator & participating countries:

Potsdam Institute for Climate Impact Research (Germany)

United Kingdom, Austria, Sweden, Netherlands, Finland, Italy, Poland, Switzerland, Spain

Total investment / EU contribution:

EUR 6 944 384 / EUR 6 944 384

Start & End dates (Duration):

September 2019 to August 2023 (4 years)

Website:

<https://www.cascades.eu/>



RECEIPT

Project Name:

REmote Climate Effects and their Impact on European sustainability, Policy and Trade

Description:

RECEIPT is mapping connections between European socio-economic activities and remote climatic hazards, aiming at providing quantitative information on the European risks from remote climatic events. The project will develop a map of global hotspots of remote areas with climatic features relevant for Europe, and scientific narratives describing the impact on Europe's food security, financial sector, international development and coastal infrastructure. It will deliver a Europe-wide socio-economic risk assessment showing the differences between high-end and moderate climate change conditions.

Several partners supported the IPCC assessment reports as lead or contributing authors. Publications on food security impacts of export restrictions, impact of multiple hazards on the global trade and production networks, and strategies to increase societal resilience produced by the project were also cited in the Working Group II report.

Project coordinator & participating countries:

Stichting Deltares (Netherlands)
Austria, Germany, Norway, Italy, United Kingdom, Belgium, Switzerland, Poland, Austria

Total investment / EU contribution:

EUR 6 998 996 / EUR 6 998 996

Start & End dates (Duration):

September 2019 to August 2023 (4 years)

Website:

<http://climatestorylines.eu/>

EXTREME EVENTS and OVERSHOOTING

The risks and extremes will worsen with rising temperatures. IPCC warns that exceeding 1.5°C warming will expose many human and natural systems to additional severe risks, compared to remaining below this important threshold. The Panel underlines the benefits of near-term mitigation as a way to substantially reduce projected losses and damages related to climate change. The ultimate message from the scientific community is therefore very powerful: “there are clear benefits to keeping warming to 1.5°C rather than 2°C or higher. Every bit of warming matters”.

Climate change increases the frequency and intensity of extreme weather and climate events. It also changes the spatial extent and location of extreme events, which can occur over wider regions or in previously unheard-of areas, as well as their duration and timing, so they last longer and happen earlier or later in the season. While understanding extreme events is key to prepare for and avoid the worst impacts, it is challenging because these events are location- and context-specific.

In this challenging context, it is critical that we leverage all the instruments in our toolbox to accelerate progress in building our adaptive capacities as highlighted by the EU Adaptation Strategy. It also requires continuation of efforts on strengthening coherence and synergies between climate adaptation and the broader work on disaster risk reduction as part of various policy efforts, including the Union Civil Protection Mechanism and the Sendai Framework for Disaster Risk Reduction at an international level. New instruments such as Destination Earth and Digital Twins hold great promise and can be leveraged to boost our understanding of present and future climate extremes at planetary and local scale.

EU-funded research plays an important role in these efforts by improving our understanding of both extreme events and the consequences of future warming trajectories, and by making this knowledge available for guiding policy responses. Projects are developing innovative models, tools and methods with improved accuracy and more detailed information on weather extremes, but also on vulnerability and resilience. Their outputs are essential to design disaster risk management strategies to protect natural resources, sensitive economic sectors such as agriculture, water or energy, critical infrastructure and civil society. In their work, they are applying the latest digital breakthroughs such as artificial intelligence, machine learning and high-performance computing to enable effective approaches to adaptation.

“There are clear benefits to keeping warming to 1.5°C rather than 2°C or higher. Every bit of warming matters.”



XAIDA

Project Name:

Xtreme events: Artificial Intelligence for Detection and Attribution

Description:

Heatwaves in Europe remained deadly during several extremely hot summers in the recent past, even after the implementation of adaptation measures. XAIDA unites attribution, artificial intelligence, convection-permitting climate modelling, and a strong interaction with stakeholders to improve climate risk assessment in a timely fashion. Through sustained communication on extremes, and the development of methods to understand extremes, the ambition is to feed impactful climate services.

