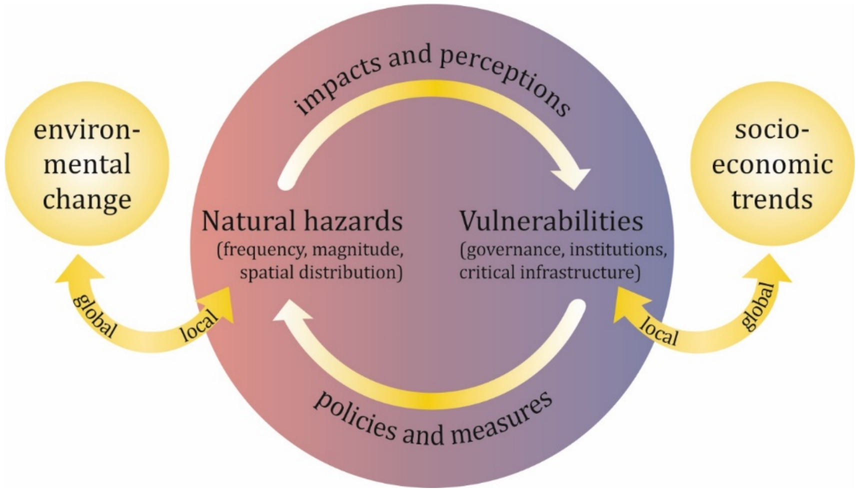
Natural hazards and vulnerability:
The Baltic Sea region in a rapidly changing world



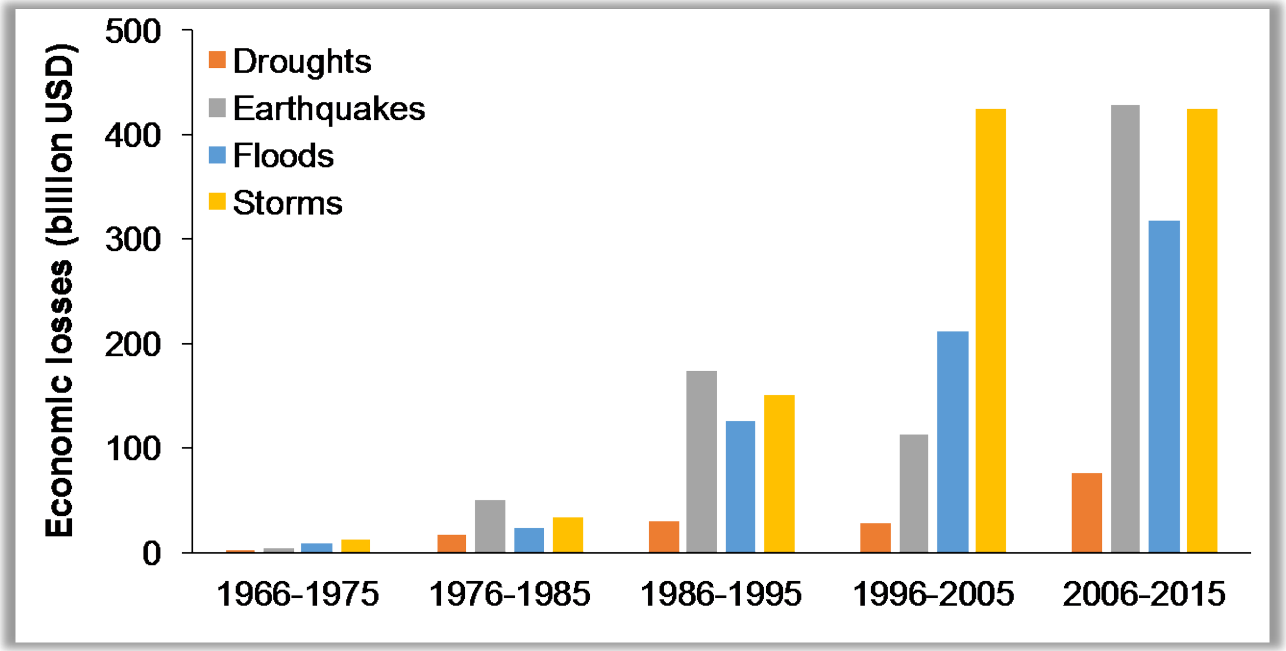
Giuliano Di Baldassarre, Beatriz Quesada Montano, Daniel Nohrstedt, Johanna Mård, Steffi Burchardt, Cecilia Albin, Sara Bondesson, Korbinian Breinl, Frances Deegan, Diana Fuentes, Marc Lopez, Mikael Granberg, Lars Nyberg, Monika Rydstedt Nyman, Emma Rhodes, Anna Rutgersson, Valentin Troll, Stephanie Young, Colin Walch, Charles F. Parker and many other CNDS fellows

Baltic Earth Conference, Helsingor, Denmark, 11-14 June 2018

CNDS – A joint initiative by Uppsala University, Karlstad University and Swedish Defence University

“To protect,
or not to protect.”

Global figures: Increasing losses



Source: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

Baltic Sea region

Impact of natural hazards
Drought, extreme temperature, floods and storms in Estonia, Latvia, Lithuania, Sweden (1977-2013):

- **Fatalities** = 237 people
- **Economic losses** = 3 925 873 000 US Dollars

These figures are underestimated

- Global dataset (EM-DAT) –some events are missing
- Only direct damage –no account for cascading events

Source: EM-DAT: The Emergency Events Database - Universite catholique de Louvain (UCL) - CRED, D. Guha-Sapir, Brussels, Belgium

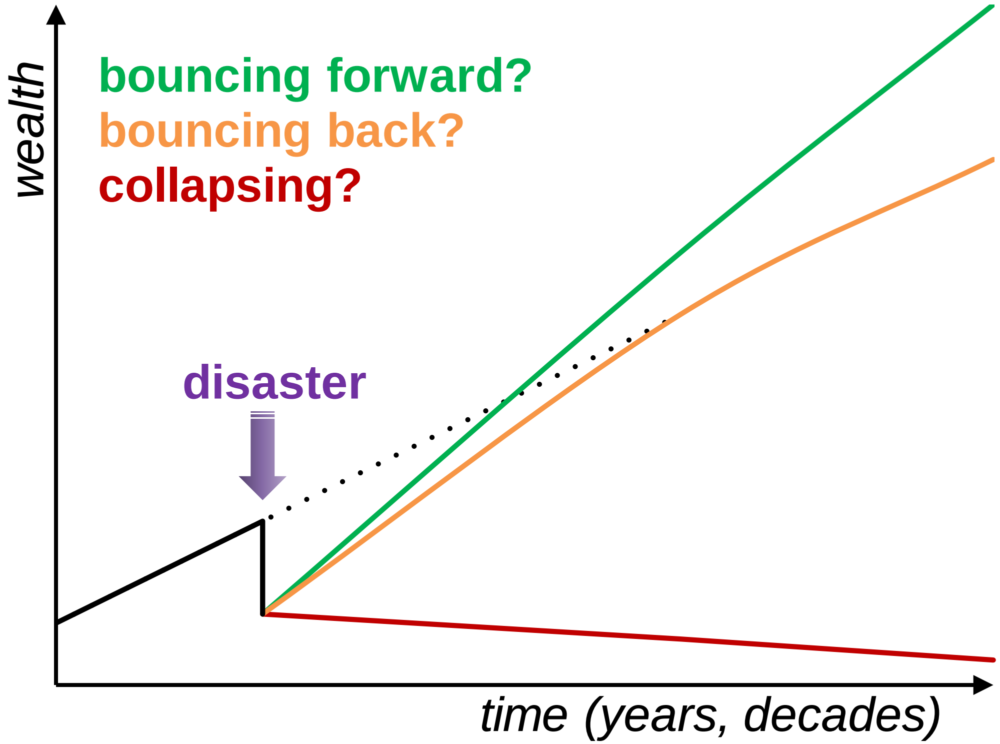
MS Estonia disaster 1994

The ship sank in 1994 in the Baltic Sea in one of the worst maritime disasters of the 20th century, with 852 lives lost.

