

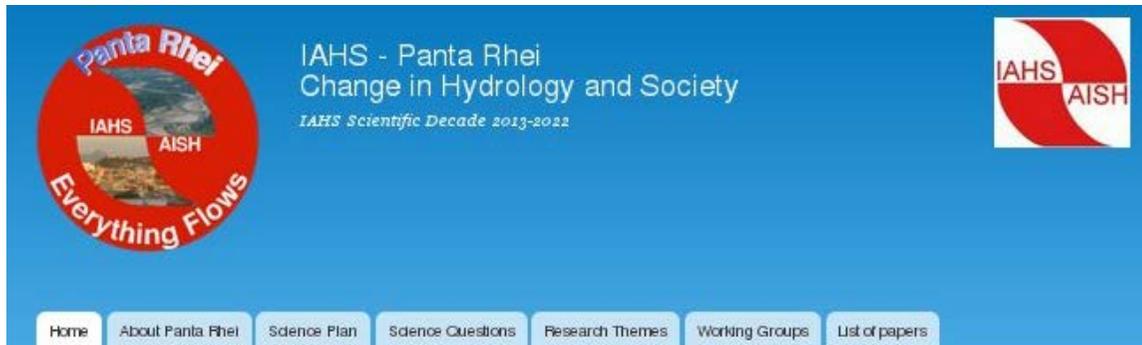
# How people and ecosystems organize their storage requirements

Hubert H.G. Savenije

Hongkai Gao

Markus Hrachowitz

# Panta Rhei



## Panta Rhei Everything Flows

The new Science Initiative of the  
International Association of  
Hydrological Sciences  
(IAHS)  
[www.iahs.info/pantarhei](http://www.iahs.info/pantarhei)

- Navigation
- The Panta Rhei Structure
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Bologna IAHS 2014-6th IAHS International Symposium on Integrated Water Resources Management  
Evolving Water Resources Systems - Understanding, Predicting and Managing Water - Society Interactions

### Panta Rhei at AGU and the Panta Rhei Poster

Submitted by alberto on Sun, 12/08/2013 - 15:27

The Panta Rhei session at the AGU Fall meeting is going to be held on Tuesday, December 10 and Wednesday, December 11. We will publish a report on the session that counts more than 90 contributions! A Poster on Panta Rhei will be presented in the session to introduce Panta Rhei to the international scientific community. The poster is available for [download here!](#). I am looking forward to see in person all of you that are attending AGU!  
Alberto Montanari



Tags:

[Panta Rhei](#) [AGU](#) [poster](#)

[Read more](#)

### Call for Research Themes and Working Groups of Panta Rhei

Submitted by alberto on Wed, 10/30/2013 - 09:57

The call for Research Themes and Working Groups of Panta Rhei was published on October 30, 2013. The publication of the call marks the actual start-up of the involvement of the community in Panta Rhei. Please read the call at the above linked pages. We are looking forward to receiving the feedback from the community, through innovative ideas and availability to establish a mutual cooperation. Please do not hesitate to contact us for any clarification!

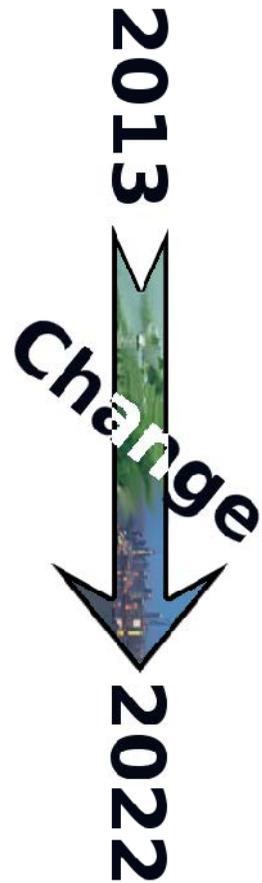


**Please beware that the first deadline for proposing Research Themes and Working Groups is fixed at January 31st, 2014.**



# Panta Rhei: the IAHS Science Initiative 2013-2022

Launched in July 2013 at the IAHS General Assembly  
Montanari et al. (2013)



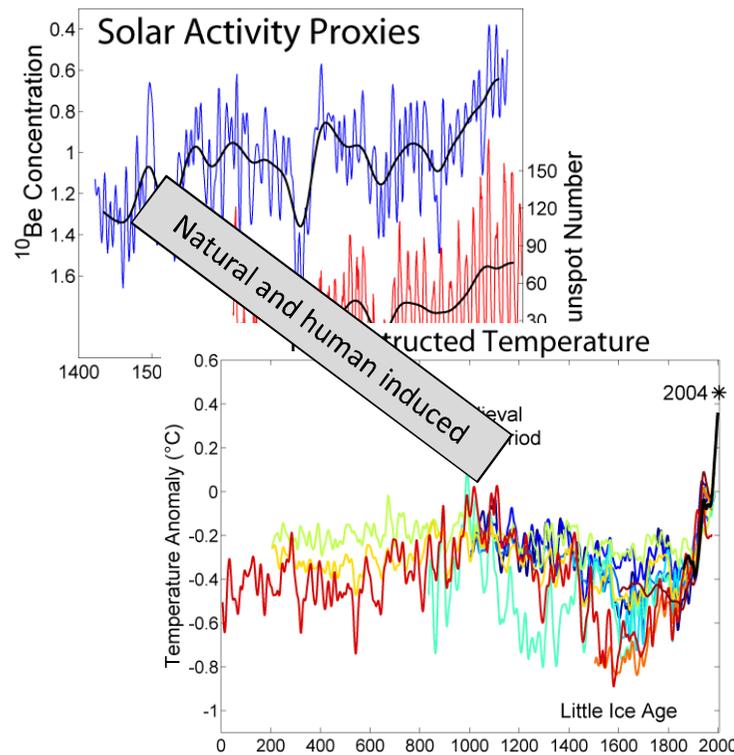
No man ever steps in the same river twice, for it's not the same river and he's not the same man

**Nothing is permanent except change**  
Heraclitus of Ephesus  
(c.535 BC - 475 BC)  
Greek philosopher

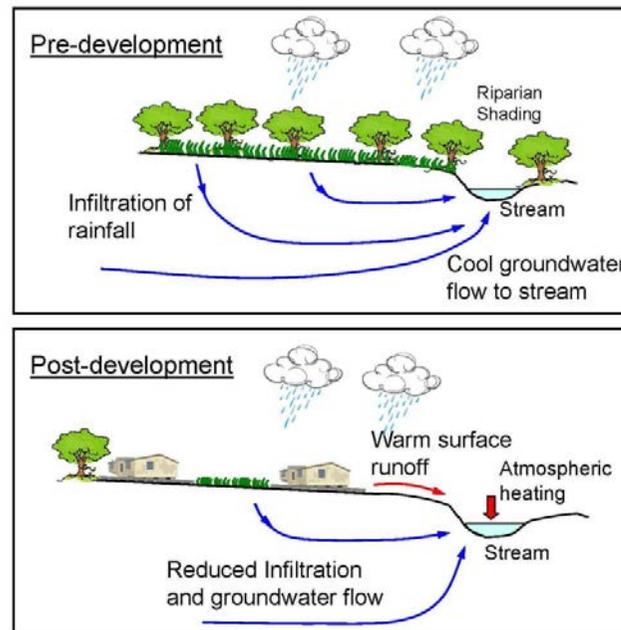
They must often change, who would be constant in happiness or wisdom.  
Confucius (551 - 479 BC)

