Modeling the interplay between droughts, floods and human activities

Maurizio Mazzoleni
Vincent Odongo
Elena Mondino
Giuliano Di Baldassarre

Centre for Natural Disaster Science

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

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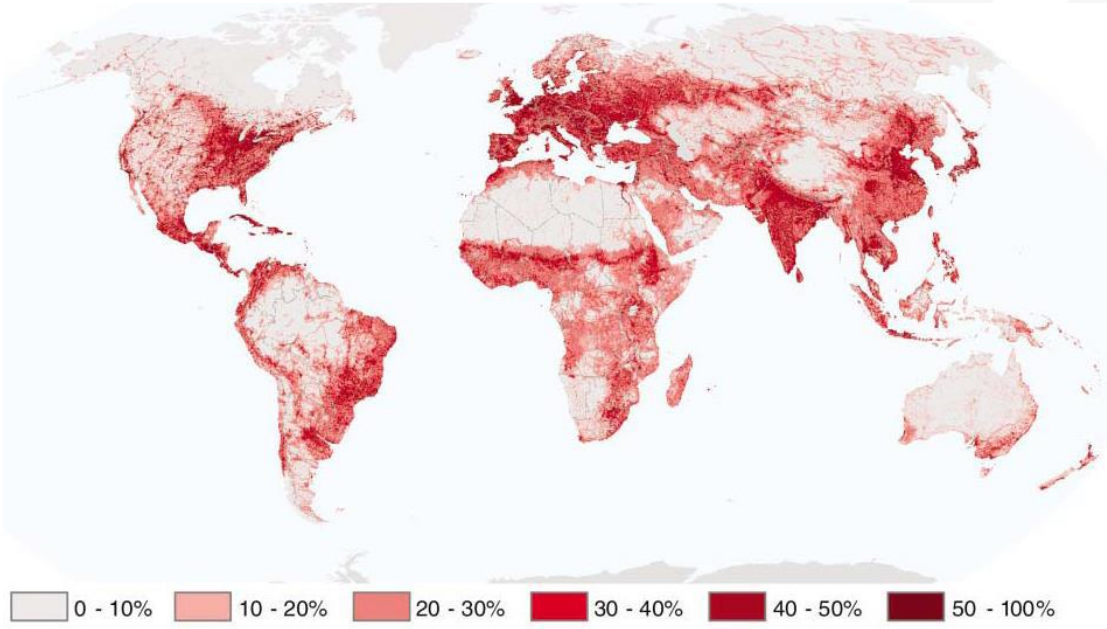
Introduction

- Risks from extreme hydrological events are increasing
- Traditional approaches for risks assessment only consider effect of extreme events on society