Soomer et al. (International Journal of Legal Medicine, 2001)

Fundamental Questions

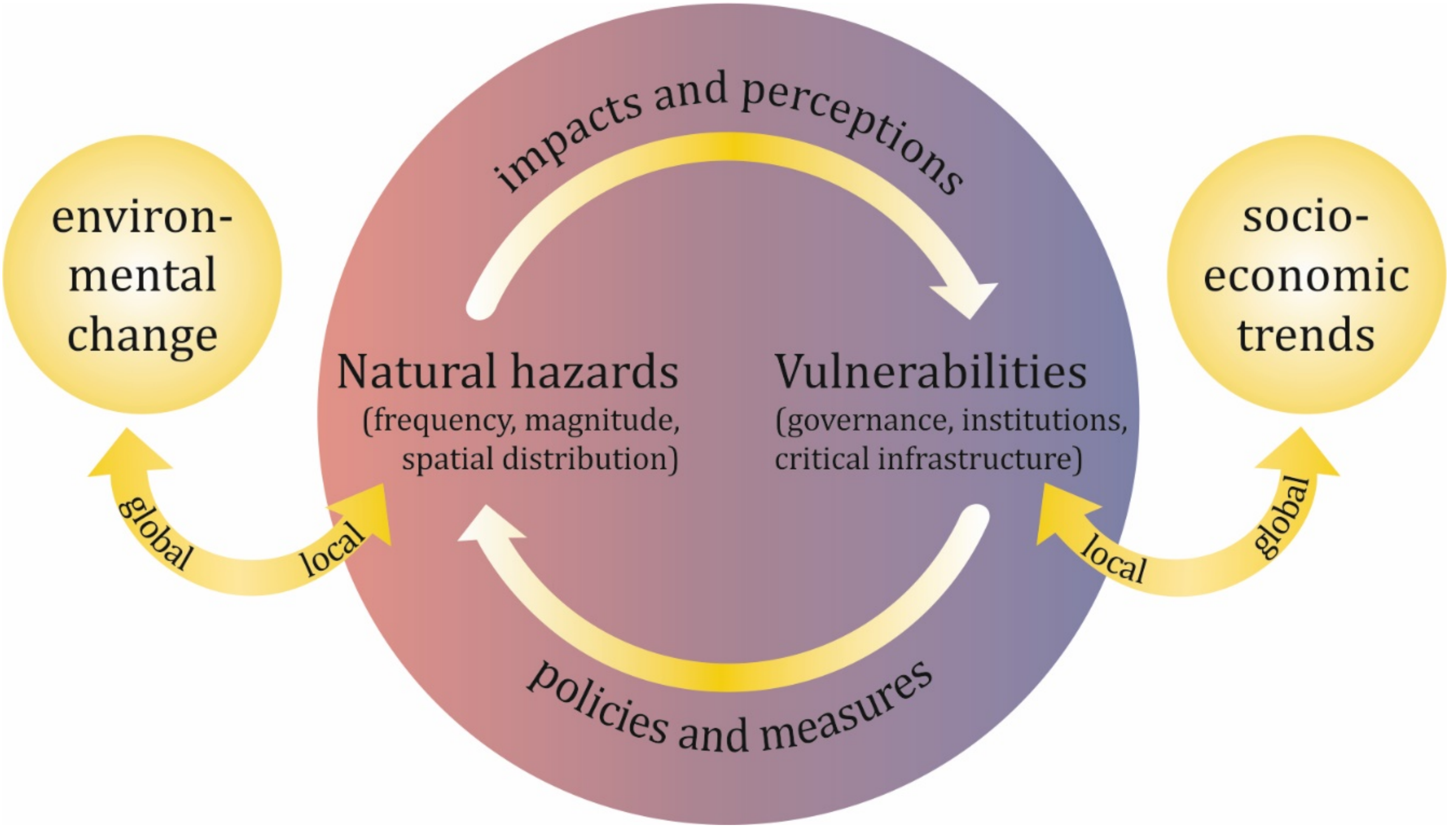
What makes socio-natural systems fragile, robust or resilient?



Di Baldassarre et al. (Earth's Future, 2018)

Research Framework

The Nexus of Natural Hazards and Socio-Technical Vulnerabilities



Di Baldassarre et al. (Earth's Future, 2018)

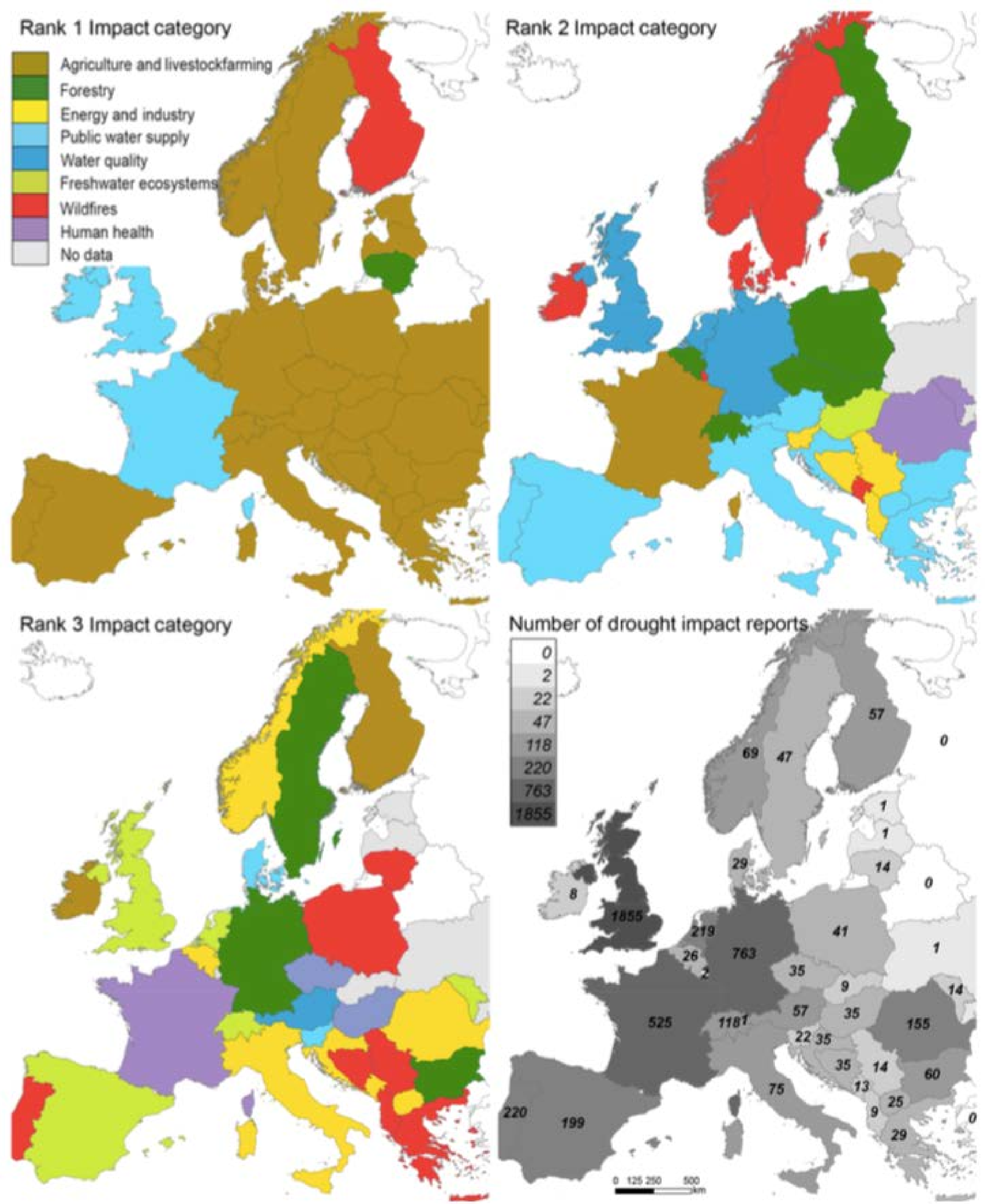
Drought:
Less water than “normal”

European Drought Impact report Inventory (EDII)

Research database
about 5000 impact reports
from 33 European countries

Baltic Sea region:

- Agriculture
- Wildfires
- Forestry
- Public Water Supply



Stahl et al. (Nat. Haz. & Earth System Sci., 2016)

Drought in Sweden: Fiction or reality?