# Hydrological Change

## Climate change



## Land use change



## River training



Genoa – Flood event in 2011



Tunnelling of Seveso River

From University of Minnesota <http://troutstreamresearch.saf1.umn.edu/>

# International scientific associations in Hydrology



EGU – European Geosciences Union ([www.egu.eu](http://www.egu.eu))



AGU – American Geophysical Union ([www.agu.org](http://www.agu.org))



IAHS – International Association of Hydrological Sciences ([www.iahs.info](http://www.iahs.info))  
(along with National Hydrological Associations)

## Why a major research initiative?

- Focus on an emerging scientific challenges
- Strengthen international cooperation and competition
- Facilitate international exchange and comparison of research results
- Promote the visibility of Hydrology as a science
- Inspire and create opportunities for young researchers

# How people and ecosystems organize their storage requirements

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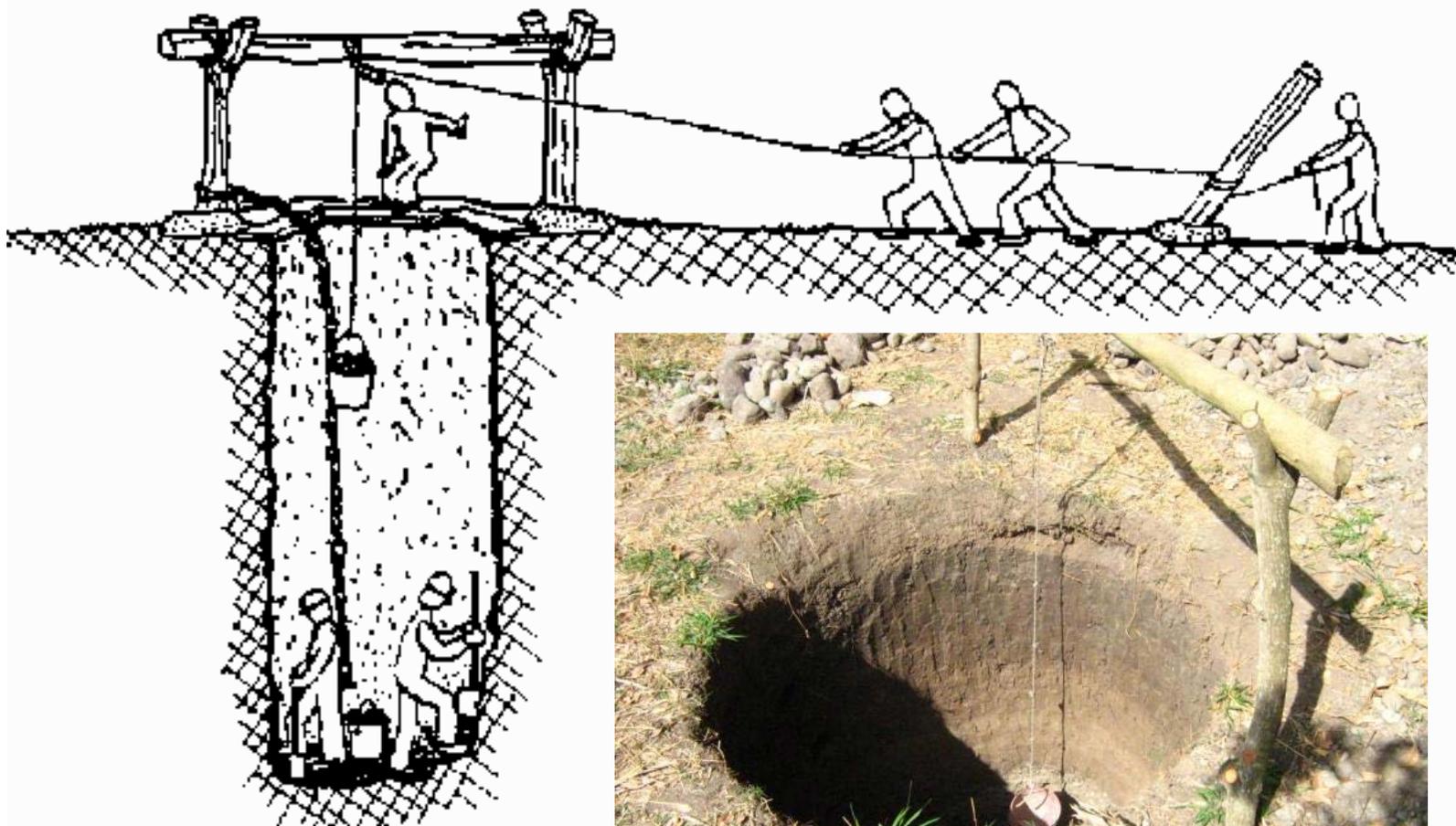
# Start of the Anthropocene