The project's objectives therefore are:

- a. characterize, detect, attribute, and project extreme events with a novel impact-based approach;
- b. assess their underlying causal pathways and physical drivers;
- c. assess new event types and develop storylines of yet-unseen but physically-plausible events for present and future climates.

In its research programme, XAIDA has a particular focus on developing new data-driven methods to simulate impacts from weather and other factors, thus contributing to IPCC Working Group II's science base.

Project coordinator & participating countries:

Centre National de
la Recherche Scientifique (France)
Switzerland, Netherlands, United Kingdom,
Germany, Spain

Total investment / EU contribution:

EUR 5 999 241 / EUR 5 999 241

Start & End dates (Duration):

September 2021 to August 2025 (4 years)

Website:

<https://xaida.eu>



FIREURISK

Project Name:

Developing a holistic, risk-wise strategy for European wildfire management

Description:

Wildfires constitute a reality affecting a significant part of the European and global populations, causing considerable ecological and atmospheric impacts, with almost one third of the global landmass experiencing recurrent fires. Although wildfires are a natural and even necessary ecosystem process, they may also pose a significant threat, leading to negative consequences and severe damages.

To address the new wildfire risk conditions in Europe it is imperative to focus on improving our understanding of the vulnerability and resilience of communities and countries at a variety of spatial and temporal scales. Such risks comprise human casualties (morbidity and mortality), cultural and economic losses, social disruption, major infrastructure damage, and deterioration of natural capital and biodiversity. The main objective of FIREURISK is therefore to develop, test, and disseminate an integrated, science-based strategy for wildfire risk management in Europe.

Project coordinator & participating countries:

Associação Para O Desenvolvimento Da Aerodinâmica Industrial (Portugal)
Spain, Greece, Italy, Finland, Germany, France, Sweden, Netherlands, United Kingdom, Cyprus, Bulgaria, Ukraine, Israel, Romania, Croatia, Australia, Canada

Total investment / EU contribution:

EUR 10 539 794 / EUR 10 271 044

Start & End dates (Duration):

April 2021 to March 2025 (4 years)

Website:

<https://fireurisk.eu/>



PROVIDE

Project Name:

Paris Agreement overshooting: reversibility, climate impacts and adaptation needs

Description:

PROVIDE will address a knowledge gap identified in the IPCC Special Report on Global Warming of 1.5°C: the distinct impacts of different overshoot scenarios depending on a) the peak temperature of the overshoot; b) the length of the overshoot period; and c) the rate of change in global temperature over the time period of the overshoot.

The project will use an innovative multi-scenario framework and a risk-threshold-centered approach to assess the impacts and quantify adaptation needs, options and costs, accounting for local socio-economic vulnerabilities, adaptive capacity, sectoral and urban development challenges as well as uncertainty about impact reversibility for a wide range of overshoot pathways. Co-development with local and regional actors will ensure that perspectives of decision-makers and stakeholders are fully incorporated. Overshoot proofing of existing adaptation strategies will establish concrete examples of how to reduce vulnerabilities and enhance adaptation action.

Several researchers funded under the project participated as lead or contributing authors in IPCC reports.

Project coordinator & participating countries:

Humboldt-Universität zu Berlin (Germany)
Switzerland, France, United Kingdom, Belgium,
Portugal, Austria, Norway, Pakistan, Canada

Total investment / EU contribution:

EUR 6 019 538 / EUR 5 994 538

Start & End dates (Duration):

September 2021 to August 2024 (3 years)

Website:

<https://www.provide-h2020.eu/>

ADAPTATION MEASURES and ENABLING SOLUTIONS

REGIONAL and CROSS-CUTTING MEASURES

As underlined in the previous sections, adaptation responses must be tailored to each particular context to be effective. For example, within Europe, the Mediterranean basin will have very different needs than the Atlantic coast, whereas adaptive measures in cities will not be the same as those on agricultural land. The wide range of climate risks, and combinations thereof, call for a diverse portfolio of flexible, scalable and replicable solutions that can be adjusted to local circumstances. This is why cross-fertilisation and exchange of knowledge between all relevant stakeholders about best practices, but also about what doesn't work and for which reasons is so essential if we are to be successful in scaling adaptation efforts rapidly.

