Applications for a newly developed risk and resilience tool

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By the mid-century, many parts of the United States will experience longer summers with more extreme heat events. While swelteringly hot days are uncomfortable, they can become dangerous for some households, particularly those without air conditioning. Intense heat, stronger storms, extended droughts—climate change poses a formidable list of hazards for communities across the country in the coming decades.

The need to plan for these risks is clear: More resilient systems prevent deaths, improve health outcomes, and minimize losses from damaged infrastructure. However, bridging the gap between global climate trends and targeted resilience measures is not necessarily straightforward.

Data that drives the decision-making process

A new, publicly available tool, the Climate Risk and Resilience Portal (ClimRR), provides a window into how future climate realities could affect U.S. cities and towns. Planners and decision-makers can get map-based analyses driven by peer-reviewed climate data using the free portal. The U.S. Department of Energy's (DOE) Argonne National Laboratory developed this tool with funding from telecommunications company AT&T and the U.S. Federal Emergency Management Agency (FEMA).

ClimRR transforms complex, large climate datasets into local reports that non-technical audiences can understand and apply for numerous purposes. In global computer climate models, a single point represents 100 square kilometers (62 square miles) or more. At that coarse resolution, it is very hard to look at extremes in precipitation or winds, for example, that occur on smaller scales. Infrastructure decisions also require information about evolving climate trends at spatial scales, typically tens of kilometers.

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The tool also can zoom in to plots as small as 12 square kilometers (7.5

square miles), and the Argonne team plans to provide even finer spatial resolutions within the next couple of years. Currently, users can analyze climate variables, including average temperatures, precipitation, wind speed, and degree days—a measure of heating and cooling needs. Next year, the portal will incorporate inland and coastal flooding, drought, and wildfire projections.

The need for a new tool emerged from 2017's brutal hurricane season. Hurricanes Harvey, Irma, and Maria, among other climate-driven events, made it the costliest year to date for U.S. disasters. With valuable infrastructure and connectivity for millions of people at stake, AT&T recognized that fortifying its own network would not matter if, for example, the electric grid powering its communication towers went down. "Resiliency can't be built in a vacuum," said Charlene Lake, chief sustainability officer and SVP-Corporate Social Responsibility at AT&T, when ClimRR was announced in November 2022. "Our world is interdependent. We want other organizations and communities to see where they're potentially vulnerable to climate change and take steps to become resilient." AT&T commissioned Argonne's Center for Climate Resilience and Decision Science to aid its adaptation efforts, and the project began.

An integrated tool that opens new possibilities

Though public climate datasets exist, few organizations have the expertise and computing power to use them at regional or local scales. Argonne scientists used a method called dynamical downscaling to integrate regional forecasting with global climate models. An alternate approach, statistical downscaling, bases future predictions on historical climate and weather data. Dynamical downscaling bolsters this process with the same one used to generate weather forecasts, allowing for stronger estimates and a broader range of climate variables.

Argonne's Center for Climate Resilience and Decision Science is modeling the atmospheric physics. More people do not do this because the computational load is immense, but Argonne has some of the most powerful computers in the world. Using the Argonne Leadership Computing Facility, a DOE Office of Science user facility, researchers first validated the ClimRR model by backcasting, or having it predict conditions in the past and comparing those predictions with the historical record. This allowed the team to see where the model predictions were closer to real-world observations and where they did not match so that the team could develop confidence in the model calculations. They then used the model to project average conditions from 2045 to 2054 under different greenhouse gas emissions scenarios.

Climate projections in ClimRR can be overlayed with community and infrastructure information from FEMA's Resilience Analysis and Planning Tool (RAPT). The combination illuminates local-scale climate risks in the context of existing communities, such as the location of vulnerable populations and critical infrastructure.

In Philadelphia, Pennsylvania, for example, ClimRR predicts average annual temperatures will be about 3.5 to 4 degrees Fahrenheit higher, depending on emissions trends. As outlined in a sample use case, users can overlay socioeconomic information on the heat map. Planners can see where there are high numbers of people who might be disproportionately affected by extreme heat, such as those over age 65. The data can also be exported to other geospatial analysis systems and combined with other data layers, such as whether homes have air conditioning or where more of the population might have trouble getting to cooling centers based on car ownership and walking distance.

This new tool offers many other analysis opportunities nationwide. For example, tribal and Alaska native communities could use ClimRR to examine how temperature changes pose risks to natural resources. The introduction of wildfire and flood data in 2023 will open new possibilities for emergency response agencies to allot resources and prepare for worst-case scenarios.

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