

Updating Rainfall Statistics for Infrastructure Planning and Design in a Changing Climate

Daniel Wright, PhD, M. ASCE
Assistant Professor



Department of Civil and
Environmental Engineering
UNIVERSITY OF WISCONSIN-MADISON

WISCONSIN
INITIATIVE ON
CLIMATE
CHANGE
IMPACTS

A red silhouette map of the state of Wisconsin, positioned to the right of the text in the top right corner.

HYDROCLIMATE EXTREMES RESEARCH GROUP @ UW-MADISON

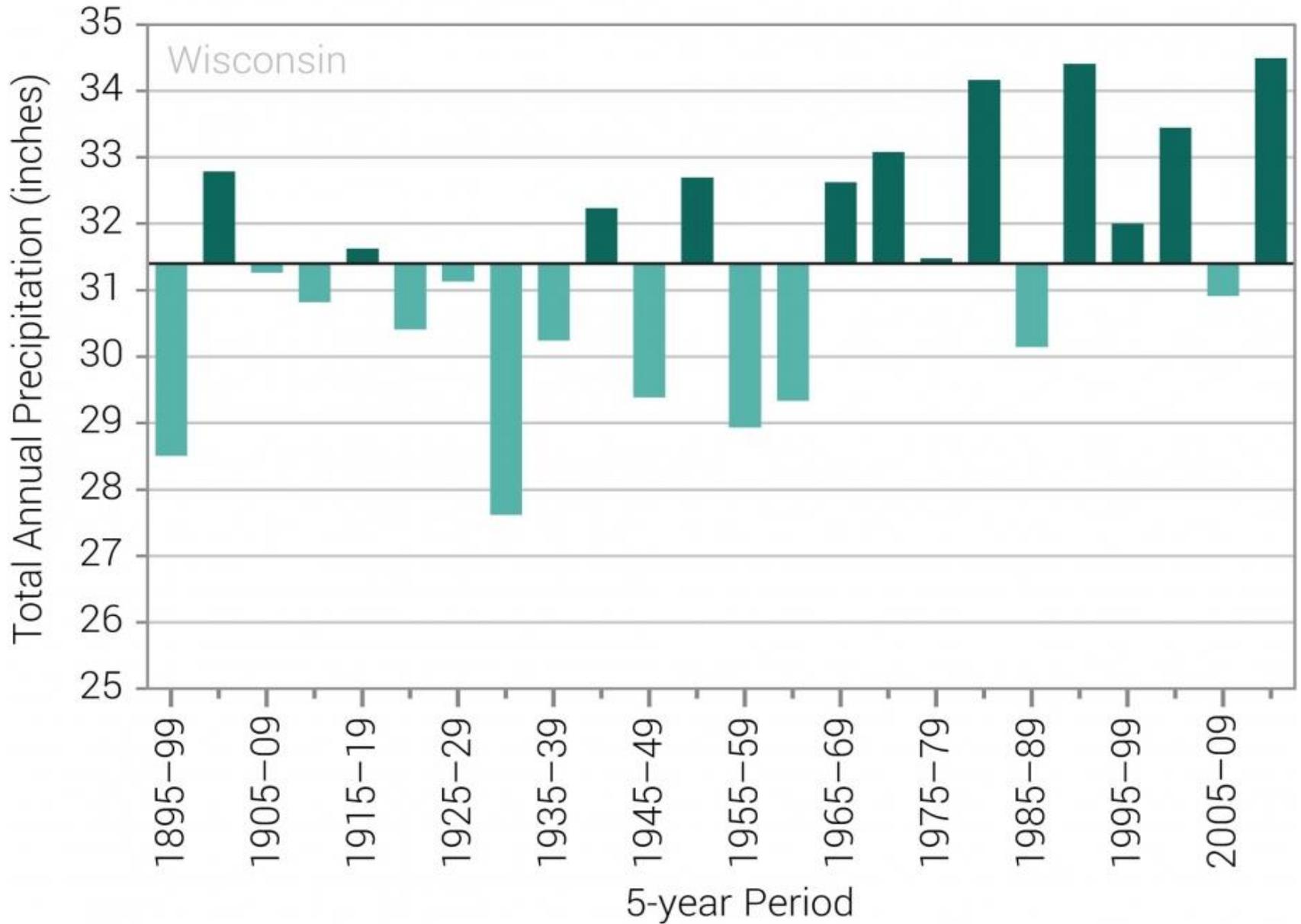


What do we do?

- Use statistics and high-performance computing to understand and predict rainfall, floods, and landslides
- Develop software to advance our research and to support others



Observed Annual Precipitation



Local / Regional Issues

Chicago Tribune
Post-Tribune

POST-TRIBUNE SUBURBS

Save the Dunes to hold talk on Lake Michigan shoreline erosion

By MEREDITH COLIAS-PETE
POST-TRIBUNE | SEP 16, 2019 | 11:06 AM

MENU The Eagle News Sports Opinion Obituaries Galleries Events Classifieds Contact us 73°

BREAKING Flash flood watch for Saturday evening to early Monday for south-central Wisconsin

