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CORDIS Results Pack on

climate services

A thematic collection of innovative EU-funded research results

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How climate services can help decision taking in a changing climate: Stories from Horizon 2020 projects

Research and Innovation

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Editorial

How climate services can help decision taking in a changing climate: Stories from Horizon 2020 projects

Climate services turn scientific knowledge on climate variability and change into actionable information that can be exploited by a wide range of users, including public authorities, businesses and the public. The information allows the users to account for the effects of climate change into their decision making, thereby minimising risks and seizing available opportunities to achieve a more resilient society and economy. This CORDIS Results Pack focuses on 10 EU-funded projects that have developed vital tools and expertise to help mitigate the impacts of a changing climate through the application of climate services.

Global warming, together with exacerbating climate variability and extremes, threaten the well-being of European citizens and are already damaging our economy and natural capital. Despite mitigation efforts, climate change will continue to create significant stress across Europe and the need to adapt to its impacts will not cease.

The EU is taking on these challenges with the European Green Deal and is transforming its growth strategy and the way in which decisions are taken. Climate services are capable of integrating climate information to support policymaking, planning and management on timescales that extend from months to decades. They are tailored to users' needs and provide additional information on concerns such as crop pests and disease, water management, insurance decisions, urban planning, maintenance and resilience of infrastructure and related investments, and healthcare management.

The importance of EU-funded research

Climate services have been a key research and innovation priority under Horizon 2020 with several call topics dedicated to advancing this area and further supporting the implementation of the Paris Agreement and EU Strategy on Adaptation to Climate Change. This funding leverages on the wealth of data provided by the Copernicus Climate Change Service (C3S). It has been instrumental in the emergence of a climate services market through activities that generate economic value from available climate information, provide demonstrable benefits and solutions to society, make efforts to mitigate and adapt to climate change more cost-effectively and, in turn, render the European economy more competitive.

This CORDIS Results Pack aims to raise awareness of climate services among decision-makers by show casing 10 EU-funded projects and the help they can provide. An added value is the presentation of results through the eyes of actual users who were involved in the development and testing of the tools to give first-hand experience of their benefits and caveats.

H2020_Insurance: Latest climate data and tools for insurance and disaster risk reduction

Transferring risk to the insurance sector and compensating people adequately when extreme events happen enhances resilience in our societies. EU-funded innovation has translated climate science into a wealth of data sets, tools and services to address this pressing need.

Global climate change and increasingly frequent and severe weather events are impacting lives and livelihoods around the world. Reducing impact requires integrating scientific climate models and catastrophic events risk into insurance/reinsurance schemes. The EU-funded project H2020_Insurance brought together experts from nine European countries, Hong Kong and Kenya to facilitate that process.

Climate science for the insurance industry and beyond

Although insurers and policymakers must rely on science for risk assessment and modelling, the scientists behind the data are rarely at the table themselves. "The H2020_Insurance project brings the insurance sector, the business sector, policymakers, scientists and academics directly into the same conversation," says project co-coordinator Tracy Irvine. "This enhances insight and accelerates the incorporation of the latest science into risk modelling and, subsequently, into real-world decisions," adds co-coordinator Fred Hatterman.

This unique cooperation has enabled rapid delivery of tools and services for situations ranging from floods in the Danube region and typhoons in China to climate risks to forest resources, agricultural losses of smallholder farmers in Tanzania and even health in central Berlin and Potsdam.

Having an open source loss model is rewarding for all (re)insurance companies, brokers as well as for the public sector.

Marc Wüest, SWISS Re natural hazards expert

The project outcomes improve existing modelling processes and address gaps in risk assessment for regions and hazards. For example, the Danube Flood Model covering a huge area including four major capital cities harnesses some of the latest modelling advances and explicitly integrates climate change scenarios. Irvine and Hatterman explain: "The Future Danube Model can be used for climate risk quantification, support of EU framework directives implementation, climate-informed urban and land use planning, water resources management, and climate-proofing of large-scale infrastructure."

Novi Sad, Serbia is a case point. It is preparing its first wastewater treatment plant (WWTP), a big public investment that must be climate-proof. "We noticed that in the past decade the climate began to change rapidly, which has had a significant impact on our combined sewer system. When we were presented with the idea of the H2020_Insurance project, we decided to participate in order to get a better understanding of future events. The results of the H2020_Insurance project will help us prepare the WWTP and optimise the whole sewer/drainage system," says Radoica Stefanović, manager at the Public Utility Company for Waterworks and Sewerage of Novi Sad.

The Oasis Loss Modelling Framework is an associated non-profit framework that develops and provides free access to its open-source catastrophe modelling platform by the same name. Within H2020_Insurance, it developed a new user interface for non-insurance entities including cities, governmental users and academics available for download on GitHub. "Having an open source loss model is rewarding for all (re)insurance companies, brokers as well as the public sector," says Marc Wüest, SWISS Re natural hazards expert and active member of the project's External Innovation Advisory board.

