

# Floods, Drought and Warming – What can a Civil Engineer do?

Ashish Sharma

Civil and Environmental Engineering  
UNSW, Sydney, AUSTRALIA

<http://www.civeng.unsw.edu.au/staff/ashish.sharma>



# UNSW

THE UNIVERSITY OF NEW SOUTH WALES

a lot of students, teachers and colleagues who have helped form the ideas here

Acknowledgements

Conrad Wasko (now at USyd), Denis Lettenmaier (UCLA), and

# Where I am from

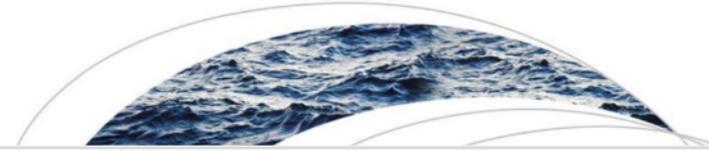


A photograph of a university campus at night. A wide, paved walkway leads towards a large, modern building with a prominent glass facade and a central tower. The walkway is lined with tall, slender, illuminated light poles that cast a warm glow. Several people are walking along the path. In the background, a banner for 'AUTONOMOUS ROBOTICS COMPETITION' is visible. The sky is dark blue, and the building's lights are on.

UNSW – 19<sup>th</sup> global (QS)

Civil Engg – 10<sup>th</sup> global/1<sup>st</sup> Au

Water Res – 9<sup>th</sup> global/1<sup>st</sup> Au



## Water Resources Research

### COMMENTARY

10.1029/2018WR023749

#### Key Points:

- Extreme precipitation is increasing with rising temperatures
- Flood magnitudes, however, are decreasing at the same time
- However, this is not a complete story; very rare floods are rising while frequent floods are reducing; reasons for this are explored

## If Precipitation Extremes Are Increasing, Why Aren't Floods?

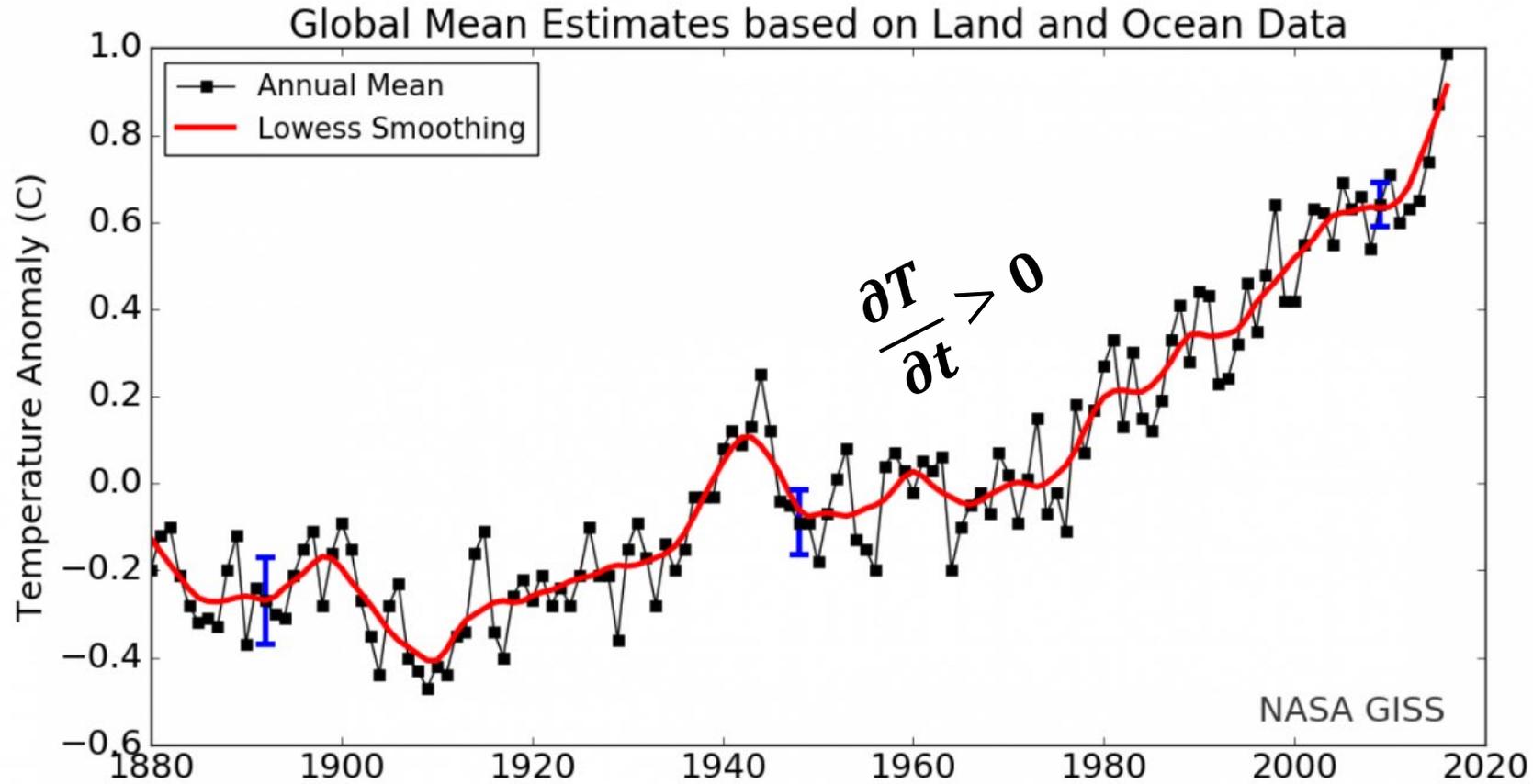
Ashish Sharma<sup>1</sup> , Conrad Wasko<sup>2</sup> , and Dennis P. Lettenmaier<sup>3</sup> 

<sup>1</sup>Civil and Environmental Engineering, The University of New South Wales, Sydney, New South Wales, Australia, <sup>2</sup>Department of Infrastructure Engineering, The University of Melbourne, Melbourne, Victoria, Australia, <sup>3</sup>Department of Geography, University of California Los Angeles, Los Angeles, CA, USA

