

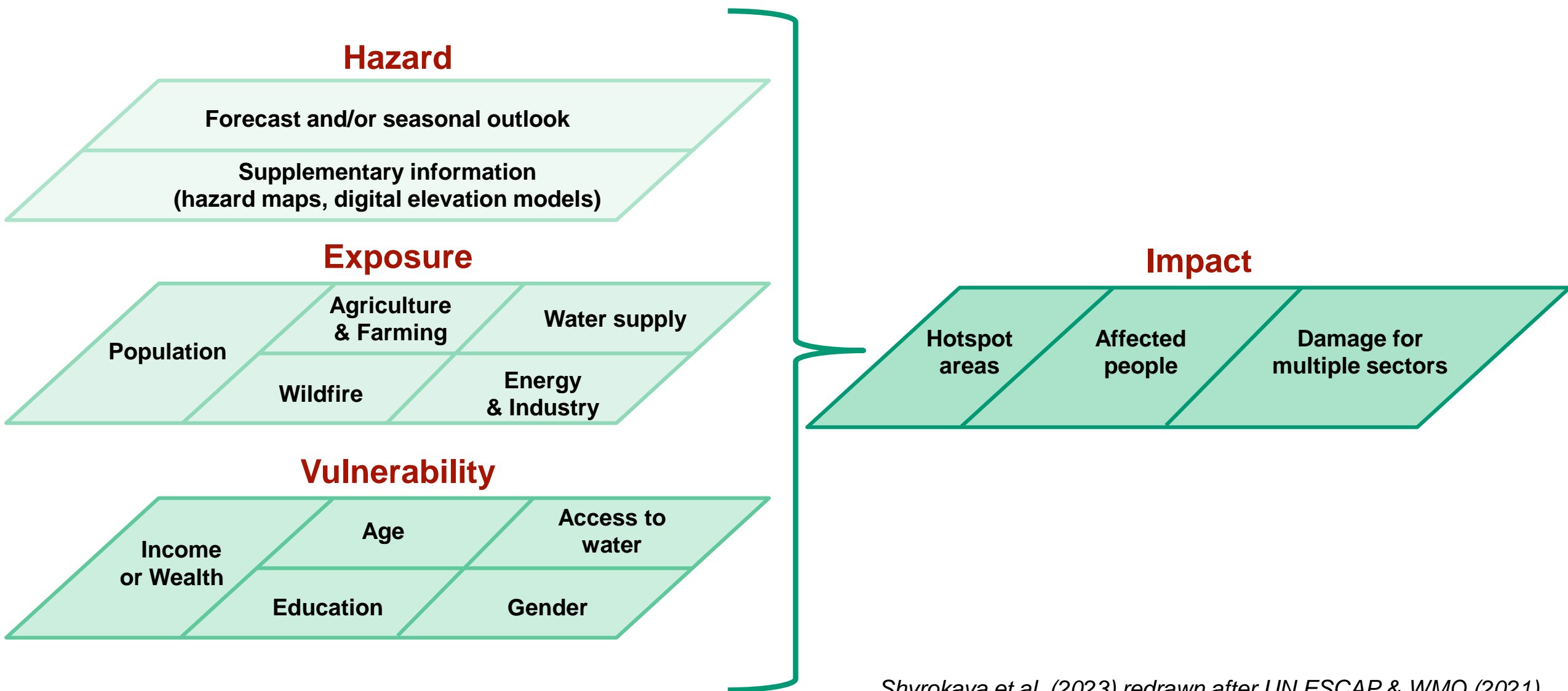


Forecasting socio-hydrological extremes



Impact-based forecasting

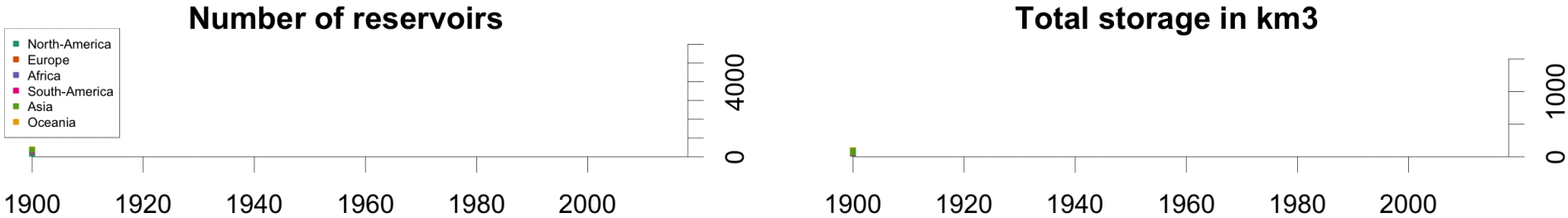
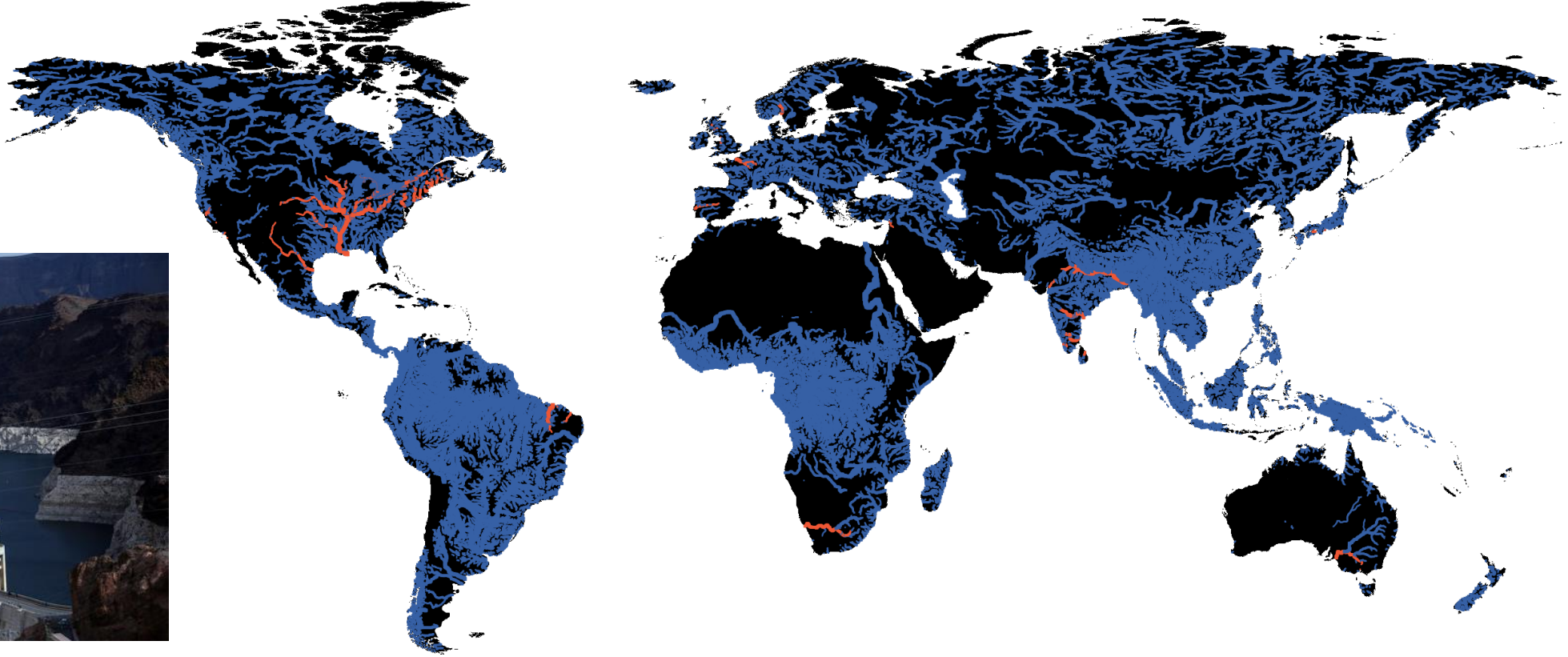
Goal: Identify most affected people/areas/sectors and prioritize response measures



Challenge #1: Human influence

Human influence (e.g. dams and reservoirs)

Global rivers impacted by reservoirs (red) in 1900



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

Socio-hydrological extremes



Direct influence

- Deliberate (reservoirs, levees)
- Not (urbanization, deforestation)