It takes a (global) village

Oasis HUB is now an independent limited liability company formed to operate the Oasis HUB portal/eMarket. Its global community of over 1 650 members represents sectors including insurance, finance, academia, engineering and consultancy. Irvine and Hatterman note: "The Oasis HUB provides our members with more than 1 700 free and commercially licensable catastrophe and environmental risk data sets and tools. We also provide innovation and commercialisation assistance to research organisations and SMEs looking to bring new climate risk assessment data, tools and services to market." Check out the project's webinar series and get started today on building resilience in our societies for a stronger and more secure tomorrow.

PROJECT
H2020_Insurance - Oasis Innovation Hub for Catastrophe and Climate Extremes Risk Assessment

COORDINATED BY
Potsdam Institute for Climate Impact Research, Germany

FUNDED UNDER
H2020-ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/730381

PROJECT WEBSITE
h2020insurance.oasishub.co/

S2S4E: Forecasting climate conditions for cleaner energy production

Renewable energy is key in the fight against climate change, but atmospheric conditions can also strongly affect the sources of such energy supply. Researchers have developed a tool that can forecast climate conditions up to 3 months in advance to help the renewable energy sector plan accordingly.

Both renewable energy generation (wind power, solar power and hydropower) and energy demand are highly dependent on atmospheric conditions. In fact, one of the main barriers for a stronger penetration of renewable sources in the energy mix is associated with their variability, as it can be difficult to forecast energy production and demand.

Additionally, climate change directly affects renewable sources and energy demand. Since weather predictions do not go beyond a few days, the renewable energy sector cannot reliably plan weeks or months in advance for the energy demand during an extreme weather event, such as a cold spell or a heatwave.

The EU-funded S2S4E project set out to explore the usefulness of sub-seasonal and seasonal predictions for the energy sector to anticipate both the renewable energy production and the demand several weeks and months ahead. "When discussing the issue of seasonal forecasts with the energy industry, we saw a gap between the predictions they were already using and the potential use of the seasonal forecasts," says Albert Soret, S2S4E project coordinator.

In winter 2015 there was a strong Super El Niño and a wind drought in USA. We started to look for scientific answers to these situations in relation to renewables, and for solutions on how to predict and cope with extreme events and got involved with developing the S2S4E Decision Support Tool.

Daniel Cabezón Martinez, Head of Meteorological Models and Special Tasks at EDP Renewables

S2S4E Decision Support Tool

The project team, consisting of industrial and academic partners, developed an online forecasting service, the S2S4E Decision Support Tool (DST) that provides an innovative service for the renewable energy sector to be resilient to climate change and extreme events. This service is tailored for the energy sector and integrates sub-seasonal climate predictions up to 4 weeks with seasonal climate predictions of up to 3 months.

S2S4E climate forecasts are based on sub-seasonal and seasonal climate data, which are post-processed to improve their reliability and to produce energy indicators useful for the renewable energy sector. The forecasts available in the DST include essential climate variables such as temperature, rain, wind speed and solar radiation; they are also used to produce forecasts of energy indicators such as energy demand due to an intensive use of air conditioning systems for cooling during a heatwave.

The S2S4E team took a transdisciplinary approach. Scientists and the energy industry came together to match the most advanced climate science with the needs, risk management practices and decision-making procedures of the perspective users of the DST. "Moreover, this forecasting tool can also be useful for people working in other sectors such as agriculture, insurance and tourism", Soret adds.

The Head of Meteorological Models and Special Tasks at EDP Renewables, Daniel Cabezón Martinez, observes: "In winter 2015, there was a strong Super El Niño and a wind drought in USA. We started to look for scientific answers to these situations in relation to renewables, and for solutions on how to predict and cope with extreme events and got involved with developing the S2S4E Decision Support Tool."

Going commercial

To improve the interface, the usability and relevance of the DST, the project members organised workshops and interviews, conducted user testing and made use of technologies such as eye tracking. The DST became operational in June 2019 and the tool is accessible via free registration.

The DST is well-suited for commercial exploitation, but this has been a challenge for the team of researchers unfamiliar with selling a product for profit. Therefore, S2S4E partnered with an expert in commercialisation to help consortium through the usual aspects of commercial exploitation, such as finding adequate business models.

"The S2S4E project does not finish after launching the DST, as we have a year and a half to validate how the tool is working and to make sure that it is useful for the renewable energy industry," reports Soret.

PROJECT
S2S4E - Sub-seasonal to Seasonal climate forecasting for Energy

COORDINATED BY
Barcelona Supercomputing Center, Spain

FUNDED UNDER
H2020-ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/776787

PROJECT WEBSITE
s2s4e.eu/

IMPREX: Anticipate and respond to Europe's water-related extreme events

Floods and droughts demonstrate the vulnerability of European society in its ability to anticipate and respond to such water-related natural hazards. An EU-funded project has improved prediction and management capabilities in coping with these extreme events.

Future hydrological extremes may be very different from today's reality and difficult to predict. They will have important implications for the water sector and the design of water management practices. "There's an urgent need for actionable research to guide decisions," says Bart van den Hurk, coordinator of the EU-funded IMPREX project. "We don't only want to know what's going on with our climate; we also need to know how to respond and act."

Our goal is the continuous and long-term utilisation of the forecasting system. The system will be even more important in future in order to be prepared for increasing occurrence of low-flow periods.