---

**Abstract** Despite evidence of increasing precipitation extremes, corresponding evidence for increases in flooding remains elusive. If anything, flood magnitudes are decreasing despite widespread claims by the climate community that if precipitation extremes increase, floods must also. In this commentary we suggest

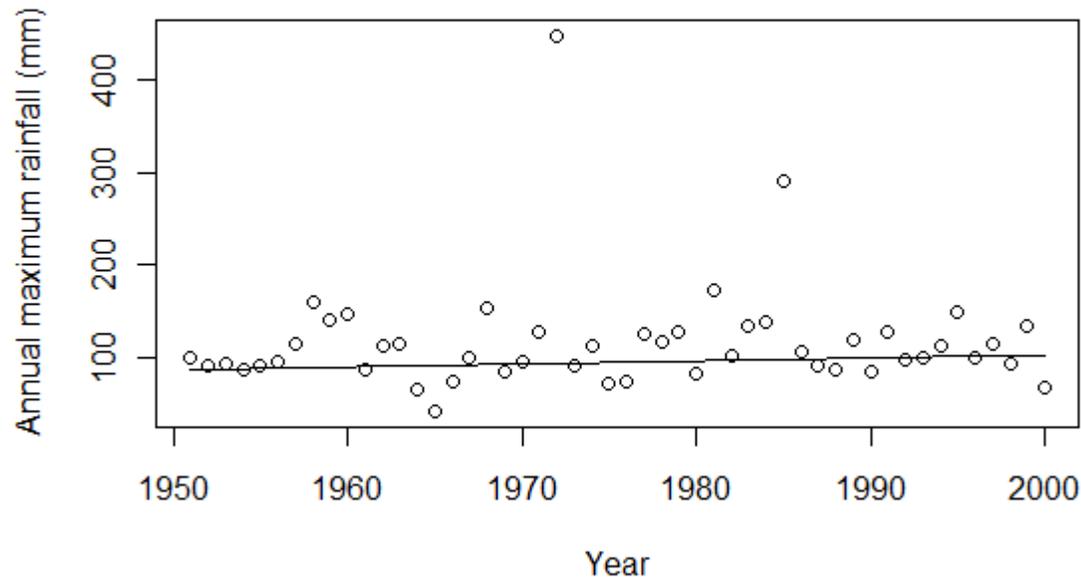
# Lets start with Temperature...



# Now consider any extreme E

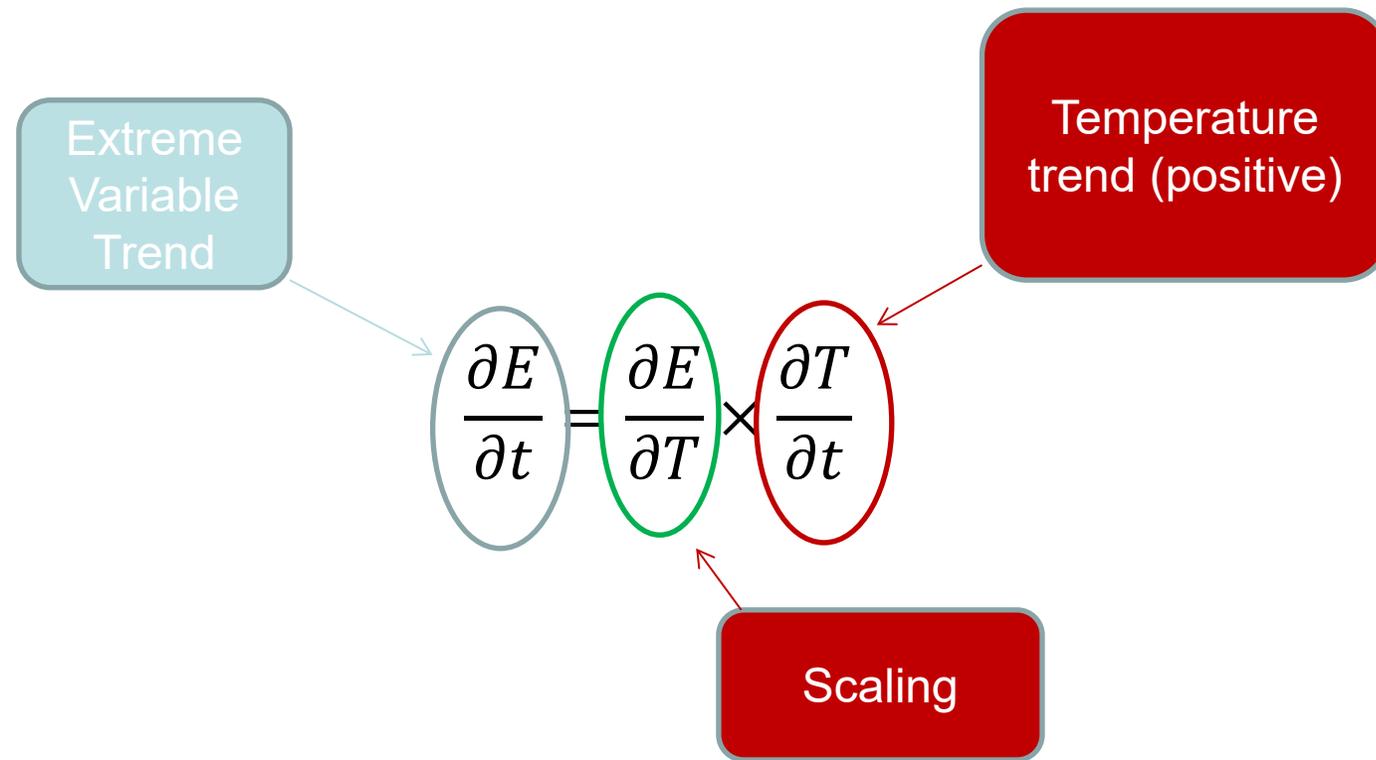
$$\text{Rate of Change} = \frac{\partial E}{\partial t}$$

Using 50 years of data with a known positive trend,  $\frac{\partial E}{\partial t}$  estimated using annual maxima, would be positive at the 5% significance level in 8 out of 100 samples, with a negative  $\frac{\partial E}{\partial t}$  showing up in 2 of 100 samples!