- First: Tapping from nature

# Scoop Hole

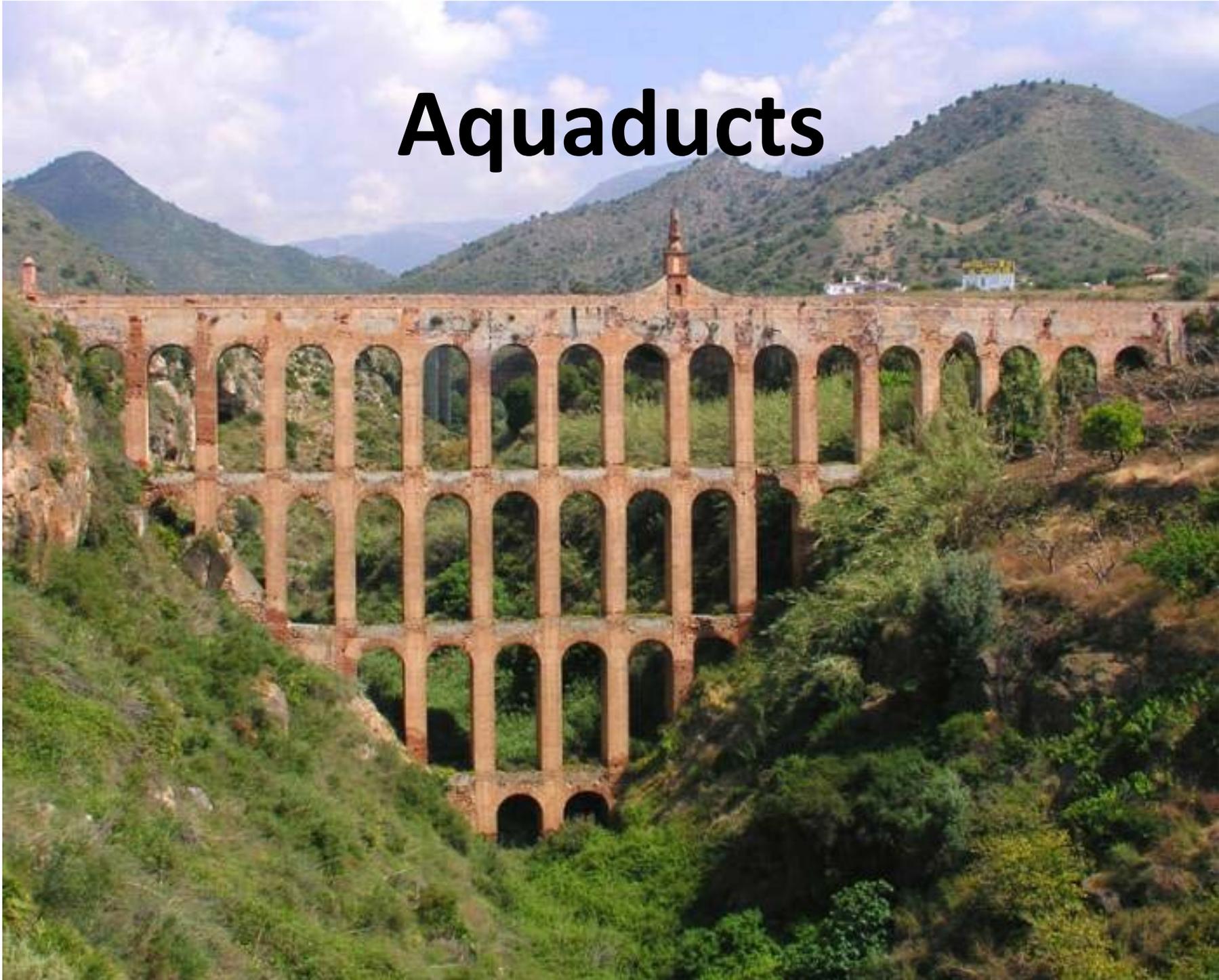


# Hand dug well





# Aqueducts



# Start of the Anthropocene

- **Firsts: Tapping from nature**
  - 9500-7000 BC dug well in Cyprus (Fagan, 2011)
- **Second: Building reservoirs**
  - Around 3000 BC in the Middle East

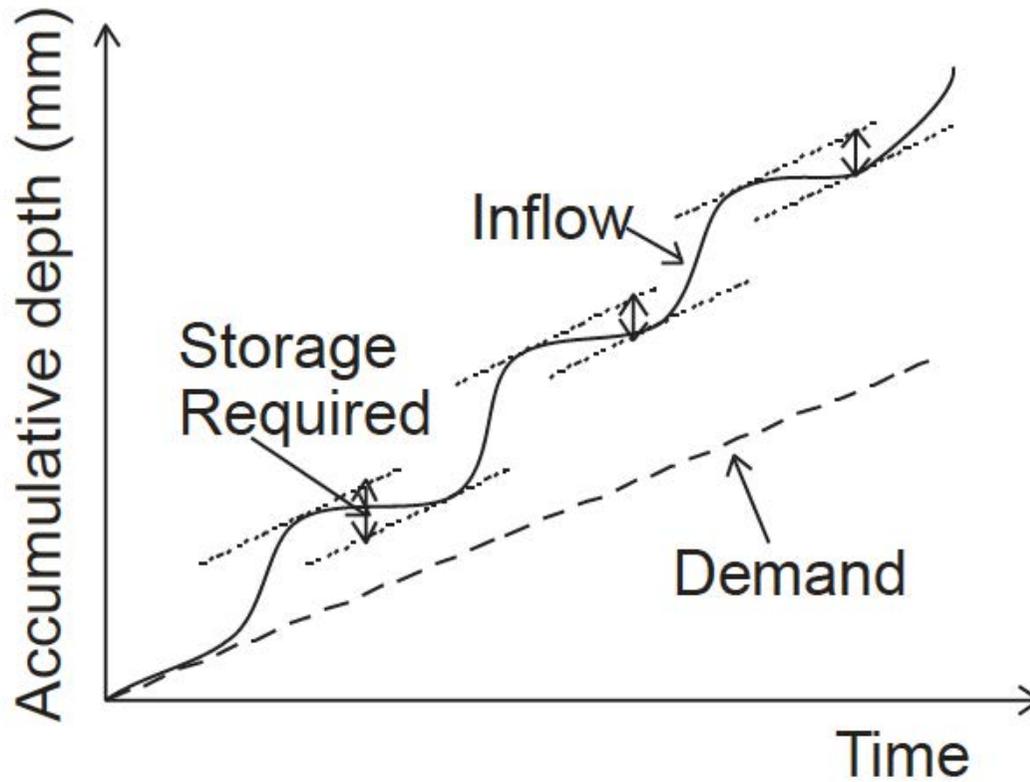
# Dams in the Anthropocene



Marib dam  
Yemen

# Dam design

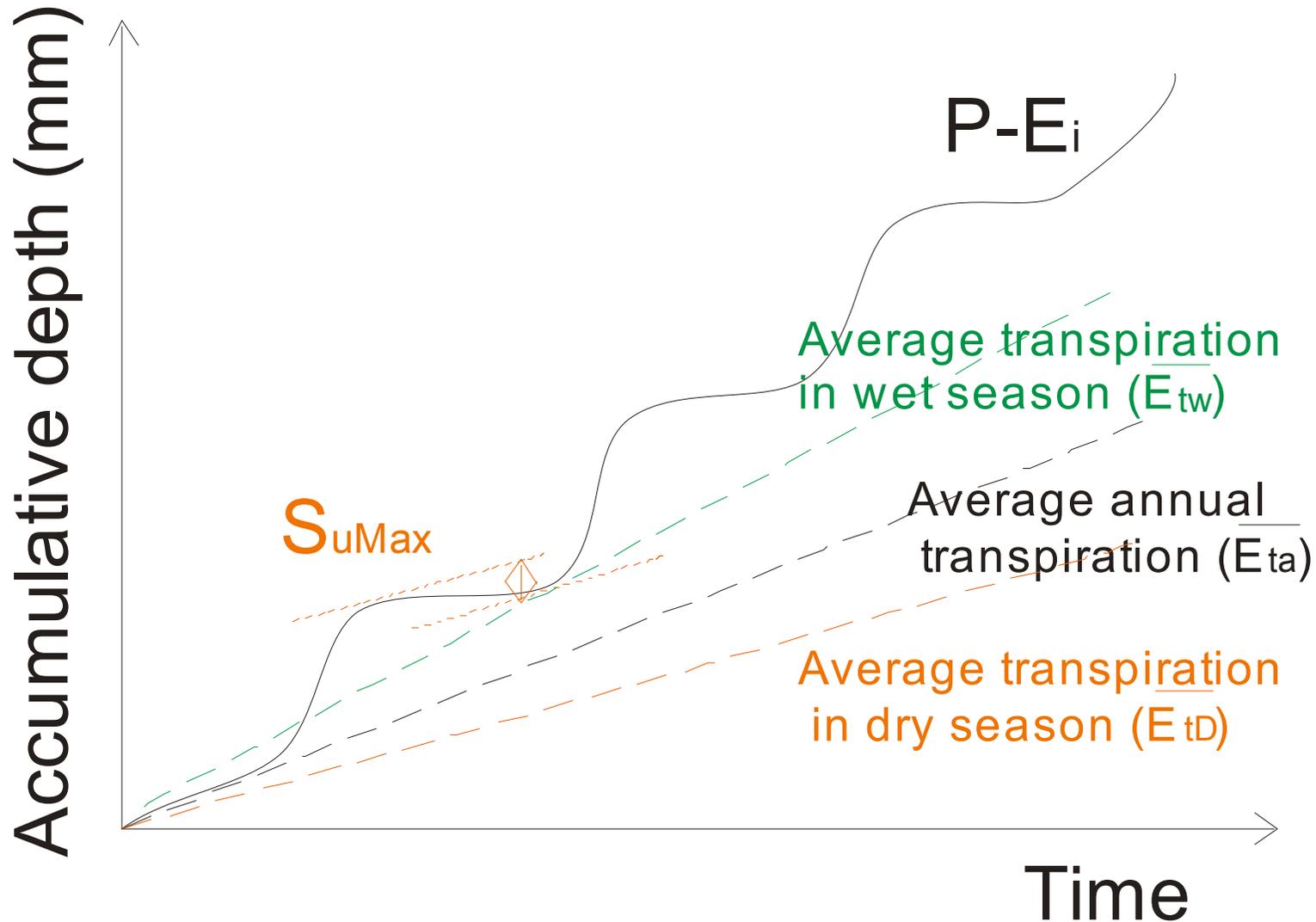
- Mass Curve Technique (Rippl, 1883)



