



Water & Society

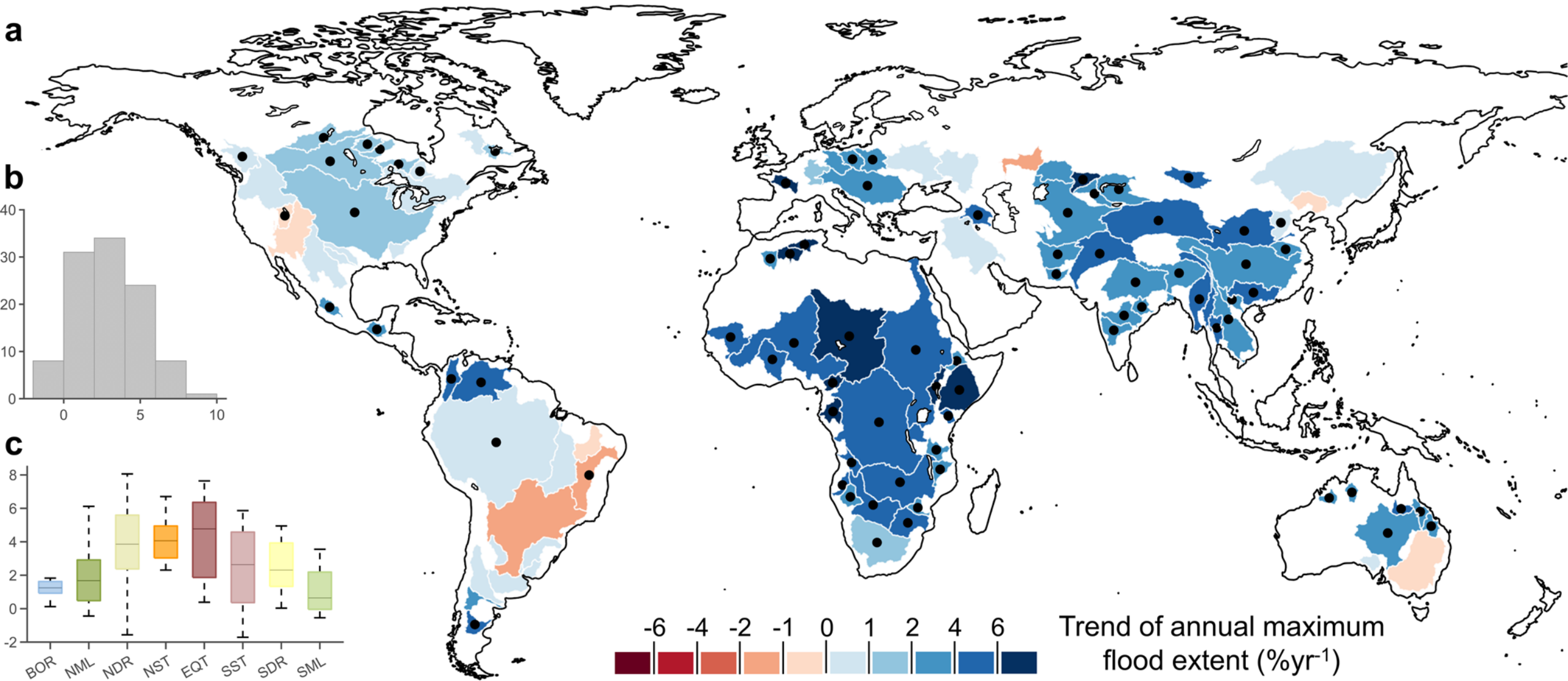
Coping with uncertainty in today's rapidly changing world

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Global trends in water resources

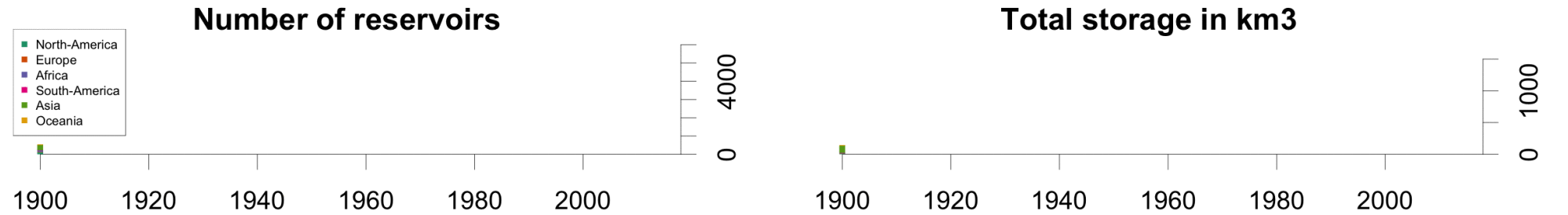
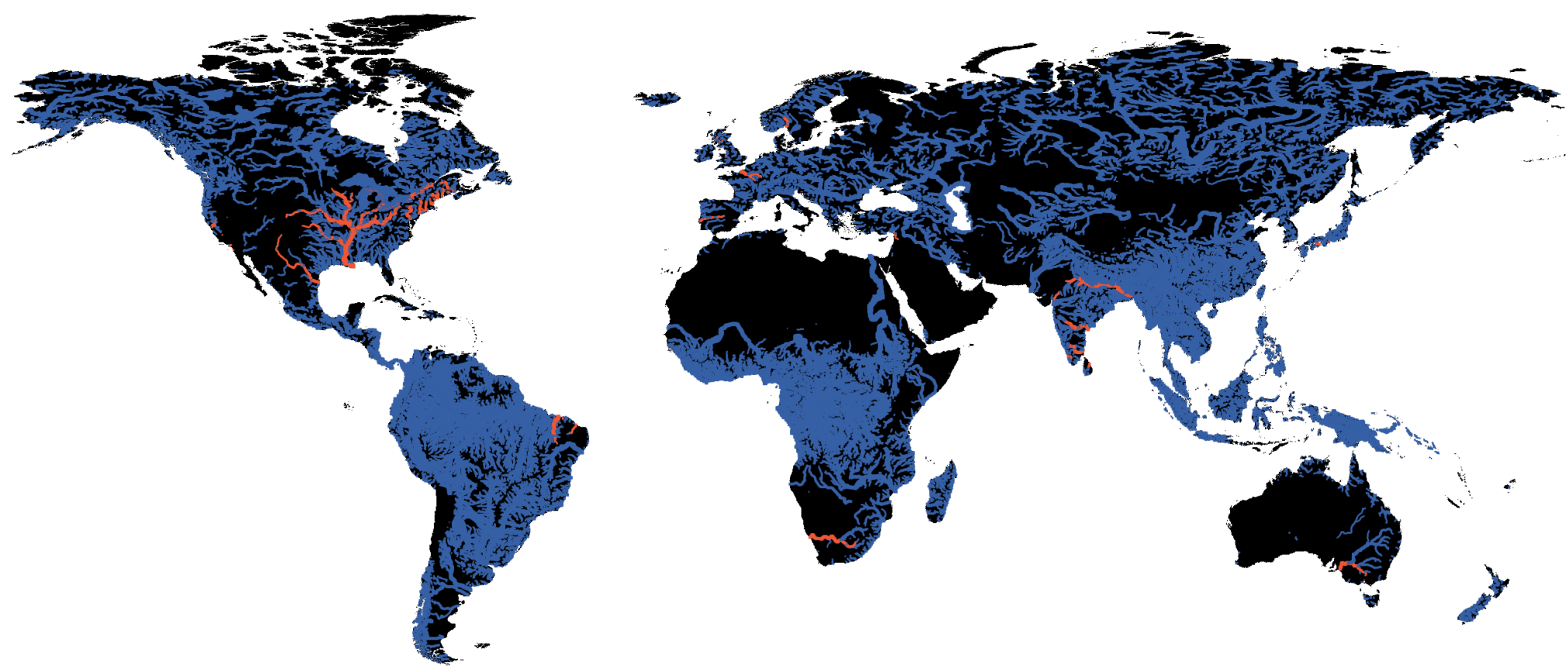
Hydroclimatic variability alone cannot explain changes in surface water dynamics