Indirect influence

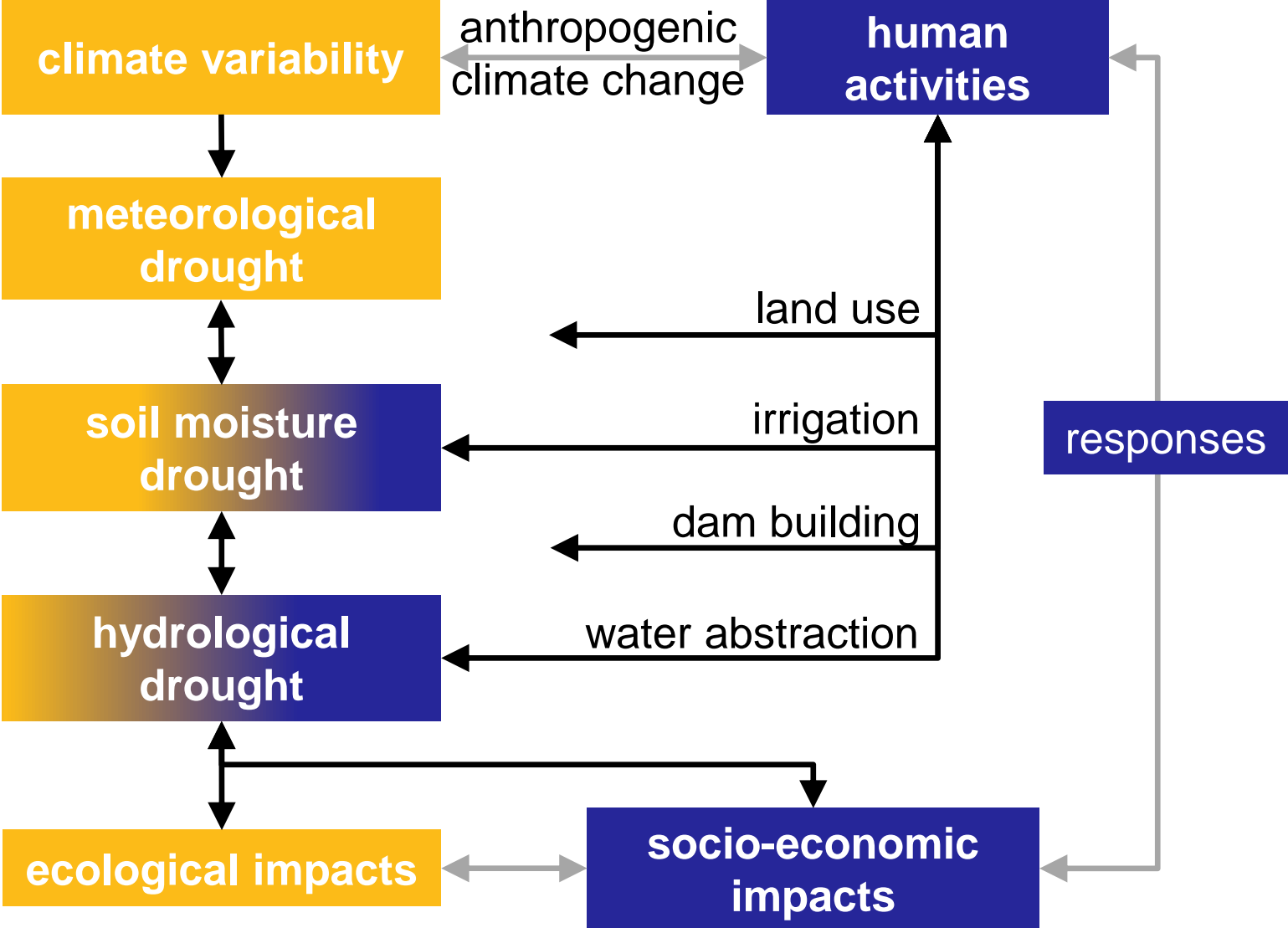
- Global warming
- Sea level rise

Human response

- Displacement & migration
- Infrastructure (feedback)

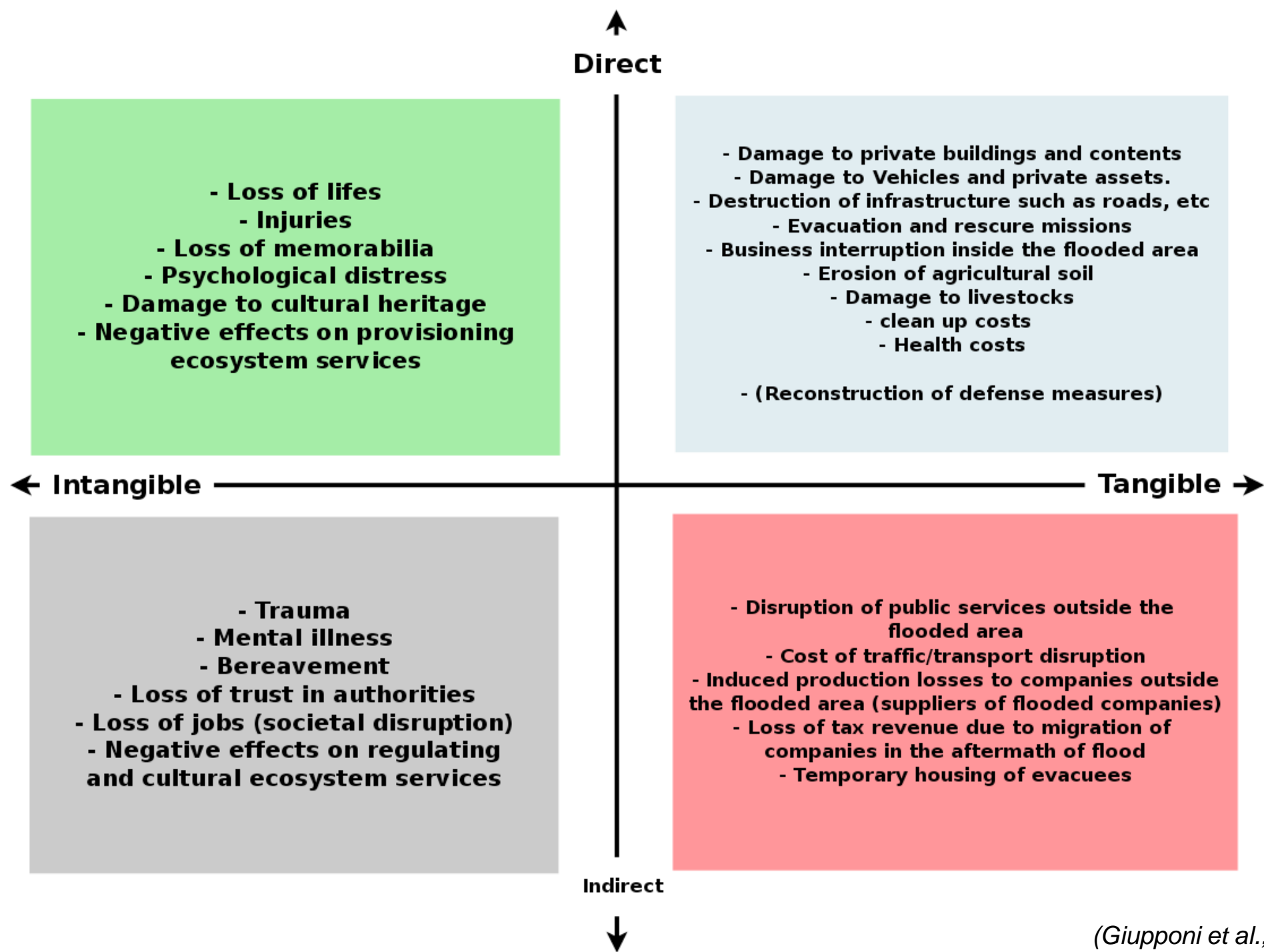
Challenge #2: Socio-hydrological feedbacks