TOP STORY

Department of Natural Resources urges caution on Blue-Green Algae in Wisconsin

JAKE EKDAHL jekdahl@wiscnews.com Aug 29, 2019

FOX BUSINESS

NEWS MARKETS PERSONAL FINANCE SMALL BUSINESS TECHNOLOGY

Corn farmers in Midwest lament flooding's effect on their crops

By Jason Racki | Published July 06, 2019 | Features | FOXBusiness

CNN health Food Fitness Wellness Parenting Vital Signs LIVE TV Edition

Two more Eastern equine encephalitis deaths reported in Michigan

By Jamie Gumbrecht, CNN
Updated 7:33 PM ET, Tue September 17, 2019

<https://www.wiscontext.org/search/content/climate>

BRACE YOURSELF

**INFRASTRUCTURE ISSUES
ARE COMING!!!!**

makeameme.org

**2018:
Monroe
County**

Source: Monroe County Herald

**2019:
Beloit**

Source: Beloit Daily News

2019: Green Bay

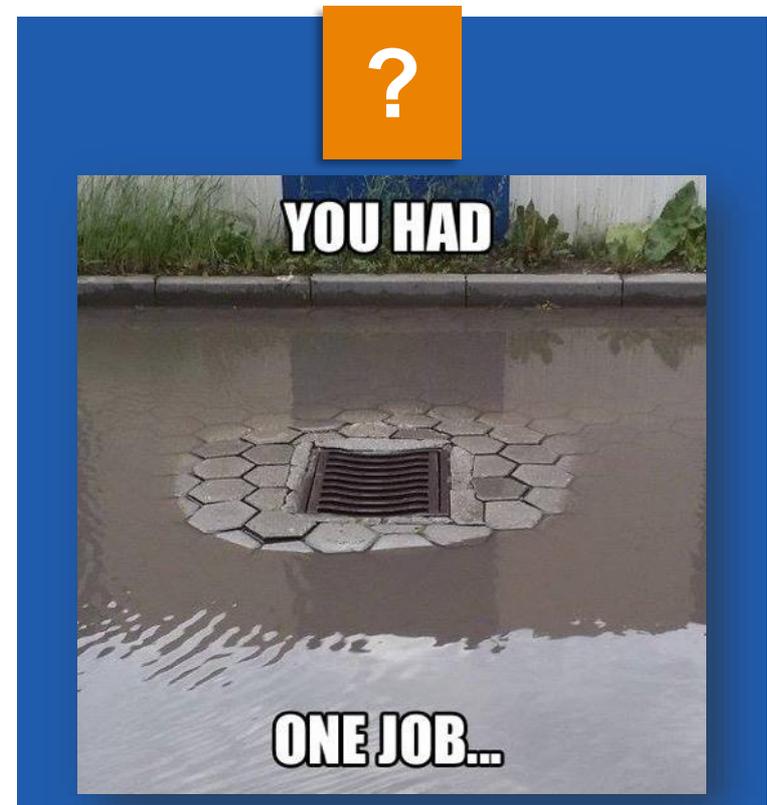
Source: USA TODAY-Wisconsin

**2016: Hwy E
Bayfield / Ashland**

Source: WisContext

**2019:
Madison**

Source: Barry Adams, WI State Journal



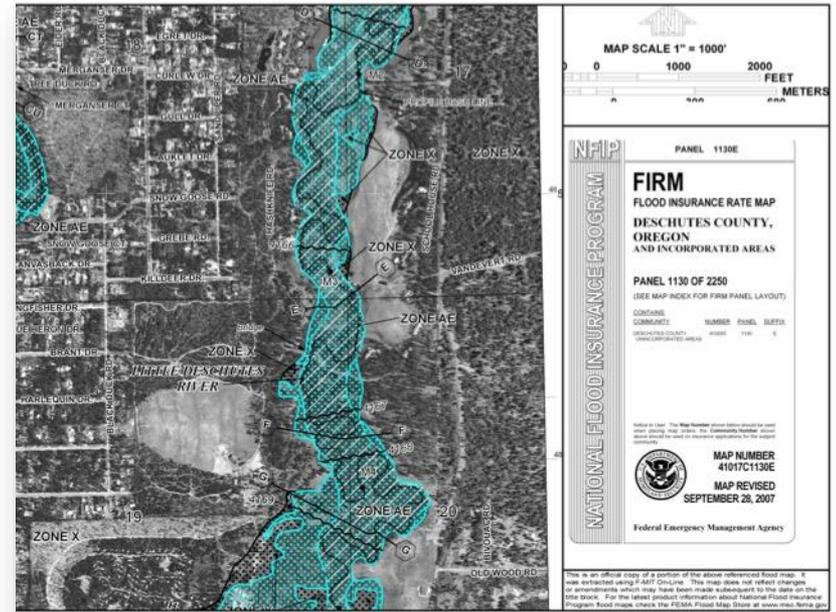
Source: <https://www.infrastructurereportcard.org/>



C'S GET DEGREES

Stormwater Infrastructure

1. A component of all other infrastructure
2. WEF: \$7.5 billion annual funding gap
3. Coming to the 2021 ASCE report card
4. Heavily reliant on rainfall statistics such as the "100-year storm"



Why Care?

X-year storms are critical:

- Infrastructure design, site development, related regulations
- Floodplain mapping/flood insurance

High costs if X-year storm is wrong:

- Infrastructure has very long lifespans and high price tags
- So does your mortgage!