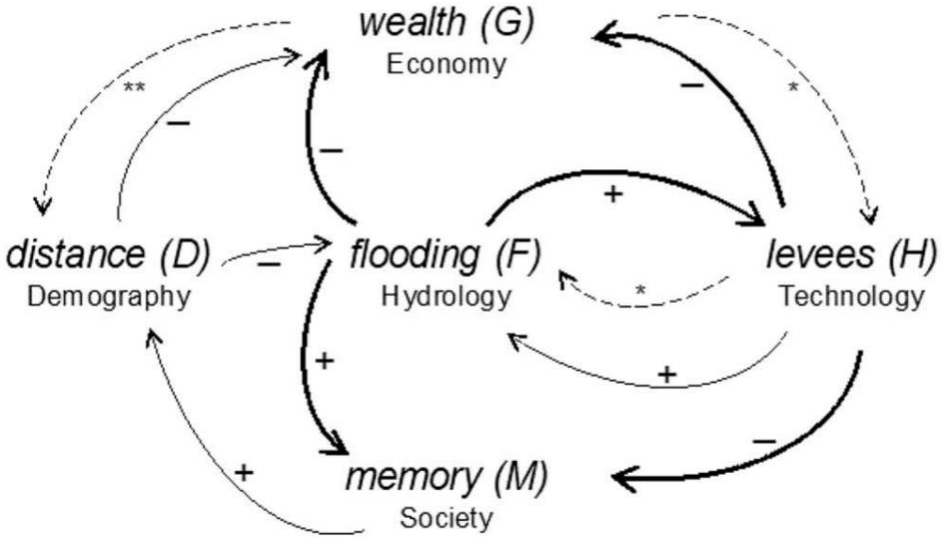
Introduction

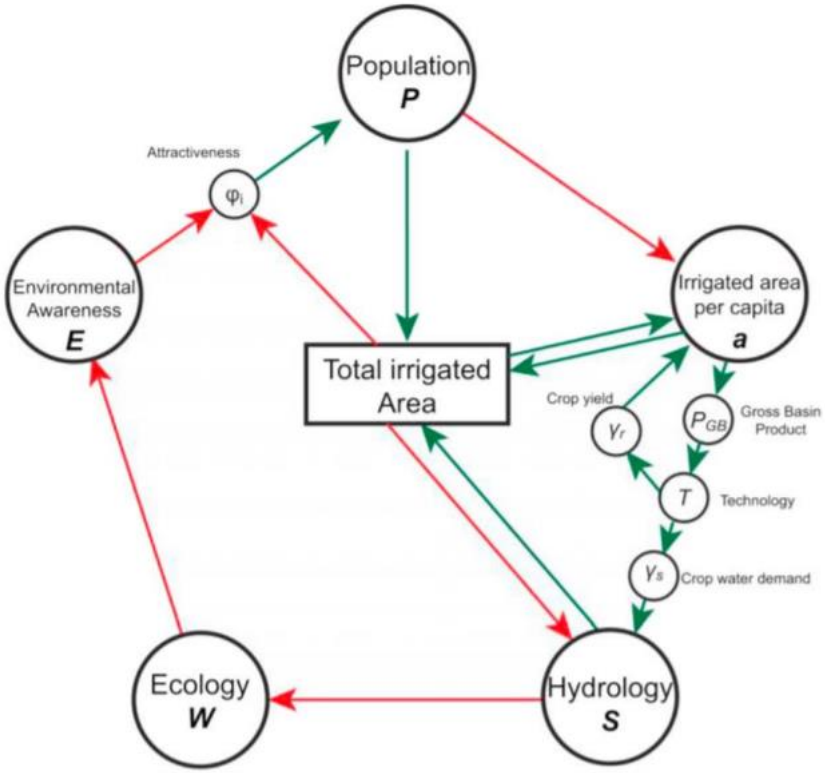
- Human activities alter the hydrological regime
- Most river basins are rapidly changing



Kareiva et al. (Science, 2007)

Socio-hydrological models





Di Baldassarre et al. (Water Resources Research, 2019)

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Objective of this study

The objective of this study is to develop and implement a novel socio-hydrological model accounting for the complex mutual interactions and dynamics between human and hydrological extremes.

In particular, we investigate how different droughts and floods mitigation strategies can influence human-water dynamics and possibly exacerbate the impact of consecutive extreme events.