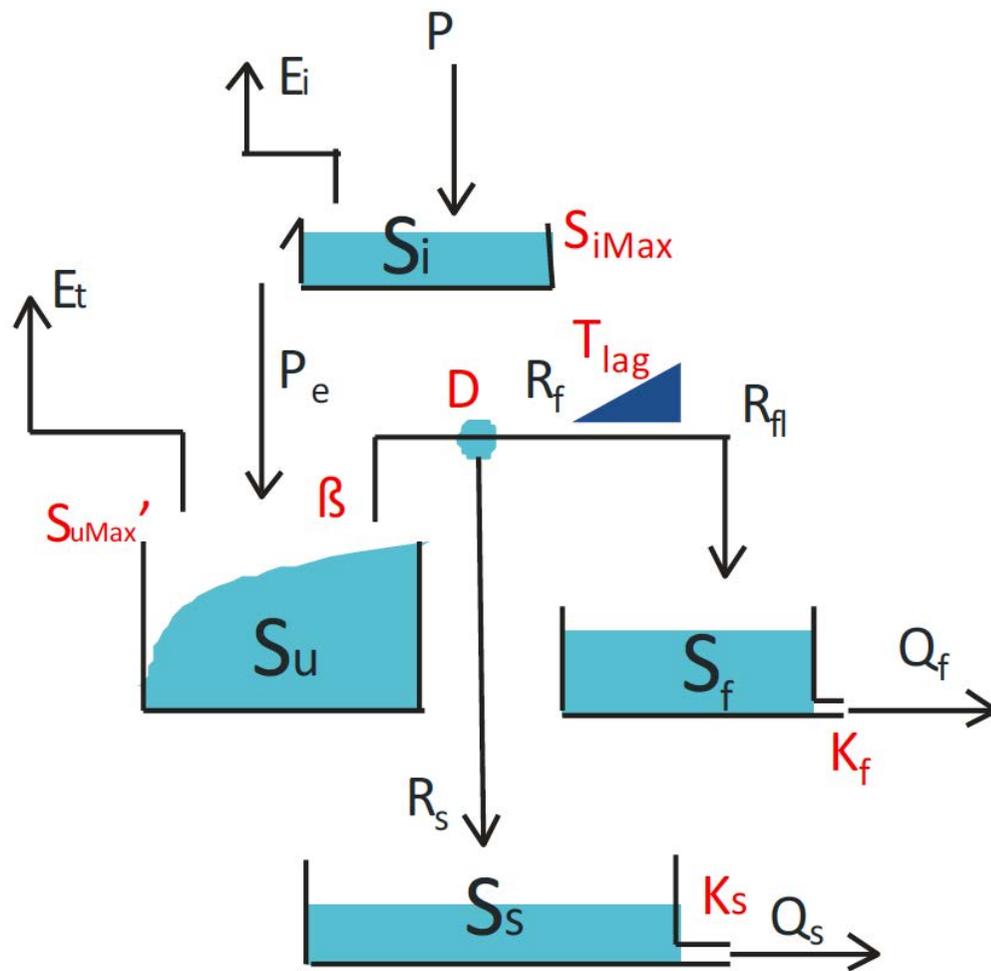
# **Are People Unique**

In designing their storage this way?