(Mazzoleni et al., *Communications Earth & Environment*, 2022)

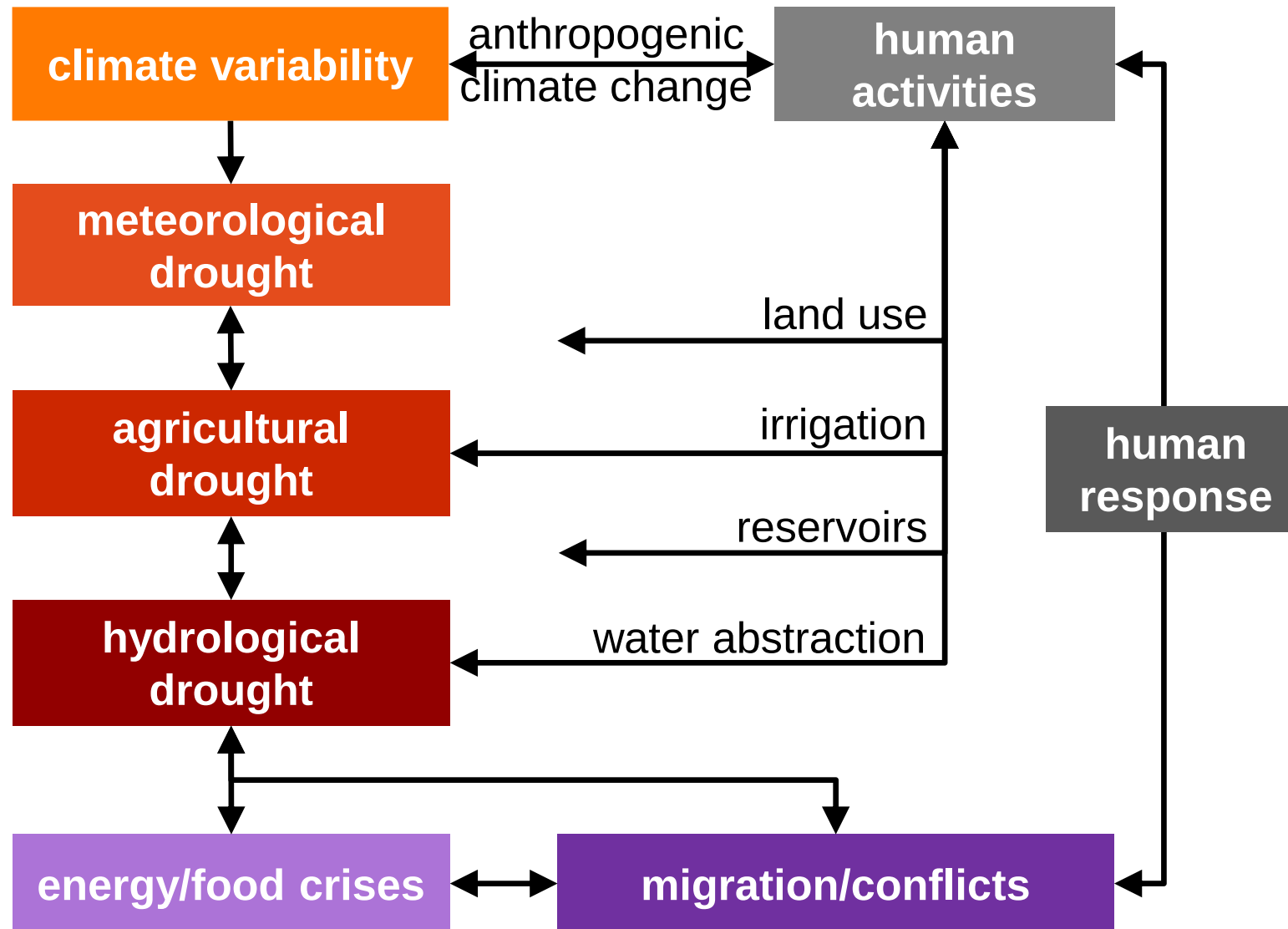
Hydrology in a rapidly changing, human-dominated world

Global rivers impacted by reservoirs (red) in 1900



(Di Baldassarre et al., *Nature Sustainability*, 2018; Animation by Niko Wanders)