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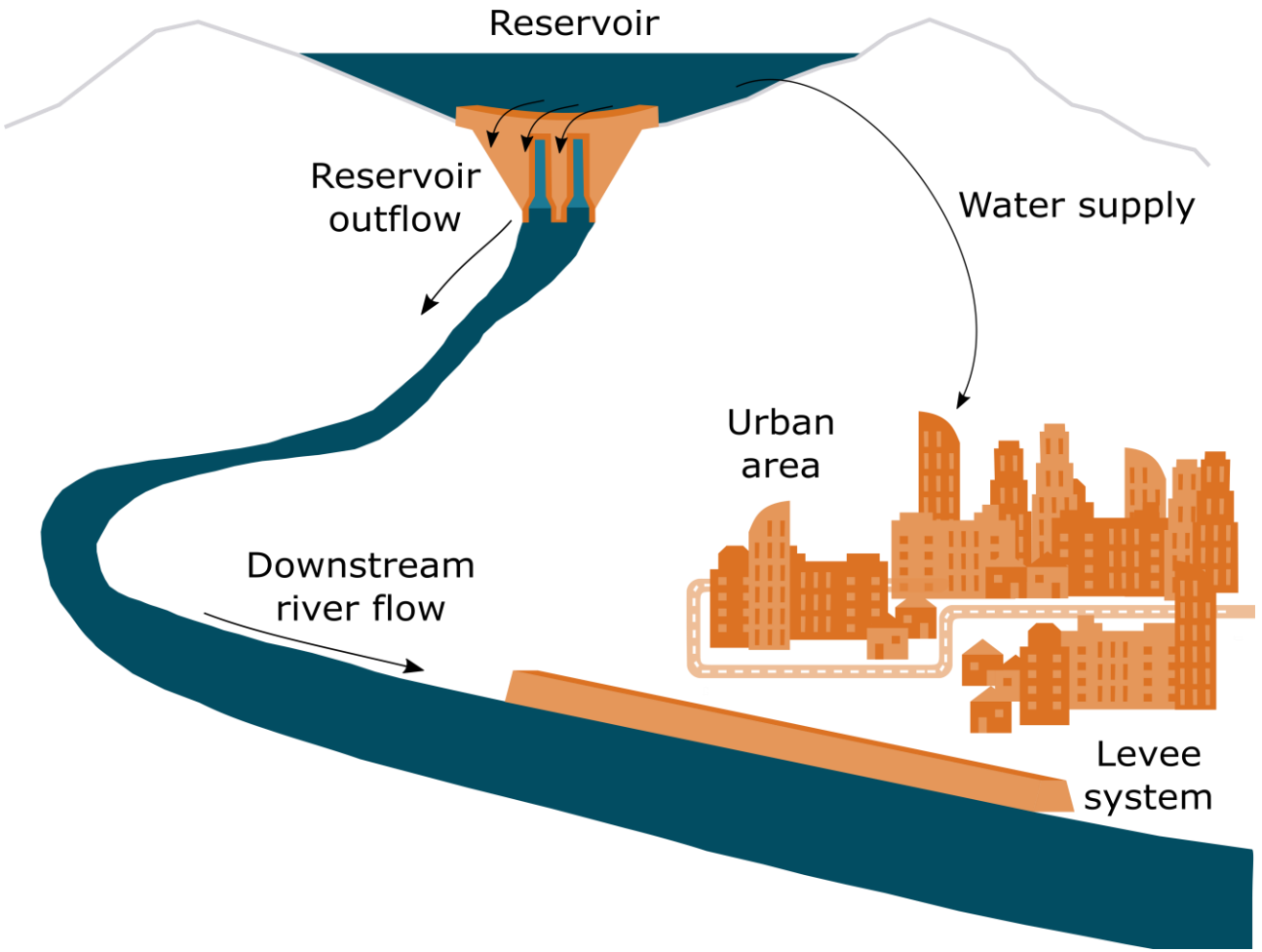