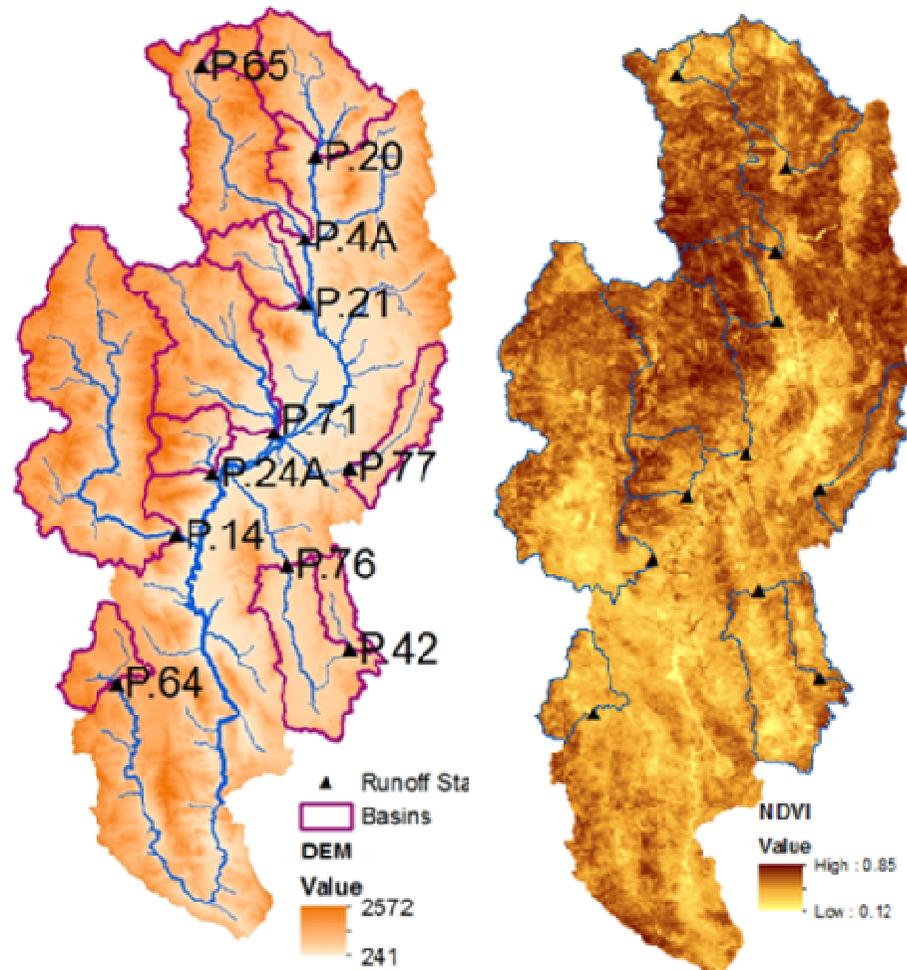
# Root storage design



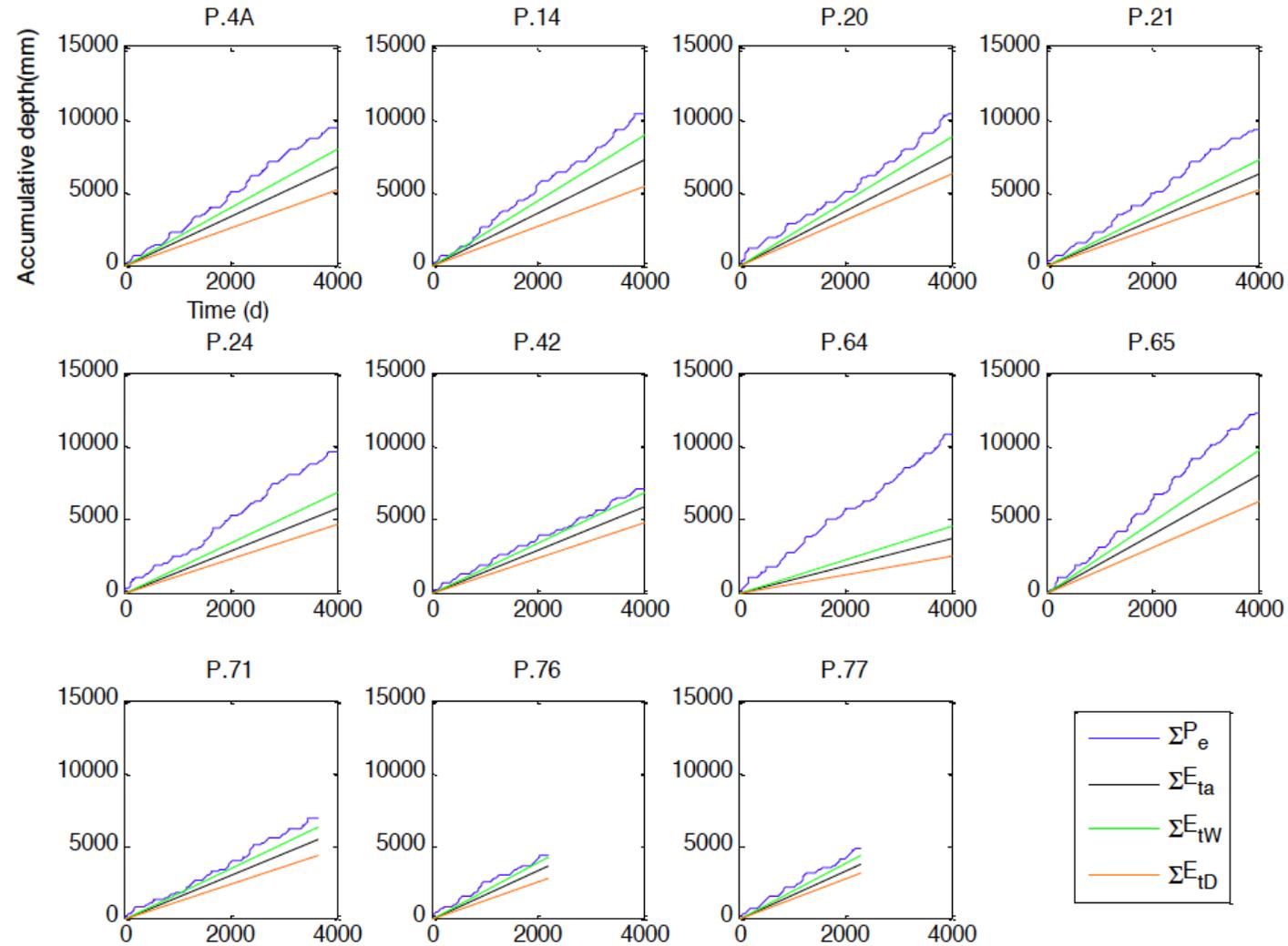
# Root storage in Models



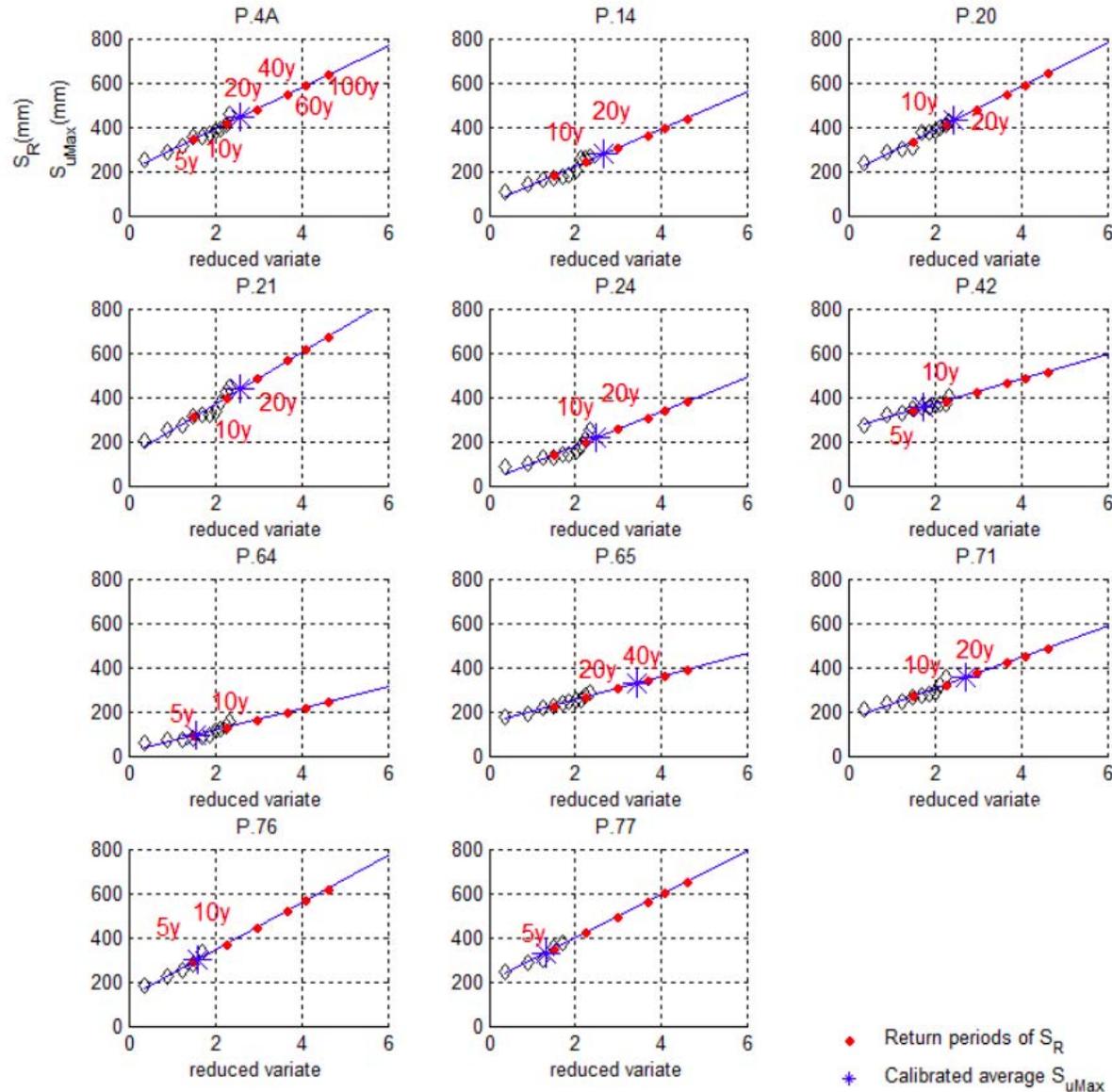
# Upper Ping, Thailand



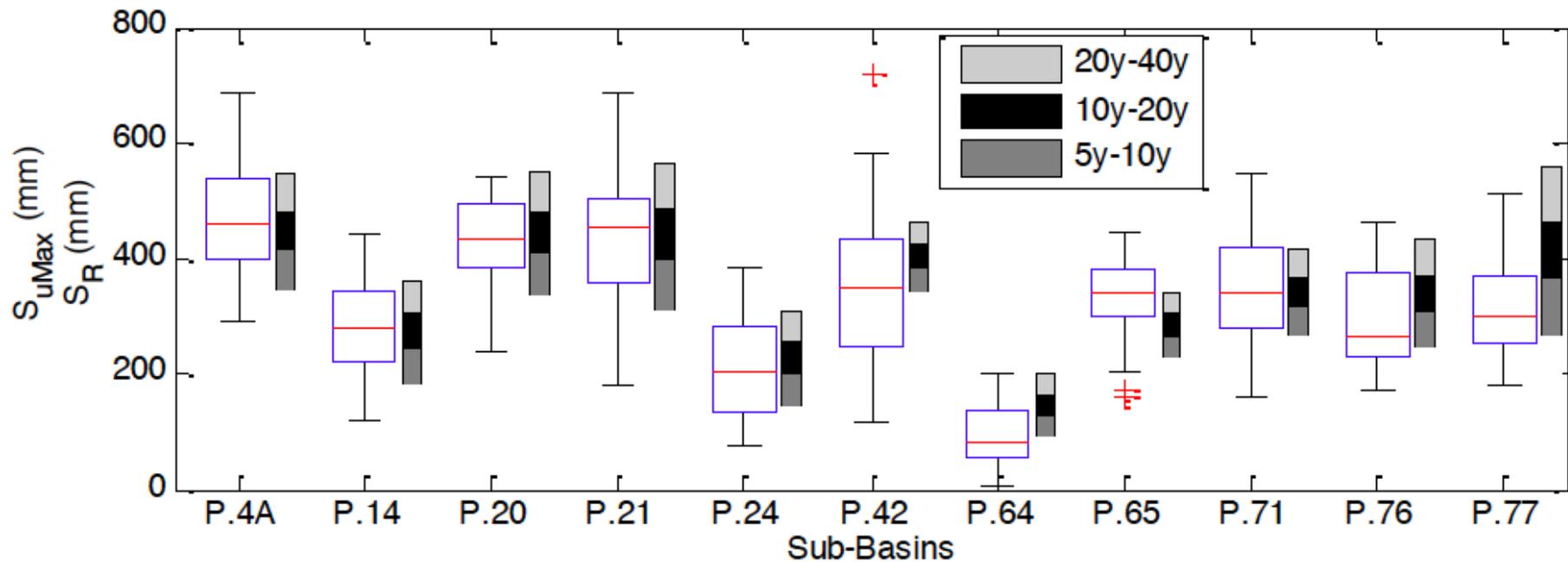