Ecological impacts (e.g. fish)


svt NYHETER Nyheter Lokalt Sport SVT Play Barn

SMÅLAND

Torkan hotar djurlivet

Fiskar, insekter, växter och djur. Torkan och det låga vattenståndet i södra Sverige påverkar hela kretsloppet.

Socio-economic impacts
(e.g. agriculture, hydropower)


svt NYHETER Nyheter Lokalt Sport SVT Play Barn

GÄVLEBORG

Lena Hägglunds kor behöver 14.000 liter vatten per dag. Här berättar hon om oron för vattenbristen. Foto: Markus Dahlberg/SVT

Många brunnar riskerar sina i sommar

Det kan bli rekordlåga grundvattennivåer i landet i sommar. Många med egna brunnar riskerar få slut på dricksvatten. En av de lantbrukare som ligger i riskområdet är Lena Hägglund i Nickora utanför Njutånger.


svt NYHETER Nyheter Lokalt Sport SVT Play Barn

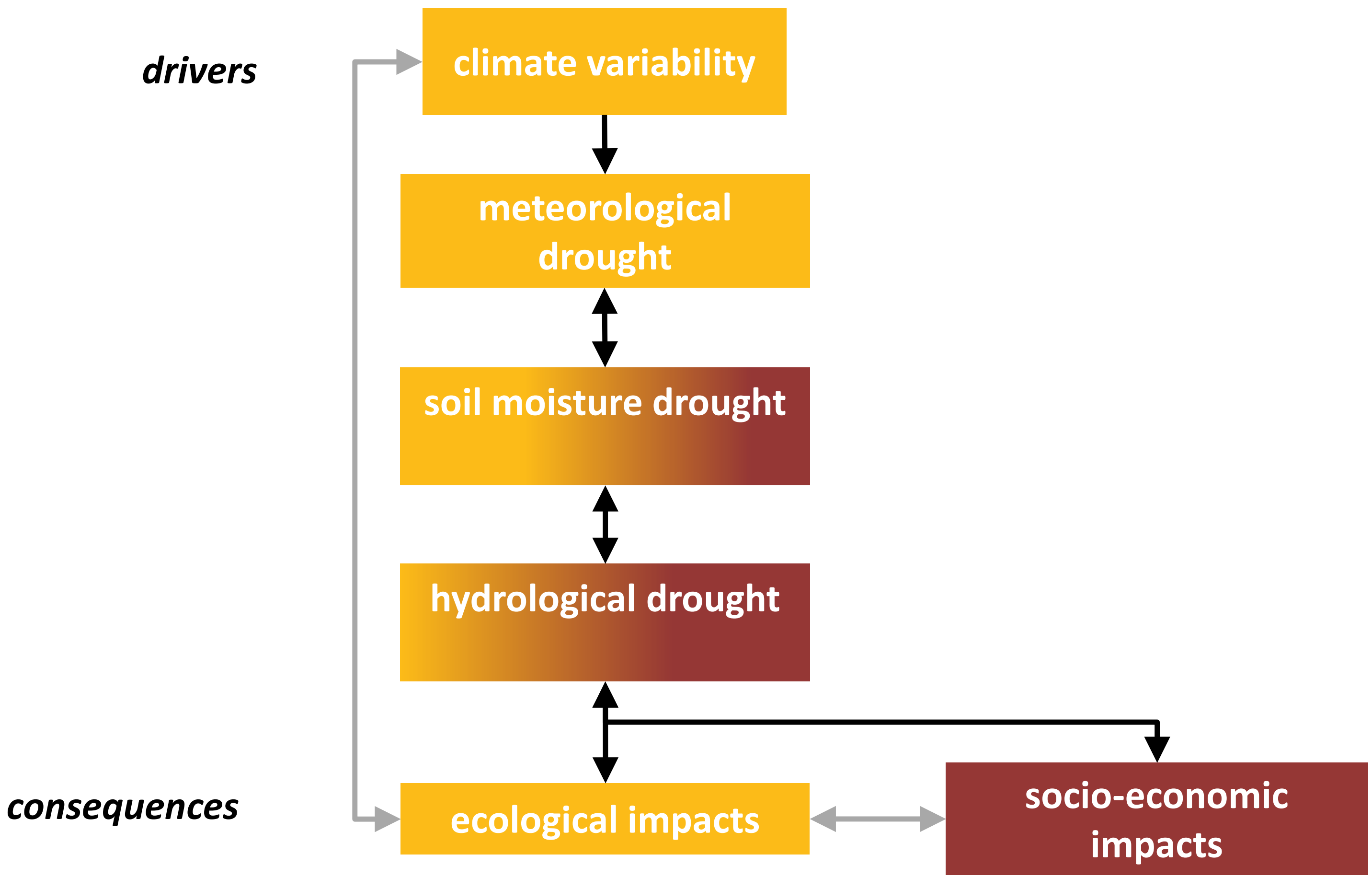
VÄRMLAND

Grete Algesten, vattenförvaltare på länsstyrelsen, varnar för att de låga vattennivåerna kan få konsekvenser för den värmländska vattenkraften. Foto: SVT

Låga vattennivåer drabbar vattenkraften

Vattennivåerna i länet är fortsatt mycket lägre än normalt och blir vattenbristen långvarig kan det få konsekvenser för vattenkraften i Värmland och miljöerna kring vattenkraftverken.

Drought propagation

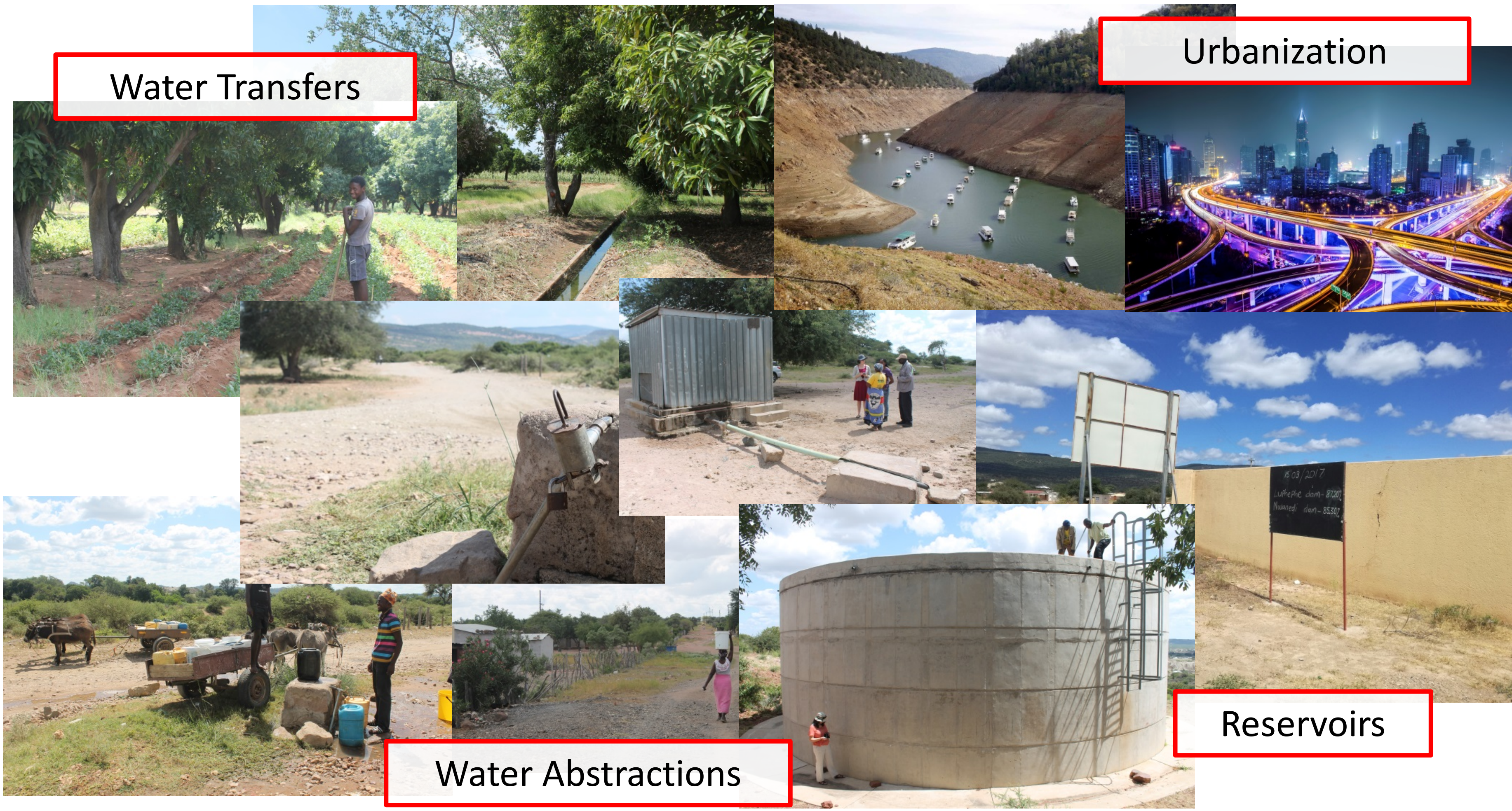


(Van Loon et al., Nature Geoscience, 2016)