Dr.-Ing. Ingo Entelmann of the German Federal Waterway and Shipping Administration

Enhancing today's routine weather prediction and climate change models

The project supported the reduction of Europe's vulnerability to hydrological extremes through improved understanding of the intensity and frequency of future disrupting events. It provided an alternative and tangible way to depict climate change consequences by focusing on past events put in a future climate context. "Our guiding principle was 'learn from today to anticipate tomorrow', and pay much attention to near-term climate predictions, that is, in the next few months or season," notes van den Hurk.

Project partners developed innovative approaches, tools and 10 practical case studies to help improve the ability to anticipate and respond to future hydrological extreme events. They demonstrated the successful uptake of innovation in practice and provided recommendations on decision-making and integration into EU policy frameworks.

The IMPREX team analysed and improved current state-of-the art forecasting systems and management procedures. It harmonised the requirements for daily operations and long-term planning, providing evidence-based solutions for improved management support. Team members also designed innovative risk assessment concepts for hydrological extremes that respond to the limitations of existing methods and assessment practices.

Toolkit for policymakers and decision-makers

A brochure presents the project's major outcomes. It includes sector-specific factsheets that outline innovative solutions developed and applied within flood risk assessments, hydropower, water transport, urban water supply, drought management

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and global water economy. Case studies illustrate how climate information was customised to meet different stakeholder needs, providing guidance on current methods and innovative tools. Lastly, three policy briefs and a position paper translate promising tools and relevant topics and approaches for various stakeholders.

The brochure also presents a complete overview of the main achievements. One such notable finding is an upgrade in forecasting capabilities for riverine shipping transport, extending the forecast range and improving ship management options to generate clear financial revenue.

The consortium developed monthly to seasonal pre-operational forecasts for optimal long-term decision making for the port of Hamburg. As the port is located in the delta of a large river, this makes it particularly prone to impacts from the interaction of offshore tidal effects and inland hydrological conditions. "Our goal is the continuous and long-term utilisation of the forecasting system. The system will be even more important in future in order to be prepared for increasing occurrence of low-flow periods," explains Dr.-Ing. Ingo Entelmann of the German Federal Waterway and Shipping Administration.

Another example is an exploration of the potential gain in hydropower value production by using adequate forecasts, setting a benchmark for the total effect of improved forecasts on hydropower revenues. A third example is an analysis of the global connection of European food production, highlighting the vulnerability of Europe's food production sector to adverse climate conditions in remote areas. Other key results include an update of water shortage risk management procedures and a forecast system for water turbidity in drinking water treatment plants.

An e-guide showcases approaches, tools and methods for decision-making in the water sector. Users can find short-range information, seasonal forecasts and climate predictions.

"In close cooperation with a broad range of water sector stakeholders, IMPREX developed approaches and tools that are used today to prepare for future hydrological extremes and climate variability," concludes van den Hurk. "This will lead to increased uptake and application of the project's solutions, while recognising the diversity of water-related challenges within the EU."

PROJECT
IMPREX - IMproving PRedictions and management of hydrological EXtremes

COORDINATED BY
Royal Netherlands Meteorological Institute, the Netherlands

FUNDED UNDER
H2020-ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/641811

PROJECT WEBSITE
imprex.eu/

CLARITY: Screening tools to help planners to prepare for floods and heat

Climate change threatens the economies of countries and cities in the EU. Researchers have developed digital tools to help city planners and policymakers develop strategies to mitigate climate change risk.

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According to the European Environmental Agency, the heat wave of 2003 in western Europe resulted in the deaths of over 70 000 people in Europe. The number of monthly heat records globally is rising and projected to be 12 times higher than in the past under a medium global warming scenario by the 2040s. If no adaptation actions are taken, this increase in heat extremes will lead to a marked increase in heat-attributable deaths – especially in urban areas.

The EU-funded CLARITY project set out to help city planners' and policymakers' efforts to easily identify and mitigate climate change risks. The project worked to create a digital tool and online platforms to bring the latest scientific knowledge in a tailored way to end-users in cities and regions. The tool can help in taking the informed decisions to ensure that the urban and traffic infrastructure they are responsible for is more climate resilient.

"We are addressing this issue at the level of the methodology, as well as at the level of science and technology," says Denis Havlik, CLARITY coordinator. The researchers adopted a seven-step methodology to 'climate-proof' urban and transport infrastructure in several expert studies in Spain, Italy, Austria and Sweden, as well as in the online services that they developed.

Digital and online tools

Project partners developed a set of different, specialised tools suited for different stakeholders involved in climate adaptation. CLARITY's MyClimateServices Platform aims to ignite collaborations at various stages of planning climate adaptation projects. The research team created a marketplace platform for various stakeholders in all stages of the climate adaptation process to match their climate adaptation-related needs and offers and it also links to the developed screening tool.

"From a planners' point of view, with the tool it will be possible to 'play' with certain scenarios in order to get a feeling of how the City of Linz will react to specific measures in terms of mitigating the urban heat island effect," observes Wilfried Hager, Head of Department of Environmental Management, City of Linz, Austria.

