Advanced forecasting to help millions on coasts and in cities cope with climate-change impacts

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Amsterdam is one of the European cities that is the most vulnerable to sea level rises. Credit: Adrien Olichon via Unsplash

Climate adaptation requires communities to plan ahead for the

unavoidable changes coming our way not just immediately but decades from now.

In the freezing reaches of Greenland, fissures in the ice sheet mark the battle lines in the fight against climate change. Greenhouse gases (GHG) are driving up global temperatures, melting the ice and pushing more and more icebergs to break away from glaciers and ice sheets. When the ice melts and the water enters the ocean, it adds to rising sea levels, putting millions of people who live in low lying coastal areas across the globe at risk.

The Greenland ice sheet stores the equivalent of seven meters of sea-level rise, while the Antarctic ice sheet contains about 60 meters, and their rate of melting depends on a variety of factors, including how quickly humans reduce GHG.

"It is more or less certain that we will not escape from a two-meter sea-level rise," said Gaël Durand, an ice-sheet specialist at the Université Grenoble-Alpes in France. "The question is now 'When will it happen? Will it be in 100 years or in 2000 (years)?'"

This question, of how much and when, is not a simple one — but the answer is vital for humanity to adapt to climate change. Unlike mitigation, which means reducing GHG emissions, climate adaptation aims at building resilience to the inevitable effects of a changing climate. But in order to adapt, decision makers need reliable information on what will happen to the climate in different regions.

This is where climate predictions and projections from scientific research play a crucial role: predictions attempt to provide estimates in the short-term—for example, the average annual or seasonal temperature in five years; whereas projections extrapolate what could happen in the long-term, under different possible futures, determined by more or less

ambitious mitigation responses.

In the PROTECT project, Durand and colleagues are working on projections, to more accurately determine what will happen to the ice sheets in a world of rising temperatures and how this will impact communities living in coastal areas.

Coastal users

"We want to provide projections, but we want to be sure that these projections fit the needs of users, particularly coastal users," said Durand.

More than 200 million Europeans live within 50 km of the coastline, but rising sea levels will affect them all differently. "Typically the needs are very different, depending on the use you have of coastal land," explained Durand.

Using satellite and remote sensing data, as well as ice sheet data, the PROTECT project models how the ice sheet behavior in Greenland and the Antarctic, as well as glaciers, will impact people on a regional and even local scale, with case studies in France, the Netherlands, Greenland, and the Maldives (in the Indian Ocean). "We work with stakeholders and practitioners to better understand what type of projections they need," Durand says.

Co-design with users is a feature of another project, the European Climate Prediction System (EUCP), this one focusing on predictions. In the past, "it was often the climate scientist speaking and the user listening," said Jason Lowe, science lead for the project and the U.K. Met Office's principal fellow and head of climate services for government. "But we realized that the successful projects were when the user speaks more and the climate scientist listens and adapts to that."

Innovation in knowledge production

For example, users were asking, "What does (climate change) mean for adaptation of cities? What does it mean for water availability? What does it mean for coastal protection?" Lowe said. "You need different types of information to inform the solution."

The EUCP brought together users and organizations interested in climate predictions, as well as superusers which had specific problems to solve, to see how climate science could bolster their adaptation strategies.

With their needs in mind, the project developed new methods to create more accurate decade-timescale forecasts. EUCP contributed to the World Meteorological Organization's decadal forecasts exchange and produced new data that informed the sixth assessment of the Intergovernmental Panel on Climate Change (IPCC).

Flash flooding

"So if they're looking at flash flooding, if they're designing drainage systems, for instance, this data is available as a result of EUCP."

While the project mostly focused on temperature and rainfall, it was also able to forecast storm tracks through the Caribbean and investigate wind droughts, which is when the wind speed is low, in France.

However, beyond the successful predictions, it's the new methods that may become the project's most important legacy, said Lowe.

One new method was the ability to combine different global climate models, giving more accurate models greater weight than those which were less precise in a given scenario. "We produced the first comparison

of different methods to weight the projections," Lowe said.

The EUCP Atlas of climate projections provides pre-processed projections for Europe, and facilitates a comparison between them.

Bridging predictions and projections

The project team also developed a way to link predictions to longer-term projections. This method, allowing people to link decadal forecasts to longer-term climate projections, will also be one of the enduring legacies of the project, according to Lowe.

With more work to be done in decadal climate forecasting and projections, the EUCP will be succeeded by the ASPECT project (which stands for Adaptation-oriented Seamless Predictions of European ClimaTe), due to start next year. This continued effort is expected to improve our ability to forecast far into the future.

"We also think we can take the idea of joining predictions to projections, and move it from something that's academically interesting to something that can be used in climate services," he said. Climate services provide climate information which allows people and organizations to organize their activities and adapt to climate change.

Even if humanity cuts its emissions drastically, the climate is already changing and people around the world need to adapt. To do this, they need the vital and impartial information that projects such as PROTECT and EUCP provide.

More information: PROTECT: cordis.europa.eu/project/id/869304

EUCP: cordis.europa.eu/project/id/776613

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