100-year Storm

has 1% chance of happening
each year at a specific location

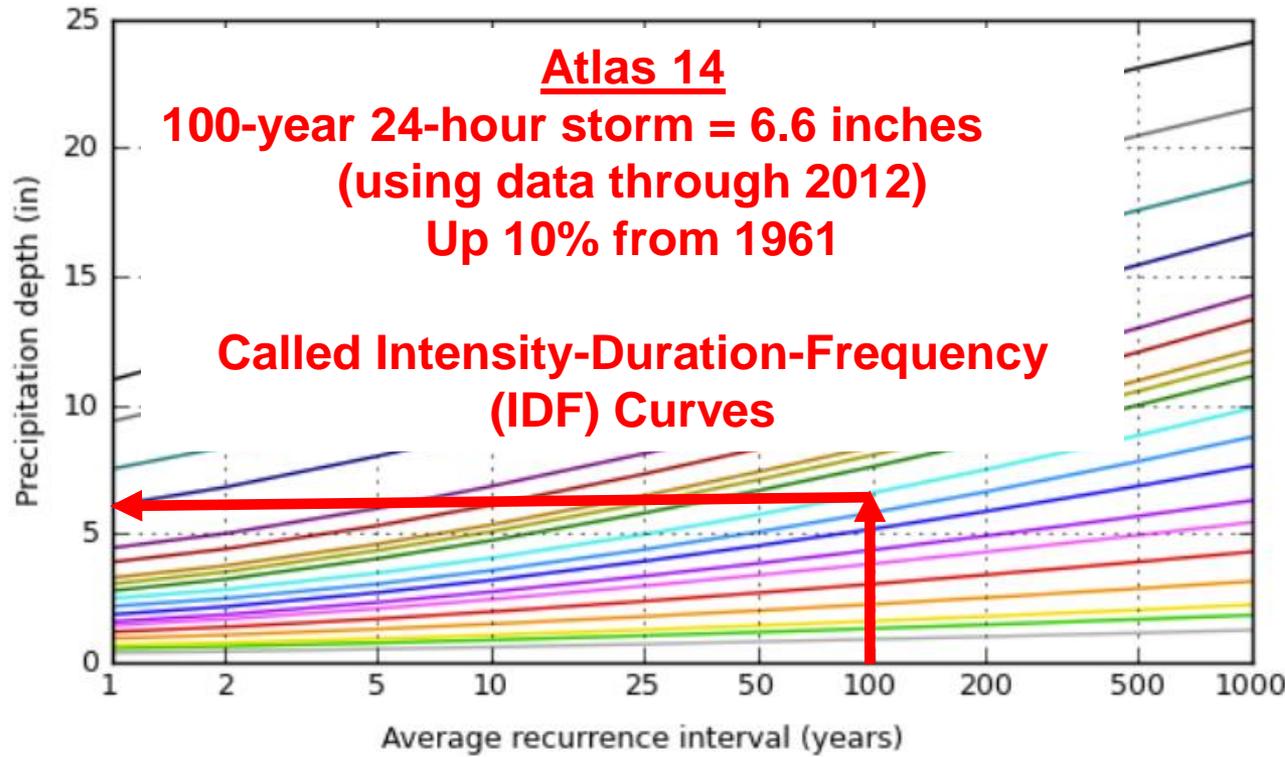
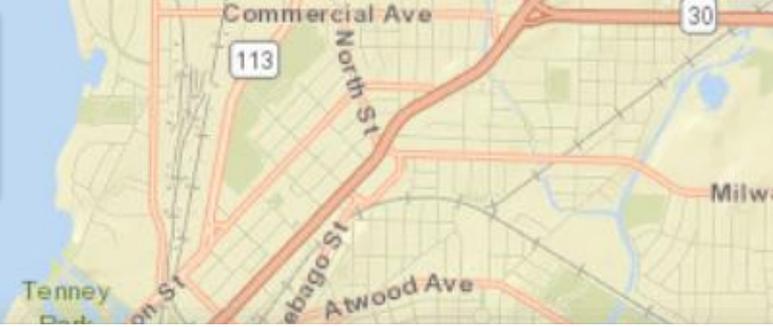
100-YEAR 24-HOUR RAINFALL (INCHES)



Technical Paper 40
100-year 24-hour storm = 6 inches
(published in 1961)