As the effects of climate change are becoming ever more intense, the EU Adaptation Strategy emphasises the urgency to step up our efforts by combining soft measures such as awareness raising, governance improvements and conducive policy frameworks with accelerated roll out of breakthrough solutions that include nature-based approaches to reduce the impacts of climate extremes, upgrading our water management systems to better cope with storm overflows and droughts, innovative insurance schemes to hedge against climate risk, early warning systems, advanced climate analytics and many others.

“The wide range of climate risks call for flexible, scalable and replicable solutions that can be adjusted to local circumstances.”

The EU R&I is heavily investing in developing innovative solutions and climate services that help reduce climate risks and increase protection. The EU Mission on Adaptation to Climate Change is at the heart of these efforts. It focuses on building regional adaptation pathways together with designing, testing and deploying place-based solutions to support adaptation at the local level. Some of the examples in this chapter are part of the first projects of the Mission piloting a local approach to Europe-wide climate challenges like water management, food and crop security, or disaster risk resilience. The rationale behind the Mission is to create an inclusive and vibrant community of practice that will share lessons-learned and join forces to overcome the fragmentation and systemic challenges inherent to the European adaptation landscape by engaging, mobilising and connecting local actors across the continent.



ARSINOE

Project Name:

Climate-resilient regions through systemic solutions and innovations

Description:

ARSINOE seeks to develop actionable solutions and to foster an innovation ecosystem to further climate resilience and enable adaptation to climate change across Europe. The project employs a holistic approach focused around an intelligent, data-driven, multi-system, dynamic modelling framework. This approach integrates technological, digital, economic, social, governance, and environmental aspects with social innovation, building regional adaptation pathways in compliance with the goals of the EU Green Deal and the regional climate impacts highlighted by the IPCC.

Uniquely, ARSINOE connects innovators and end-users in different European regions to create novel innovation packages, business models, and implementation concepts that promote sustainability and growth through European cross-fertilization. Demonstrators are developed and tested for applicability, reproducibility, potential, and effectiveness in nine highly diverse European regions that represent a large spread of vulnerabilities, risks, and adaptation challenges for economic sectors and ecosystems.

Project coordinator & participating countries:

Panepistimio Thessalias (Greece)
United Kingdom, Denmark, France, Germany,
Netherlands, Spain, Turkey, Italy, Bulgaria,
Cyprus, North Macedonia, Albania, Romania,
Belgium

Total investment / EU contribution:

EUR 15 643 021 / EUR 14 834 277

Start & End dates (Duration):

October 2021 to September 2025 (4 years)

Website:

<https://www.arsinoe-project.eu>



IMPETUS

Project Name:

Dynamic information management approach for the implementation of climate resilient adaptation packages in European regions

Description:

IMPETUS will develop and validate a coherent, multi-scale, multi-level, cross-sectoral climate change adaptation framework to accelerate the transition towards a climate-neutral and sustainable economy. The project's Resilience Knowledge Boosters will build a robust stakeholders' community complemented with reliable data and assessment methods to support decision- and policy-making. Communities will thus be empowered to co-design, assess, deploy, and monitor climate adaptation Innovation Packages.

IMPETUS will span all 7 EU biogeographical regions —continental, coastal, Mediterranean, Atlantic, Arctic, boreal, and mountainous— thus covering all key community systems, climate threats, and multi-level governance. The project will implement and validate specific measures to adapt to and mitigate climate change, like multi-functional wetlands, controlled environmental agriculture, sand dunes restoration, post-fire restoration of forests, heat awareness, or assessment of economic impacts.