Drought propagation



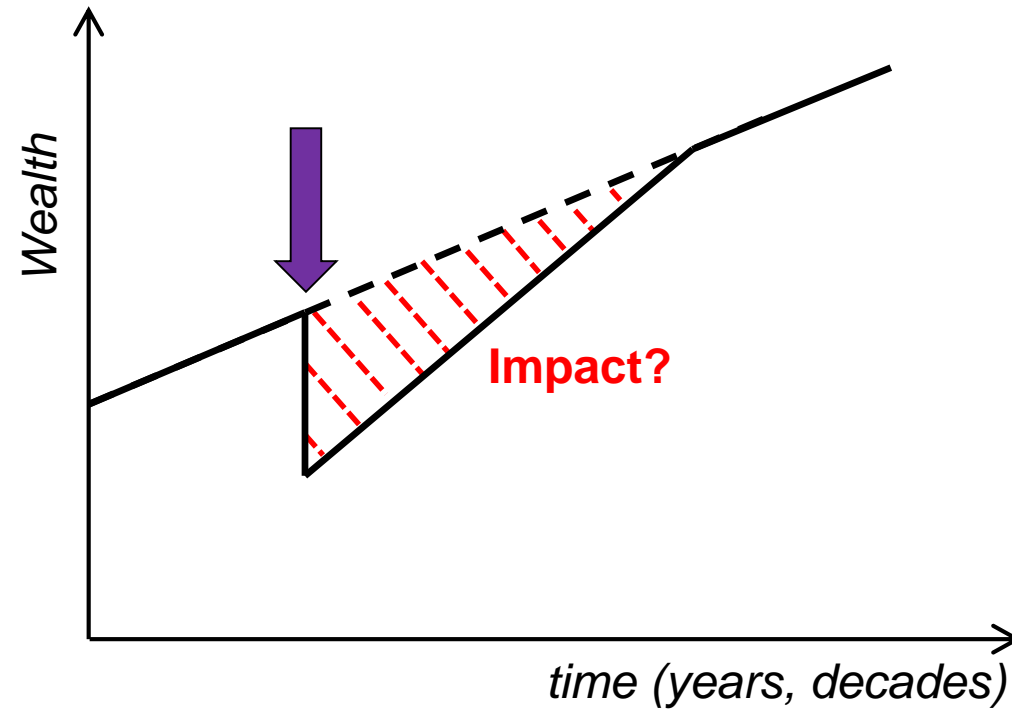
(Van Loon et al., *Nature Geoscience*, 2016)