GULF OF MEXICO

ALONSO SOLAR AREA PRODUCTION
STANDARD PARALLEL 37° AND 47°

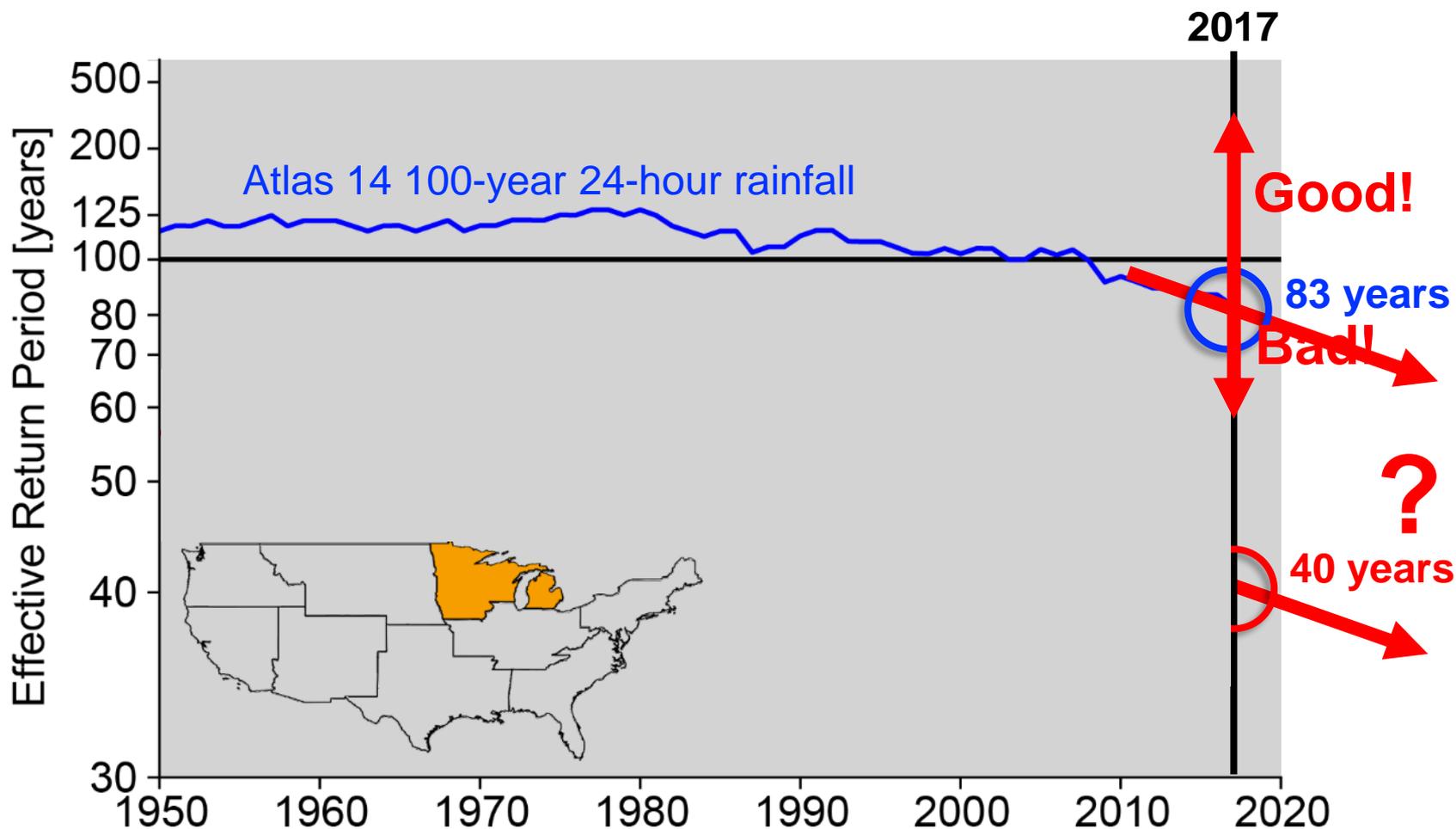


Duration	
5-min	2-day
10-min	3-day
15-min	4-day
30-min	7-day
60-min	10-day
2-hr	20-day
3-hr	30-day
6-hr	45-day
12-hr	60-day
24-hr	



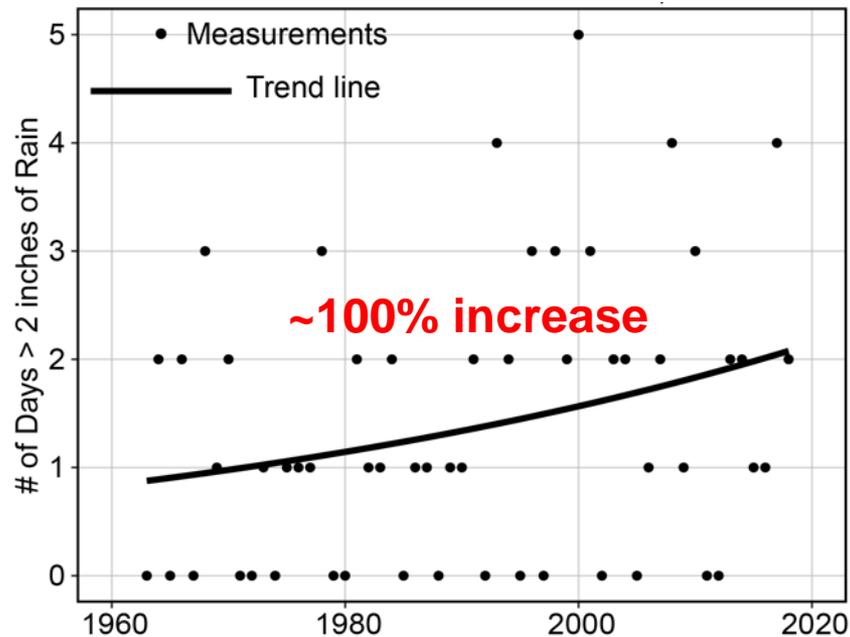
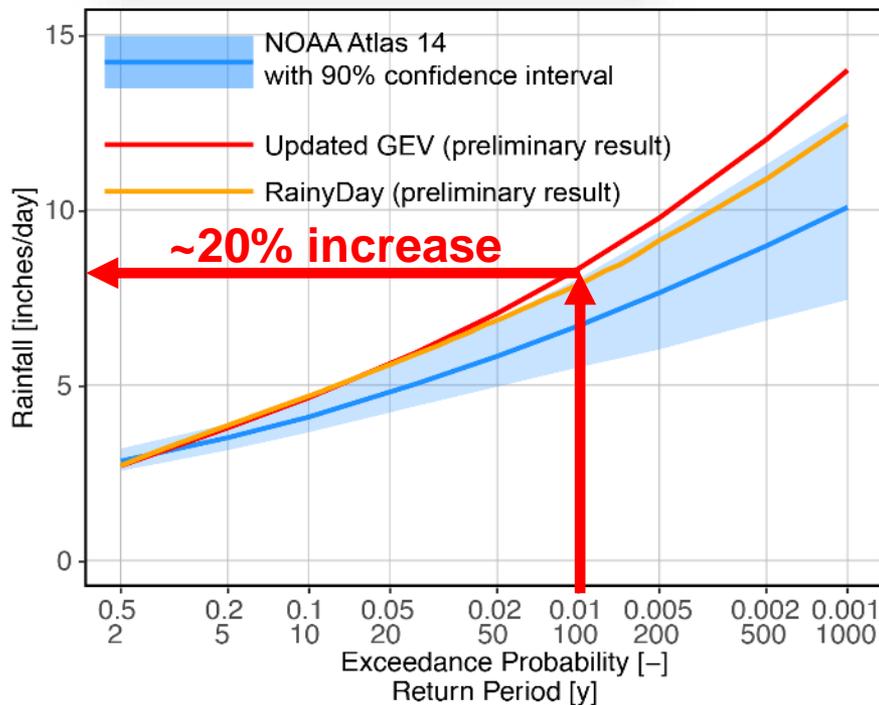
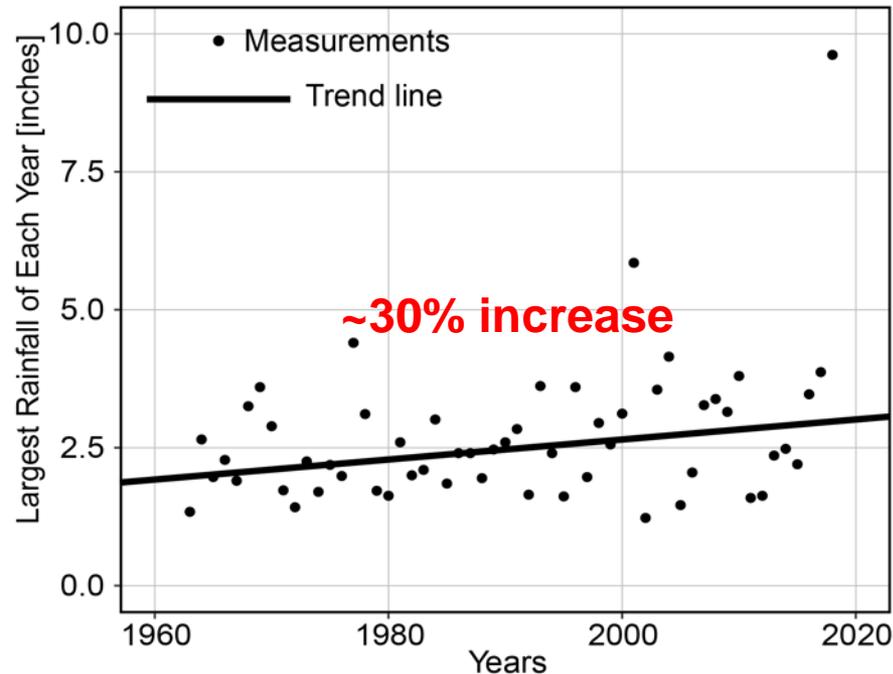
How are existing rainfall statistics holding up?