Project coordinator & participating countries:

Fundación Eurecat (Spain)
Norway, Germany, Greece, Italy, Netherlands,
Latvia, France, Switzerland

Total investment / EU contribution:

EUR 16 224 768 / EUR 14 872 468

Start & End dates (Duration):

October 2021 to September 2025 (4 years)

Website:

<https://climate-impetus.eu/>



MYRIAD-EU

Project Name:

Multi-hazard and sYstemic framework for enhancing Risk-Informed mAnagement and Decision-making in the EU.

Description:

The objective of MYRIAD-EU is to catalyse the paradigm shift required to move towards a multi-risk, multi-sector, systemic approach to risk management, instead of addressing risks and hazards independently. The project will develop forward-looking disaster risk management and climate adaptation pathways that assess the trade-offs and synergies of various strategies across sectors, scales, and hazards.

The interlinkages between the different hazards and sectors will be studied in 5 pilot projects throughout Europe: Scandinavia, the North Sea, the Canary Islands, the Danube region, and the Veneto region. Each pilot will address at least 3 of the following socio-economic sectors: infrastructure and transport, food and agriculture, ecosystems and forestry, energy, finance, or tourism.

The project will deliver open-source software for multi-hazard multi-risk scenario generation, and policy recommendations.

Project coordinator & participating countries:

Vrije Universiteit Amsterdam (Netherlands)
Italy, Austria, Germany, United Kingdom,
Norway, Belgium, Spain, Romania

Total investment / EU contribution:

EUR 4 999 802 / EUR 4 999 802

Start & End dates (Duration):

September 2021 to August 2025 (4 years)

Website:

<https://www.myriadproject.eu>



BRIGAIID

Project Name:

BRIdges the GAP for Innovations in Disaster resilience

Description:

BRIGAIID's objective was to bridge the gap for innovations in disaster resilience by providing integral, on-going support for climate adaptation innovations. The project has guided the development of innovations from prototype to commercial deployment by providing methods and tools designed to increase social, technical, and market readiness. The resources developed have also been made available for future innovators, and take the form of three "pillars of support": a) a testing and implementation framework to evaluate and enhance innovations; b) a business development and financing framework for increasing market readiness; c) resources to boost market outreach to end-users and innovators, such as an online innovation sharing platform.

BRIGAIID has helped in the development, marketing, and implementation of some of the most promising climate disaster resilience innovations in Europe, leveraging technologies such as drones, 3D printing, blockchain, IT applications, machine learning, and biological systems. Some are still in pre-commercial stage, while others have reached the market and are being implemented.

Project coordinator & participating countries:

Technische Universiteit Delft (Netherlands)
Belgium, Italy, Germany, Portugal, United Kingdom, Spain, Israel, Albania, Romania, Greece, Poland

Total investment / EU contribution:

EUR 8 817 445 / EUR 7 739 805

Start & End dates (Duration):

May 2016 to September 2020
(4 years & 5 months)

Website:

<https://cordis.europa.eu/project/id/700699>

BUILDING CLIMATE-RESILIENCE IN WATER and AGRICULTURE SECTORS

Water is the primary medium through which we experience the effects of climate change, and it will play a pivotal role not only in how the world adapts to, but also how it mitigates rising temperatures given that water availability will limit the range of available options.

Already at the current levels of warming, water availability is becoming less predictable in many places. IPCC warns that, in the future, increases in frequency, intensity and severity of droughts, floods and heatwaves, combined with continued sea-level rise will expose millions of people to acute water and food insecurity with a high risk of triggering conflicts, political instability and refugee crises. In the agri-food systems, water-related risks add to other pressures associated with climate change such as increased vulnerability to crop failure and pest damage.

We also know that despite ambitious mitigation efforts, Europe will not be spared from water-related challenges: IPCC cautions that one of the key risks for the continent in the coming decades is water scarcity in southern and western central part of the continent, with significant human, economic and ecological losses. On the other hand, above 3°C warming, coastal flood damage is projected to increase at least 10-fold by the end of the 21st century. In this context, it does not come as a surprise that water gets particular attention in the EU Adaptation Strategy.