A virtual marketplace

"By eliminating the need for tedious search, the 'MyClimateServices' platform aims to assist in the growth of the European climate services market," Havlik adds.

CLARITY developed the Climate Services Information System (CSIS), a screening tool and service to facilitate the combination of data and services to assess the hazards, exposure to risk and options users have in climate adaptation for various types of urban development and infrastructure projects. The project team has also developed two advanced screening web services: one for professionals involved in urban/regional planning, and one for planning adaptation measures for transport infrastructure.

"I am very proud of our climate resilience screening services for urban and traffic infrastructure. To the best of my knowledge, nothing similar exists today, and being able to perform a rapid and inexpensive screening for climate risks and possible adaptation options is key to widespread climate change adaptation in Europe," Havlik concludes.

From a planners' point of view, with the tool it will be possible to 'play' with certain scenarios in order to get a feeling of how the City of Linz will react to specific measures in terms of mitigating the urban heat island effect.

Wilfried HAGER, Head of Department of Environmental Management, City of Linz, Austria

PROJECT
CLARITY - Integrated Climate Adaptation Service Tools for Improving Resilience Measure Efficiency

COORDINATED BY
AIT Austrian Institute of Technology GmbH, Austria

FUNDED UNDER
H2020-ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/730355

PROJECT WEBSITE
clarity-h2020.eu/

VISCA: Climate and agricultural forecasts help vineyards adapt to climate change

Wine is integral to European culture and its economy, but wine grapes, especially sensitive to local climate, could be in trouble. An easy-to-use decision support system with the latest climate and agronomic models should keep wine flowing.

Spain, France and Italy alone – the main wine-growing Member States – accounted for one third of the world's vineyards in 2019. Predicting local climate variations critical to quality and quantity has always been fraught with uncertainty; climate change and severe weather events have significantly increased this and its subsequent impact. The EU-funded VISCA project

has developed and demonstrated the potential of a decision support system (DSS) to enhance the resilience of wine grape farms facing increasing climate-related challenges.

Science is helping farmers

Farmers continuously evaluate potential adverse conditions across all timescales. Typically, short-term decisions (a few days ahead) rely on meteorological data using global or regional models, reducing the accuracy of local predictions. For decisions made weeks (mid-term) or months (seasonal or long-term) in advance, experience has been the guide but is no longer as reliable given climate change and sudden extreme weather events.

Project coordinator Josep Maria Solé Tasias of METEOSIM SL explains: "VISCA DSS integrates climate and agricultural models with actual vineyard data to identify effective adaptation strategies. It includes short-term, mid-term, and seasonal weather forecasts and climate projections linked to agricultural models to enable forecasts of the phenology (the seasonal growth cycle of grapevines), required irrigation and sugar accumulation." The forecasts can identify the probability of extreme events like heatwaves, heavy precipitation or spring frost several days to months in advance. The intuitive user interface also simplifies interpretation of the novel and complex analyses and the platform is easily accessible on smartphones, tablets and computers.

VISCA DSS helps us to make better decisions on vineyard management. Without it we could not explore the optimum pruning date to implement the crop forcing technique in time.

Xavier Bordes of Codorníu

Personalised planning

The VISCA DSS data, graphics and services are flexible and modular and can be exploited separately. Users provide initial information about the vineyard, including definition of parcels, irrigation regime, and essential features such as soil type and grape varieties. They can then upload real data such as actual irrigation either manually or automatically; the updates are used to improve future forecasts. The services are interconnected, and the data is updated on a daily, weekly or monthly basis depending on the service.

Solé Tasias explains: "The most important benefit of VISCA DSS is that, unlike most existing solutions, it integrates and couples meteorological and agronomical services in a single, easy-to-use platform. It also incorporates the latest techniques to enhance adaptation to climate change in vineyards." Crop forcing shifts the grape ripening period from hot summer months to a cooler month later in the growing season and shoot trimming slows sugar accumulation. Xavier Bordes of Codorníu, where the crop forcing technique was applied in one plot to achieve grape ripening in October instead of July, says: "VISCA DSS helps us to make better decisions on vineyard management. Without it we could not explore the optimum pruning date to implement the crop forcing technique in time." It also helped minimise the spread of mildew (fungus) during a wetter spring and hotter summer than normal in Spanish vineyards.

A toast to enhanced resilience, more secure livelihoods and a bountiful table

Field tests in Spain, Italy and Portugal have demonstrated the usefulness of model predictions and that should improve with increasing user input. The VISCA DSS should be equally useful in other countries and for other crops, including olives, grains and rice. In short, VISCA has given us all a reason to raise our glasses and cheer.

PROJECT
VISCA - Vineyards' Integrated Smart Climate Application

COORDINATED BY
Meteosim SL, Spain

FUNDED UNDER
H2020-ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/730253

PROJECT WEBSITE
visca.eu/

Climate-fit.City: Making cities better prepared for climate change

Many cities are impacted by climate extremes but lack plans to deal with them. Using the most reliable scientific data available, an EU-funded project created tools and services to help cities build climate change resilience and boost sustainable economic growth.

The possibility of modelling land use change greatly helps advising on climate adaptation measures. Specifically, it allows us to build in heat stress resilience inside urban planning processes in a co-creative, convincing and scientifically sound manner.