Human activities

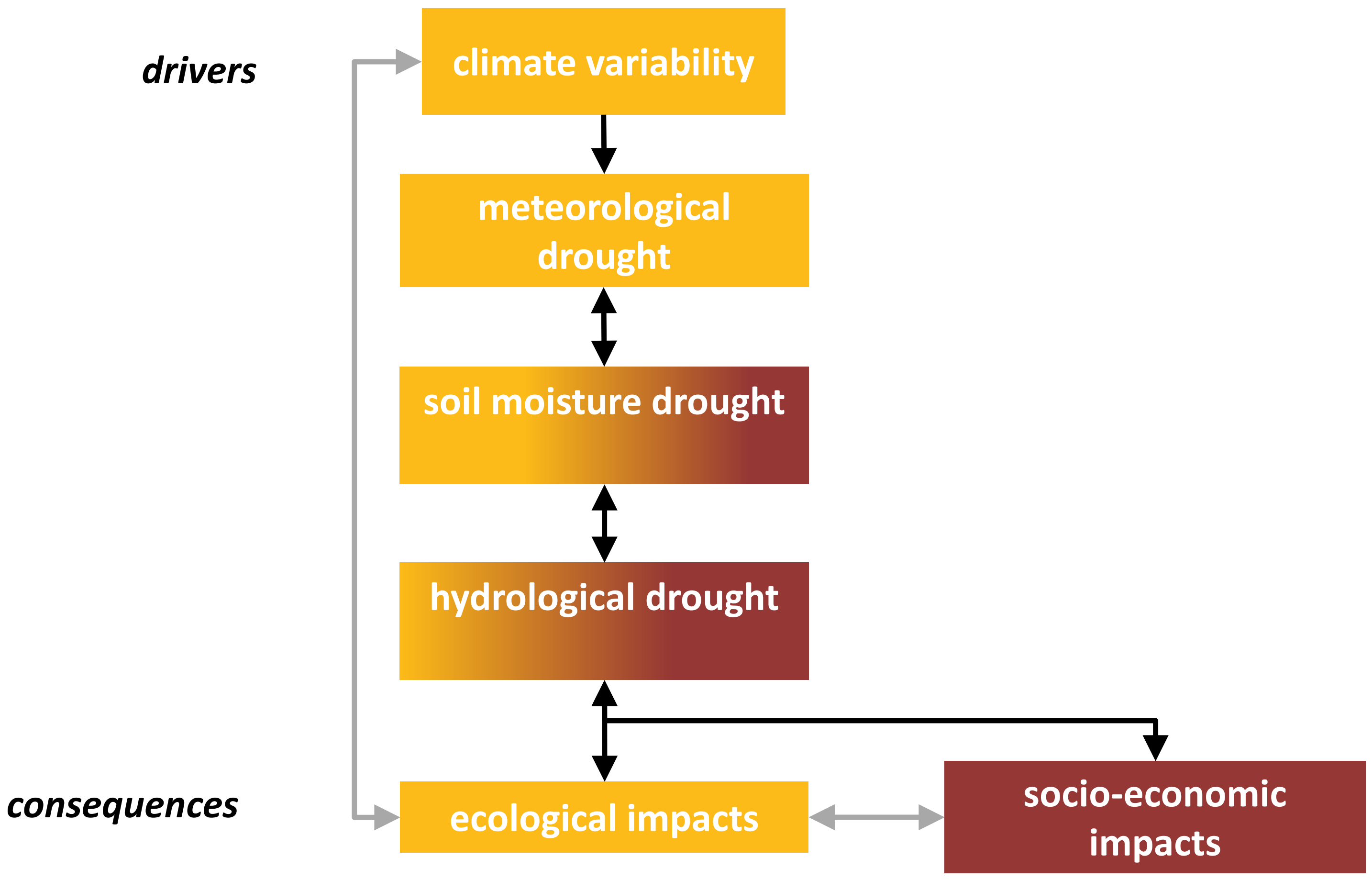
Human alteration of hydrological droughts (Anthropocene)

- Deliberate: Water management, disaster risk reduction, etc.
- Accidental: Land-use change, Compound effects, etc.



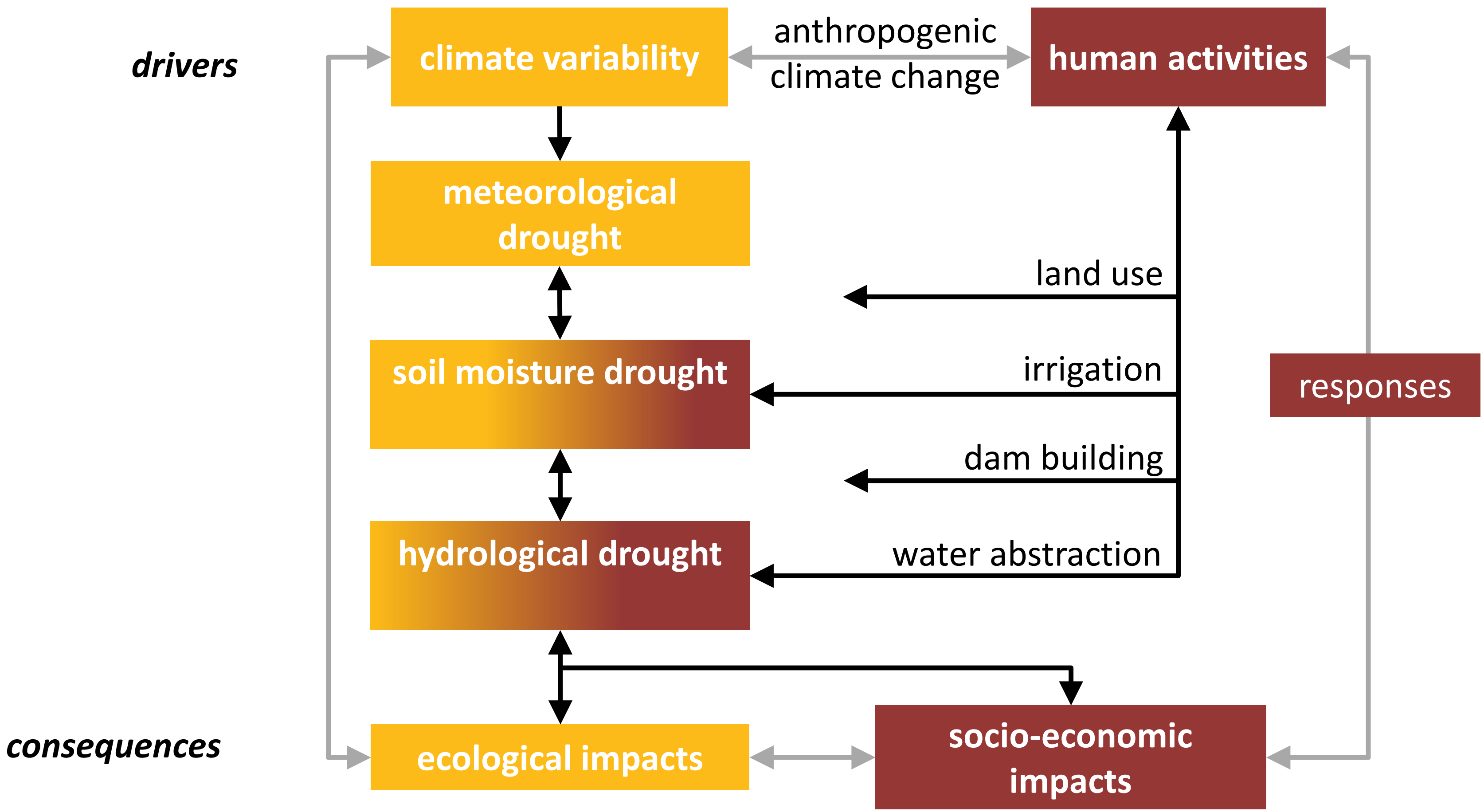
(Source: Sally Rangecroft)