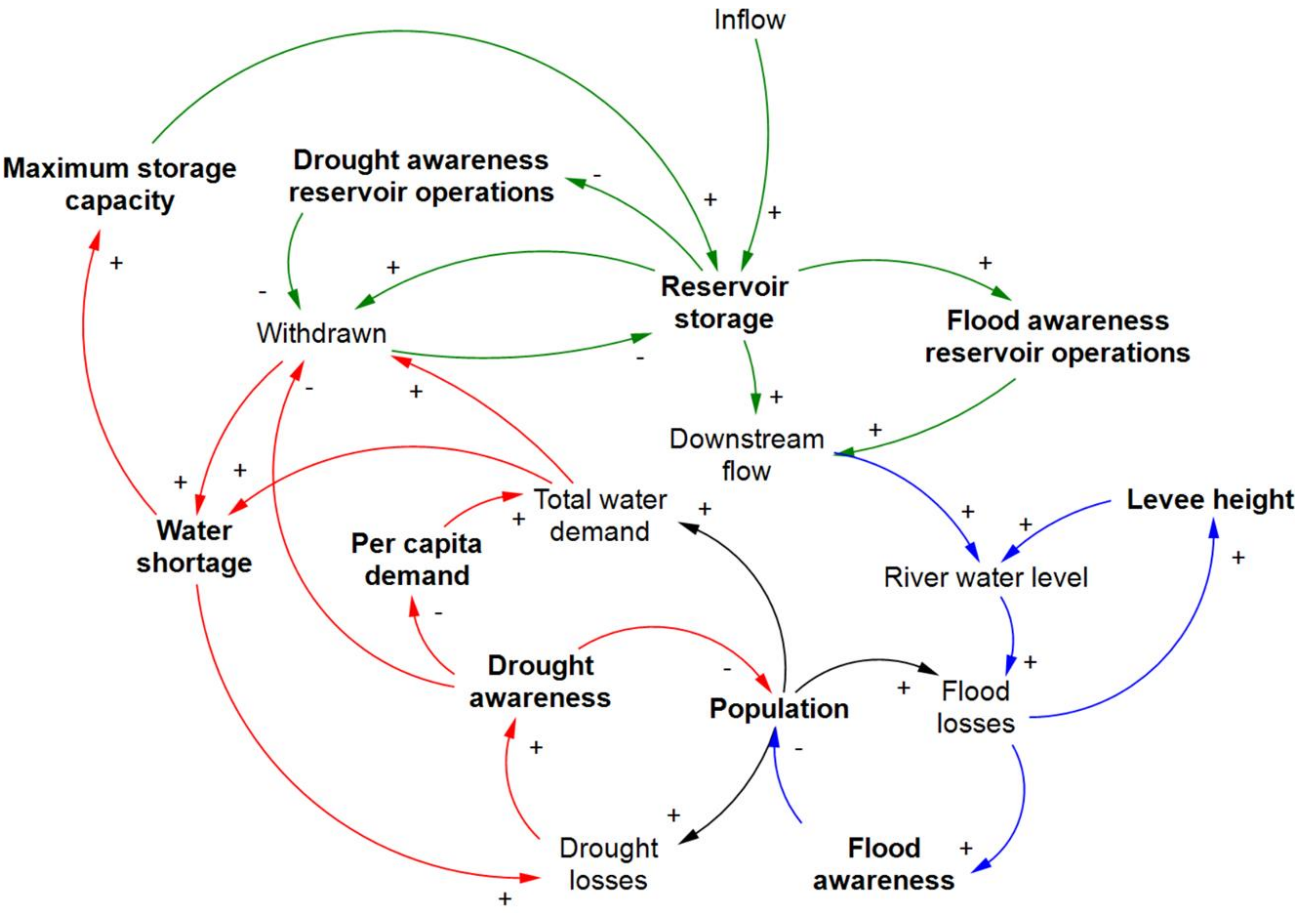
Synthetic reality