Barbara Vojvodikova, Service development partner at the IURS-Institute for Sustainable Development of Settlements

Cities are on the frontline of climate change impacts as they concentrate people, infrastructure, economic activities and many other resources into confined spaces.

From knowledge to action

The associated social, economic and infrastructural risks can be dramatically curbed through efficient design and mitigation strategies. This requires climate-informed decision-making across all levels of governance and planning. Although there is a vast body of publicly available climate data, it is not always presented in line with the requirements of specific regions and sectors. Often, the economic and social benefits of climate services are not clear, quantifiable or specific enough to be used easily and effectively.

Working closely with city officials and urban stakeholders, the EU-funded Climate-fit.City project transforms complex, urban climate data into a set of highly usable tools to address local challenges.

Six tailored services

Project partners demonstrated the added value of the Climate-fit.City urban climate services for local decision-making in six cases across Europe. Primary urban climate data is provided by the project coordinator VITO, the Flemish Institute for Technological Research. The institute developed a flexible and highly precise computer model called UrbClim to generate detailed urban maps at a spatial resolution ranging from 100 metres to a kilometre.

The Active Mobility service provides usable, detailed and future-conscious climate data to traffic planners. "This information should allow cities to select new roads that can be promoted for active mobility, identify unfavourable regions or routes severely exposed to extreme weather conditions, and plan future infrastructure," notes project coordinator Filip Lefebre. It is incorporated as additional climatic feature in the existing GPS data analysis tool Bike Citizens Analytics that supports bicycle traffic planning in cities.

The Building Energy service delivers accurate energy simulations to increase thermal comfort and lower heating and cooling

consumption in buildings. Urban data is added to the Meteonorm software. The tool enables designers to access precise information about the radiation, temperature, humidity and wind speed of their city site.

Yet another service provides information on the relationship between heat and health. The online demonstrator in Barcelona presents the risk of mortality during warm days, while London's online demonstrator presents the risk of mortality during warm days and the likelihood of death per 1 ºC temperature increase.

The Emergency Planning service helps predict changes in the frequency of extreme events. Data serve as input to the climate-proof city emergency plan to create more efficient emergency responses and future investment planning to extreme rainfalls and flooding.

Using the Urban Planning service, end users can simulate various city development and land-use scenarios under climate change and model the distribution of heat stress levels. "The possibility of modelling land use change greatly helps advising on climate adaptation measures. Specifically, it allows us to build in heat stress resilience inside urban planning processes in a co-creative, convincing and scientifically sound manner," notes Barbara Vojvodikova, the service development partner at the Institute for Sustainable Development of Settlements, Czechia.

"Urban areas need to establish adaptation processes to become less sensitive to the negative impacts of climate change. This transformation needs to be cross-sectoral as climate change impacts many urban activities that are linked to each other. Climate-fit.City provides an integrated perspective, reaching out to different sectors such as health, active mobility, tourism management, urban planning, green infrastructure and emergency planning," concludes Lefebre.

PROJECT
Climate-fit.City - Pan-European Urban Climate Services

COORDINATED BY
Flemish Institute for Technological Research, Belgium

FUNDED UNDER
H2020-ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/730004

PROJECT WEBSITE
project.climate-fit.city/

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PROSNOW: Seasonal forecast tool enables ski resorts to better adapt to climate change

Rising temperatures can decrease snow cover, cause earlier spring melts or shorter snow cover seasons in winter resorts. A novel tool that forecasts the weather of a whole season can help ski resorts cope with climate change.

People often take snow on the ground for granted, but ski resorts cannot afford to do the same. Snow is critical to their operation and economic viability. However, global warming makes forecasting of when and how much snow falls hard to pin down. One way ski resorts can 'weather-proof' their operation is through snowmaking. This common solution allows ski

© Charline Bisiau

resorts to cope with fluctuations of natural snowfall and provide snow-covered ski slopes all year long but, still, it requires a lot of water and it doesn't overcome all the challenges.

Resorts would still face a difficulty: current forecasting tools are limited in their ability to predict snowfall on various timescales ranging from days to weeks to months.

This is where the EU-funded PROSNOW comes in. "PROSNOW's ambition was to build a seamless weather and climate planning tool that should help ski resorts manage the use of artificial snow," notes project coordinator Samuel Morin. The new tool can make winter resorts more resilient to climate change by accurately forecasting seasonal snowfall and temperatures combined with long-term climate projections; this information can help better planning for the future.

An emerging climate service for seasonal forecast on snow conditions

The PROSNOW® tool is an emerging European climate service that helps ski resorts to make better decisions. It can predict the snow conditions from the next few days (up to 5 days) to a whole season. All information is provided at a segmented ski slope level at a minimum of 1-hour resolution.

The integration of weather and seasonal forecasts serve as input to high-resolution models of snow cover. The snow models simulate snow melting, changes in snow structure, and the impact of grooming and snowmaking configurations. The operational tool combines these models with on-site data, remote sensing snow-cover data and statistical data from past observations.