Source: Seth Westra

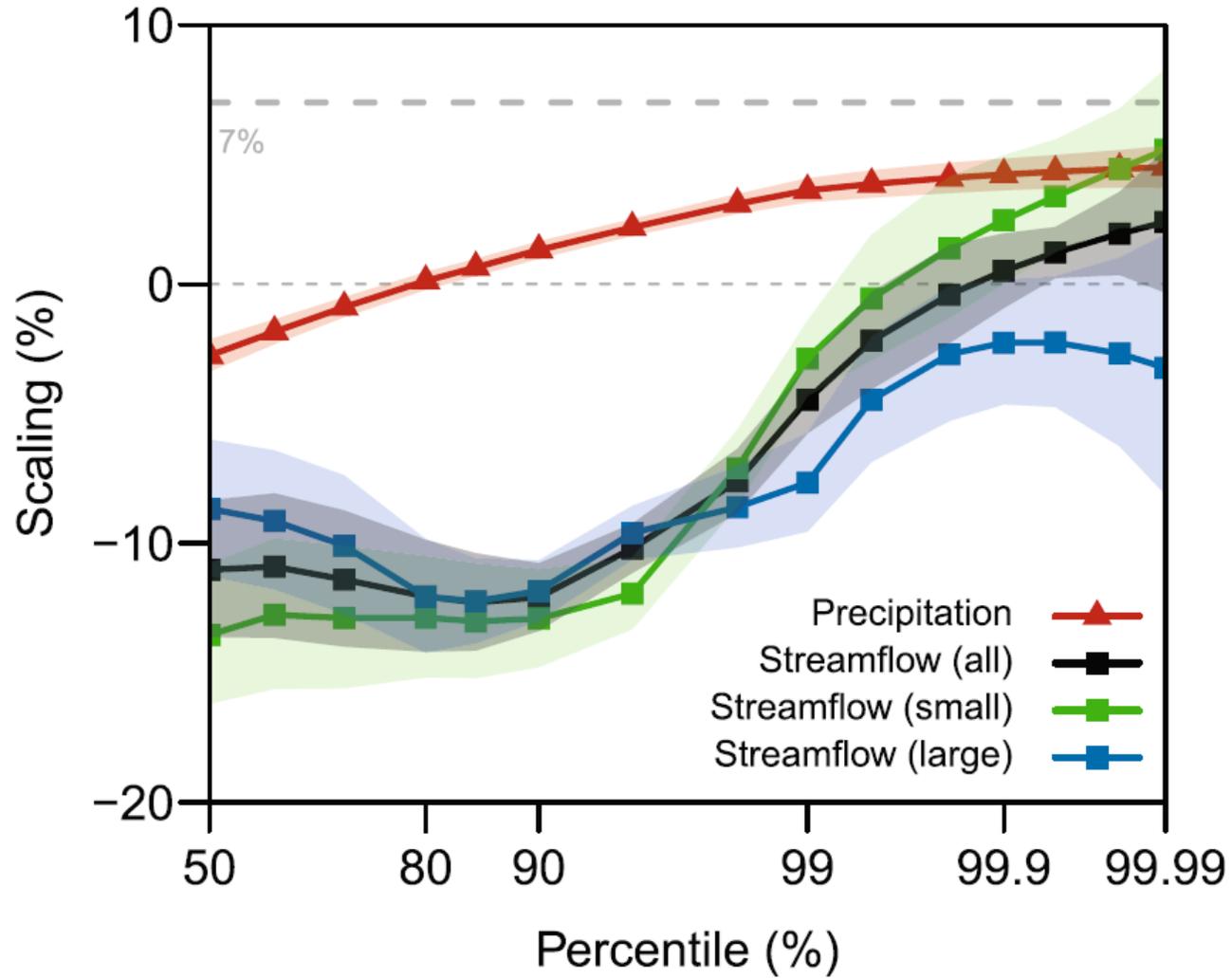
# So how to estimate when extremes are changing?



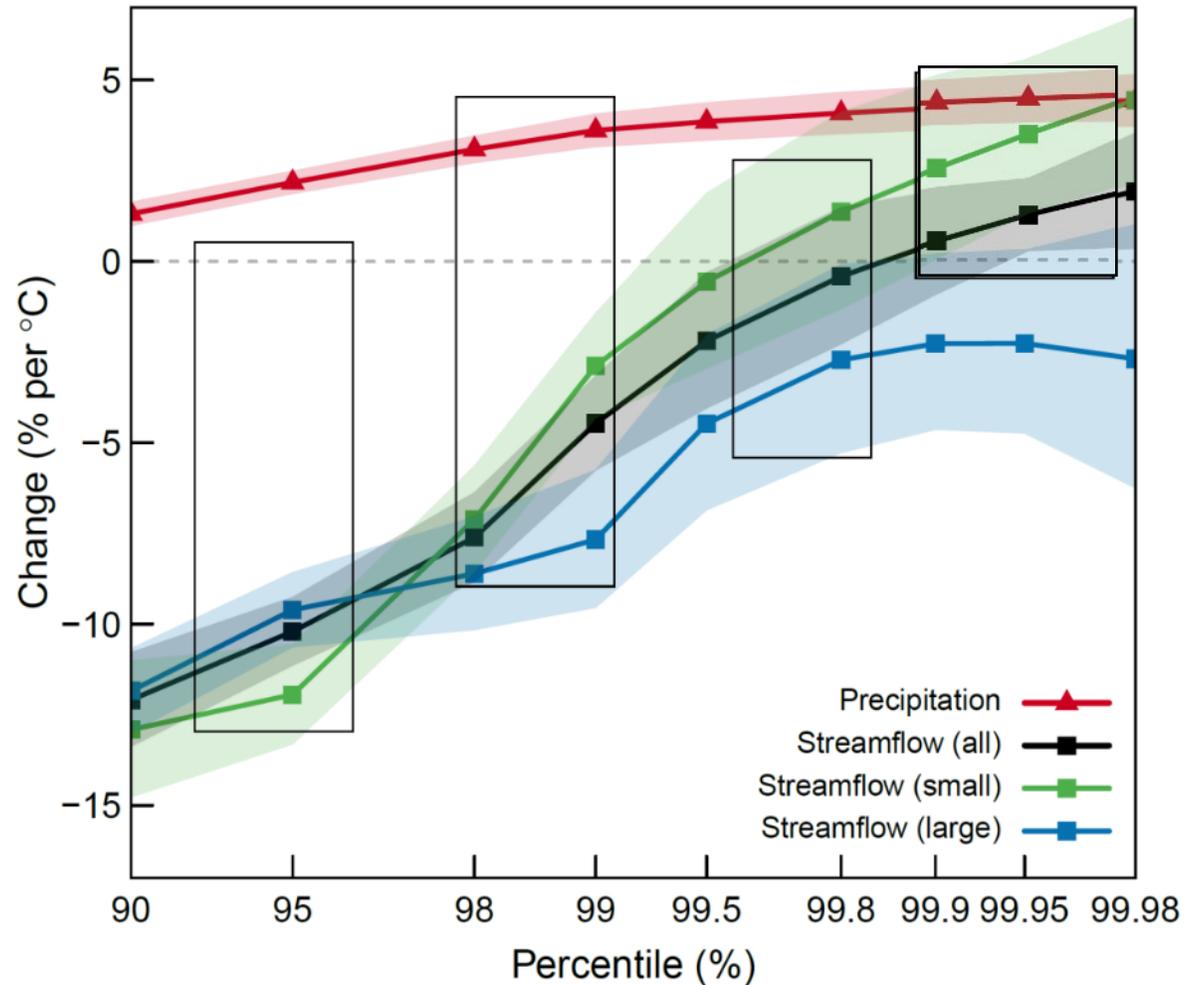
If Scaling is positive,  $\frac{\partial E}{\partial t}$  is positive. If Scaling is negative,  $\frac{\partial E}{\partial t}$  is negative