# 11 sub-catchments



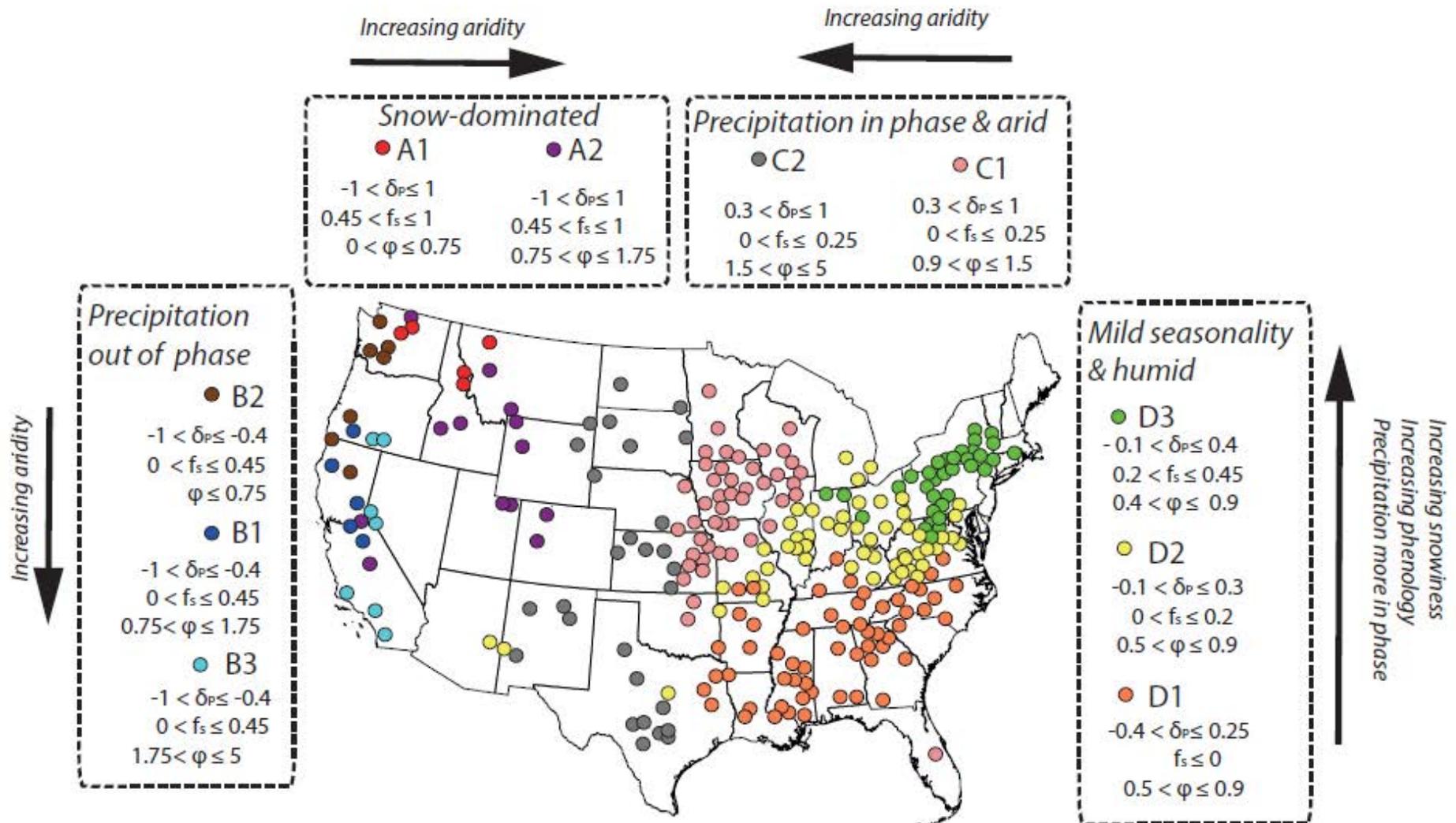
# Gumbel extremes



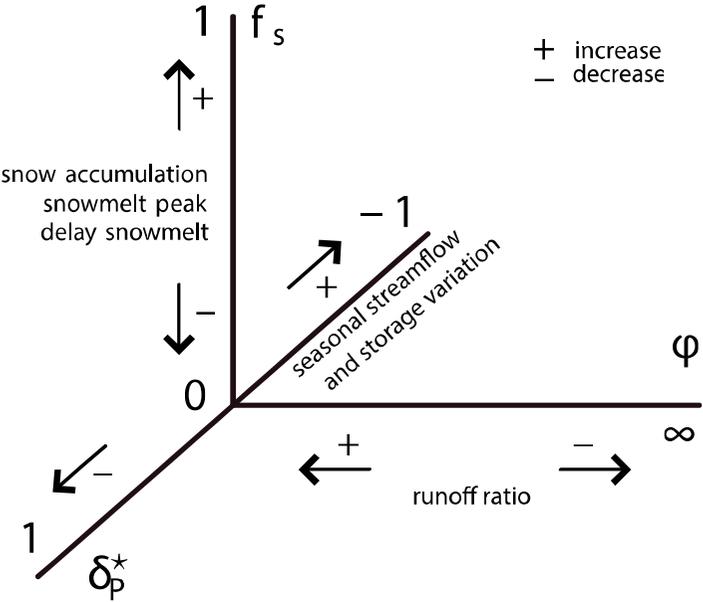
# Comparing design storage with calibrated storage