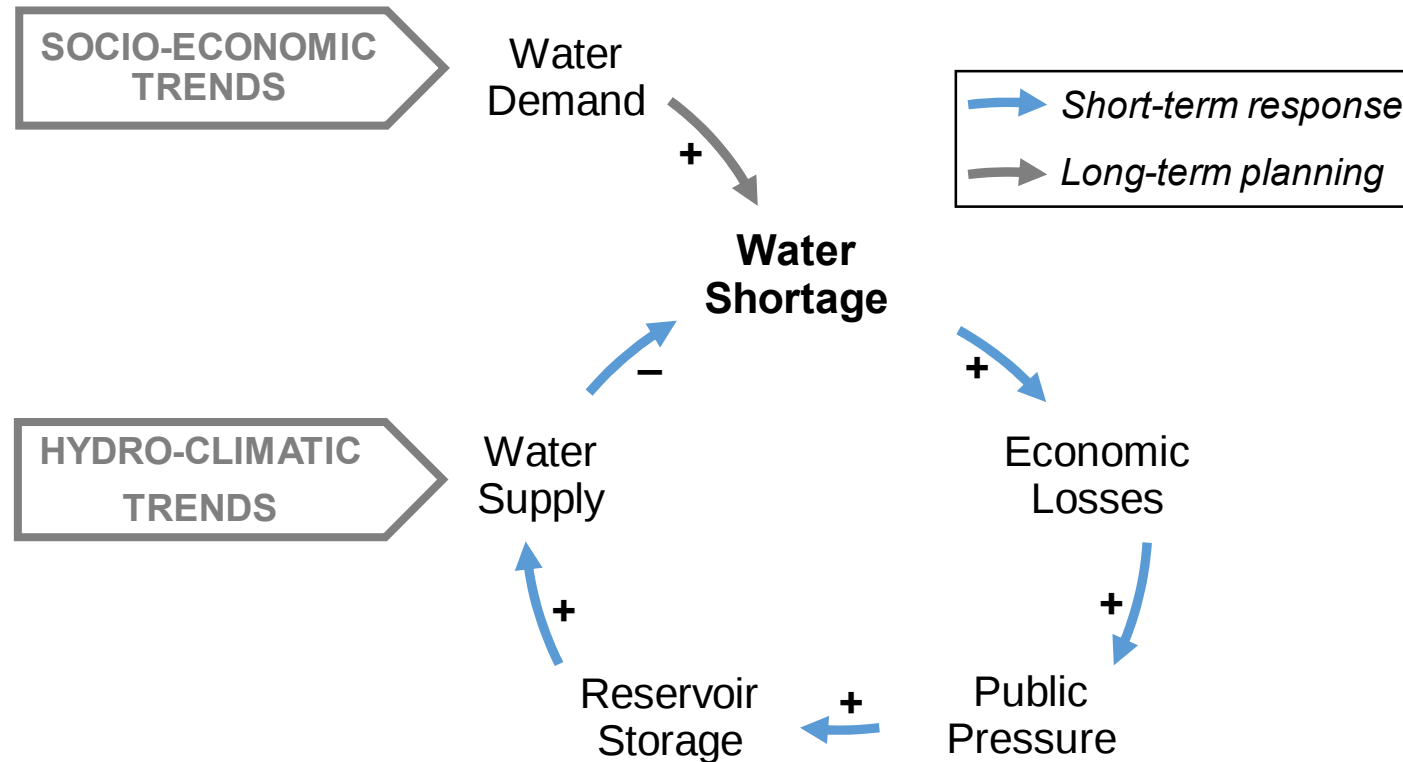
Drought propagation, impacts and feedbacks