Wright, D.B., C.D. Bosma, T. Lopez-Cantu, U.S. hydrologic design standards insufficient due to large increases in frequency of rainfall extremes, *Geophysical Research Letters* (2019).

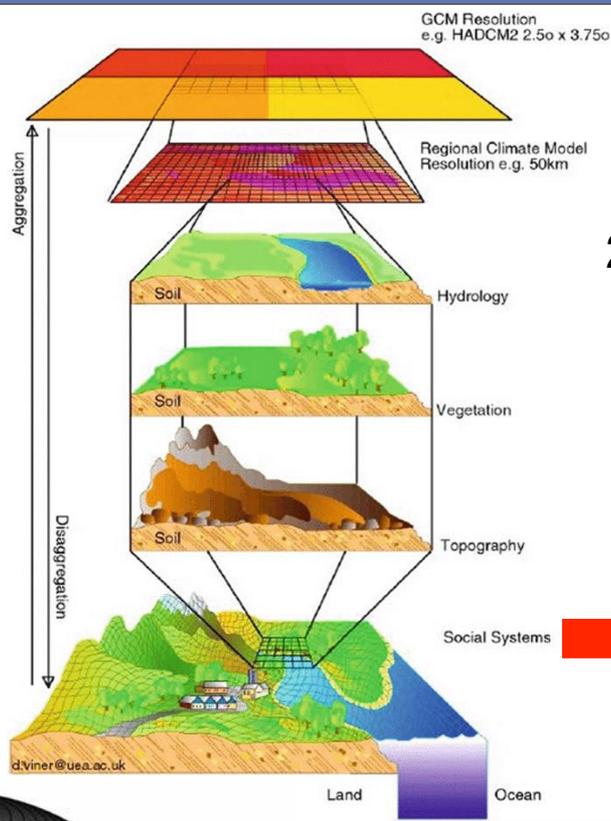


**WHAT CAN
BE DONE?**

Option 1: Update using recent data



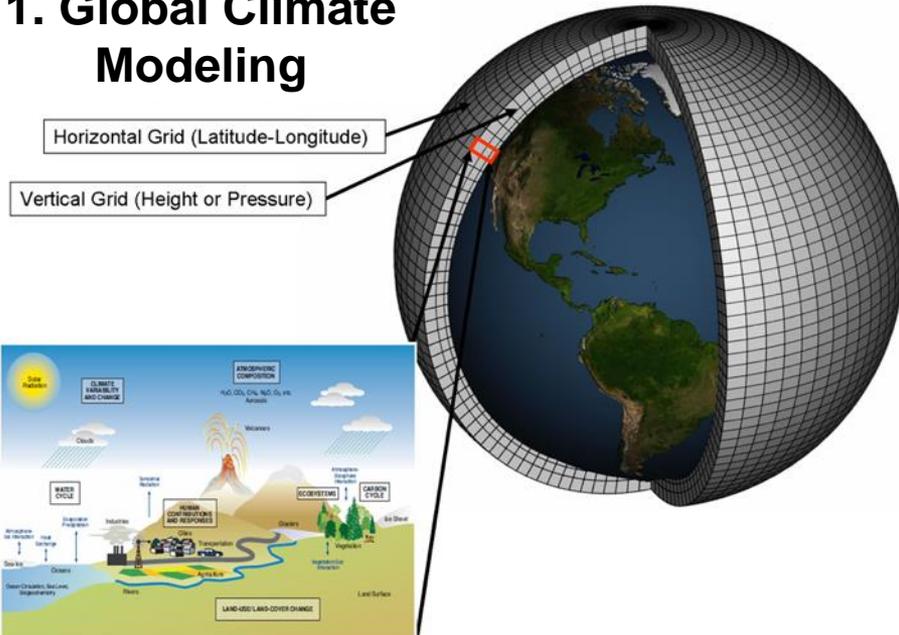
Option 2: Predict future statistics



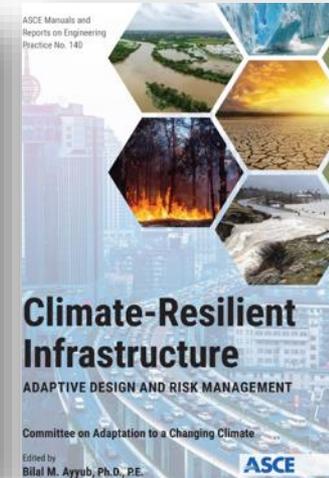
2. "Downscaling" Rainfall



1. Global Climate Modeling



3. Applications



WHAT'S OUR PLAN?