Challenge #3: Impacts are complex



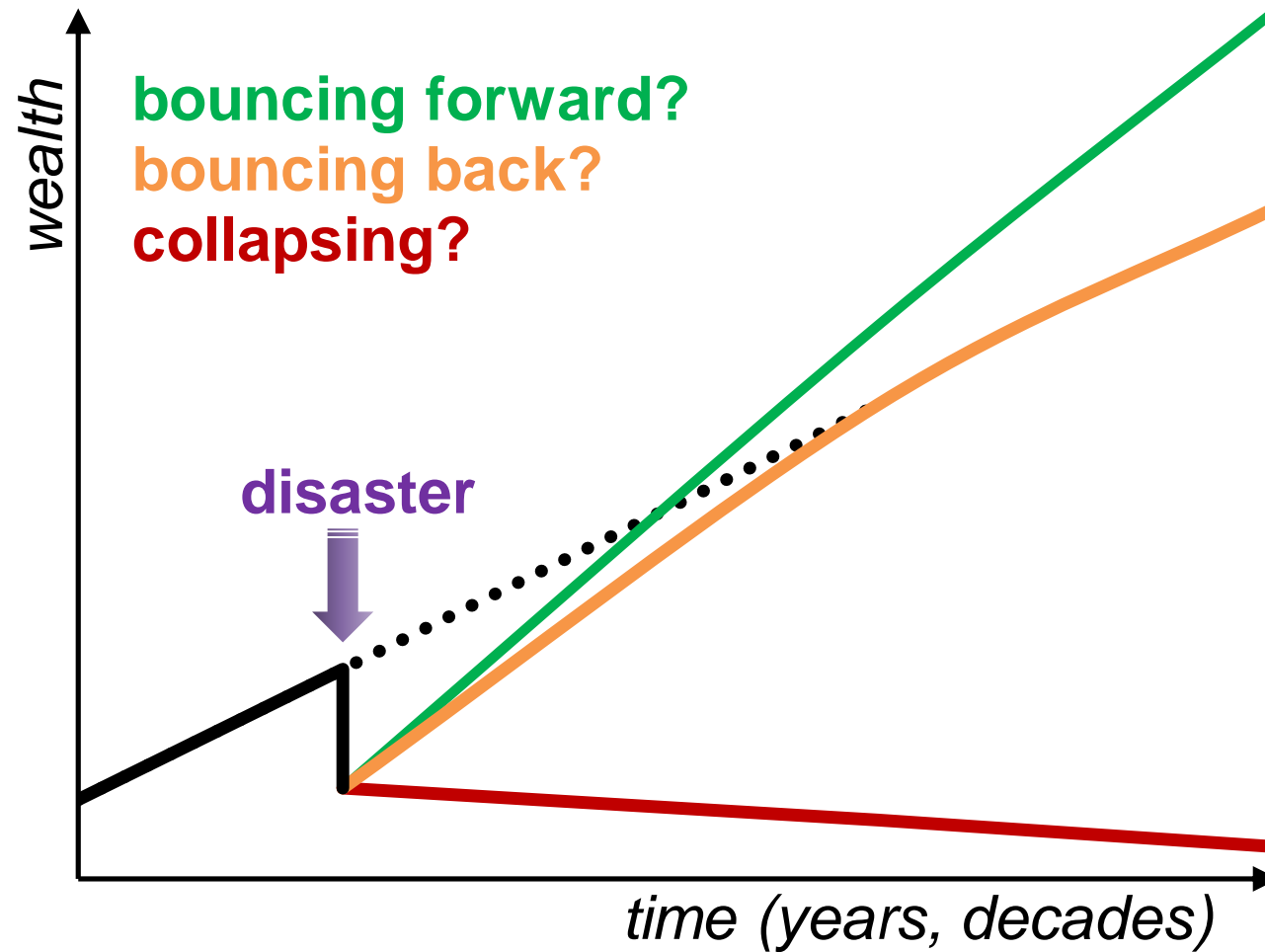
Challenge #4: Impacts are dynamic

Dynamics (recovery trajectories)



(Green et al., CONHAZ, 2011)

Dynamics (recovery trajectories)



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

Challenge #5: Impacts are unevenly distributed

Flood fatalities & economic inequalities

nature

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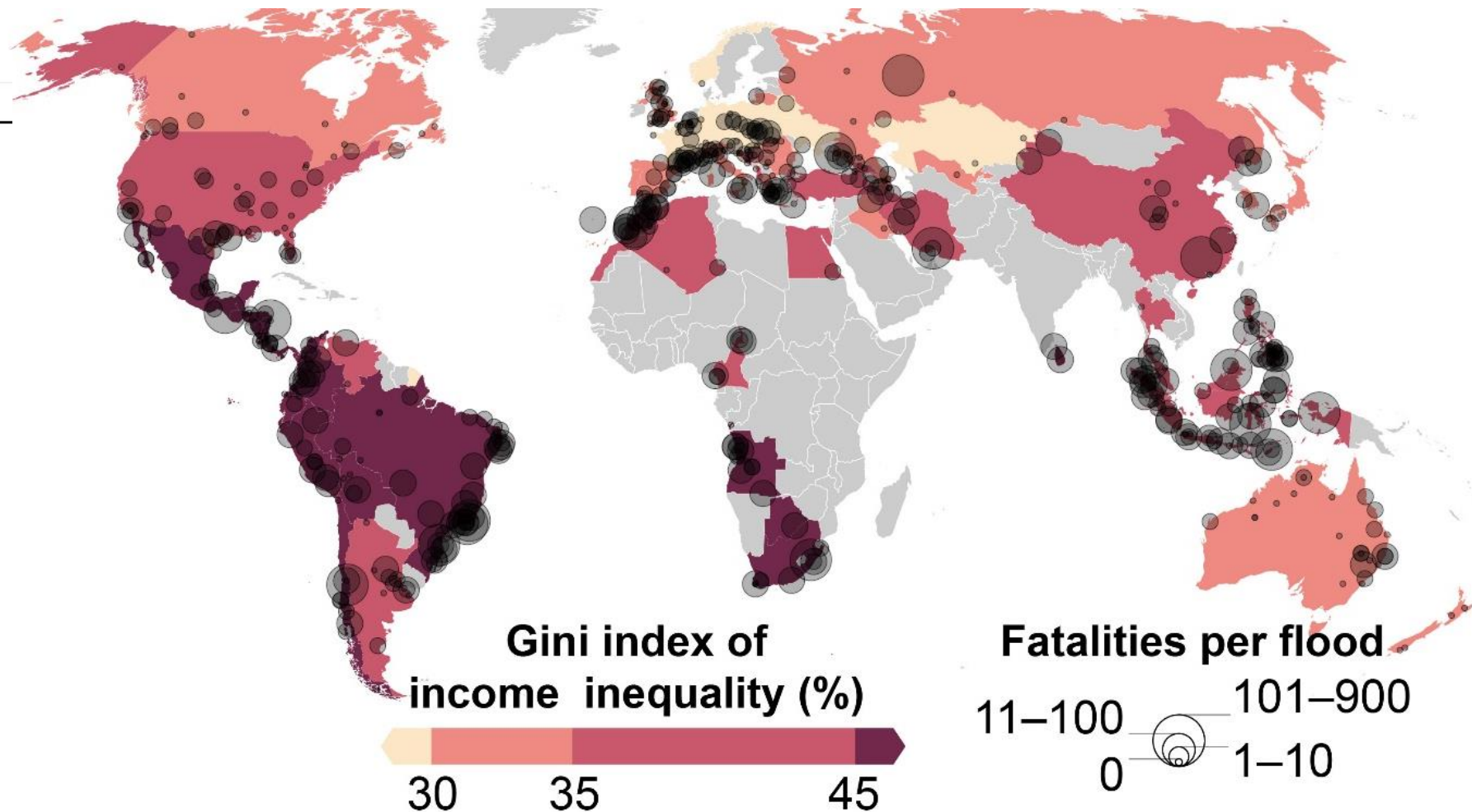
RESEARCH HIGHLIGHT | 20 April 2023