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

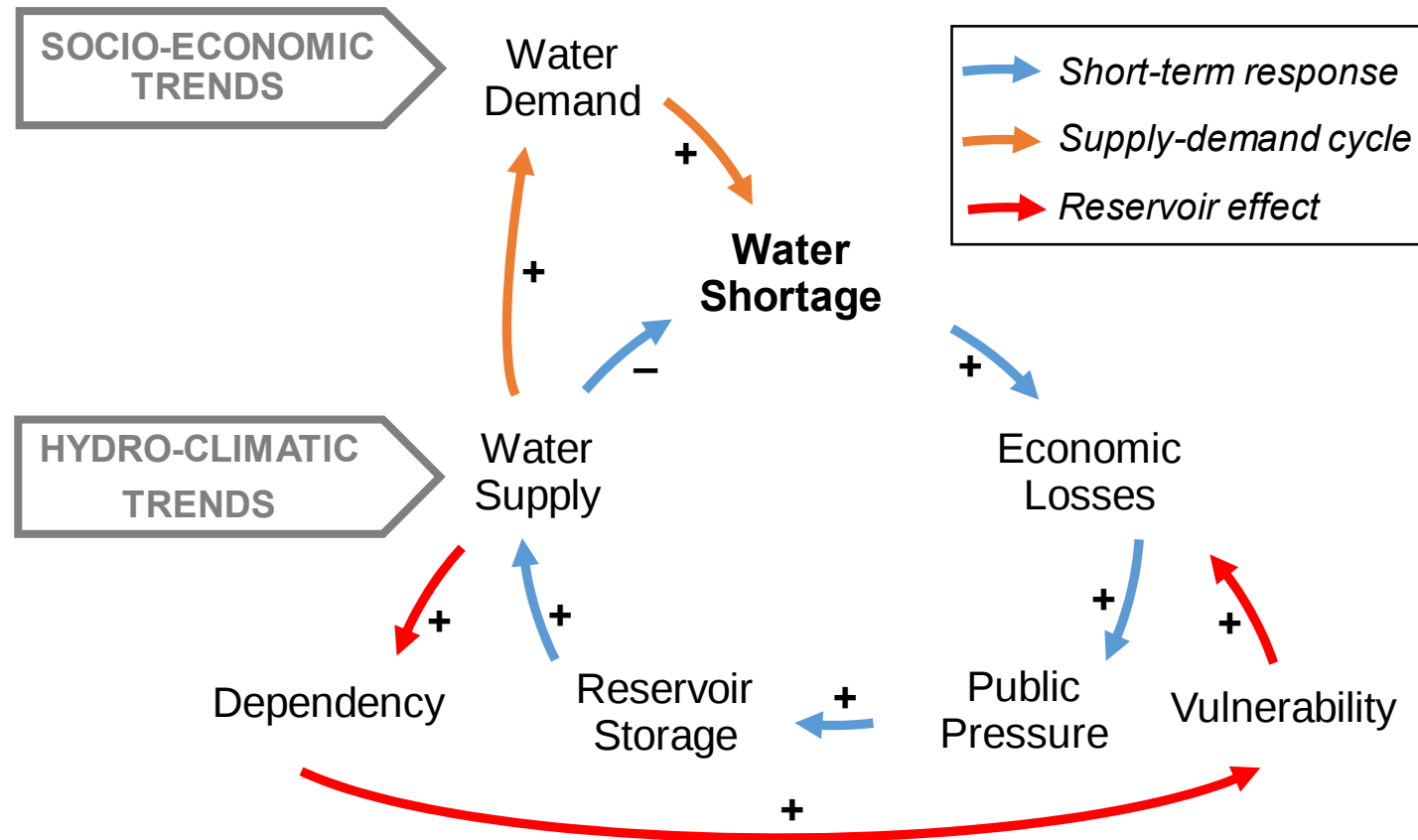
Dams, reservoirs and droughts

Planning or building dams and reservoirs to cope with drought



Sociohydrological feedbacks

Intended benefits and **unintended consequences**



Example: the “Day Zero” water crisis in Cape Town

Cape Town counts down to Day Zero as water supply evaporates

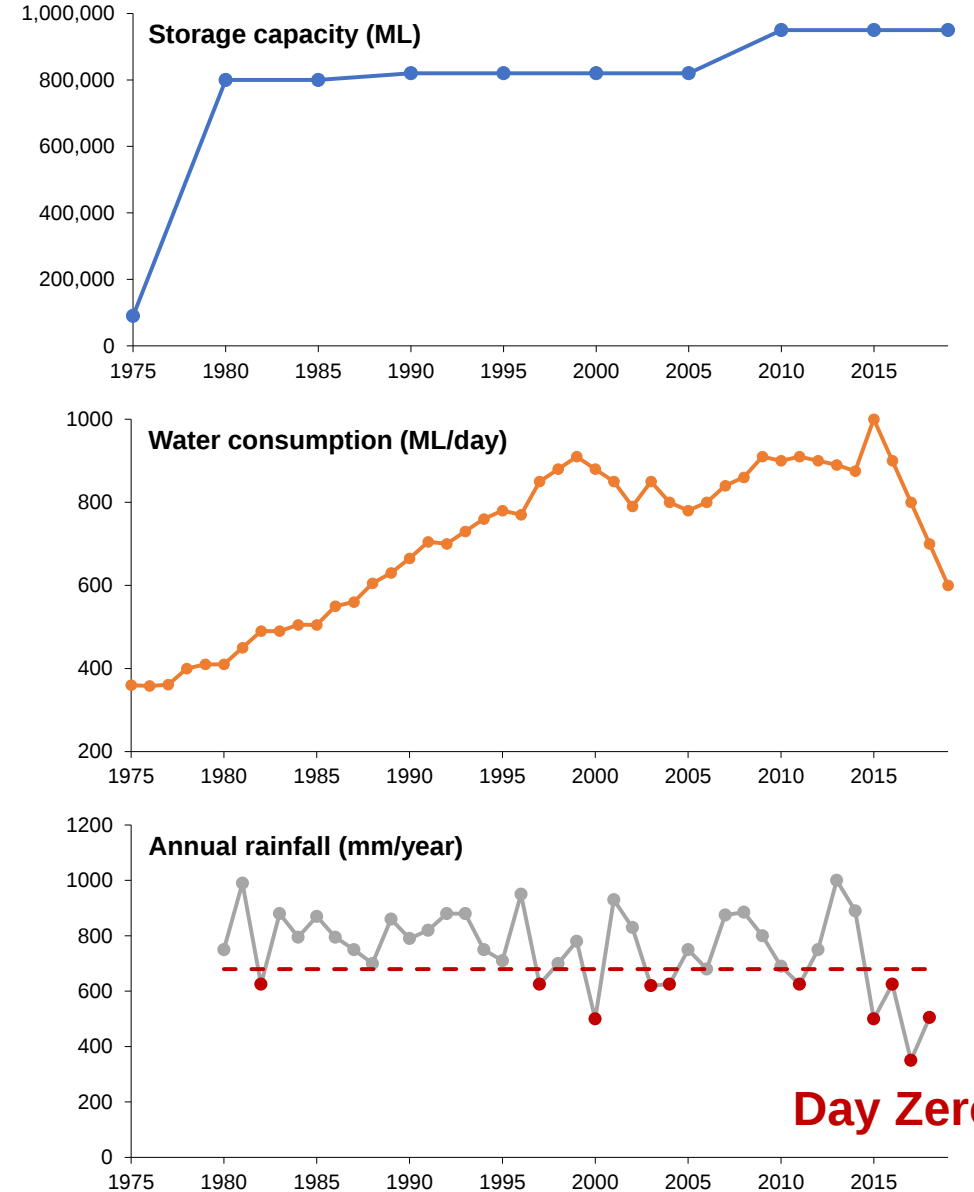
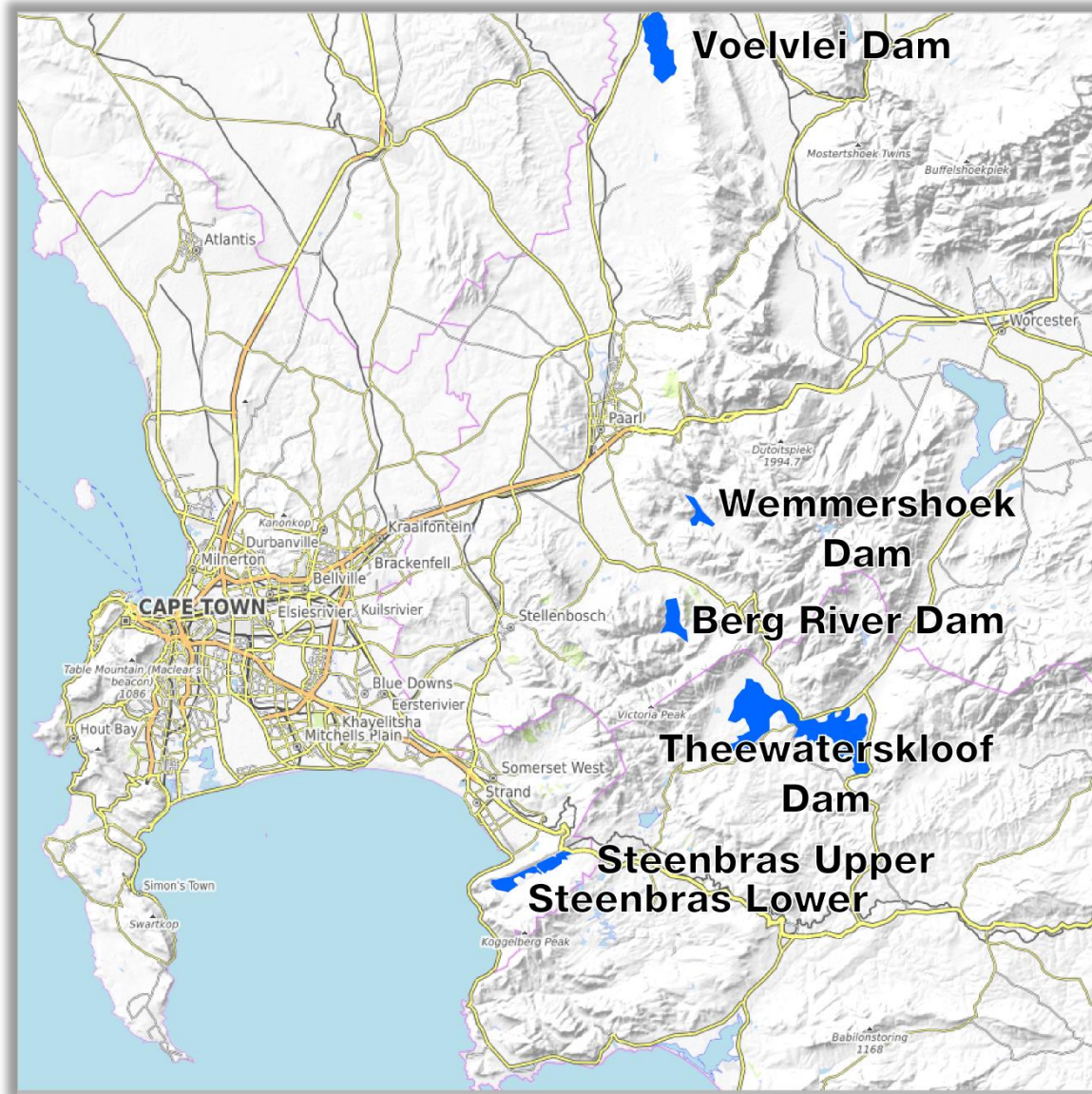
Drought-hit South African city risks becoming world's first big metropolis to go dry