Part 1: WICCI Infrastructure Working Group

The Wisconsin Rainfall Project:

Part 2: Updating rainfall statistics using recent storms

Part 3: Future rainfall statistics using “downscaling”

Part 1: The WICCI Infrastructure Working Group

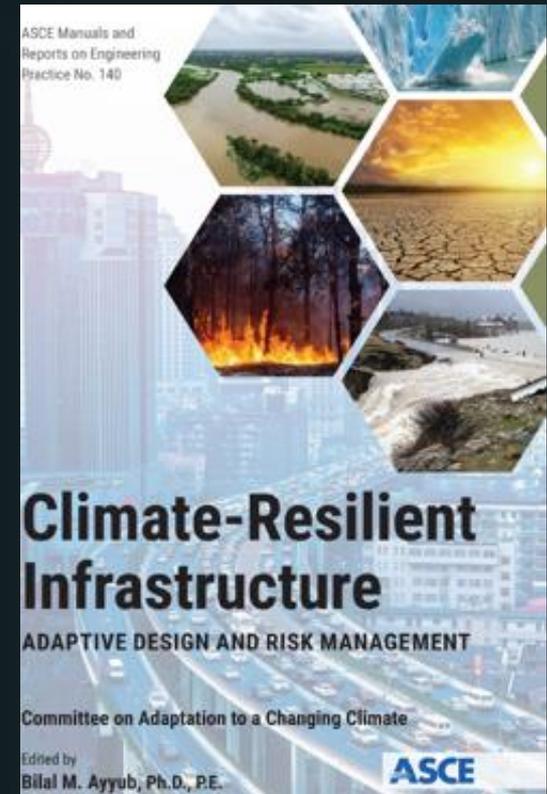
- **Chair: Robert Montgomery**
Principal Engineer, Emmons & Olivier Resources
Prof. of Practice, Civil and Environmental Engineering
University of Wisconsin-Madison
rmontgomery@eorinc.com
- **Co-Chair: Maria Hart**
Principal, Nomad Planners
maria.hart@nomadplanners.com
- **Co-Chair: Daniel Wright**
Assistant Prof., Civil and Environmental Engineering
University of Wisconsin-Madison
danielb.wright@wisc.edu



Part 1: The WICCI Infrastructure Working Group

Working Group Draft Charter

- “... climate changes will affect the performance of almost all types of civil and environmental engineering facilities, such as urban drainage, bridges, reservoir and flood management, and transportation.”
- “[the WG] will synthesize available information, supplemented by additional analysis (as resources allow), to develop and communicate approaches for designers and managers to use in evaluating the resilience of their engineering infrastructure.”



Part 1: The WICCI Infrastructure Working Group



AMERICAN SOCIETY OF CIVIL ENGINEERS
AMERICAN PUBLIC WORKS ASSOCIATION

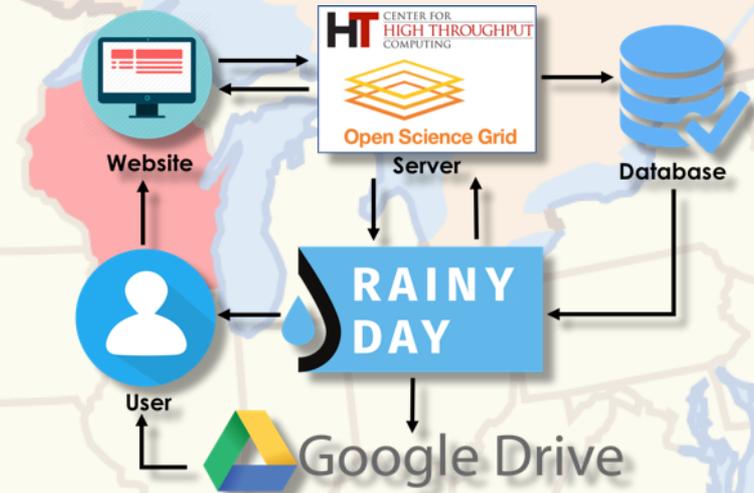
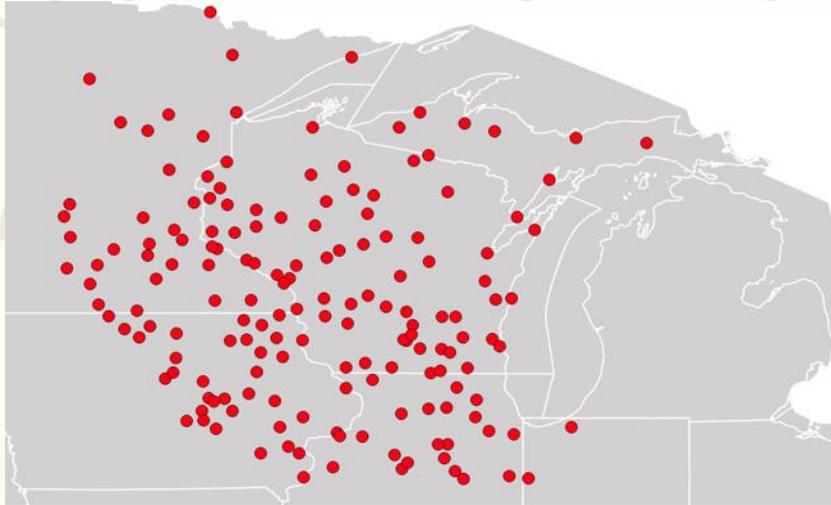