Scaling equals 7% per °C rise in temperature for rainfall extremes

# In a nutshell...



# 1. The rare to very rare extremes...

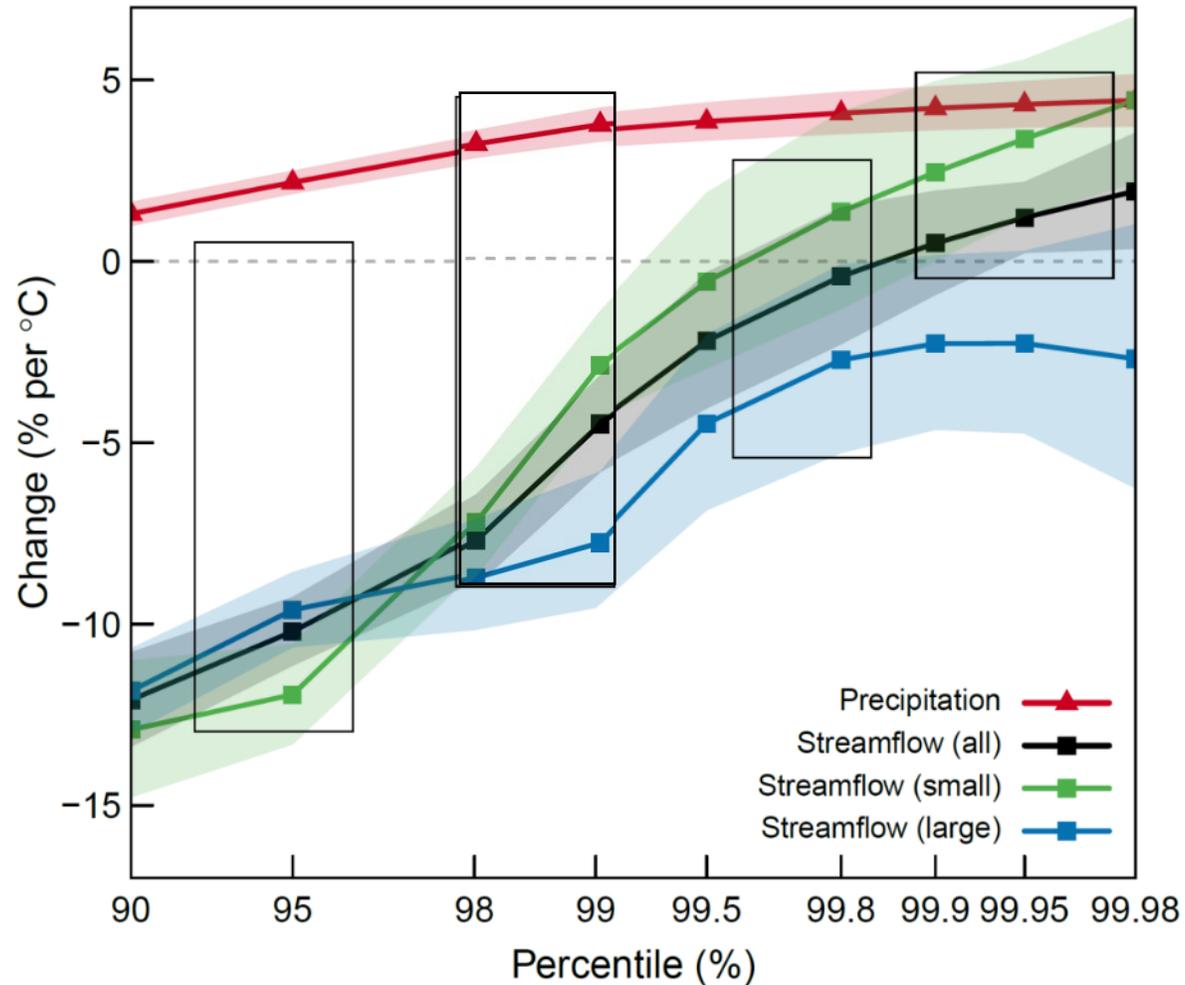


Flow scaling increasing  
Approaching Rainfall Scaling (7%)  
Especially for Smaller (or Urban) catchments