Cape Town residents queue for water. Vast lawns and swimming pools in wealthy suburbs have hampered efforts to conserve resources in the drought-stricken region © EPA

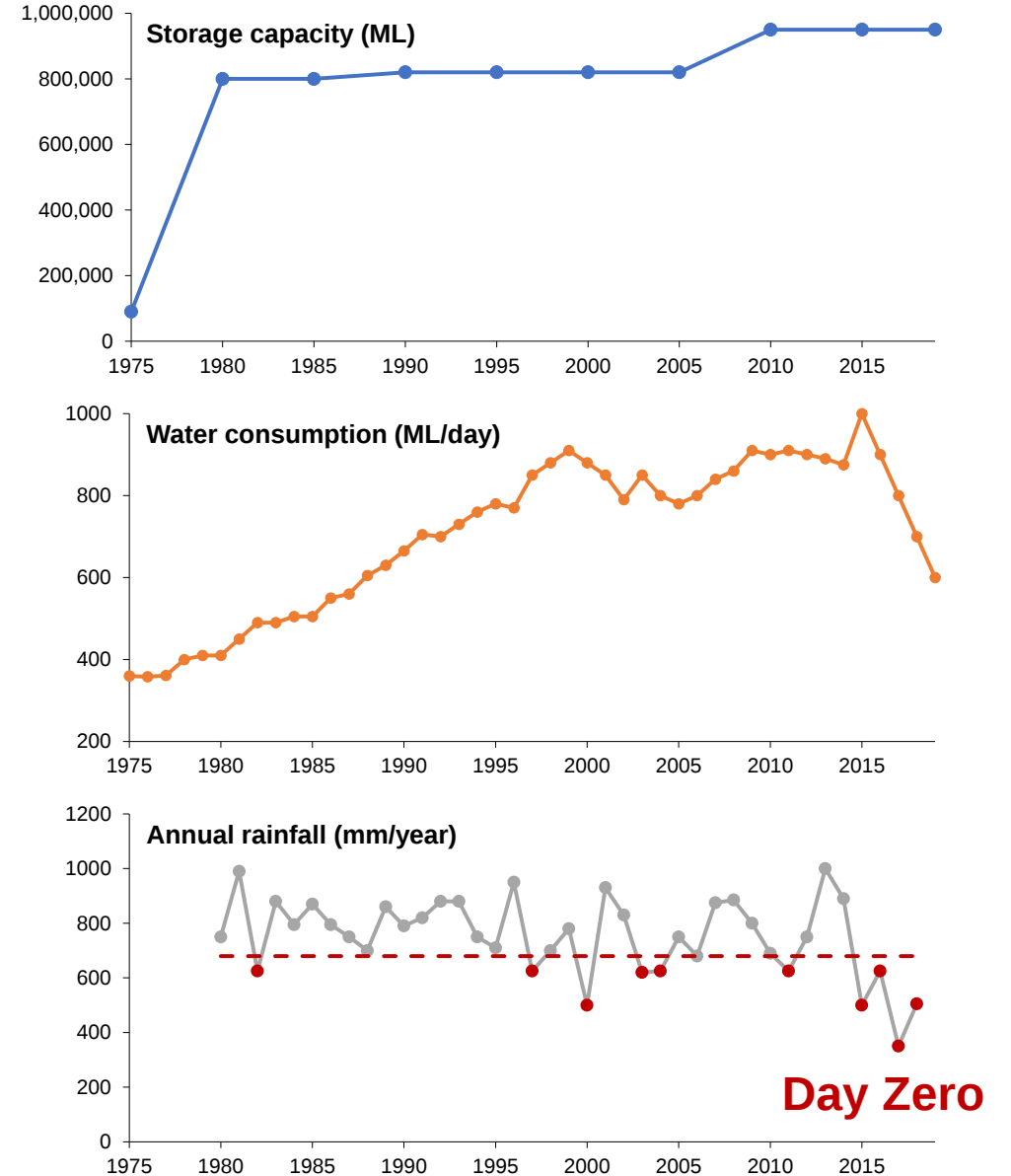
(Financial Times, 2018)

Western Cape Water Supply System



Unintended consequences

- **Supply-demand cycles**
 - Western Cape Water Supply System
 - Lock-in condition
- **Reservoir effects**
 - Attenuate hydrological variability
 - Delay salient information and thus response