Drought propagation



(Van Loon et al., Nature Geoscience, 2016)

Human-drought interactions



(Van Loon et al., Nature Geoscience, 2016)

Dams and reservoirs

- **Water shortages:** Supply-below-demand events

- **Reservoirs' intended benefits (among others):** Secure water supply
    - More than 50% in GRaND database

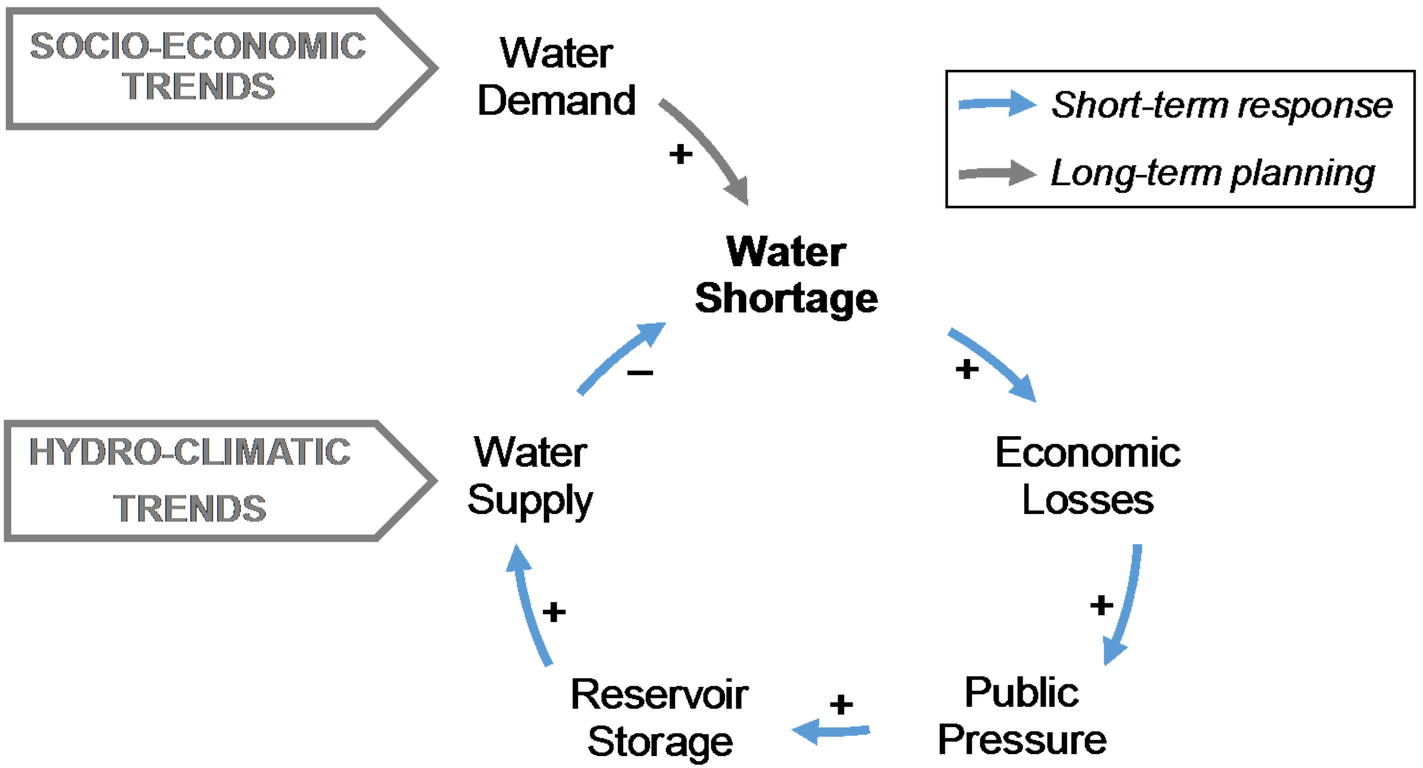
Riga's water reservoir (Source: Latvenergo.lv)

Unintended consequences

- **Reservoirs or other types of water infrastructure**
  - Supply-demand cycles
  - Reservoir (Titanic) effects

Traditional model

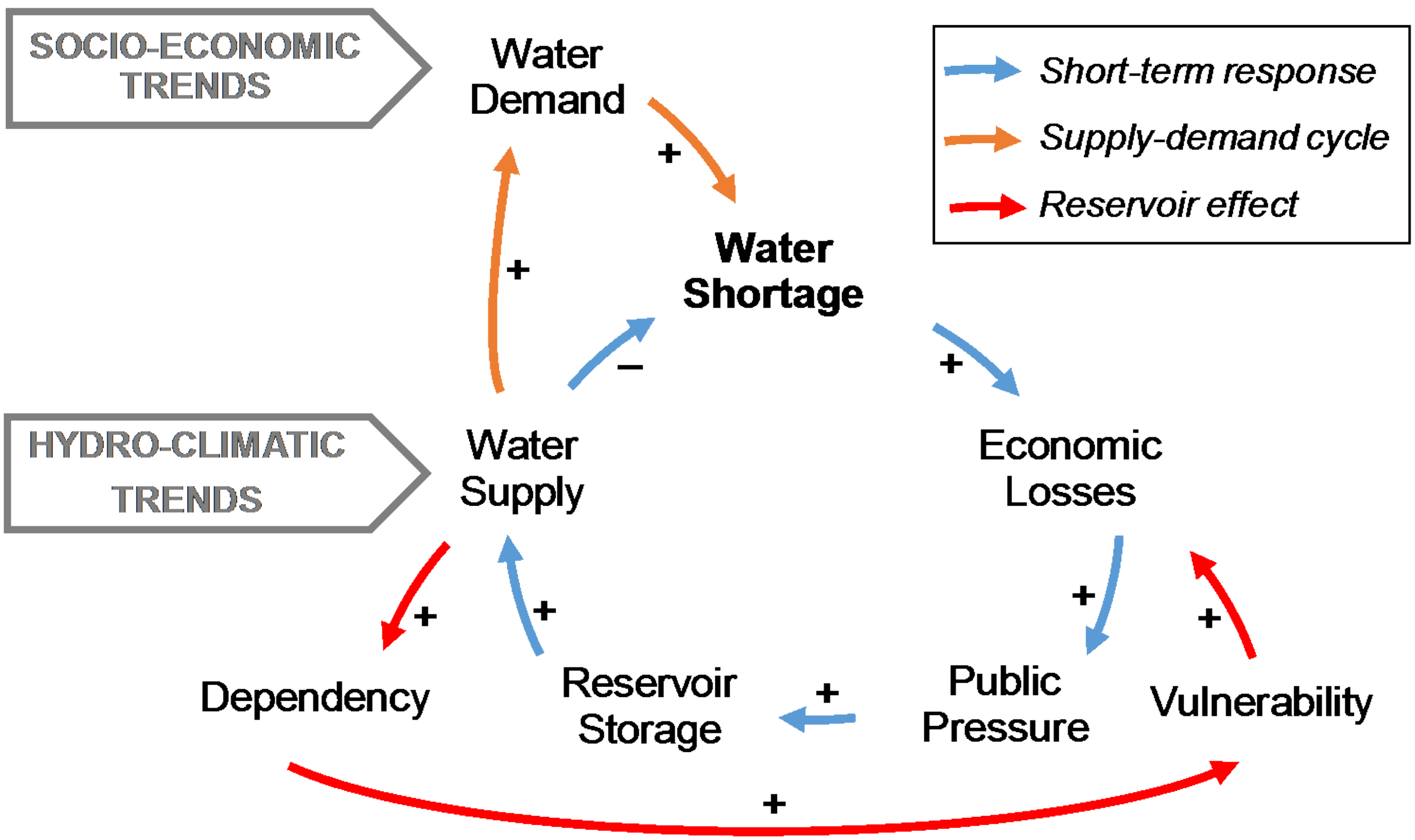
Water management and planning (decadal time scale)