Against this backdrop, the EU is taking action to make our water management and agriculture systems more resilient to climate change while fostering synergies with other policy objectives such as climate change mitigation, sustainable land-use and food security. EU-backed projects are developing innovative and cost-effective adaptation measures such as tailor-made climate services, improved early warning systems, solutions to manage and save water as well as more climate-resilient crop varieties and agricultural practices, harnessing the potential of digitalisation and other cutting-edge technologies such as artificial intelligence and precision farming. Water is also one of the key priority sectors in the focus of the EU Mission on Adaptation to Climate Change.

While much of EU-funded research focuses on the specific impacts in Europe, some projects are geared towards supporting adaptation of the most vulnerable populations world-wide, in particular in low-income countries such as those located in Sub-Saharan Africa. These efforts contribute to the international dimension of the EU Adaptation Strategy and the broader EU-Africa partnership.

“ More frequent and intense droughts, floods and heatwaves, combined with sea-level rise, will expose millions to acute water and food insecurity, triggering instability and conflict. ”



TRANSFORMAR

Project Name:

Accelerating and upscaling transformational adaptation in Europe: demonstration of water-related innovation packages

Description:

The IPCC Special Report on Global Warming of 1.5°C demonstrates that, even in a best-case scenario of sustained emissions reductions, there will be large stress on agri-food systems, infrastructure, ecosystems, and public health due to unavoidable climate impacts. To reduce climate-related risks, transformational adaptation is needed: TRANSFORMAR's overarching goal is to upscale and accelerate this process.

Building on existing successful initiatives, the project will address water-related risks and impacts of climate change through six lighthouse demonstrator regions and communities that will test solutions. A full-scale socio-economic impact assessment of climate change impacts and adaptation pathways, downscaled to the demonstrator scale, will generate novel insights, especially on water challenges due to climate change.

Project coordinator & participating countries:

University of Antwerp (Belgium)
Italy, France, United Kingdom, Finland, Spain,
Germany, Greece, Czechia, Norway, Malta

Total investment / EU contribution:

EUR 12 700 000 / EUR 11 900 000

Start & End dates (Duration):

October 2021 to September 2025 (4 years)

Website:

<https://www.transformar.eu>



RESCCUE

Project Name:

RESCCUE - RESilience to cope with Climate Change in Urban arEas - a multisectorial approach focusing on water

Description:

RESCCUE aimed at helping cities around the world to become more resilient to physical, social, and economic challenges by focusing on the water sector. The project developed methodologies and tools to support cities in their resilience-building process, focusing on three target cities: Barcelona, Bristol, and Lisbon.

RESCCUE used abundant, extensive, and reliable climate data —both from observations and from climate projections— that were downscaled to local level to feed different hazard models, including complex, cascading, and compound disasters. Hazards were assessed through newly developed sectorial, integrated- or loosely-coupled models of fluvial and tidal floods, which helped in identifying their cascading effects on urban services and critical infrastructures. These results were fed into impact models to perform comprehensive risk assessments —including tangible and intangible damages like socio-economic— and to evaluate the hazard reduction achieved by implementing adaptation strategies

Project coordinator & participating countries:

Aquatec Proyectos para el
Sector del Agua SA (Spain)
United Kingdom, Portugal, Kenya, France

Total investment / EU contribution:

EUR 8 057 266 / EUR 6 896 991

Start & End dates (Duration):

May 2016 to November 2020
(4 years & 7 months)

Website:

<https://toolkit.resccue.eu/>



MED-GOLD

Project Name:

Turning climate-related information into added value for traditional MEDiterranean Grape, OLive and Durum wheat food systems

Description:

Agriculture is weather-driven and climate-constrained, with expected increased vulnerability to crop failure and pest damage under climate change. In the Mediterranean region, higher than average projected climate change will further threaten an extremely rich and intertwined biological and cultural diversity. The long-term goal of MED-GOLD was to make European and global agriculture and food systems more resilient to climate change through the use of climate services, which it demonstrated through case studies for three major Mediterranean food systems: grapes and wine, olives and olive oil, and durum wheat and pasta.