Floods claim more lives where inequality reigns

Flood mortality rates are far higher in countries with larger income disparities.



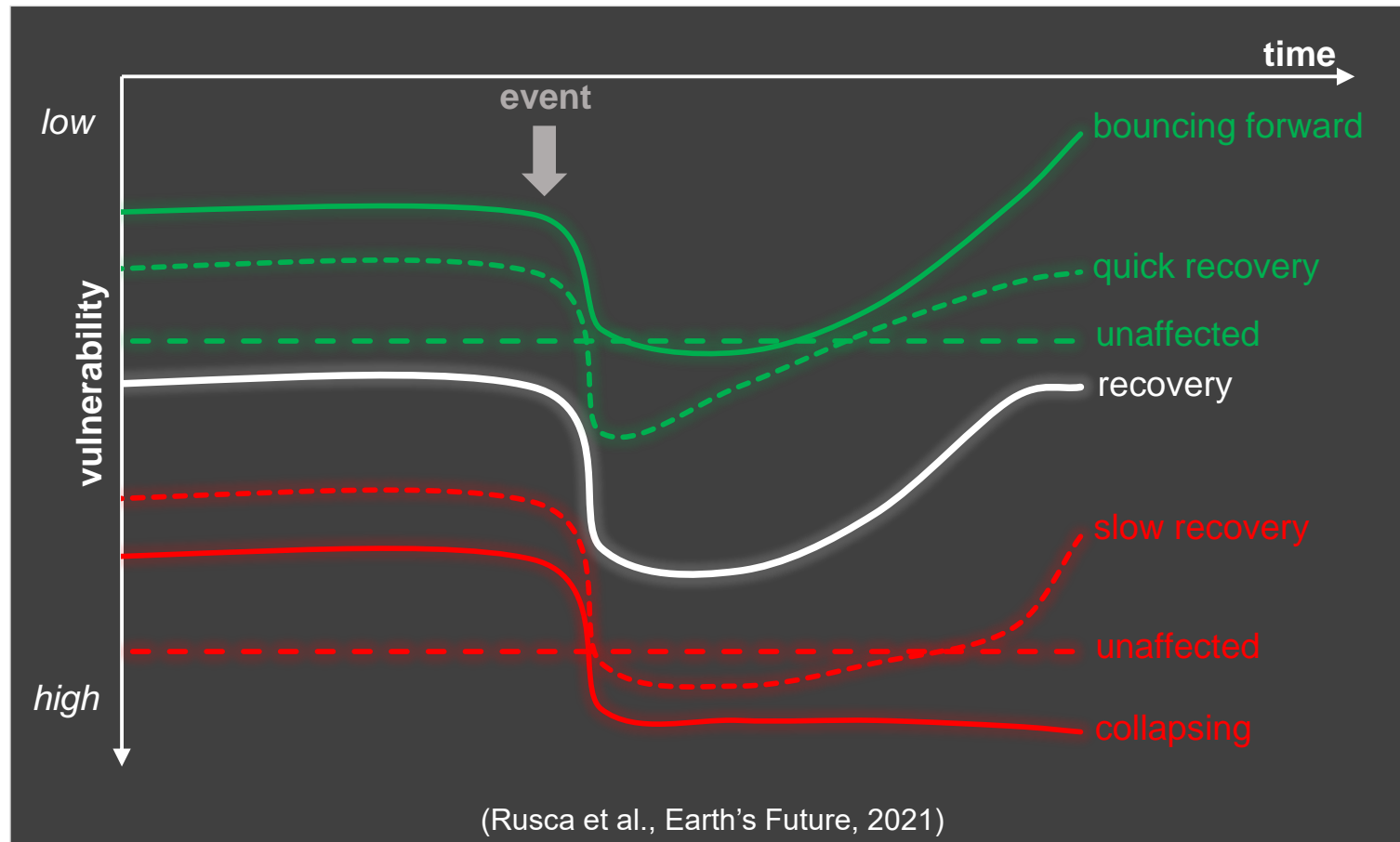
Lower-income areas of New Orleans, Louisiana, were affected most by the flooding caused by Hurricane Katrina in 2005. Credit: Mario Tama/Getty