(Di Baldassarre et al., under review)

Socio-hydrological model

Intended benefits and unintended consequences (decadal time scale)

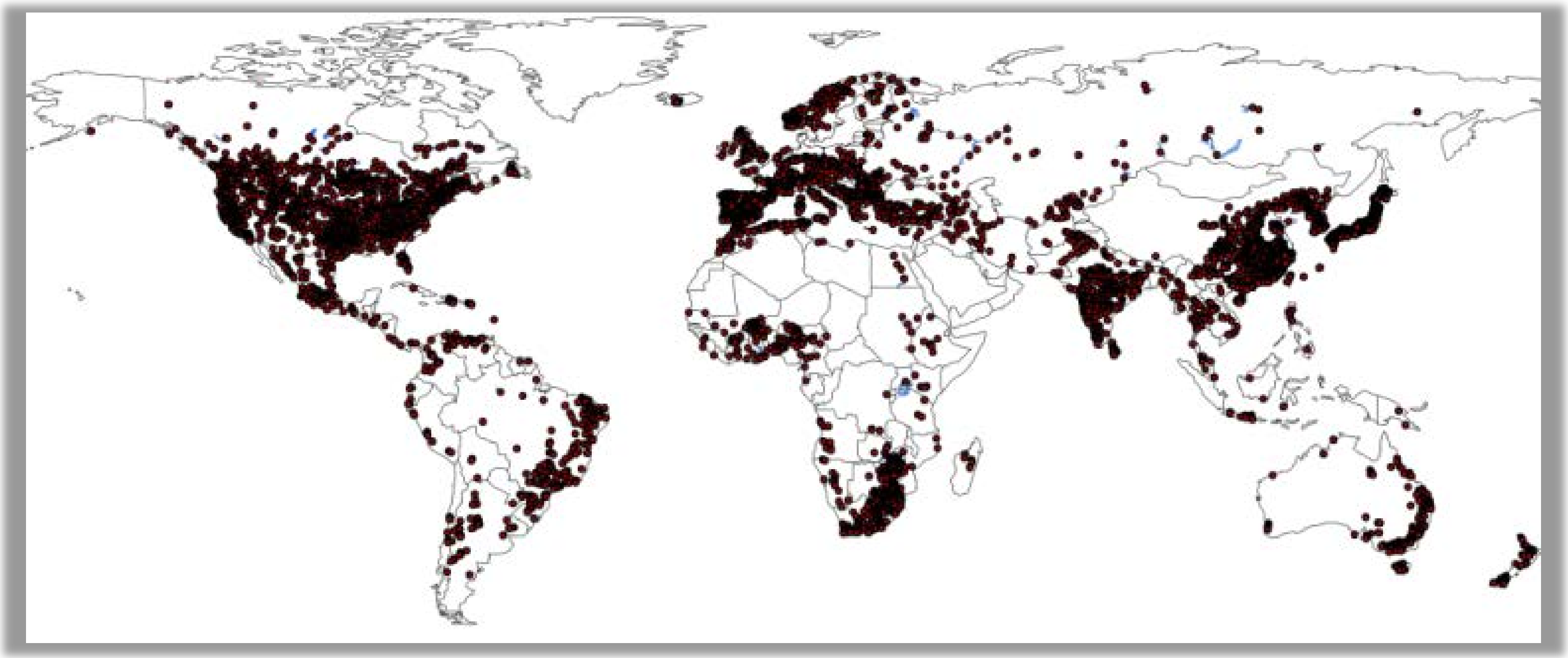


(Di Baldassarre et al., under review)

Global analysis

Reservoir capacity vs. water demand (worldwide)

- GRanD database
- World Bank

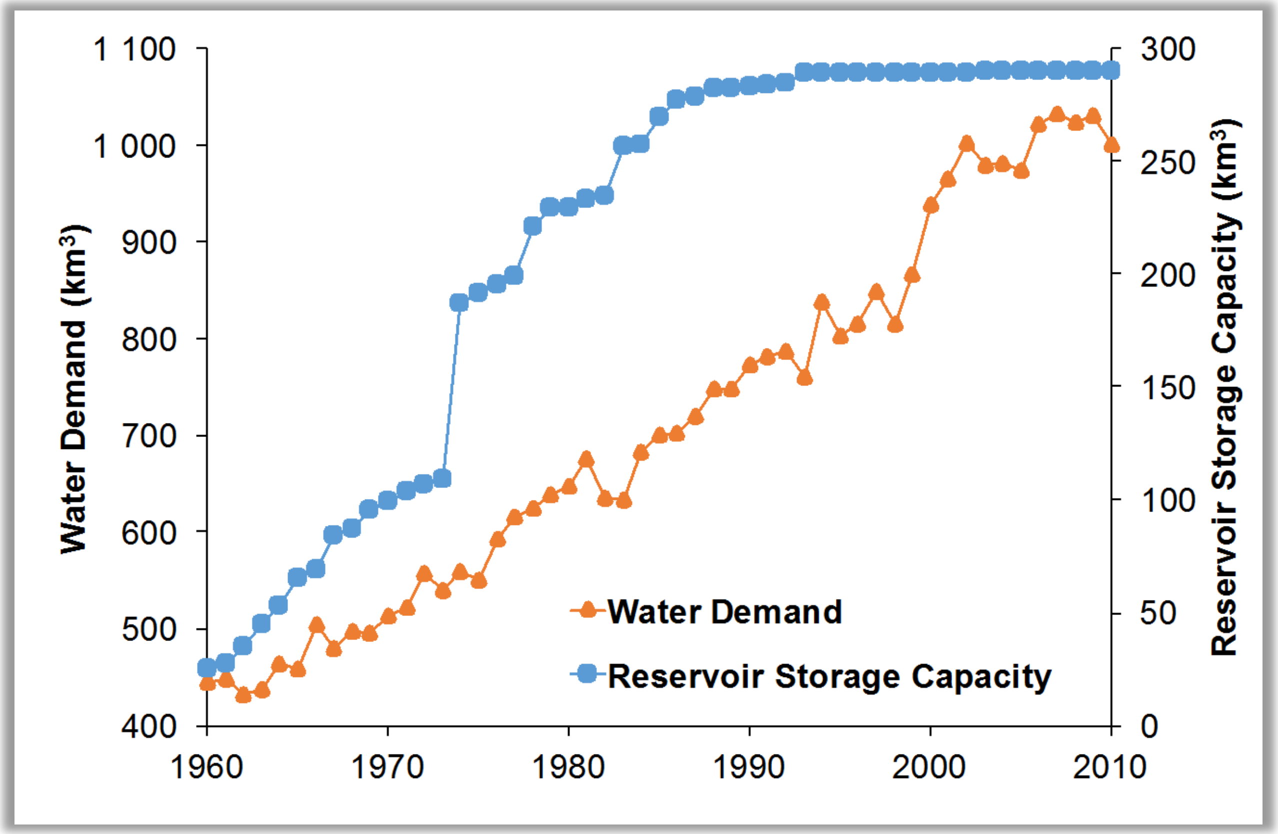


(GRanD database; Lehner et al. 2012)