Causal Loop Diagram

Type of systems:

1. **Reservoir**
2. **Drought**
3. **Flood**
4. **Population**



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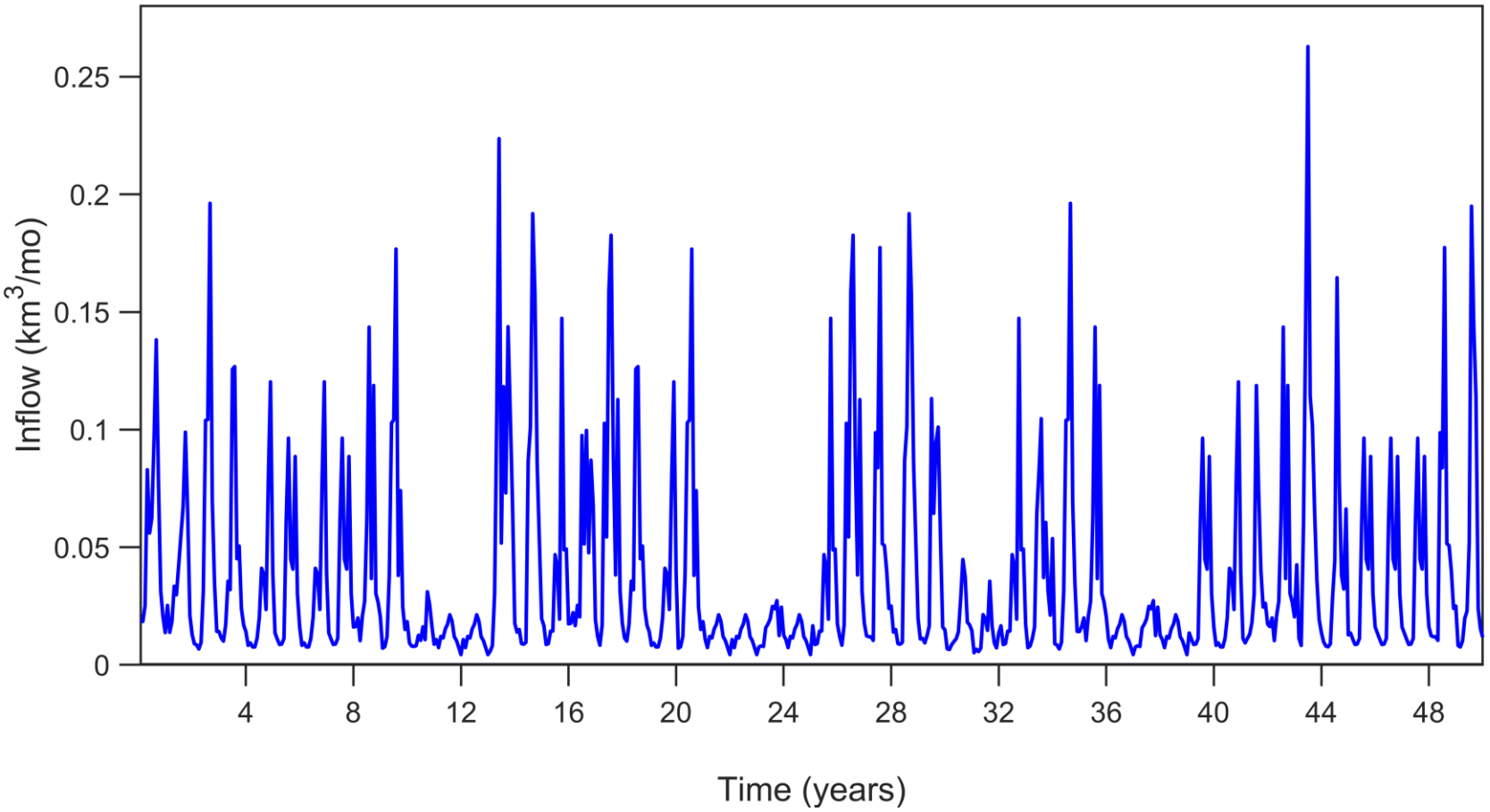
Water management strategies

Name	Description
Fatalist	No actions are implemented
Water exploitation	Only reservoir enlarging and hedging policies are considered to tackle droughts
Water conservation	Only reduction in per-capita demand is considered to tackle droughts
Fighting floods	Only levee reinforcement is considered to tackle floods