**Urban flooding will increase**

**Will impact more as urban  
populations increase**

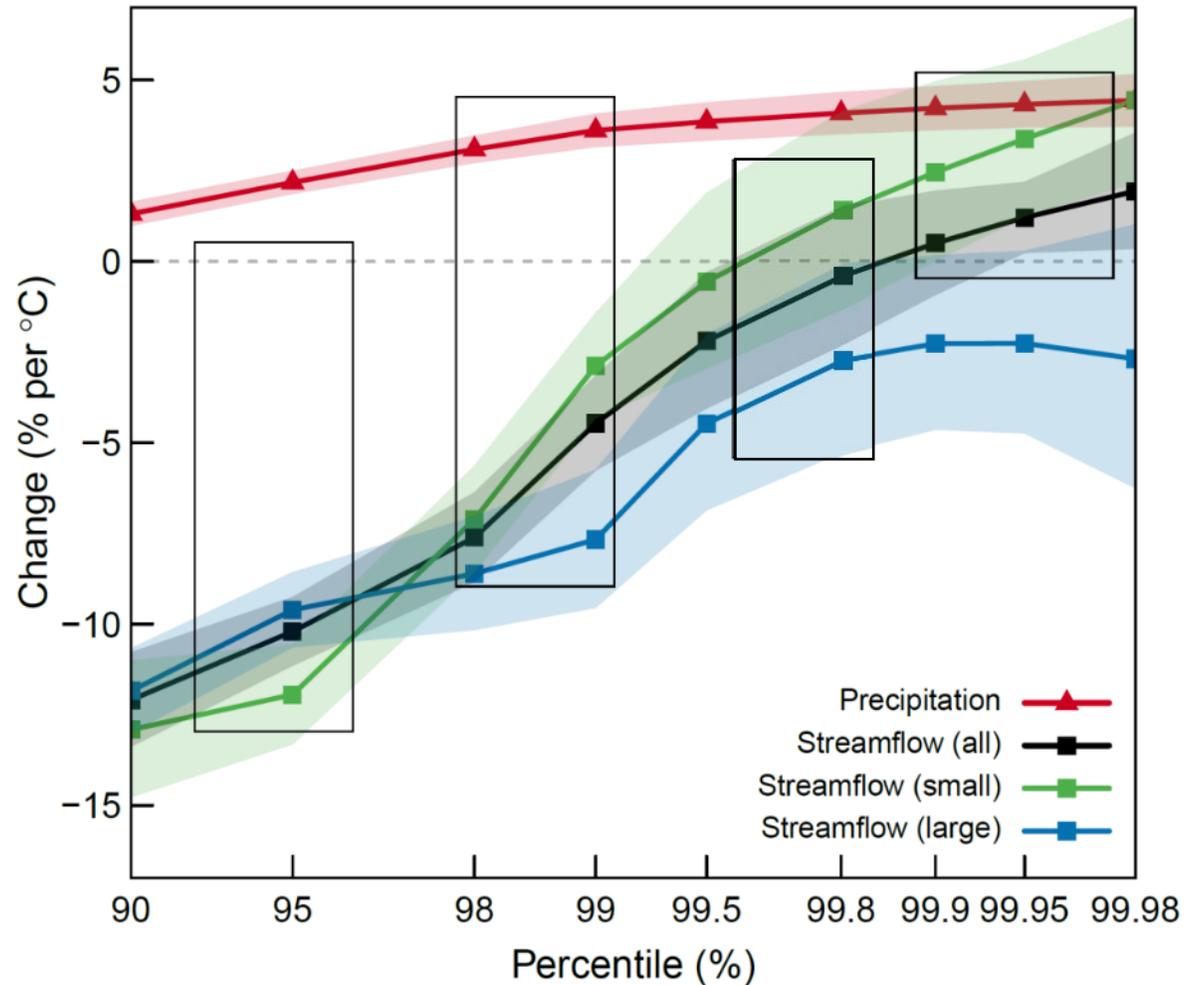
## 2. Flow and rain... are not the same...



Rainfall increasing at greater rate than flow  
Difference gets smaller as rareness increases  
Opposite signs for low percentiles