Global analysis

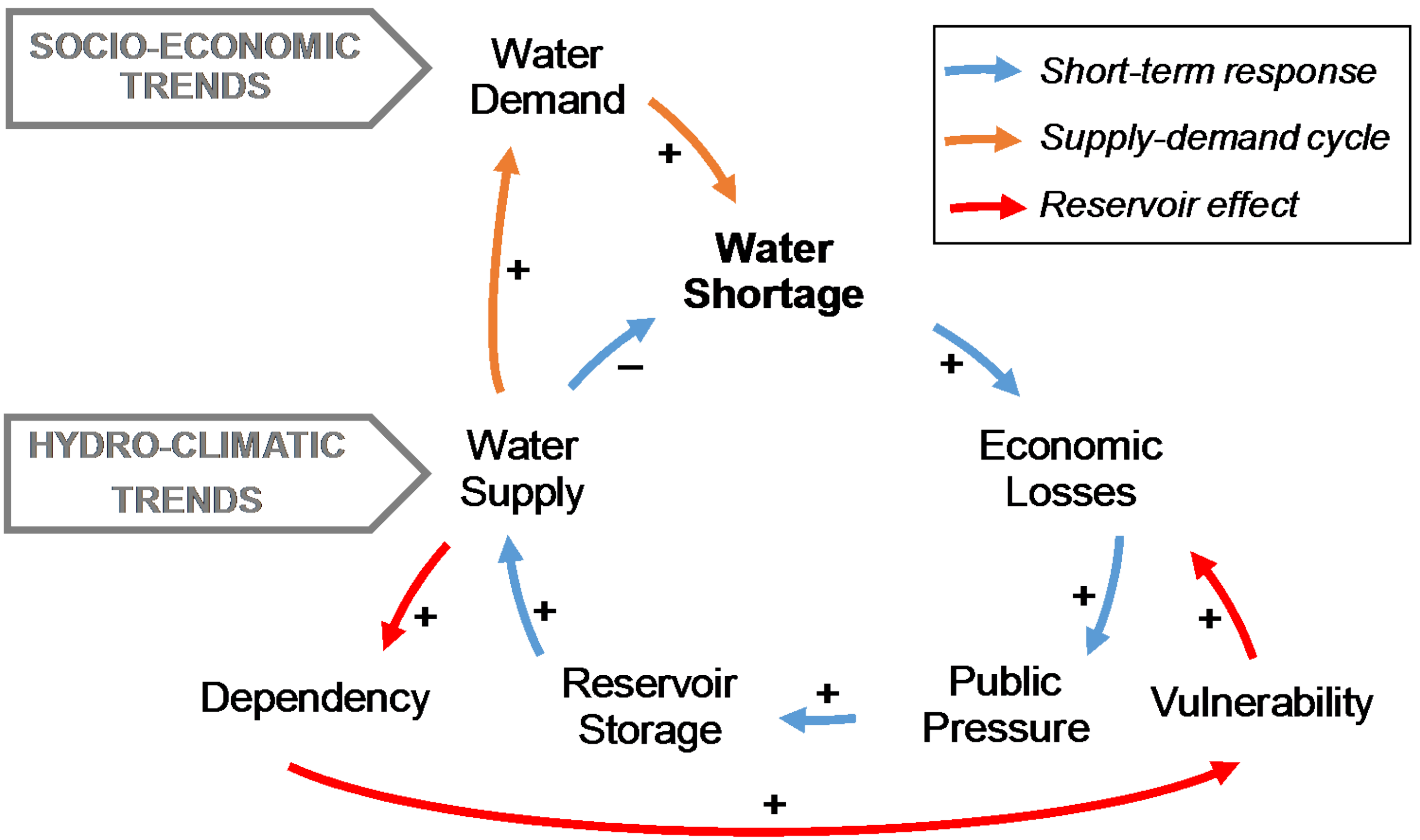
Reservoir capacity vs. water demand (worldwide)

- 1960s and 70s: Faster growth in reservoir capacity
- From 1980s: Faster growth in water demand (likely more shortages)



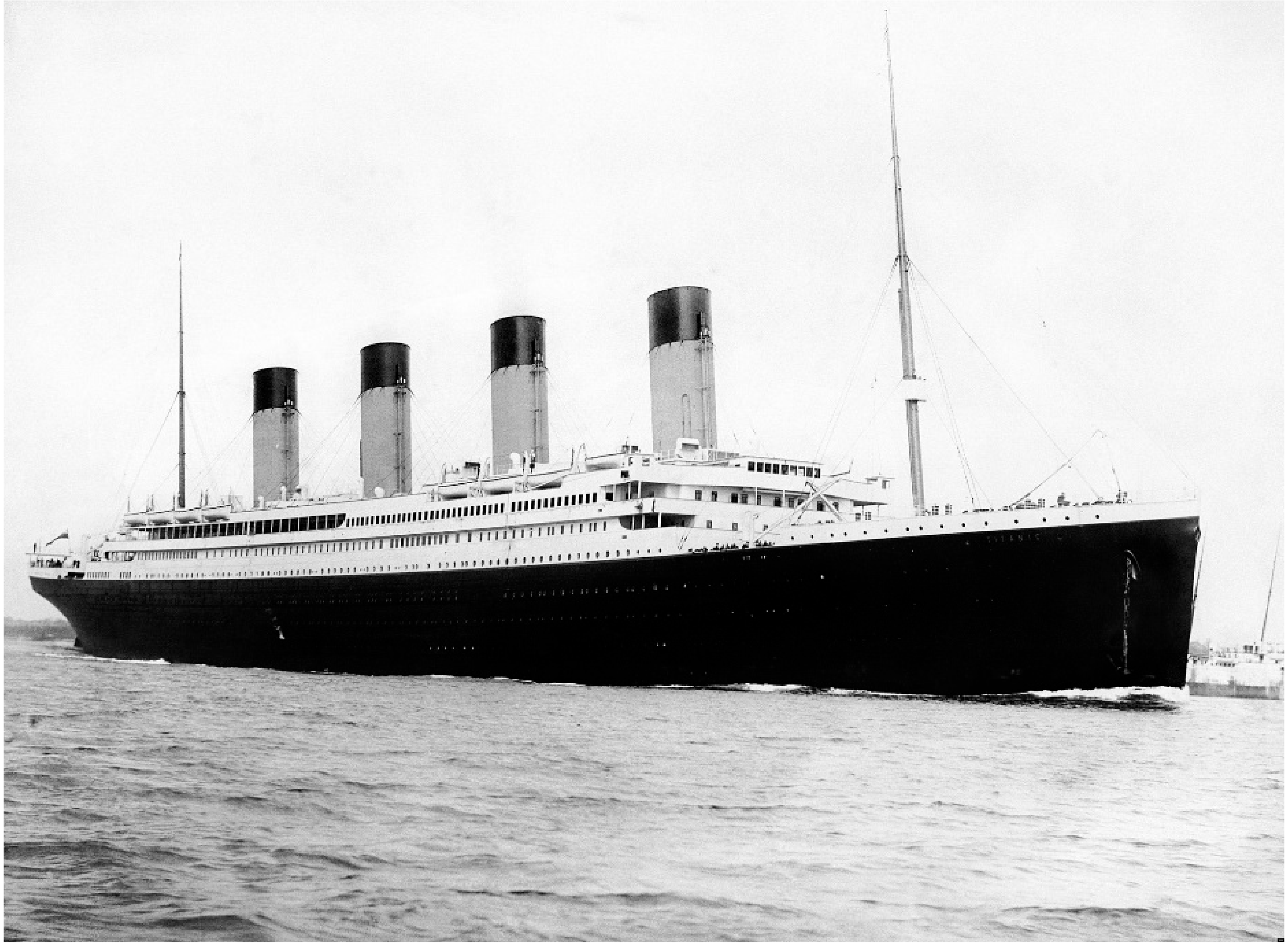
Socio-hydrological model

Intended benefits and unintended consequences (decadal time scale)



(Di Baldassarre et al., under review)

Titanic effect



Kemshall et al., Social Policy & Administration, 1997

Reservoir effect

Heavy reliance on structural protection measures can increase vulnerability!

Drought example: Maja collapse

- Water storage brought benefits and allowed agricultural growth, BUT… …increased dependence on water made people more vulnerable
- Prolonged drought conditions as a plausible hypothesis for collapse

(Aimers & Hodell, Nature, 2011; Lucero, Am Anthropol, 2002; Kuil et al., WRR, 2016)

“To protect,
or not to protect.”