Main outcomes of MED-GOLD include prototype climate services co-produced and tested with major industrial players of the global food system, using MED-GOLD methods for user engagement, cloud-based processing, and visualization of data. This enabled unprecedented replicability and scalability across regions, sectors, and users, as tested in Colombia for coffee

Project coordinator & participating countries:

Agenzia Nazionale Per Le Nuove Tecnologie,
L'energia E Lo Sviluppo Economico Sostenibile
(Italy)

United Kingdom, Spain, Belgium, Portugal,
Greece, Colombia

Total investment / EU contribution:

EUR 4 990 967 / EUR 4 990 967

Start & End dates (Duration):

December 2017 to May 2022
(4 years & 6 months)

Website:

<https://www.med-gold.eu>



DOWN2EARTH

Project Name:

Translation of climate information into multilevel decision support for social adaptation, policy development, and resilience to water scarcity in the Horn of Africa Drylands

Description:

DOWN2EARTH is addressing the multi-faceted challenges of water scarcity and food insecurity within the context of climate change in the Horn of Africa Drylands by facilitating community-centred adaptation and resilience. It uses a multidisciplinary, inclusive approach, bringing together local communities, academic experts, novel decision-support tools, multi-level governance structures, regional climate centres, and NGOs. It will deliver state-of-the-art and community-relevant climate services that focus on water scarcity and its consequences for increasingly vulnerable rural populations in the most vulnerable countries (Kenya, Somalia, Ethiopia).

Directly aligned with the IPCC Working Group II, the research activities proposed are aimed at improving regional climate services and promoting adaptation to climate change through new and enhanced decision-support tools, capacity building, citizen science, information dissemination, expansion of data networks, and climate change adaptation policy implementation.

Project coordinator & participating countries:

Cardiff University (United Kingdom)
Kenya, United Kingdom, Netherlands, Belgium,
Italy, Germany, Denmark, Ethiopia

Total investment / EU contribution:

EUR 6 645 663 / EUR 6 645 663

Start & End dates (Duration):

September 2020 to August 2024 (4 years)

Website:

<https://www.down2earthproject.org>



CONFER

Project Name:

Co-production of Climate Services for East Africa

Description:

East Africa is highly vulnerable to the impacts of climate change because climatic factors, especially rainfall, dictate the quantity and quality of water resources in the region. CONFER co-produces new climate services for East Africa —encompassing 11 countries and about 365 million people— focused on water, energy, and food security. The services are co-designed with stakeholders and end-users to enhance their ability to plan for and adapt to seasonal climate fluctuations.

To build capacity, CONFER includes an extensive training programme, building on earlier initiatives and targeting practitioners and journalists. The services will be disseminated to all the national meteorological and hydrological services in the region, which work with boundary organizations to provide tailored support to end-users such as farmers, fishers, dam operators, or watershed managers. Used in the frontline of climate change impacts, the project will build resilience to climate change impacts like crop failures, livestock loss, migration, or famines.

Project coordinator & participating countries:

Norice Norwegian Research Center AS (Norway)
Kenya, United Kingdom, South Africa, Germany

Total investment / EU contribution:

EUR 6 999 177 / EUR 6 999 177

Start & End dates (Duration):

September 2020 to February 2024
(3 years & 6 months)

Website:

<https://www.confer-h2020.eu>

NATURE-BASED SOLUTIONS FOR ADAPTATION

Examples of nature-based solutions (NBS) for climate resilience include floodplain restoration to reduce inundation risks, coastline stabilisation by means of vegetation such as mangroves or green urban spaces that alleviate heat island effects, improve water storage and discharge capacity. NBS, however, hold significant potential not only to reduce climate risks, but also to mitigate warming through their carbon sink function, while simultaneously improving our lives through other co-benefits such as better health and well-being as well as provision of quality jobs and business opportunities.

