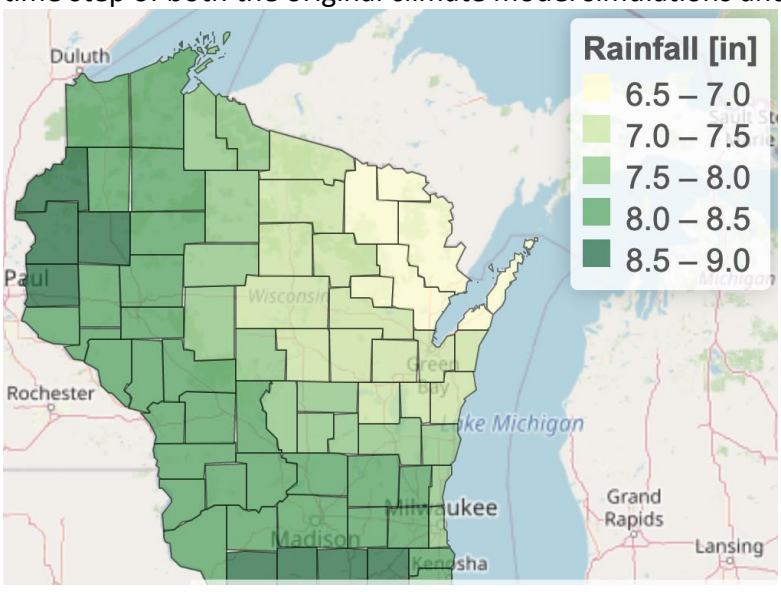
FACT SHEET—Past and Future Extreme Rainfall Information using Downscaling

While useful, global climate models lack the local detail needed for infrastructure design, planning, and related applications. Downscaling is a term that describes methods to convert these coarse resolution climate model output to finer scales. As part of the Wisconsin Rainfall Project, the UW-Madison/WICCI research team has created local-scale rainfall statistics for past, present, and future conditions using a method known as University of Wisconsin Probabilistic Downscaling (UWPD). In a recent project funded by the National Weather Service and carried out by researchers at UW-Madison and the University of Illinois, UWPD was shown to have advantages over other downscaling methods in its ability to predict extreme rainfall conditions.

To capture local-scale rainfall patterns in UWPD, coarse resolution climate model simulations are merged with historical local and regional rain gauge measurements to create statistical equations of the likelihood and amount of precipitation each and every day for both past and future climate conditions. This expression varies in time and by location as the atmosphere changes. For example, when a climate model predicts a warm, humid day with high atmospheric instability, UWPD would predict not only a high probability of rain but also a possibility of very heavy rain. This prediction is based on prior comparison of model-simulated atmospheric conditions to historical rainfall observations. From this set of day-to-day predictions, it is possible to predict the largest rainfall value at all locations for each year. From the largest values from each year, one can calculate statistics such as 10-year and 100-year storms across a region. Unlike some rainfall statistics, however, UWPD results are limited to the 24-hour duration, since that is the time step of both the original climate model simulations and rain gauge measurements.



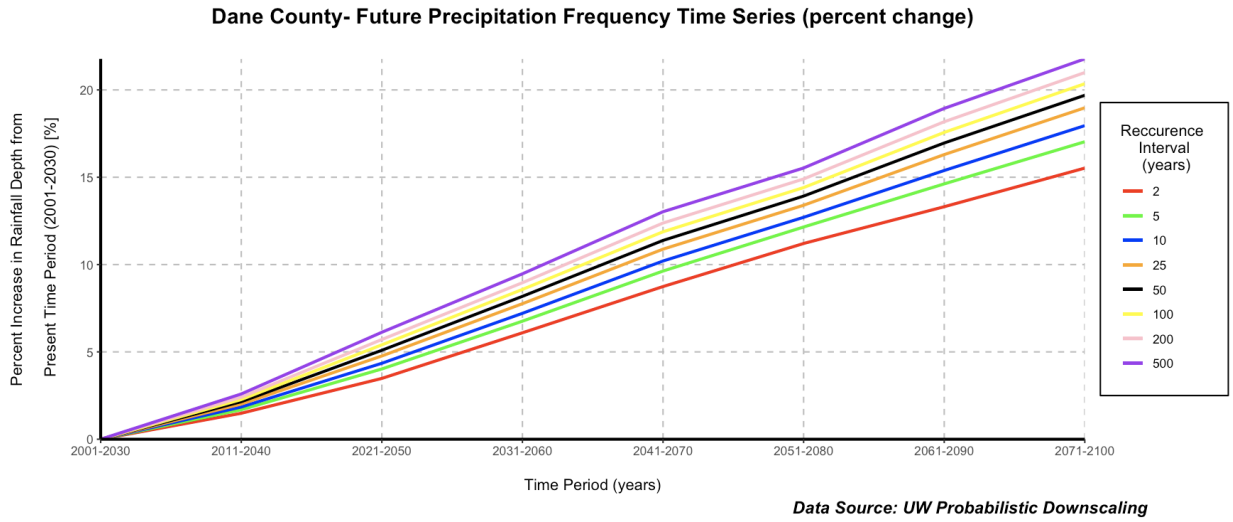
Left: 100-year 24-hour rainfall map for the end of the 21st century, based on the average downscaled projections from 22 global climate models. This map shows the results for the RCP8.5 "business as usual" high emissions scenario (for more explanation of this and other emissions scenarios, see here).

Summary of Data

- County-level rainfall Intensity–Duration–Frequency (IDF) statistics and uncertainties for 24-hour duration, every ten years from 2001-2100 for Wisconsin
- For 2010 onwards: Two greenhouse gas emission scenarios (RCP4.5—low/intermediate emissions scenario; RCP8.5—high emissions "business as usual" scenario)
- Recurrence Intervals: 2, 5, 10, 25, 50, 100, 200 and 500 years
- 22 Climate models from the Coupled Model Intercomparison Project Phase 5 (CMIP5) are each downscaled individually to provide both the average across all models and uncertainty estimates, in the form of 90% confidence intervals.

Example Results and Key Findings

Below: Percent increase in precipitation for the RCP8.5 "business as usual" high emissions scenario, relatively to a present day (2001-2030) baseline. The projected percentage generally rainfall amounts increase throughout the 21st century, and the largest percentage increases are found for the rarest events such as the 100- and 500-year storm.



Further Information

- Daniel Wright, David Lorenz, and Zhe Li, *Final Project Report—The Wisconsin Rainfall Project: Current and Future Rainfall Information for Infrastructure and Planning*, technical report to Wisconsin Dept. of Natural Resources, March 31, 2021 (download here)
- Shu Wu, Momcilo Markus, David Lorenz, R. James Angel, and Kevin Grady. *A Comparative Analysis of the Historical Accuracy of the Point Precipitation Frequency Estimates of Four Data Sets and Their Projections for the Northeastern United States*. Peer-reviewed scientific paper published in Water in 2019 (download here)
- Web-based data visualization and download portal (access here)
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