Synthetic inflow to the reservoir



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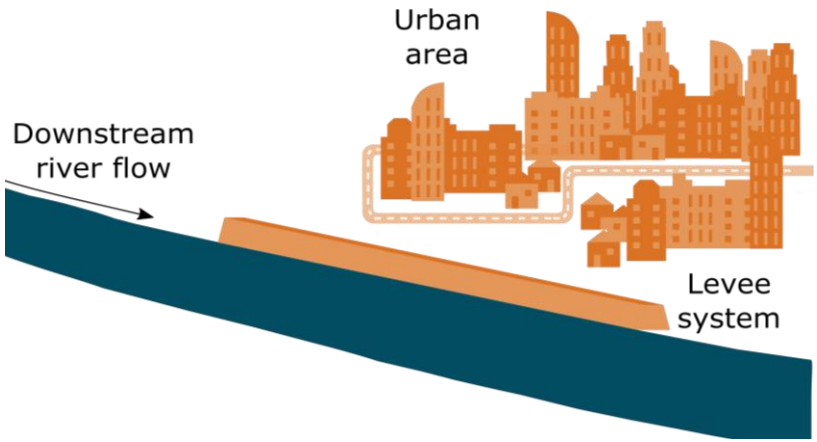
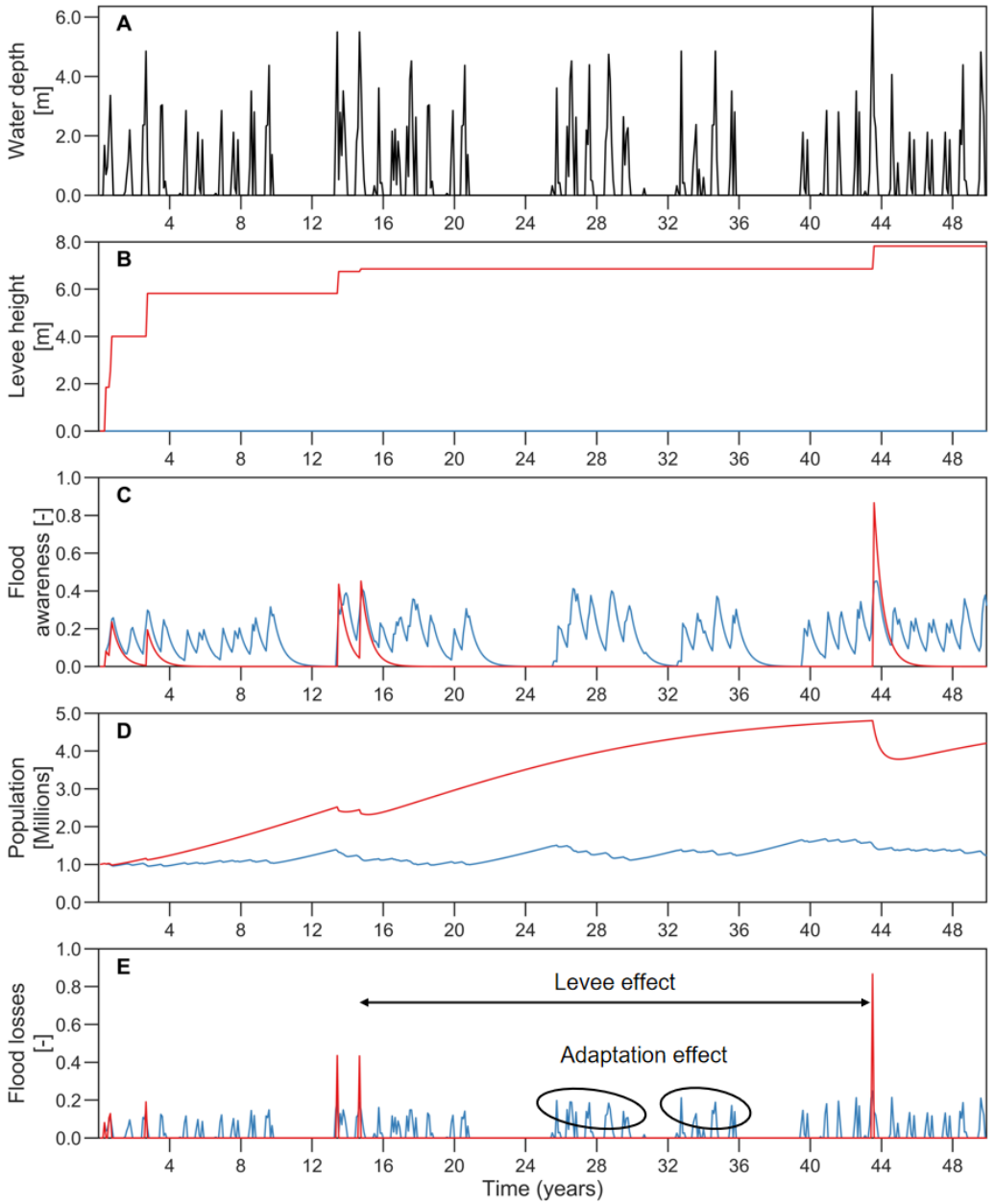
Results - Flood model