**A larger rainfall peak will lead to a lower flood peak – especially for non-extreme rainfall events**

### 3. Large catchment floods reduce more...

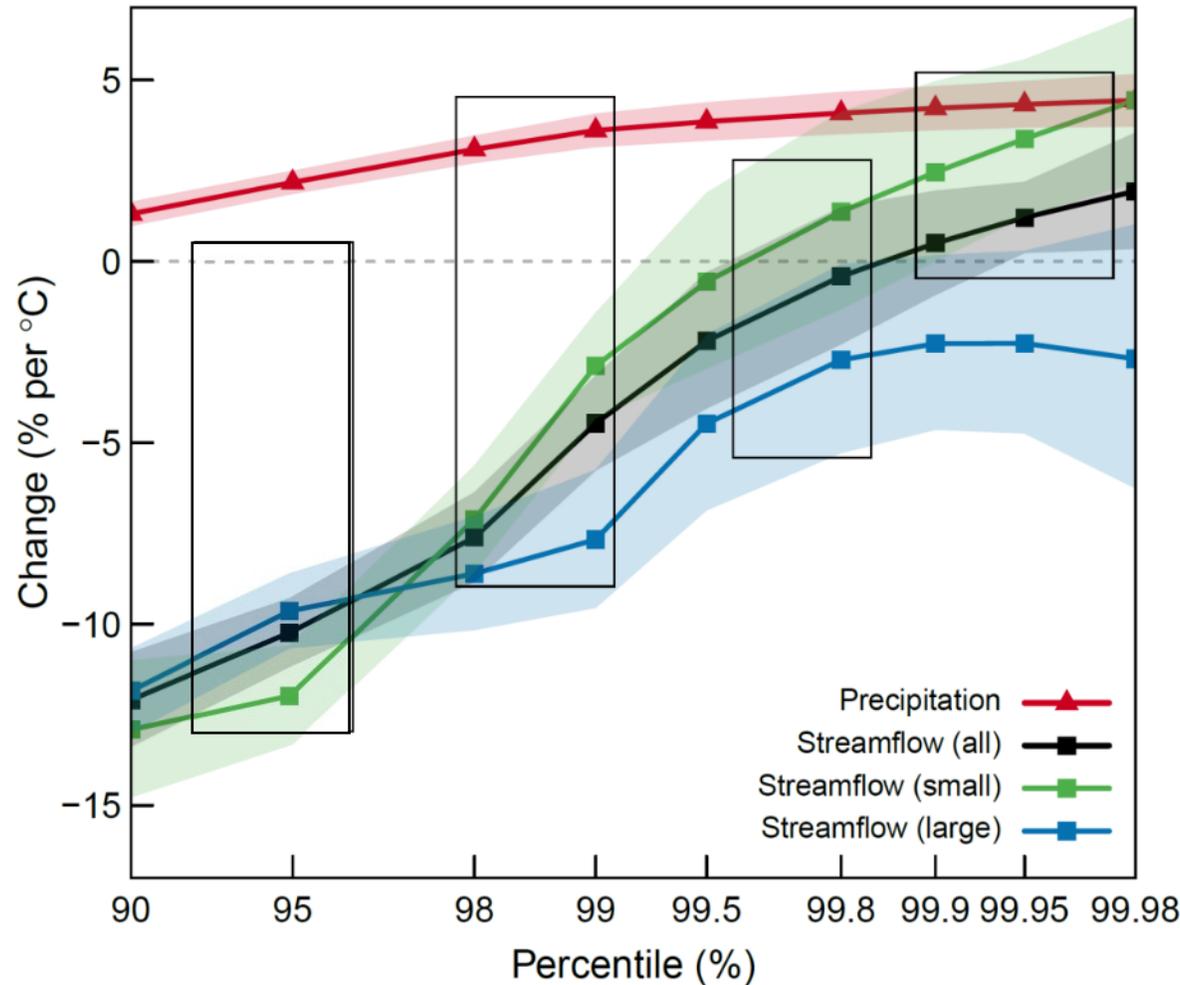


Discharges increase more for smaller catchments  
Discharge universally decreasing for larger catchments

**Pre-storm moisture conditions markedly different**

**Large catchment floods reducing due to drier soils**

# 4. Reservoir inflows will reduce...



Extreme floods lead to spill (storage impact low)  
Frequent floods needed to fill dams  
Frequent floods reducing 10-15% for each degree rise in temperature

**Also...dry soils mean more water demand**

**And higher temperatures mean more reservoir loss**

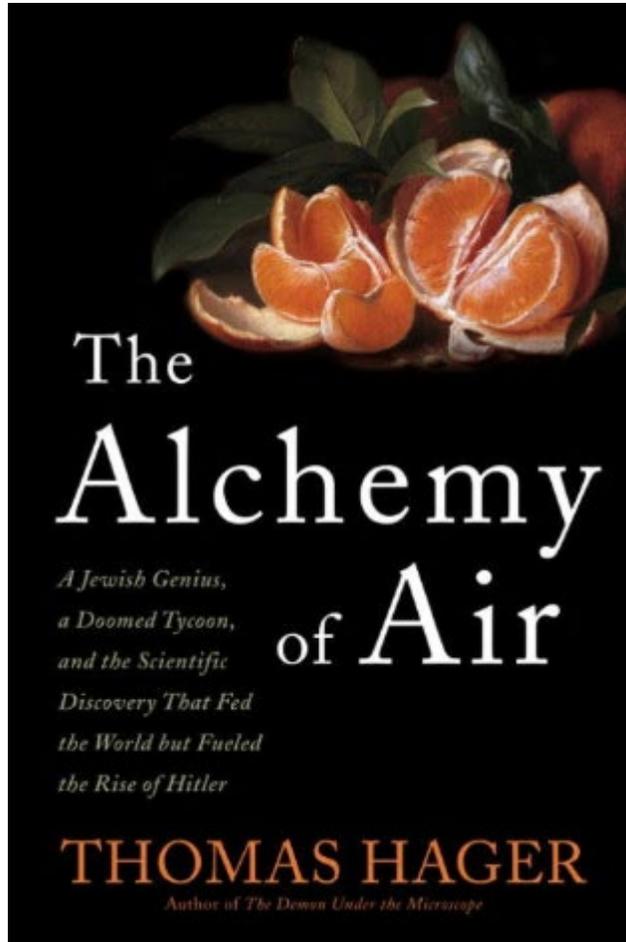
United Nations University  
Institute for Water, Environment and Health