PROSNOW® eases the decision-making process and provides more precise snow data to inform snow management strategies and tactics throughout the winter season. "We offer a seamless system for predicting snow cover, snow depth, and the combination of natural snowfall and technical snowmaking. Ski area operators can thus decide which operations they want to perform on the slope. With the service we offer, we also help operators to monitor and better manage water and energy use," explains Morin.

PROSNOW is in fact very useful for us. At the beginning we were afraid that the project would have been too far from our operational needs. But we are happy to see that the results of theoretical research can have very direct and practical applications to our everyday-life in ski-resorts.

Nicolas Briançon, snow manager at 'La Plagne' ski resort, France

Addressing key concerns and surpassing expectations

Building trust with ski area operators who typically express scepticism about various innovative weather forecast solutions was particularly rewarding. Some of their concerns come from the inherent uncertainty involved with any forecast in mountain regions more than about 5 days out.

"PROSNOW is in fact very useful for us. At the beginning we were afraid that the project would have been too far from our operational needs. But we are happy to see that the results of theoretical research can have very direct and practical applications to our everyday-life in ski-resorts," notes Nicolas Briançon, snow manager at 'La Plagne' ski resort, France.

Commercial exploitation of PROSNOW® will prove a tremendous boon for more than 600 ski resorts in the Alps over the 2020/2021 winter season. Scientists are working to further improve the planning tool so that it can find use in more ski resorts across Europe. A series of webinars is also currently taking place to present the tool.

PROJECT
PROSNOW - Provision of a prediction system allowing for management and optimization of snow in Alpine ski resorts

COORDINATED BY
Météo France, France

FUNDED UNDER
H2020-ENVIRONMENT

CORDIS FACTSHEET
cordis.europa.eu/project/id/730203

PROJECT WEBSITE
prosnow.org/

Blue-Action: New tools to combat the ripple effects of a warming Arctic

The poles are heating up faster than the rest of the planet, causing extreme weather events in the Northern Hemisphere. Improving our capacity to forecast these events will help us better prepare for the changes ahead.

In the shipping industry, one of key questions is how to avoid the storms, especially in the Arctic. The prototype of an interactive web map we co-developed in Blue-Action, allows us to assess the risks of polar lows and adapt shipping routes accordingly"

Øivin Aarnes, a principal specialist for Environmental Risk and Preparedness at DNV GL - Oil & Gas

Faced with a changing climate, businesses, policymakers and local communities need to access reliable weather and climate information to safeguard human health, well-being, economic growth and environmental sustainability. However, important changes in climate variability and extreme weather events are difficult to pinpoint and account for in existing modelling and forecasting tools. Moreover, many changes in the global climate are linked to the Arctic, which according to the Arctic Report Card is warming twice as fast as anywhere else on Earth. This is making weather and climate prediction particularly challenging.

Improving forecast accuracy at longer timescales

A large consortium of international partners has established the EU-funded Blue-Action project with the aim to help society better understand and prepare for the effects of a changing Arctic climate. The project evaluates the impact of Arctic warming on the Northern Hemisphere and develops new techniques to improve forecast accuracy on seasonal to decadal timescales. "We aim to improve the safety and well-being of people in the Arctic and across the Northern Hemisphere, reduce the risks associated with Arctic operations and resource exploitation, and support evidence-based decision-making by policymakers worldwide," notes project coordinator Steffen M. Olsen.

Blue-Action is working on a new and exciting research area that closes the gap between short-term weather forecasting and long-term climate change projections. "We are probably the only project that engages both with ocean observations and climate models, contributing to the co-design of effective climate services," adds Olsen.

Ocean observations, climate modelling and climate services

Ocean observations are crucial to making near- and long-term climate predictions and also forecasting the sea-level rise and changing climate patterns in a warming world. Blue-Action is involved in global programmes for ocean observations, including the Overturning in the Subpolar North Atlantic Programme that studies the link between water mass transformation at high latitudes and ocean circulation in the North Atlantic. "For the first time, we shed further light on the link between variable Atlantic ocean currents, the Atlantic meridional overturning circulation (AMOC), the ocean heat content and the sea surface temperature. We also demonstrated that the melting of the Greenland ice

© NASA_Kathryn Hansen

sheet plays a limited role in weakening ocean circulation in the AMOC, but can possibly affect climate variability on a decadal scale," explains Olsen.

The project also employed novel techniques to initialise climate models that forecast the conditions in the North Atlantic years ahead. "We can now provide useful information on climate conditions over Europe for the winter, sea ice conditions for the next few years and oceanic conditions for the next decade," adds Olsen. Using the new models, researchers revealed further clues of how ocean heat in the Barents Sea affects climate change in the Arctic.

Ultimately, project partners developed climate service tools that facilitate decision-making. These include a prototype app for optimising snowmaking in ski resorts, an early warning system for heat waves in cities, and a system that analyses extreme weather conditions in the Arctic for the shipping industry. "In the shipping industry, one of the key questions is how to avoid the storms, especially in the Arctic. The prototype of an interactive web map we co-developed in Blue-Action, allows us to assess the risks of polar lows and adapt shipping routes accordingly," concludes Øivin Aarnes, a principal specialist for Environmental Risk and Preparedness at DNV GL - Oil & Gas.