Summary

Interplay of nature and society: New risks and paradoxes

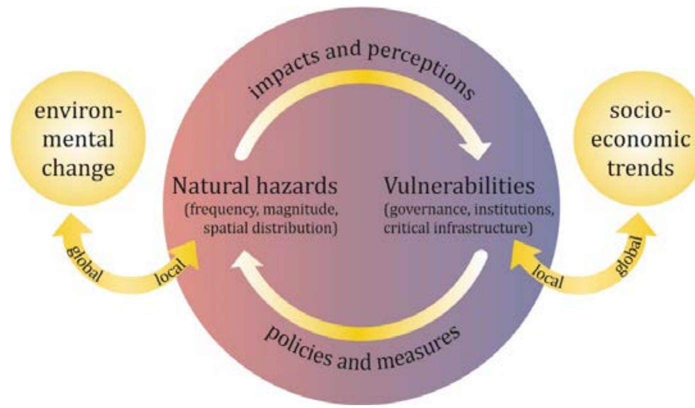
- *Supply-demand cycles, reservoir (or Titanic) effects*

Policy implications

- *Mind structural "protection"*

Research perspectives

- *Empirical and theoretical work*



More details


AGU PUBLICATIONS

Earth's Future

COMMENTARY
10.1002/2017EF000764

Special Section:
Avoiding Disasters:
Strengthening Societal
Resilience to Natural Hazards

An Integrative Research Framework to Unravel the Interplay of Natural Hazards and Vulnerabilities

Giuliano Di Baldassarre[1,2,3], Daniel Nohrstedt[1,4], Johanna Mård[1,2], Steffi Burchardt[1,2], Cecilia Albin[1,5], Sara Bondesson[1,4,6], Korbinian Breinl[1,2], Frances M. Deegan[1,2], Diana Fuentes[1,2], Marc Girons Lopez[1,7], Mikael Granberg[1,8], Lars Nyberg[1,8], Monika Rydstedt Nyman[1,8], Emma Rhodes[1,2], Valentin Troll[1,2], Stephanie Young[1,6], Colin Walch[1,5,9], and Charles F. Parker[1,4]

Acknowledgements

CNDS
Centrum för naturkatastrofslära

Panta Rhei
Everything Flows

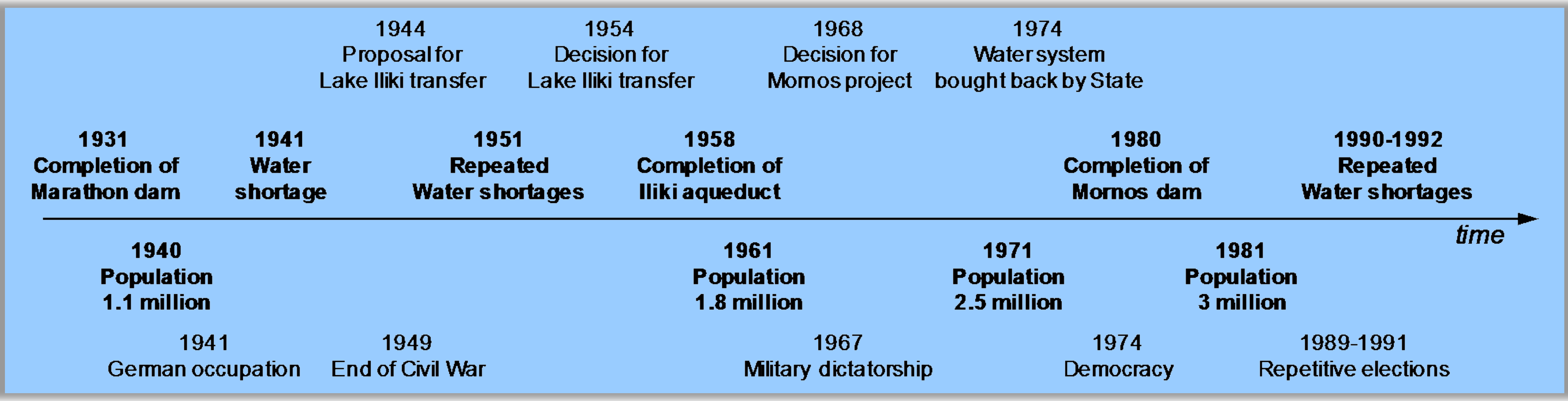
erc
European Research Council
Supporting top researchers
from anywhere in the world

Supply-demand cycle

- Increasing water supply enables increasing water demand
- In the medium-long term this can offset the initial benefits of reservoirs

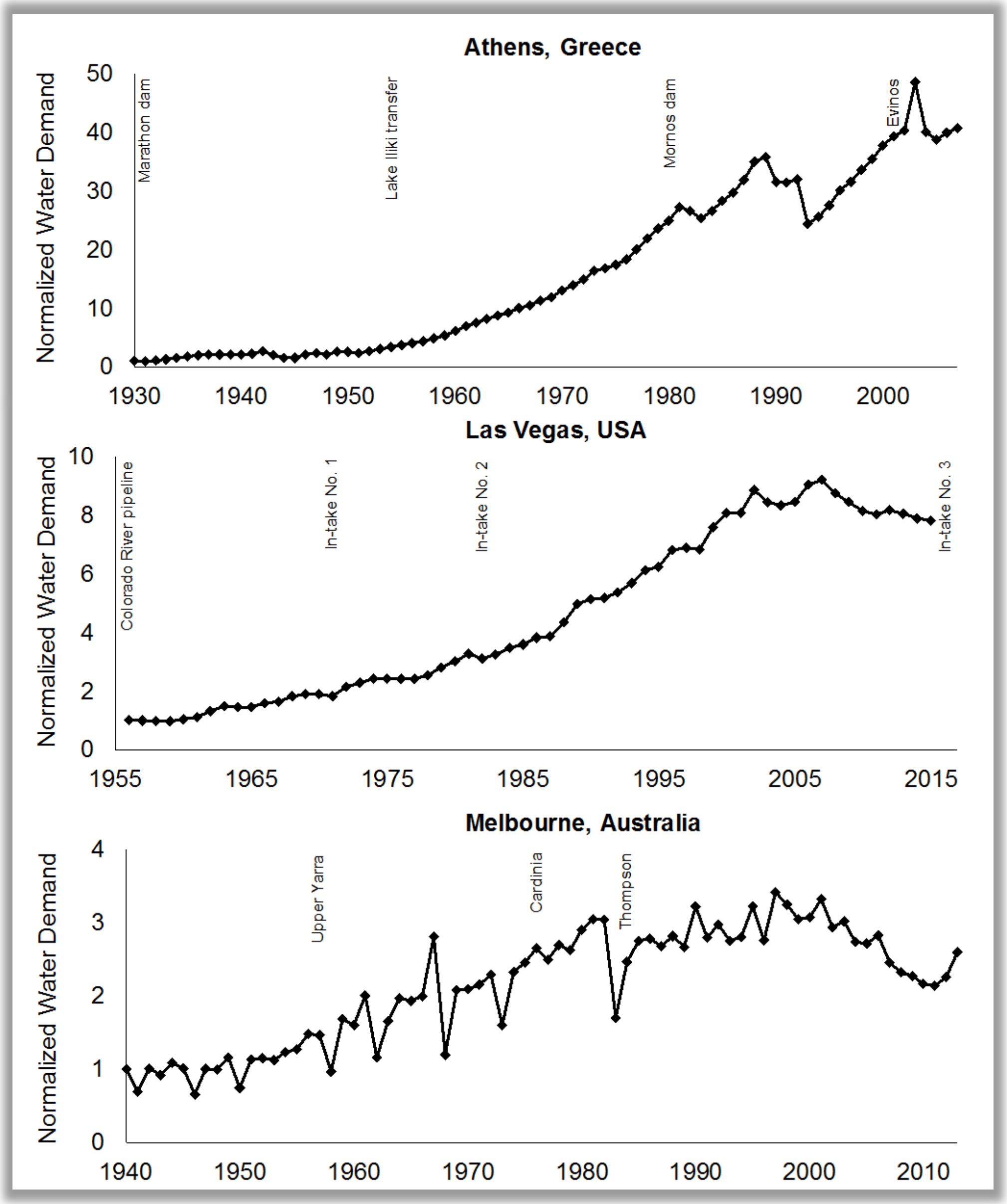
Example: Athens, Greece

- Spiral of increasing supply and demand (co-evolution)



(Kallis, Ecological Economics, 2007)

Supply-demand cycle



(Di Baldassarre et al., under review)