# GLOBAL WATER BANKRUPTCY

Living Beyond Our Hydrological  
Means in the Post-Crisis Era

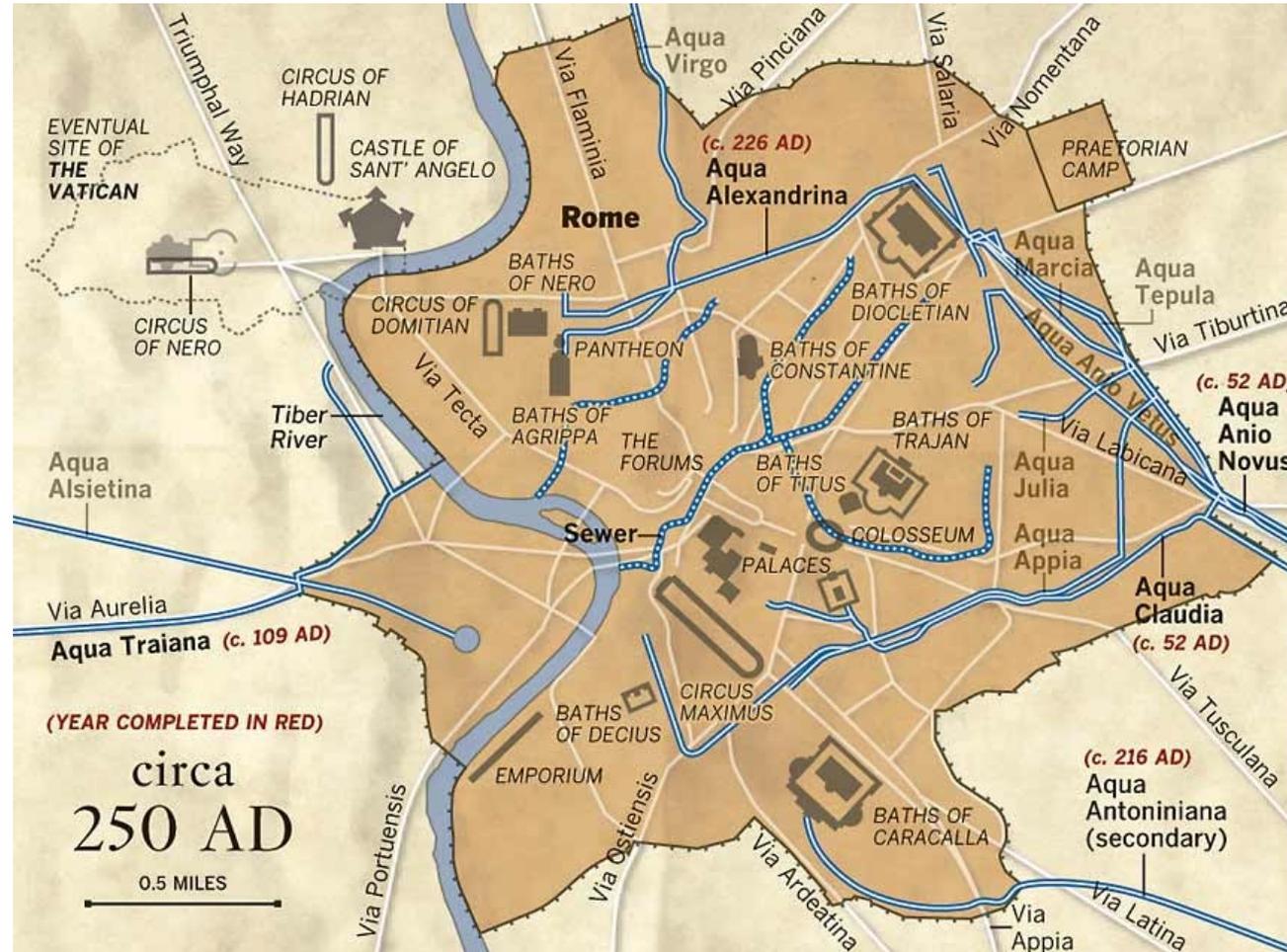


And there was another “world is ending” story once upon a time...

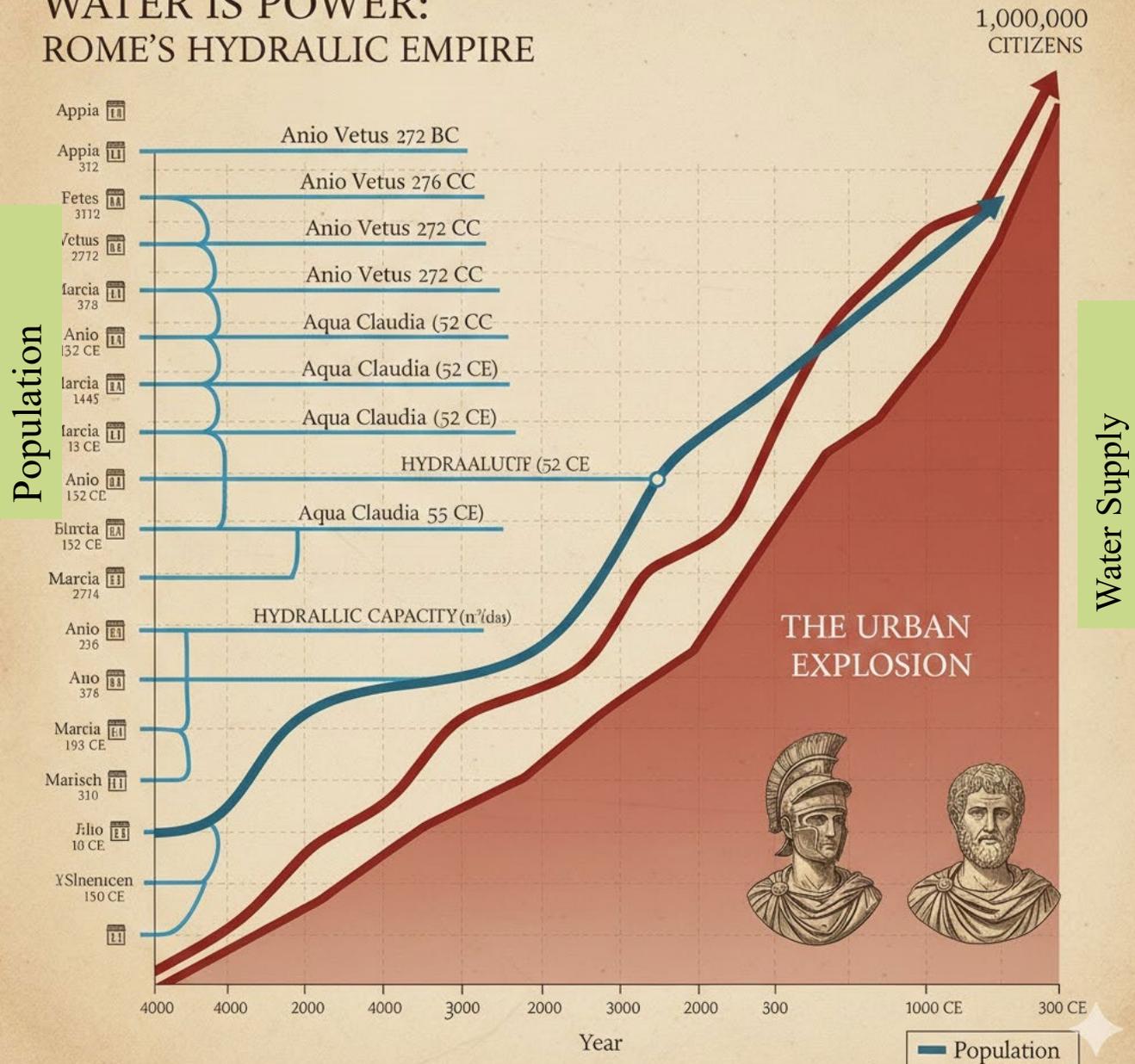


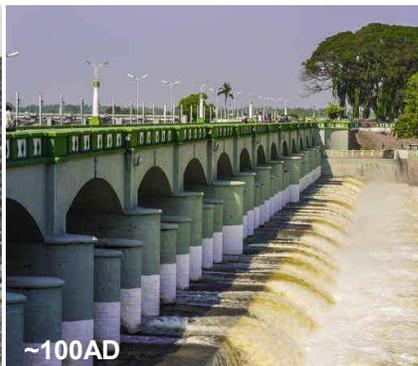
- 1798** Malthus and the Malthusian Catastrophe
- 1890's** The Great Indian Famine
- 1900's** World population to peak at 2B?
- 1910** Haber-Bosch process published
- WW1** Key source for ammunitions
- WW2** Helped generate fuel
- WW2+** Outsourced to Allies
- 1958-62** The Great China famine
- 1960s** China get first Haber- Bosch plant
- Now** World population touching 9B and rising...