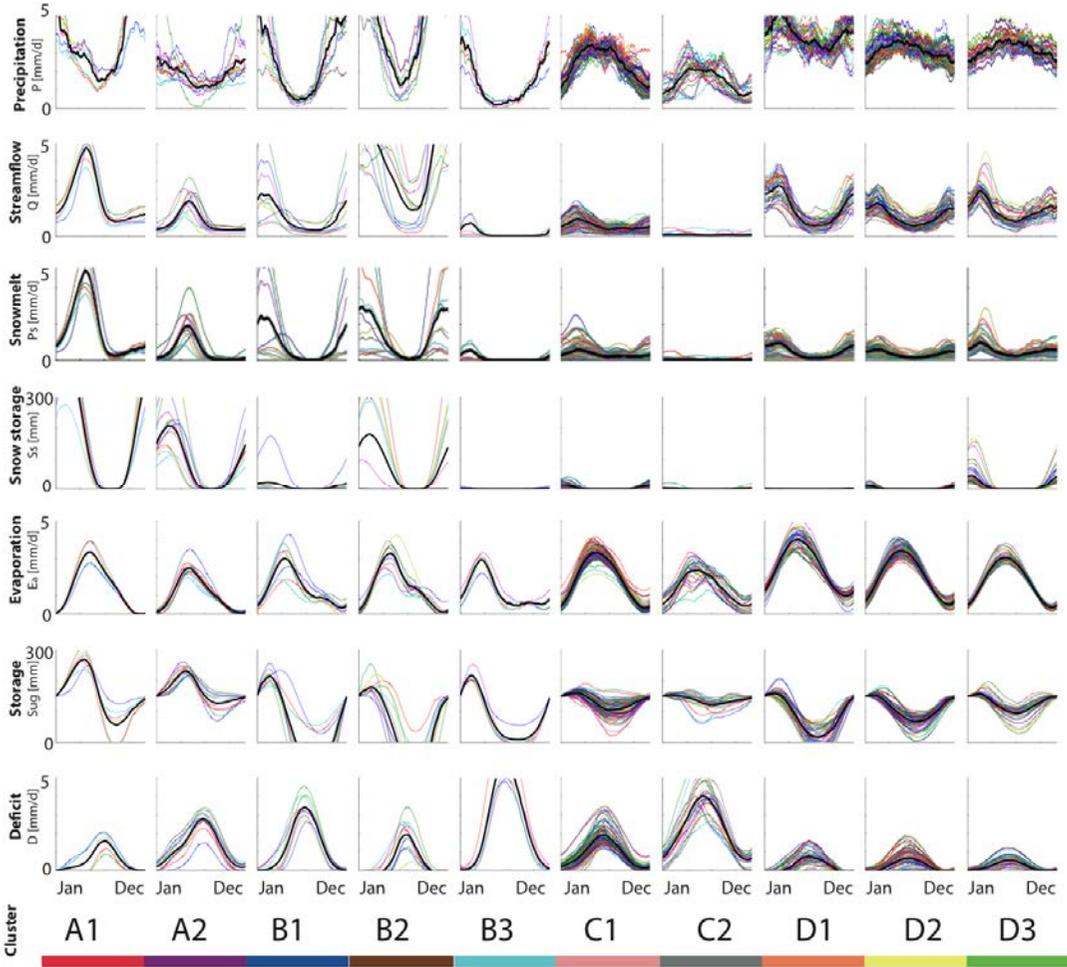
# Validation in Mopex Data Set



# Classification

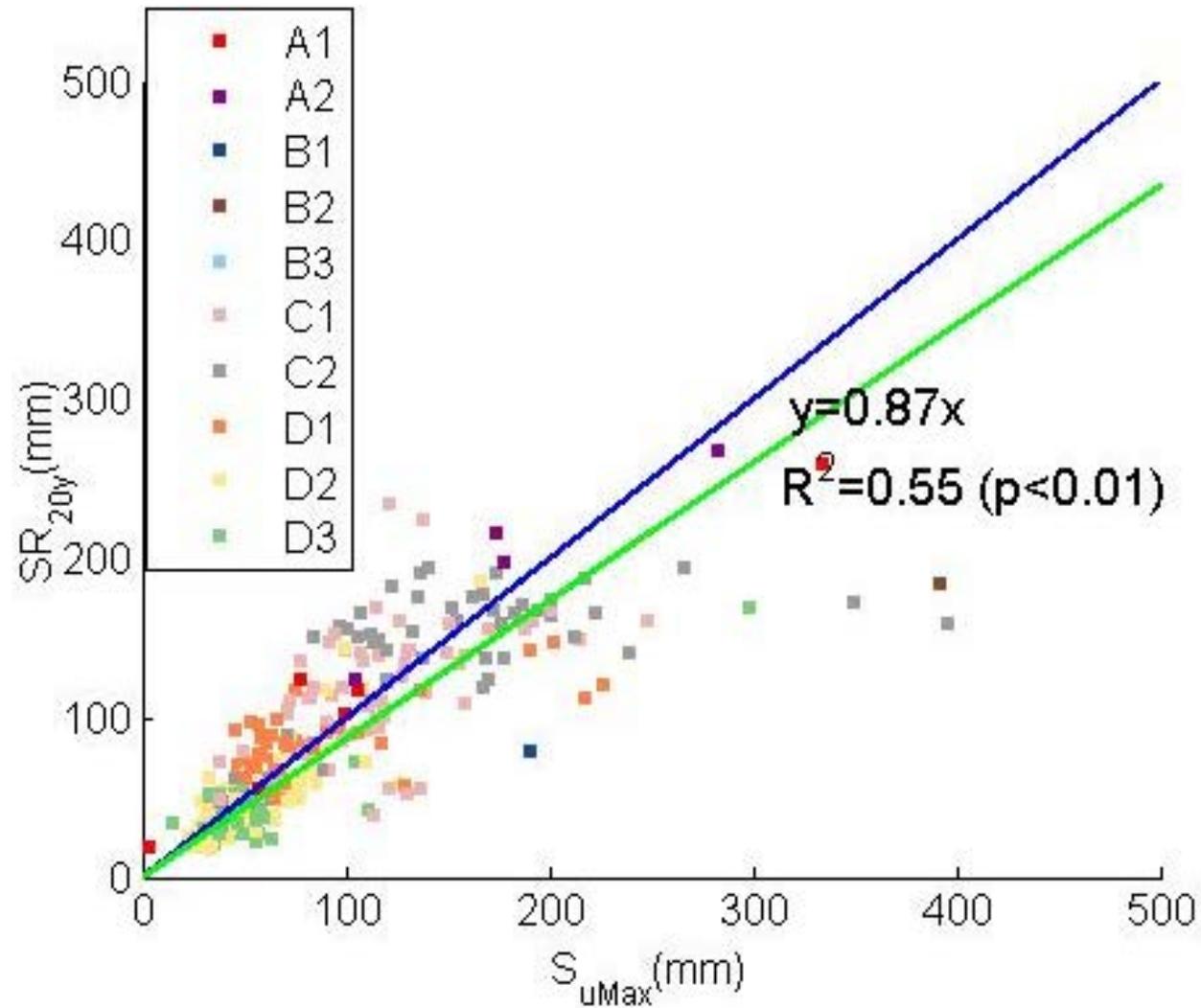


1. Seasonality
2. Aridity
3. Snowiness

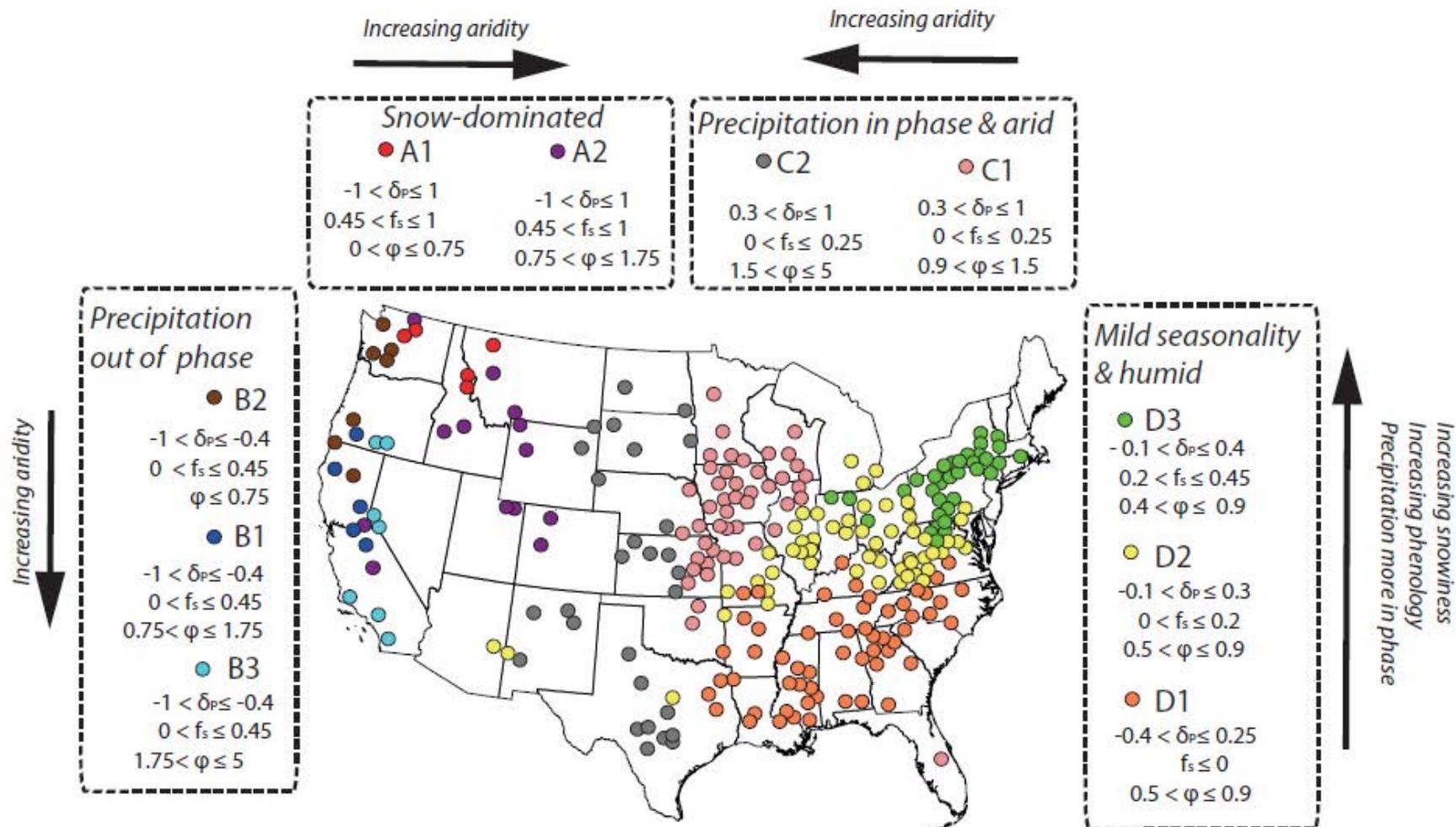


Berghuijs et al., 2014, WRR (under review)