These multiple advantages make NBS a “no-regret” option in the policy toolbox and the concept is increasingly recognised and mainstreamed across global and EU policy frameworks. The importance of NBS is also powerfully acknowledged by the IPCC, which asserts that safeguarding and strengthening nature is key to securing a liveable future. This is well reflected in the EU Strategy on adaptation to climate change, which recognises NBS as a key enabler of more systemic approaches to adaptation. However, despite the rapidly expanding knowledge base, the wider deployment of NBS hinges on overcoming barriers related to financing, replicability, but also better accounting of non-market benefits in countries’ macro-fiscal policies.

“The importance of NBS is also powerfully acknowledged by the IPCC, which asserts that safeguarding and strengthening nature is key to securing a liveable future.”

It is also crucial to recall that while offering a valuable adaptation solution, NBS themselves depend on healthy ecosystems, and so their potential is vulnerable to climate change and may decline in the future. Indeed, the latest IPCC conclusions underscore the importance of the interdependence of climate, biodiversity and human systems and call for more integrated policy approaches that build on insights from natural, social and economic sciences.

To accelerate the deployment of NBS for climate resilience, EU funded R&I investigates the best ways for applying them at scale and for various climate hazards and tackles essential barriers such as valuation of NBS benefits, development of technical standards, innovative business, governance and financing models, or improved understanding of NBS vulnerability to climatic changes, among others. Projects involve stakeholders, co-design tools to increase awareness, build capacity, create societal and political acceptance and drive demand for NBS. In parallel, the Mission on Adaptation to Climate Change will be demonstrating NBS in various contexts to de-risk their large-scale uptake and to make them an essential component of a systemic transformation towards a climate resilient future.



NAIAD

Project Name:

NAture Insurance value: Assessment and Demonstration

Description:

NAIAD's overarching goal was to identify how nature can help reduce the risks from floods and droughts, which are likely to become more frequent and intense due to climate change, through the involvement of the insurance sector as a key actor, thereby contribution to closing the climate protection gap. The project's objectives were:

- a. to further our understanding on the insurance value of nature for risk reduction;
- b. to develop a series of tools and methods to operationalise natural assurance schemes, showing how a more resilient ecosystem can help adaptation efforts;
- c. to identify nature's significantly untapped potential as part of our adaptation options.

NAIAD used rural and urban cases across Europe at different scales: from large basins like the Danube or aquifers like Medina del Campo, through cities like Lodz or Montpellier, to small neighbourhoods in the city of Rotterdam. Several papers published by the consortium were cited in the latest IPCC Working Group II report, and its researchers further contributed as leading or contributing authors.

Project coordinator & participating countries:

Confederación Hidrográfica Del Duero (Spain)
France, United Kingdom, Sweden, Denmark,
Germany, Netherlands, Slovenia, Romania,
Italy, Poland

Total investment / EU contribution:

EUR 5 081 176 / EUR 4 994 370

Start & End dates (Duration):

December 2016 to August 2020
(3 years & 8 months)

Website:

<https://www.naiad2020.eu>



RECONNECT

Project Name:

Regenerating ECOSystems with Nature-based solutions for hydro-meteorological risk rEduCTion

Description:

RECONNECT aims at stimulating a new culture of co-creation for land-use planning by linking hydro-meteorological risk reduction with local and regional development objectives in a sustainable and financially viable way. The project will also demonstrate and evaluate the multiple benefits of NBS within a network of cases covering a diverse range of local conditions, geographical characteristics, institutional/governance structures, and socio-cultural settings to successfully upscale NBS throughout Europe and internationally.