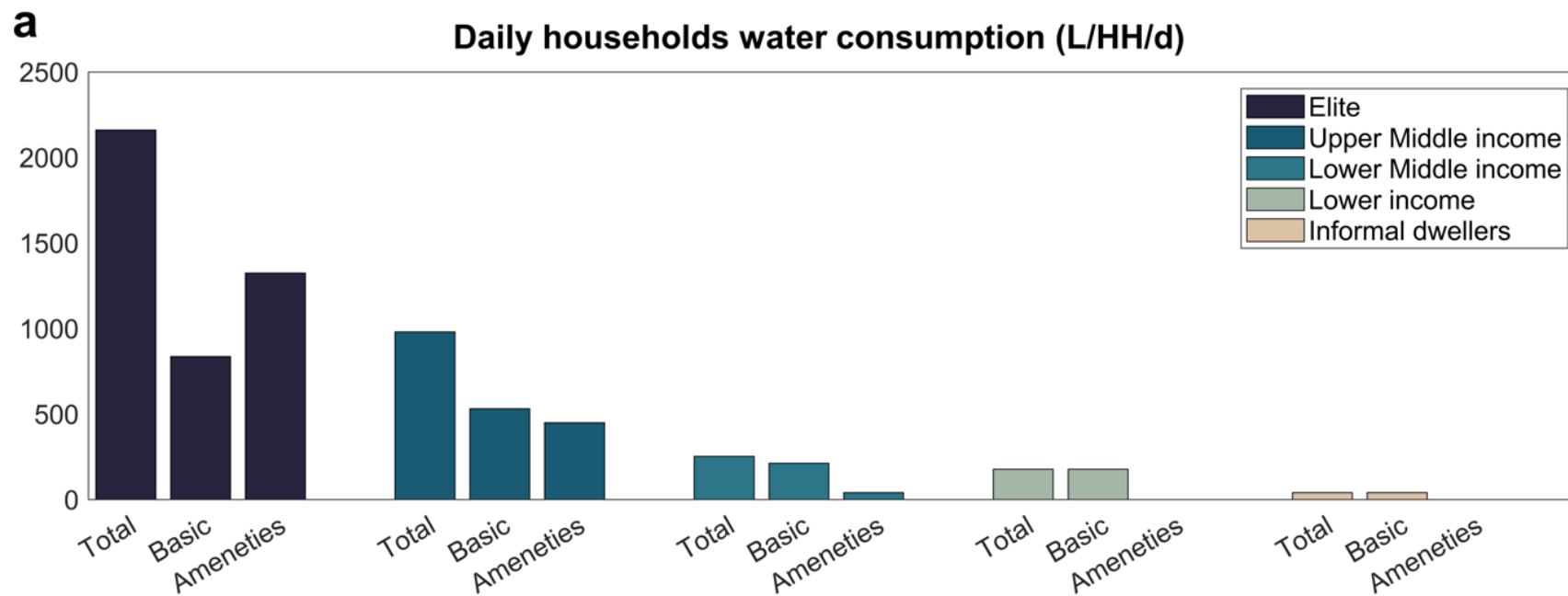
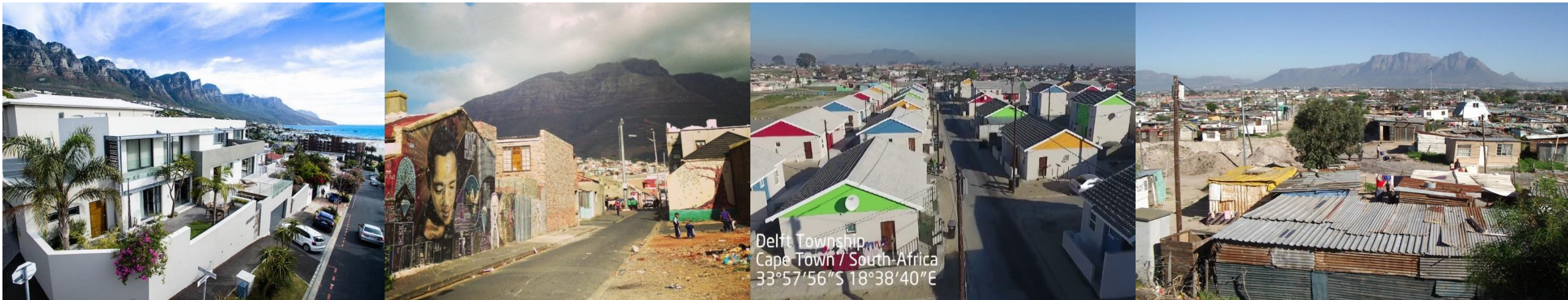




Cape Town, SA

This aerial photograph captures a stark contrast in land use and urban development in Cape Town, South Africa. The left side of the image is dominated by a dense informal settlement, characterized by a tightly packed array of small, rectangular structures with flat roofs, many of which are made of corrugated metal. The layout is irregular, with narrow, unpaved paths weaving between the dwellings. To the right, a vast, lush green forest covers a hillside, with scattered, more substantial houses and buildings nestled within the trees. The boundary between the informal settlement and the forested area is sharp and clearly defined.