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

Uneven impact of socio-hydrological extremes

- Prioritization of measures are often based on cost/benefit analysis
- Capacity to cope and recover (e.g. insurance) from different social groups
- Low-income groups and minorities often struggle to recover



New Orleans





Cape Town (SA)

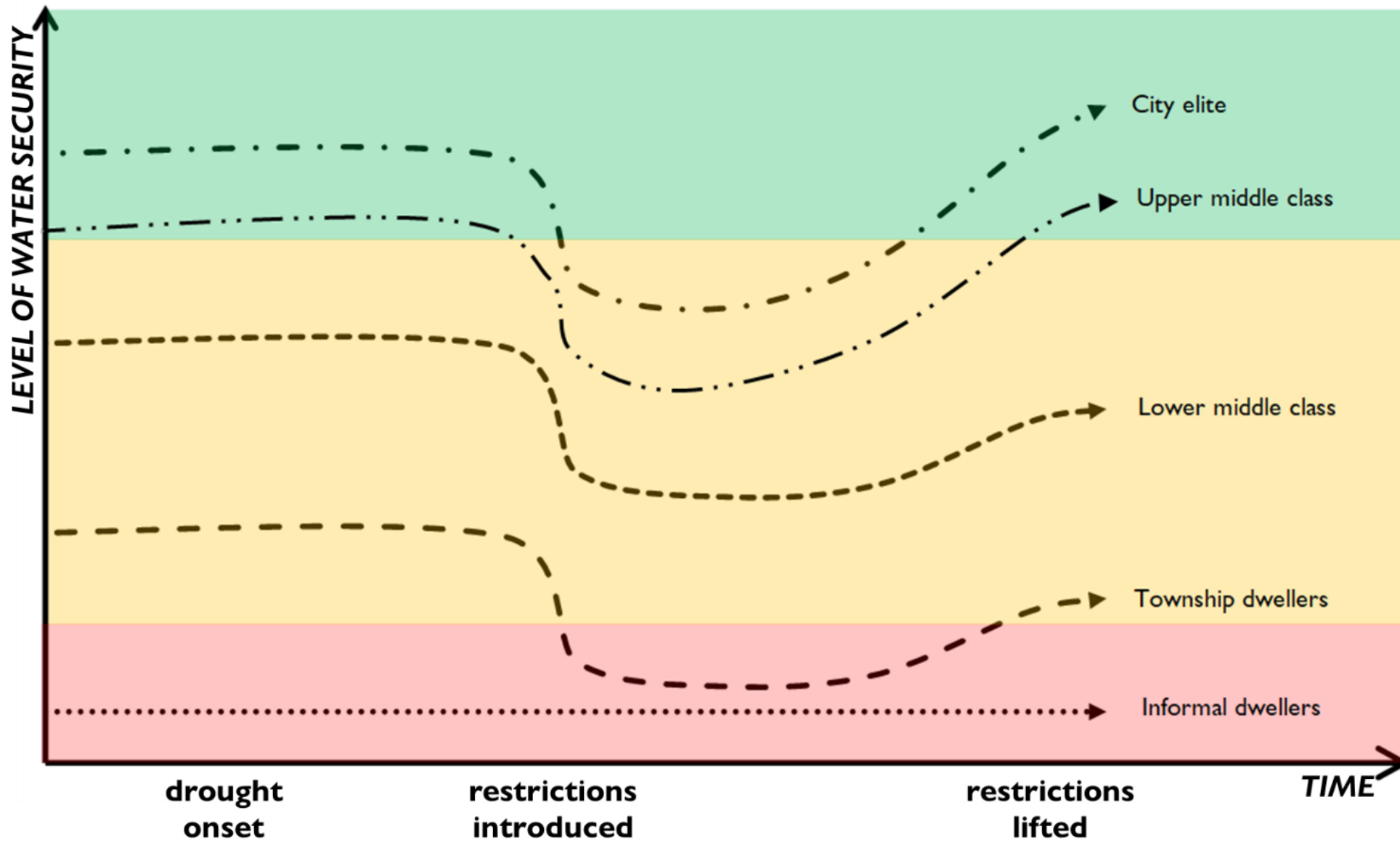
Photo by Johnny Miller (Unequal Scenes)