Madison Metropolitan Sewerage District

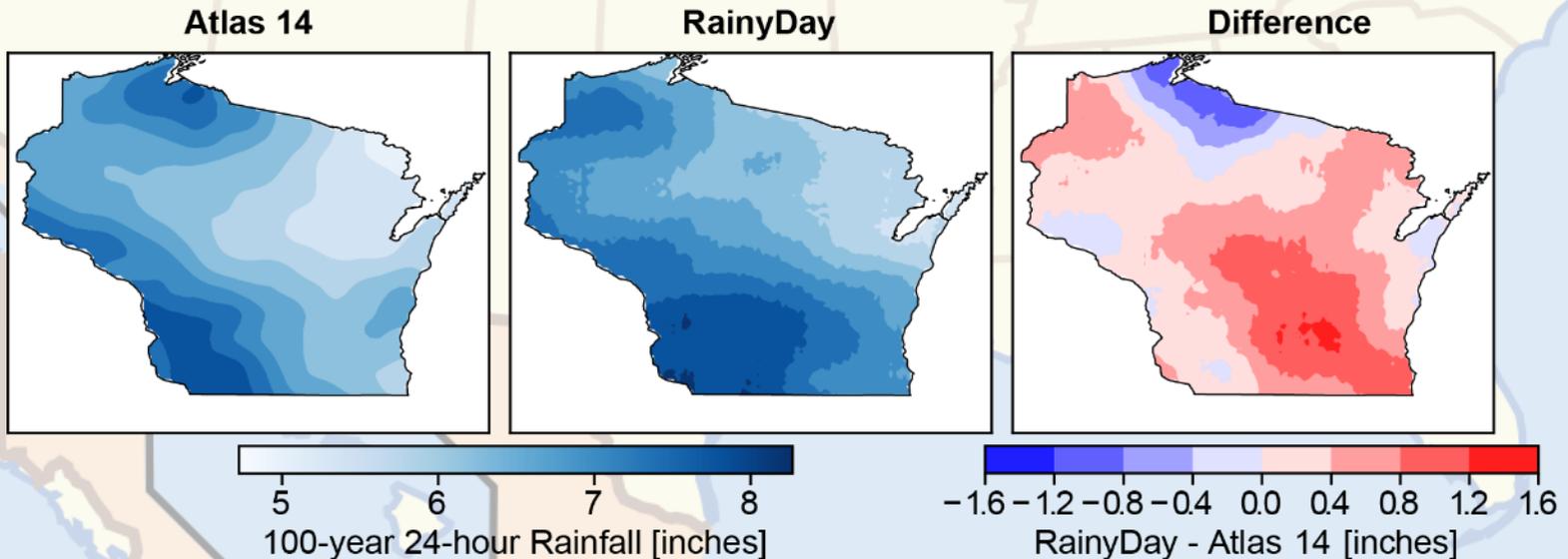
Let us know if you're interested!