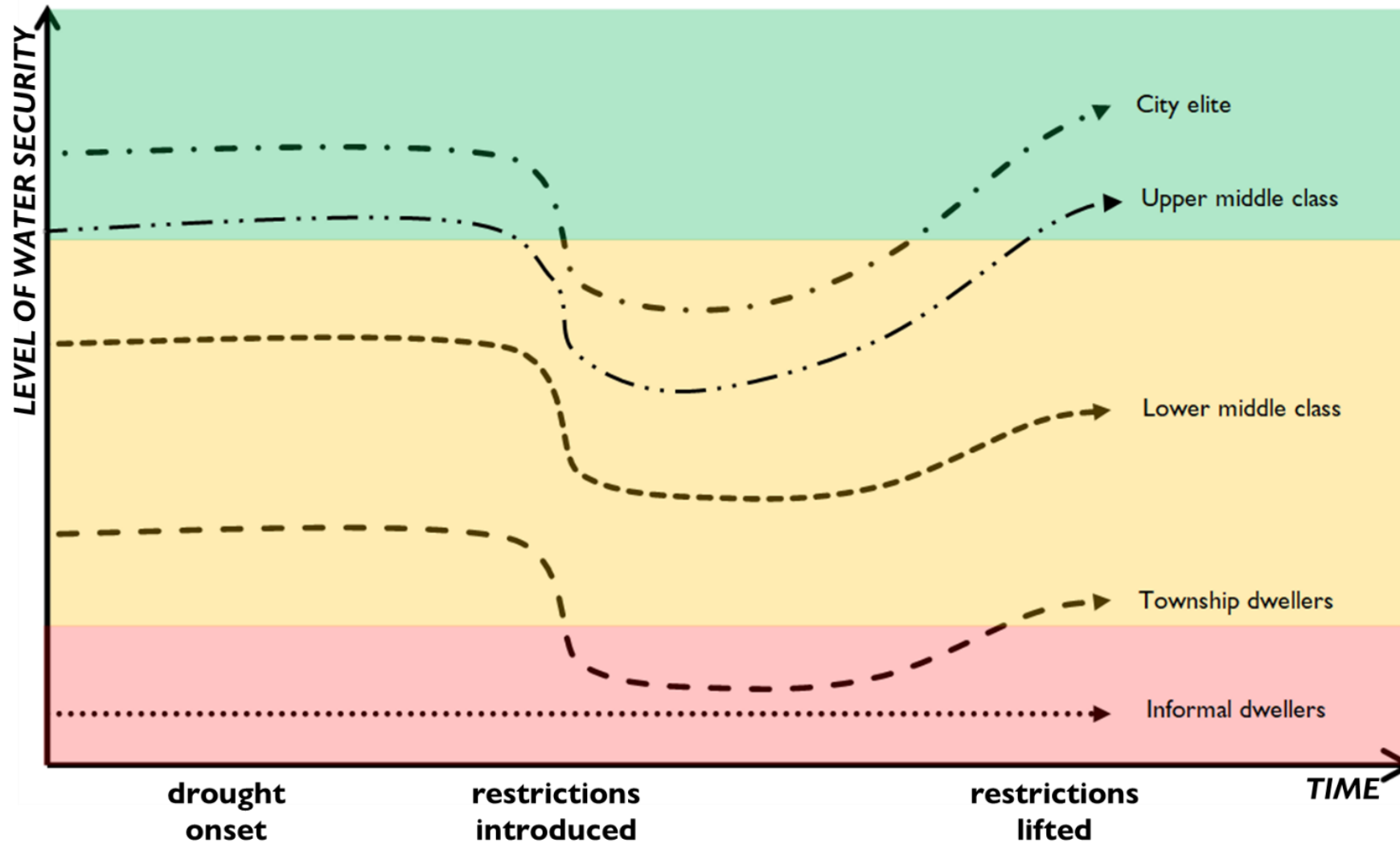
Water consumption in Cape Town



(Savelli et al., *Nature Sustainability*, 2023)

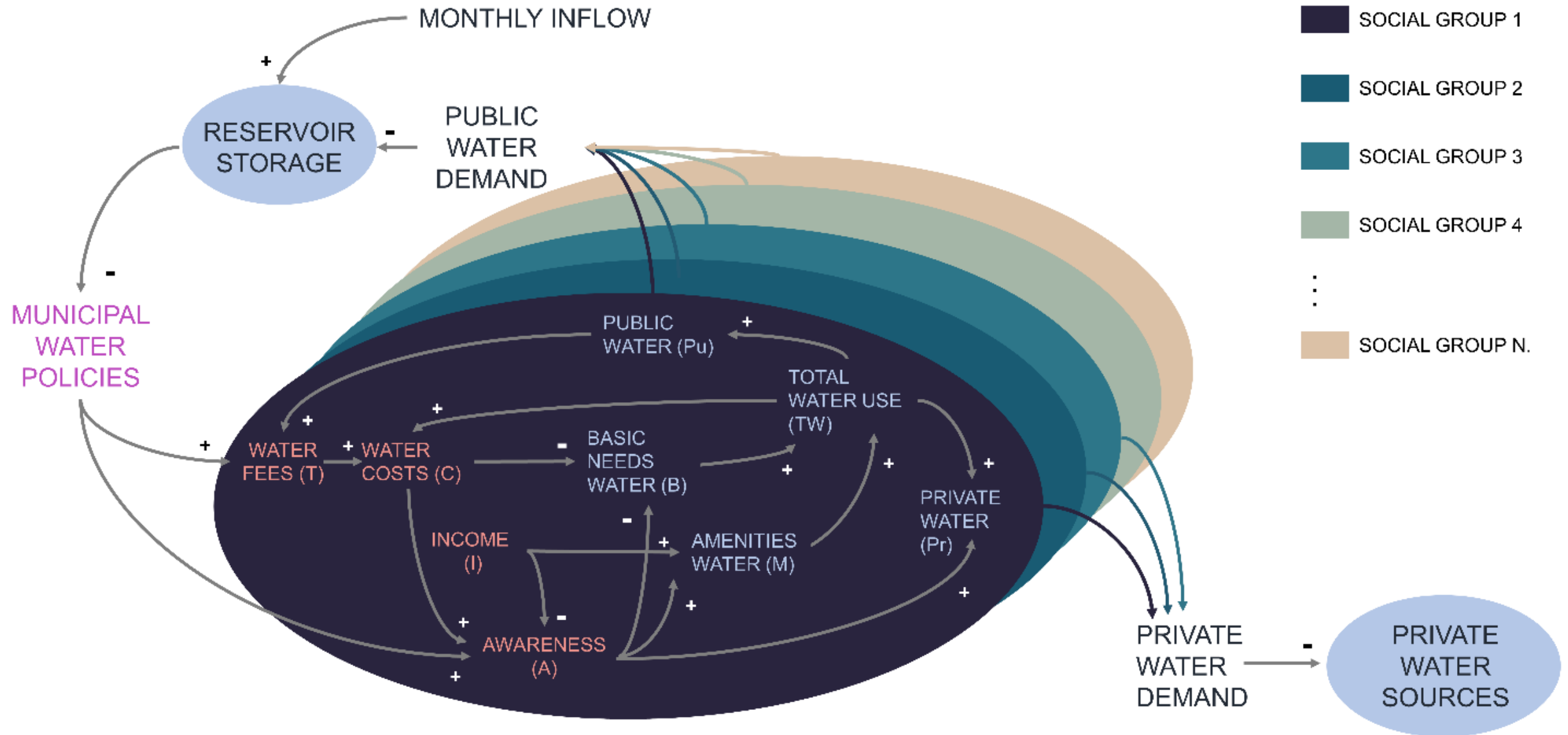
Cape Town: 2015-2018 drought (Day Zero)

Inequalities: costs and benefits unevenly distributed (e.g. impact & recovery)