PROJECT
Blue Action - Arctic Impact on Weather and Climate

COORDINATED BY
Danish Meteorological Institute, Denmark

FUNDED UNDER
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CLARA: Linking better services to the right users

Climate services play an important role in tackling climate change by identifying the risks associated with adverse climate events and mitigating those risks. Researchers have developed ways to partner up climate service providers and users using market analysis.

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Climate change poses a significant economic, societal and environmental threat to Europe and the rest of the world. Climate services are essential for transforming economies and societies to reduce climate risks, build resilience and unlock innovation in Europe.

The EU-funded project CLARA set out to be part of Europe's efforts to use climate services to better manage natural resources, improve disaster risk management and build better resilience. The initiative employed state-of-the-art seasonal and decadal forecasts and climate projections building on COPERNICUS data (Copernicus Climate Change Service) to demonstrate the benefits and economic value of climate services.

"Our primary ambition is to smooth and accelerate deployment of climate forecast-enabled services," says CLARA project

coordinator Jaroslav Mysiak. "We have fostered market uptake by employing insightful market analysis and outreach activities capable of scaling up the diffusion and use of CLARA-enabled climate services."

Linking climate services to users

"The project workflow has been designed to engage and empower users to co-design and co-develop climate services," Mysiak explains. The project team tested the added value of 15 climate services in operational environments (from disaster risk reduction, water resource management, agriculture and food security, renewable energy and air quality) and used the knowledge gained to help the potential end users to improve the services.

We have managed to tailor the WRI (Water Requirements for Irrigation) service and make it applicable to a range of potential users, not just my organisation.

Fabio Paglione, end user from the Burana Land Reclamation and Irrigation Board, Modena, Italy

"With our work, we have contributed to advancing the European roadmap on climate services through designed and tested methodologies to explore and assess the value obtained from the climate services. We have also shown ways to address business model innovation and marketability of climate services," Mysiak adds. The results are shared in a card game.

According to Fabio Paglione, end-user from the Burana Land Reclamation and Irrigation Board, Modena, Italy: "The most exciting aspect of my participation in the CLARA activities has been the opportunity to share my experience and knowledge and work together with many specialists from different disciplines. We have managed to tailor the WRI (Water Requirements for Irrigation) service and make it applicable to a range of potential users, not just my organisation. This has been very rewarding."

Forging new partnerships and collaborations

CLARA has the unique feature of an established structure for co-producing and co-developing processes in a systematic way with the purveyors and users of climate services who interact to consider the technical feasibility and costs associated with them. CLARA organised a multi-user forum also involving representatives from the Copernicus User Forums in Spain, Italy and Sweden. "The multi-user forum has created a marketplace conducive for forging new partnerships and collaborations. For example, our services are being tested and deployed beyond the areas initially envisaged such as assessing the hydropower potential of South America," Mysiak says.

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CLARA – Climate forecast enabled knowledge services

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Climateurope: Festivals and 'webstivals': the changing face of climate services networking

Climate services have come a long way since simply making climate observations available on a website. In a changing climate, climate services together with weather services, environmental impact assessments, and risk management, are increasingly used by many sectors including energy, agriculture, health and tourism.

Building and coordinating a network of users, funders and providers of climate services is the key goal of the EU-funded Climateurope project. "Coming from 51 countries worldwide, this network is an important contribution to the implementation of the European roadmap for climate services," says Chris Hewitt, project coordinator of the Met Office in the United Kingdom.

Climateurope has also established small groups of experts to assess Earth system modelling and climate service development in Europe, identifying gaps, new challenges and emerging needs. As always, communication is key, and reports, policy briefs and a series of festivals have brought together climate service user and provider communities.

Festival approach for networking

Out of an active network of 380 members, consisting of users, providers and researchers of climate information, approximately one third are climate services users, and two thirds are providers. While most members work in Europe, there are quite a few members who are located further afield. As planned, the network includes the Copernicus Climate Change Service, the EIT Climate-KIC, the Joint Programming Initiative-Climate (JPI Climate), the ERA-NET for climate services, and Horizon 2020 Earth system modelling and climate services projects.

"We have held two very successful events in Seville and Belgrade, 'festivals', that were intentionally not organised as conferences," Hewitt points out. Over 100 attendees were at each event with representatives from many sectors – agriculture to the insurance industry. The festival approach brings together the network through a varied programme, including international and local speakers, round-table discussions, interactive networking events, and local food, wine and art, as well as music.

A gender balance – 45 % women and 55 % men – has been achieved in the network. Geographic balance has been more difficult, with fewer network members in eastern Europe compared with the rest of Europe. Climateurope's response has been

The network made up of European, national and international activities and organisations is an important contribution to implementation of the European roadmap for climate services.

Prof. Chris Hewitt, Met Office, United Kingdom

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to proactively build the network in eastern Europe, for example by holding a festival in Serbia.

A series of reports documents the evolving state-of-the-art in Earth system modelling and climate services. Included are future challenges and emerging needs and policy recommendations.

COVID-19 changes the way of networking

The final festival was to be held in Riga, Latvia in June 2020 but COVID-19 intervened. "Instead, we are now holding a series of online webstivals, where the biggest challenge is making sure they are as interactive and engaging as the physical festivals were," Hewitt points out.