Part 2: Update Rainfall Statistics

- Rain gage measurements



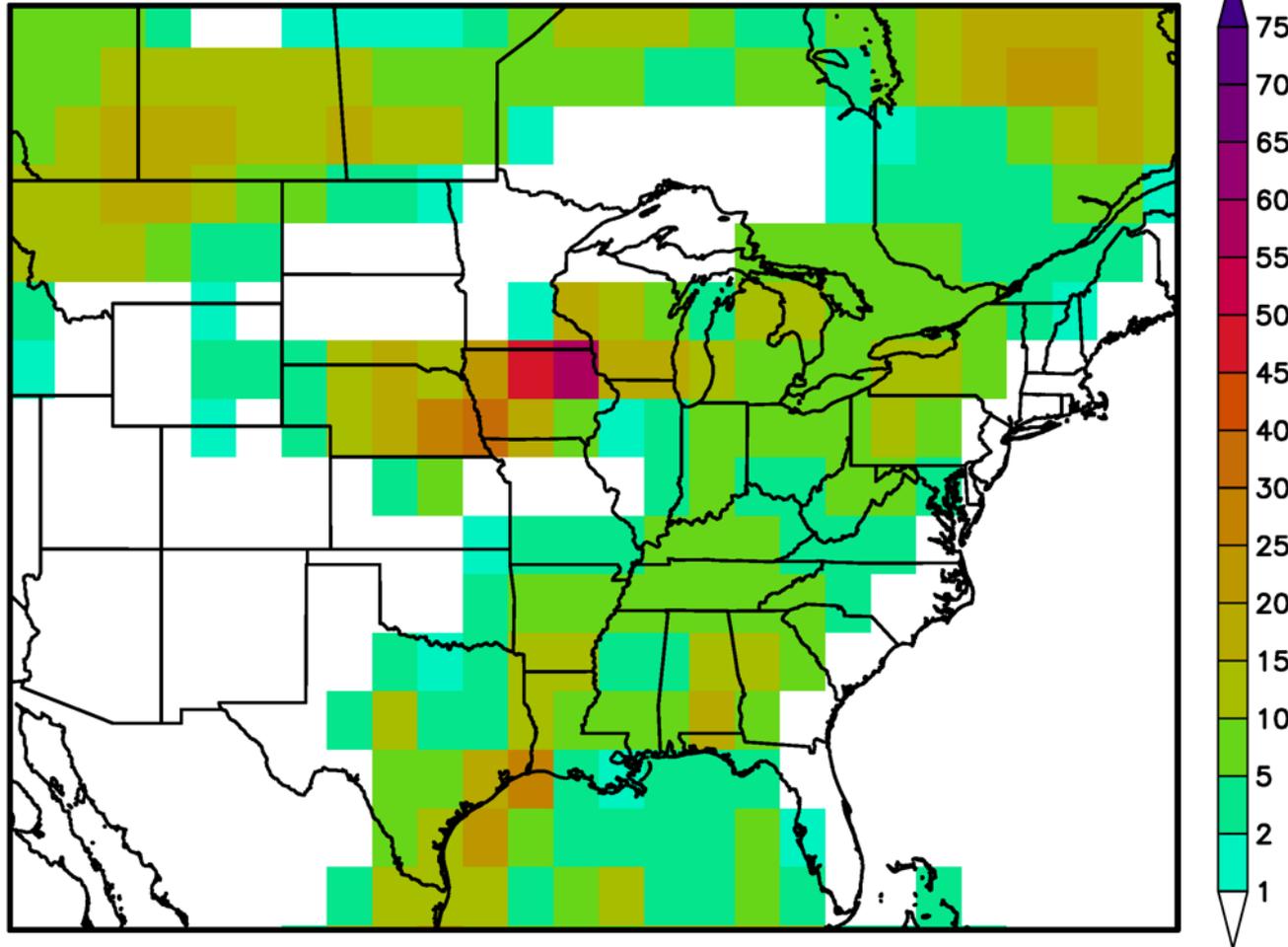
- RainyDay Software + Radar



Part 3: Future Rainfall Statistics

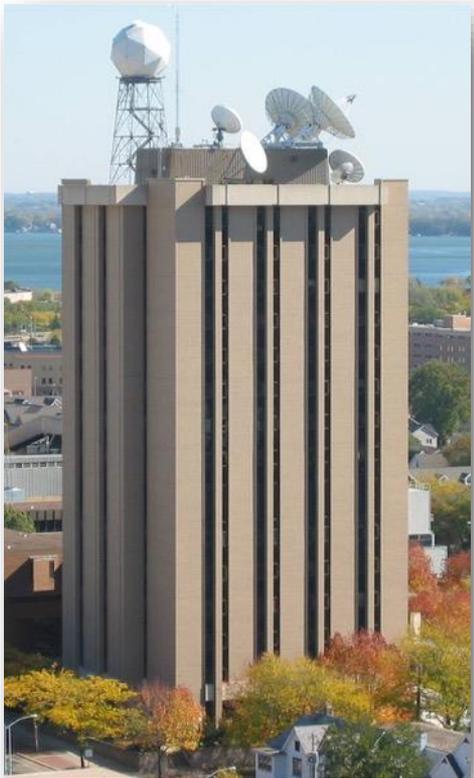
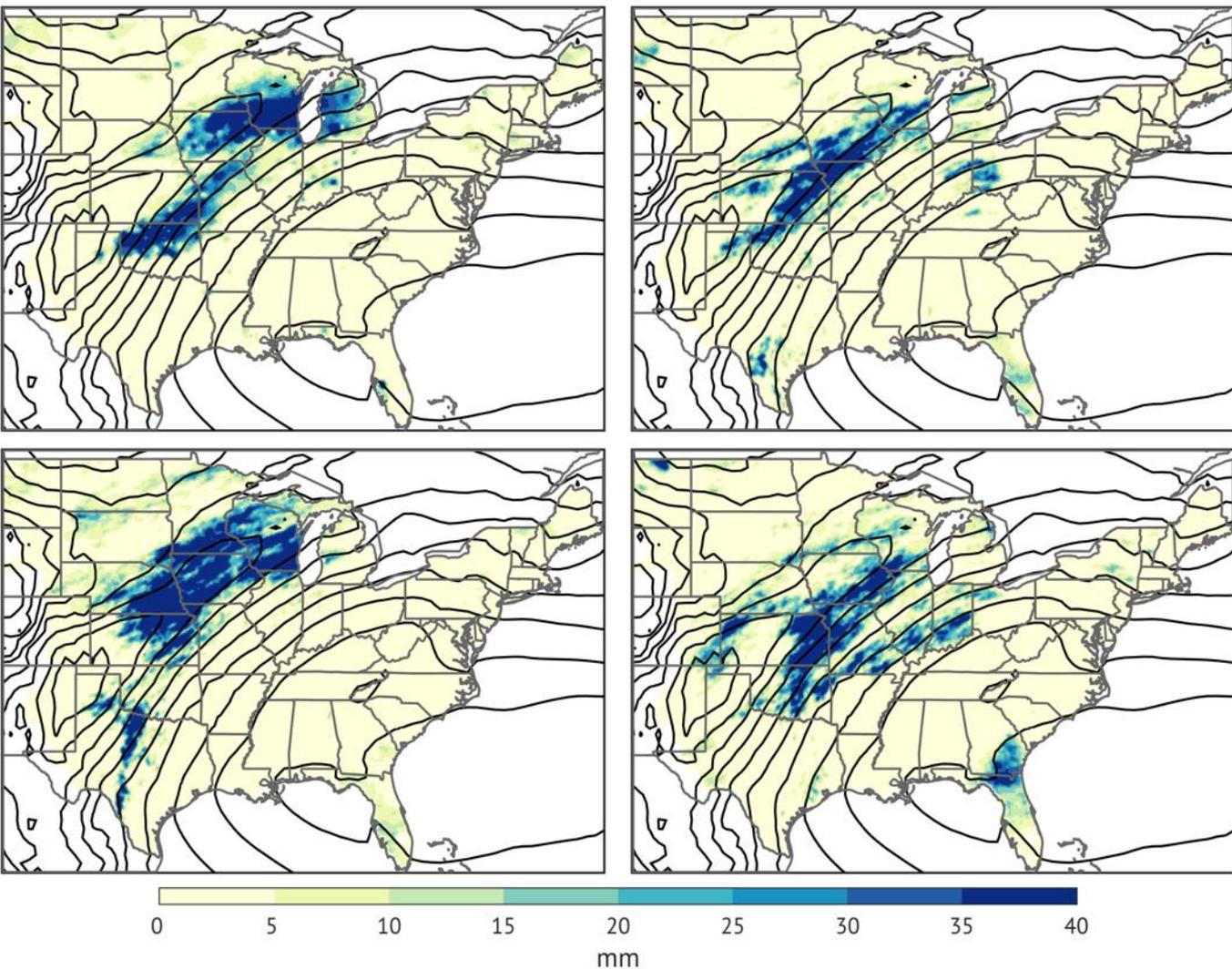
- Climate Model Downscaling

June 8, 2008 Rainfall [mm]



Part 4: Future IDF Curves

- Climate Model Downscaling



Part 4: Future IDF Curves

- Recent NWS-funded project:



Article

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

Shu Wu ^{1,*}, Momcilo Markus ², David Lorenz ¹, James R. Angel ² and Kevin Grady ²

¹ Nelson Institute Center for Climatic Research, University of Wisconsin–Madison, Madison, WI 53706, USA; david.lorenz@wisc.edu

² Prairie Research Institute, Univ. of Illinois at Urbana-Champaign, Champaign, IL 61801, USA; mmarkus@illinois.edu (M.M.); jimangel@illinois.edu (J.R.A.); kagrady2@illinois.edu (K.G.)

Finding:

Today's 100-year storm is likely to be a 20-year storm by late 21st century

SUMMARY

- Extreme rainfall is a big problem, and is getting worse
- Rainfall statistics and infrastructure practices need to be updated
- UW-Madison and WICCI are here to help—looking for funding support!
- You can help too!



THANKS!

ANY QUESTIONS?

danielb.wright@wisc.edu