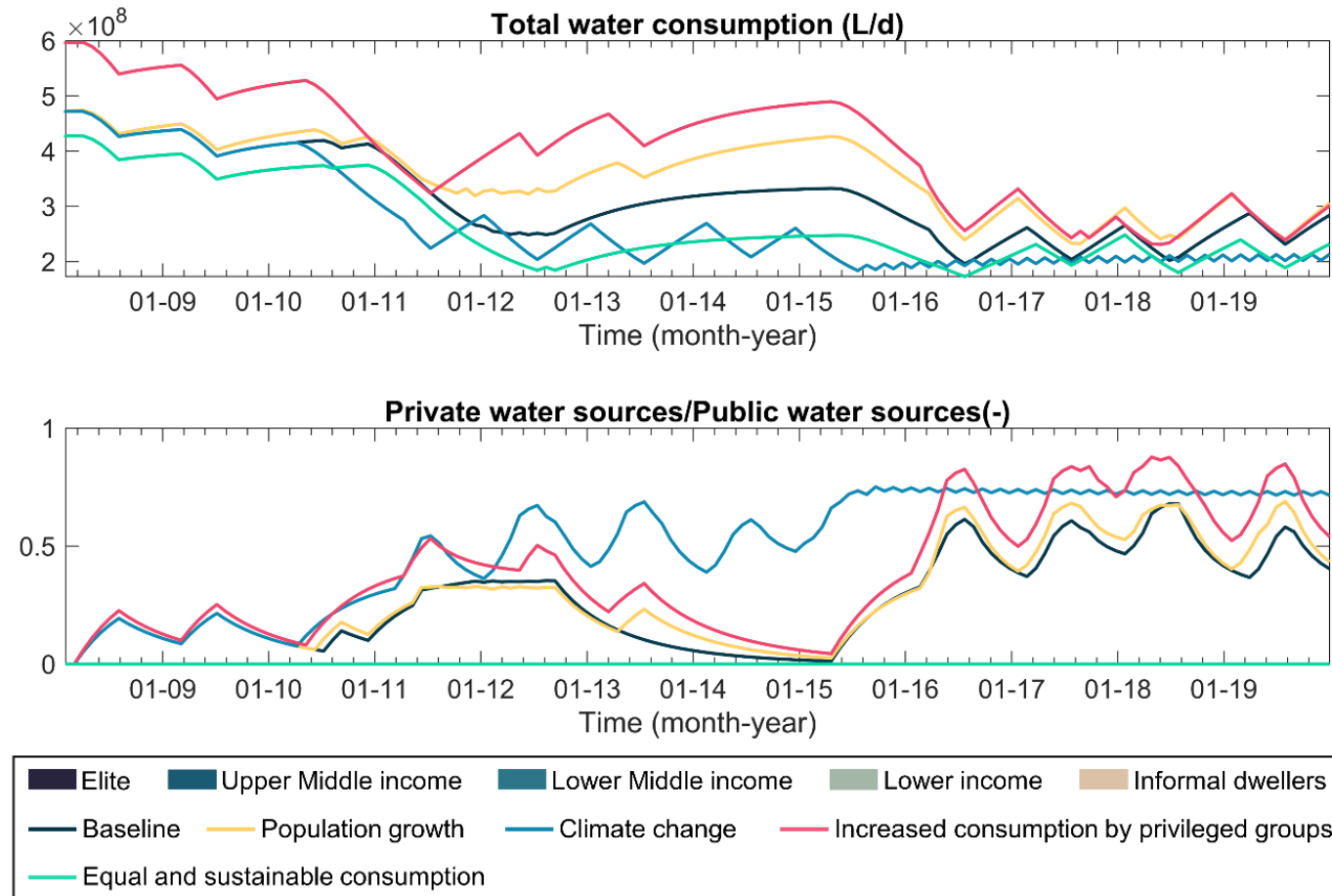
(Savelli et al., *Journal of Hydrology*, 2021)

Modelling human-drought interactions



Water crises driven by elites' unsustainable consumption

Unsustainable water use by few can exacerbate urban water crises at least as much as **climate change** or **population growth**



Conclusions

Complexity and uncertainty: There are no universal solutions

Some measures can fix:

- one specific problem
- in the short-term
- only for some

But, they often

- generate new issues
- aggravate the same problem in the long-term
- worsen for others

Modelling human-water systems

- ✓ Account for behavioural (*perception*) and political (*power*) processes
- ✓ Uncover the effects of alternative options (incl. *unintended consequences*)
- ✓ Explore **trade-offs** across multiple groups, interests and goals



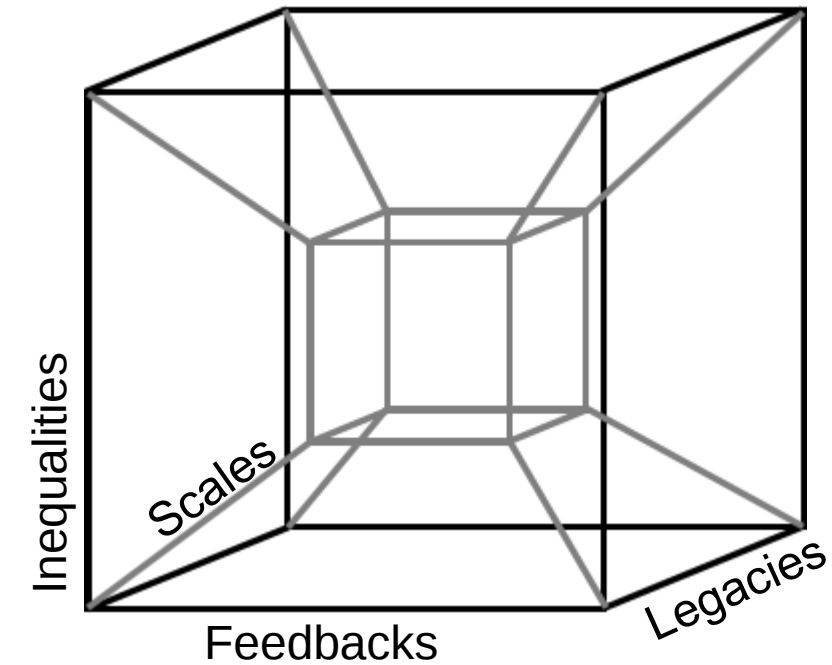
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Complexity and uncertainty



**Far better an approximate answer to the right question,
than the exact answer to the wrong question.**

John Tukey (Princeton University, 1962)