Opportunities and advantages afforded by online tools include facilitating networking and sharing experience and knowledge, but without the cost of travel and accommodation for attending face-to-face meetings. The associated reduction in carbon usage is also an issue highly relevant to the world of climate services and Earth system modelling.

Climate change brings challenges to tackle in the future

Climateurope has identified several challenges for the community it is working with. For climate modelling, key issues include ensuring support for the IPCC process, informing climate

mitigation policies, enhancing adaptation and resilience to climate change, especially extreme events, and supporting the science-based formulation of adaptation strategies.

For climate services, key challenges include understanding requirements and decision-making contexts, driving innovation and enhanced diffusion of information, assessing the value of climate services, and establishing standards for climate services.

The climate modelling and services communities would best meet these challenges if they worked together and would benefit from shared development.

"For the future, we are currently working on what the legacy of the Climateurope project will, or could look like, which will be documented in a report," concludes Hewitt. There is a commitment for the Climateurope website to stay online for at least another 5 years, which will preserve the outputs created and help maintaining the network.

PROJECT
Climateurope - European Climate Observations, Modelling and Services - 2

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Met Office, United Kingdom

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More climate services under development

MED-GOLD

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The MED-GOLD project demonstrated proof of concept for climate services in the agriculture sector through case studies for olive, grape and durum wheat crop systems, the basis for olive oil, wine and pasta production, respectively. This set of crops and related food products is of utmost climatic, ecological, economic and cultural relevance to the Mediterranean region. Reviewing operational decision-making of users involved in the project and identifying key decision steps in their management practices, project researchers designed prototype pilot service applications demonstrating the added value of data- and information-driven responses to climate changes. The MED-GOLD services share a common interface platform and offer support for better management of risks associated with the spread of pests, yield and quality losses, and other climate change-related threats. Moreover, once fully operational, services will allow users to benefit from climate-related information at different timescales from months to decades.

SECLI-FIRM

SECLI-FIRM will facilitate the use of improved climate forecasts to add practical and economic value to decision-making processes and outcomes. Both the energy and water sectors are becoming increasingly concerned about the way major climatic events affect their business. Project partners therefore offer accurate information to support the implementation of relevant decisions - to help reduce risk as well as cost. Energy organisations will benefit from seasonal climate forecasts with improvements in management decisions, ultimately leading to a better supply-demand balance in the energy sector, and thus to a more efficient energy system. This will be particularly useful in the renewable energy sector and impart corresponding benefits for climate change mitigation. Nine use cases are under development together with energy utilities, renewable energy source generators, grid operators and water utilities. They cover decision-making in energy generation, energy logistics and maintenance, energy mix planning and balancing, and water management.

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Market research on climate services

EU-MACS

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EU-MACS assessed barriers to the uptake of climate services across a wide variety of sectors in Member States, businesses and not-for-profit organisations. Focusing mainly on finance, tourism and urban planning, project partners examined the structures and interactions of the different obstacles to the uptake of climate services, aiming to improve the design of policy scenarios and selection of appropriate policy instruments. They discovered that public and not-for-profit climate service providers need to better plan and evaluate their positions in the climate service value chain and adopt improved business models with a focus on collaborative needs-based climate services. In addition, an open-data policy at EU and Member State levels is a key element for a flourishing climate services market. Application of the project's proposed policy packages in EU Member States, supported by EU-level initiatives on standardisation and market deployment monitoring, should accelerate the uptake and beneficial use of climate services across many sectors. "We loosely estimate that if the additional uptake of climate services takes place across the entire EU, this would represent easily a net societal benefit of several billion euro, as well as non-monetised benefits for societal resilience," says project coordinator Adriaan Perrels of the Finnish Meteorological Institute.

MARCO

The MARCO project gathered market research firms, climate scientists, and climate services practitioners and innovators to provide detailed insights into the very large market for climate services in Europe. The consortium conducted nine case studies, forecasting future user needs and assessing market growth until 2030 to reveal opportunities and promote market growth. Each of the studies focused on a particular sector in a given geographic area: real estate in Copenhagen, mining at EU level, legal services in London, renewable energy in Denmark, water supply and sanitation in Catalonia, critical energy infrastructures in Germany and Poland, forestry and agriculture in France, urban infrastructure in Munich, and tourism in Austria. MARCO research found that while some sectors already benefit from a substantial offer of climate services today, others are very likely to emerge more strongly in the next few years

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(e.g. health, forestry, tourism and energy infrastructure). The team discovered that better links between public and private providers are important for developing more advanced climate services, while climate services on seasonal to decadal timescales might provide further market opportunities. Finally, the project partners recommended strengthening and harmonising climate resilience legal frameworks, as well as tracking climate finance schemes and investments in both public and private domains.

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RESULTS PACK ON ENVIRONMENTAL OBSERVATIONS

This CORDIS Results Pack introduces you to nine EU-funded projects that have been contributing to the efforts to upscale Europe's EO capacities and to develop solutions meeting specific users' needs. They are also actively helping to fully realise the EuroGEO initiative.

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