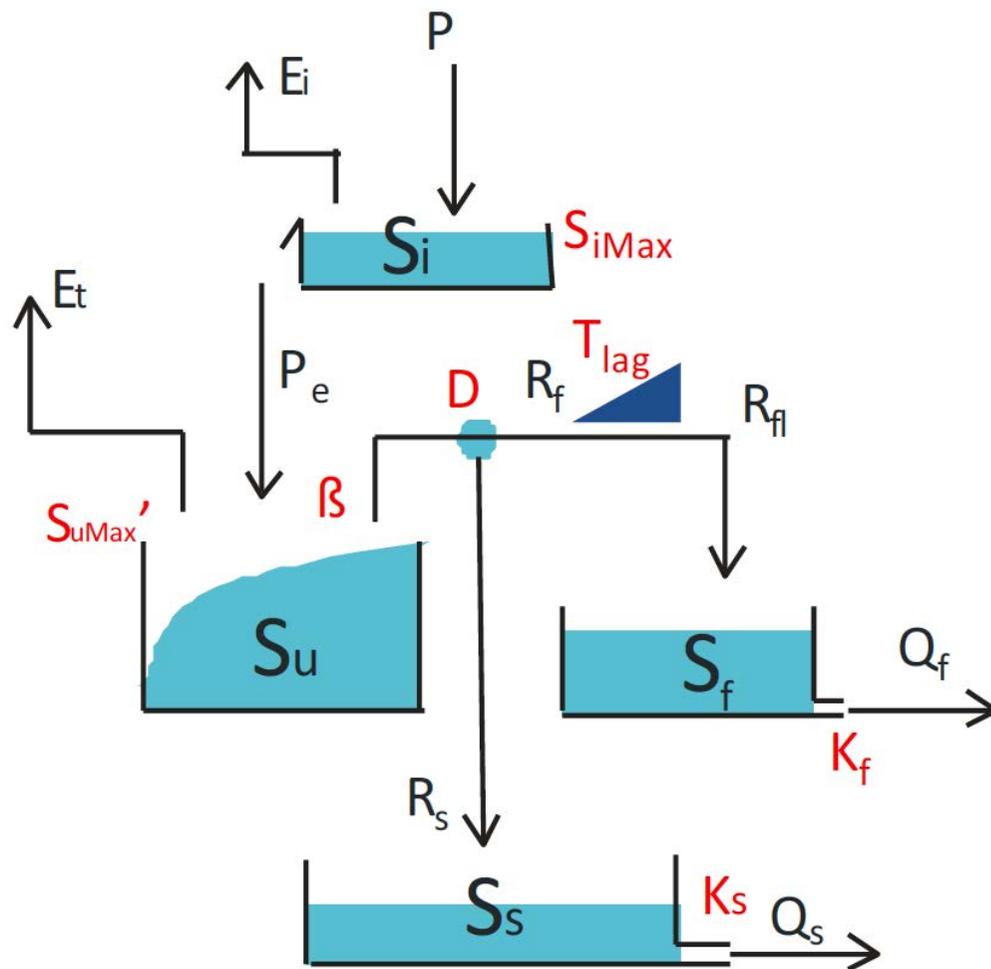
# 20 year memory comparison



# Outliers in C2 (arid areas)



# Models are alive !



**Root zone storage is the  
result of  
co-evolution**

**Root zone storage is  
essentially the result of  
an ecosystem  
interacting with the  
climate**