RECONNECT supports the IPCC Working Group II in several ways:

- a. providing knowledge and evidence base on NBS to enhance local, regional, and international policies and to support co-creation, replication, and upscaling of large-scale NBS;
- b. developing new approaches for selection, allocation, and design of NBS for hydro-meteorological disaster risk reduction and climate change adaptation;
- c. strengthening the capacity of relevant institutions and industry partners in implementing and assessing NBS;
- d. mainstreaming NBS in land-use planning, landscaping, and territorial policies by developing holistic ecosystem-based frameworks.

Project coordinator & participating countries:

Stichting IHE Delft Institute for Water Education (Netherlands)
Germany, Italy, Denmark, United Kingdom, Belgium, Austria, Switzerland, Bulgaria, Spain, Serbia, France, Croatia, Sweden, Poland, Thailand, Malaysia, Taiwan

Total investment / EU contribution:

EUR 15 399 379 / EUR 13 520 689

Start & End dates (Duration):

September 2018 to August 2024 (6 years)

Website:

<http://www.reconnect.eu/>



PHUSICOS

Project Name:

According to nature: solutions to reduce risk in mountain landscapes

Description:

PHUSICOS will demonstrate how NBS are effective in reducing the risk posed by extreme weather events on rural mountain landscapes: floodings, landslides, erosion, and snow avalanches. To assess technical innovations, the project developed an assessment framework with indicators relevant for disaster risk reduction that include not only technical feasibility, but also the impact on ecosystems, society, and the local economy.

The project also focuses on social and governance to facilitate NBS interventions, engaging with stakeholders through a co-design approach and promoting multi-scale and cross-sectoral collaboration. This includes novel governance arrangements that cut across organisational responsibilities and sectors, achieving benefits beyond disaster risk reduction.

The PHUSICOS researchers have participated as lead authors in the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.

Project coordinator & participating countries:

Stiftelsen Norges Geotekniske Institutt
(Norway)
Italy, Germany, Austria, France, Switzerland,
Spain

Total investment / EU contribution:

EUR 9 633 000/ EUR 9 472 200

Start & End dates (Duration):

May 2018 to April 2023 (5 years)

Website:

<https://www.phusicos.eu>



GROW GREEN

Project Name:

Green cities for climate and water resilience, sustainable economic growth, healthy citizens and environments

Description:

GROW GREEN will deliver an easy-to-use, replicable approach to support the development and implementation of NBS strategies in cities, contributing to their deployment at scale across Europe. Three demonstration projects will develop an evidence base to show how NBS in cities provide a cost-effective, sustainable mean of increasing urban climate and water resilience whilst delivering other co-benefits such as improvements in biodiversity, social and economic conditions. The project will also work closely with the Chinese city of Wuhan recognising its role as one of the “Chinese Sponge Cities”.

GROW GREEN delivers evidence base that further supports IPCC Working Group II findings that adaptation actions using NBS generate multiple additional benefits around health, wellbeing, and social cohesion. It also promotes coordinated cross-sectoral policies that combine mitigation, adaptation, and sustainable development through the integration of NBS in Climate Change Action Plans, rather than as a free-standing strategy.

Project coordinator & participating countries:

Manchester City Council (United Kingdom)
Poland, Spain, France, Croatia, Italy, China

Total investment / EU contribution:

EUR 11 514 817 / EUR 11 224 058

Start & End dates (Duration):

June 2017 to November 2022
(5 years & 5 months)

Website:

<https://www.growgreenproject.eu>

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Climate change is one of the greatest threats facing humanity, and the window to take action and secure a liveable future is closing fast. The European Commission presented in 2021 its new EU Strategy on adaptation to climate change, setting out how the EU can adapt to the unavoidable climate impacts. Through the Framework Programmes for Research and Innovation (Horizon 2020 and Horizon Europe), the EU has already made significant contributions to improve our understanding of the changing climate and provide innovative adaptation solutions. Building on the release of the IPCC Working Group II report "Climate Change 2022: Impacts, Adaptation and Vulnerability", this brochure puts a spotlight on and celebrates the contribution of EU-funded projects to pushing the boundaries of world-class adaptation science as a key ingredient towards climate resilient development and just transition for all.

Studies and reports