But would Malthus (or Haber or Bosch or us) have even existed had it not been for water ingenuity?



# WATER IS POWER: ROME'S HYDRAULIC EMPIRE



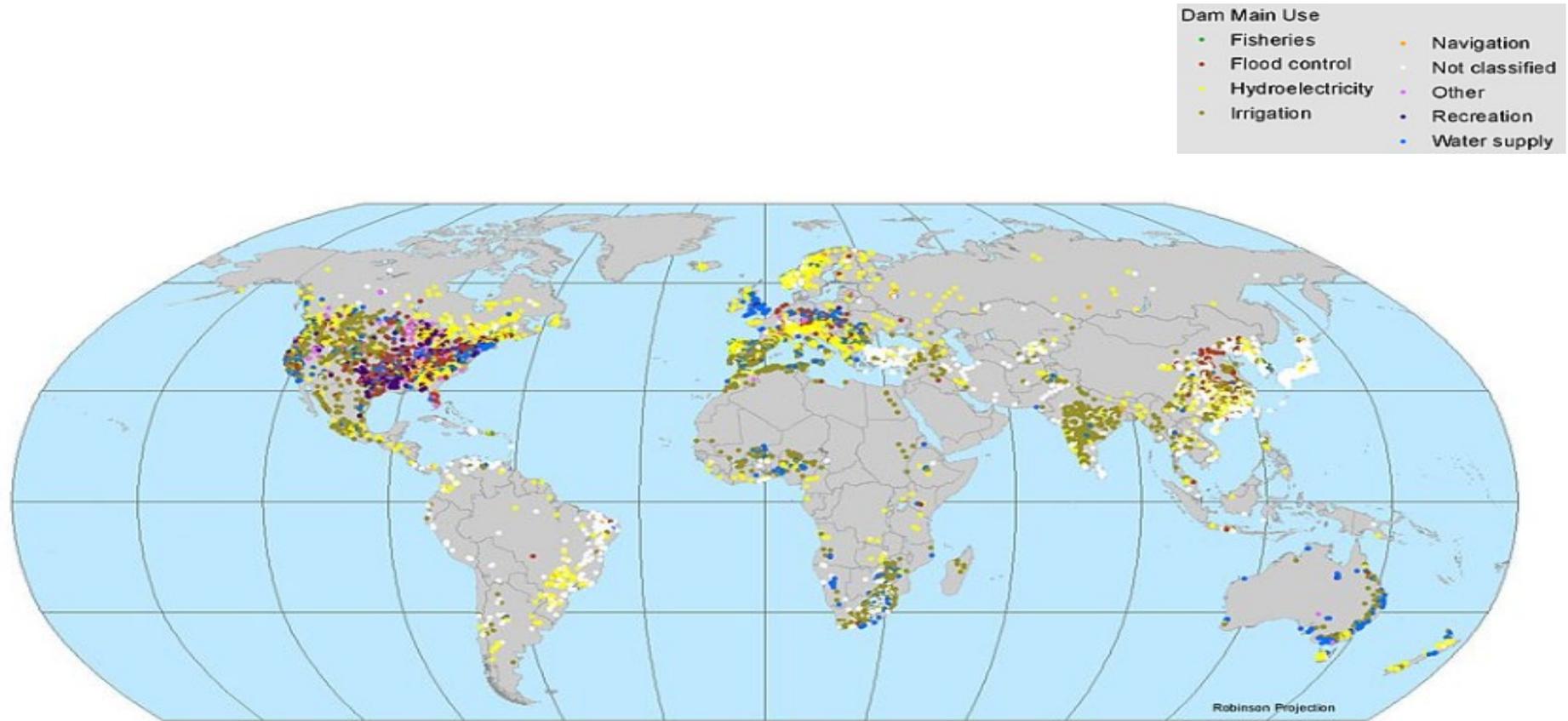












Source: GRanDv1, Lehner et al, 2011

# So how did we handle water insecurity before?



Economist.com

# So how did we handle water insecurity before?



# So how did we handle water insecurity before?



**Wilson Center**  
CHINA ENVIRONMENT FORUM  
@wilsoncef

## SPONGE CITIES

CHINA'S PUSH FOR **GREEN** (NOT **GRAY**) INFRASTRUCTURE

30 Chinese cities will each receive 400-600 million RMB to pilot **green roofs, constructed wetlands, increased tree cover, and permeable pavements** to capture, slow down and filter storm water.

Source: Lauren Sidner | Design: Carl Hooks

An infographic titled 'SPONGE CITIES' illustrating the concept of green infrastructure. It shows three stylized buildings with green roofs and trees. A blue stream flows through a green landscape with trees and permeable pavement. Below the ground level, blue water is shown filtering through the soil and into a collection system. The infographic is set against a blue sky background.

# Solutions?

Re-engineer the planet

But

Make sure we do it even better this time!

■ ■ ■

# CVEN@UNSW

Big UG program (500+ intake each year)

About 70% domestic and 30% international

Exchange options

Internships

Most are working by year 3

Most end up with consultants or government

Many launch their own consulting firms after ~5 years

Good PhD options if grades are Hons 1+

Few return for PhDs though...

# Main Differences

# Water Research Centre

[Home](#) [About us](#) [Our research](#) [Our facilities](#) [Current PhD opportunity](#) [News](#) [Contact us](#)

## Phd Opportunities (3)

A new generation of hydrologic models for remote catchments worldwide.

PhD top-up scholarships available on an Australian Research Council Discovery Project (details below) to be supervised collaboratively across three Australian Universities, including opportunities for travel and learning in reputed institutions overseas. Stipend includes a significant top-up over and above Australian RTP scholarships for eligible domestic students or residents.

# Floods, Drought and Warming – What can a Civil Engineer do?

Ashish Sharma

Civil and Environmental Engineering  
UNSW, Sydney, AUSTRALIA

<http://www.civeng.unsw.edu.au/staff/ashish.sharma>



# UNSW

THE UNIVERSITY OF NEW SOUTH WALES

a lot of students, teachers and colleagues who have helped form the ideas here

Acknowledgements

Conrad Wasko (now at USyd), Denis Lettenmaier (UCLA), and