2015-18 drought: “Day Zero” water crisis



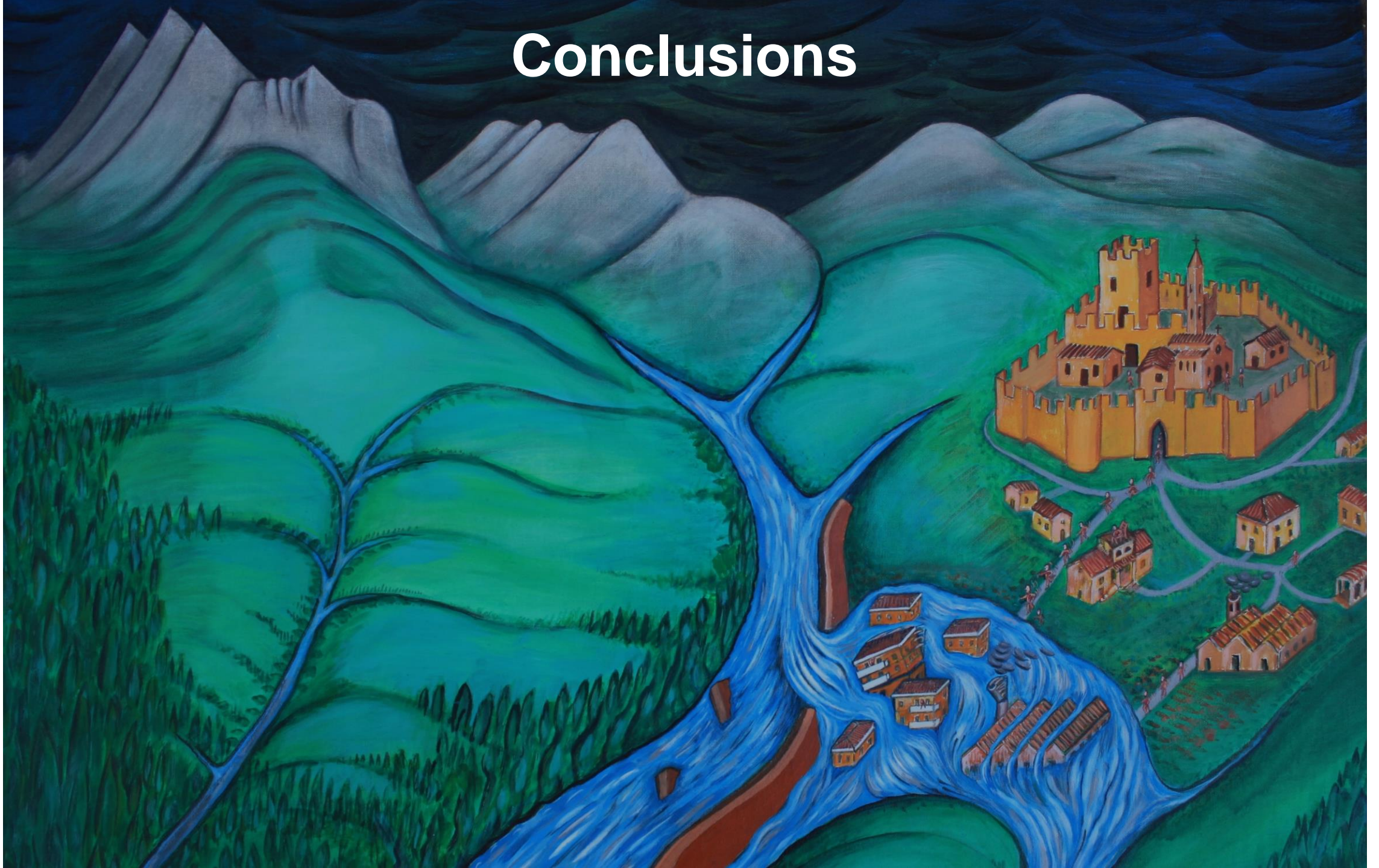
Cape Town during the Day Zero water crisis (source: Wikimedia Commons)

Impacts (and recoveries) across social groups



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

Conclusions



Challenges in Impact-based Forecasting

A stylized illustration of a landscape. In the foreground, a wide, blue river flows through a green valley. To the right, a large, orange-brown castle with a central tower and battlements sits on a hill. Below the castle, a small village with several houses is visible. In the background, there are rolling green hills and a dark, stormy sky. The overall style is painterly and somewhat somber.

Floods and droughts as socio-hydrological extremes

- New models to inform the forecast of droughts and floods

Impacts are complex, dynamic and unequal

- Social groups with high direct/tangible impacts might recover well (*while others don't*)
- Impact-based forecasting may unintentionally increase inequality (*similar to cost/benefit optimization of risk*)
- Need to account for the heterogeneity of impacts



Forecasting socio-hydrological extremes