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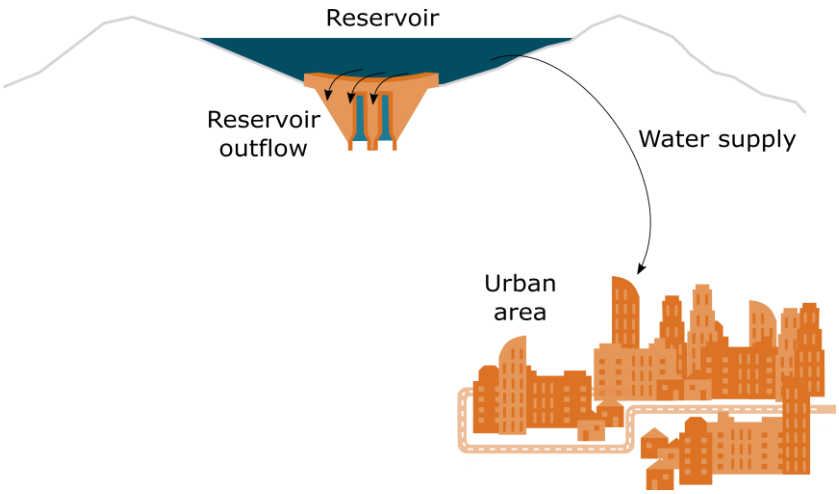
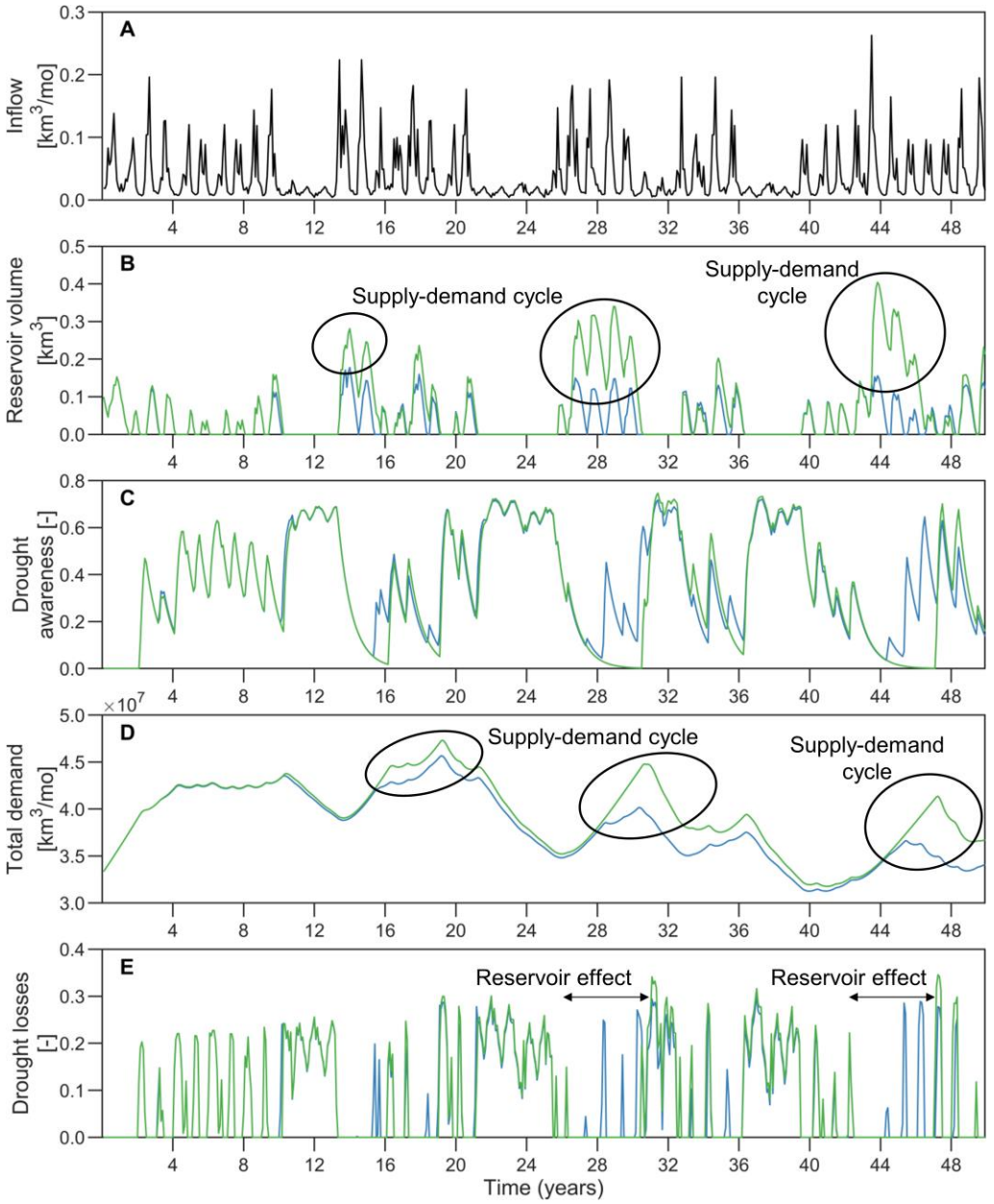
Drought model (Water exploitation)





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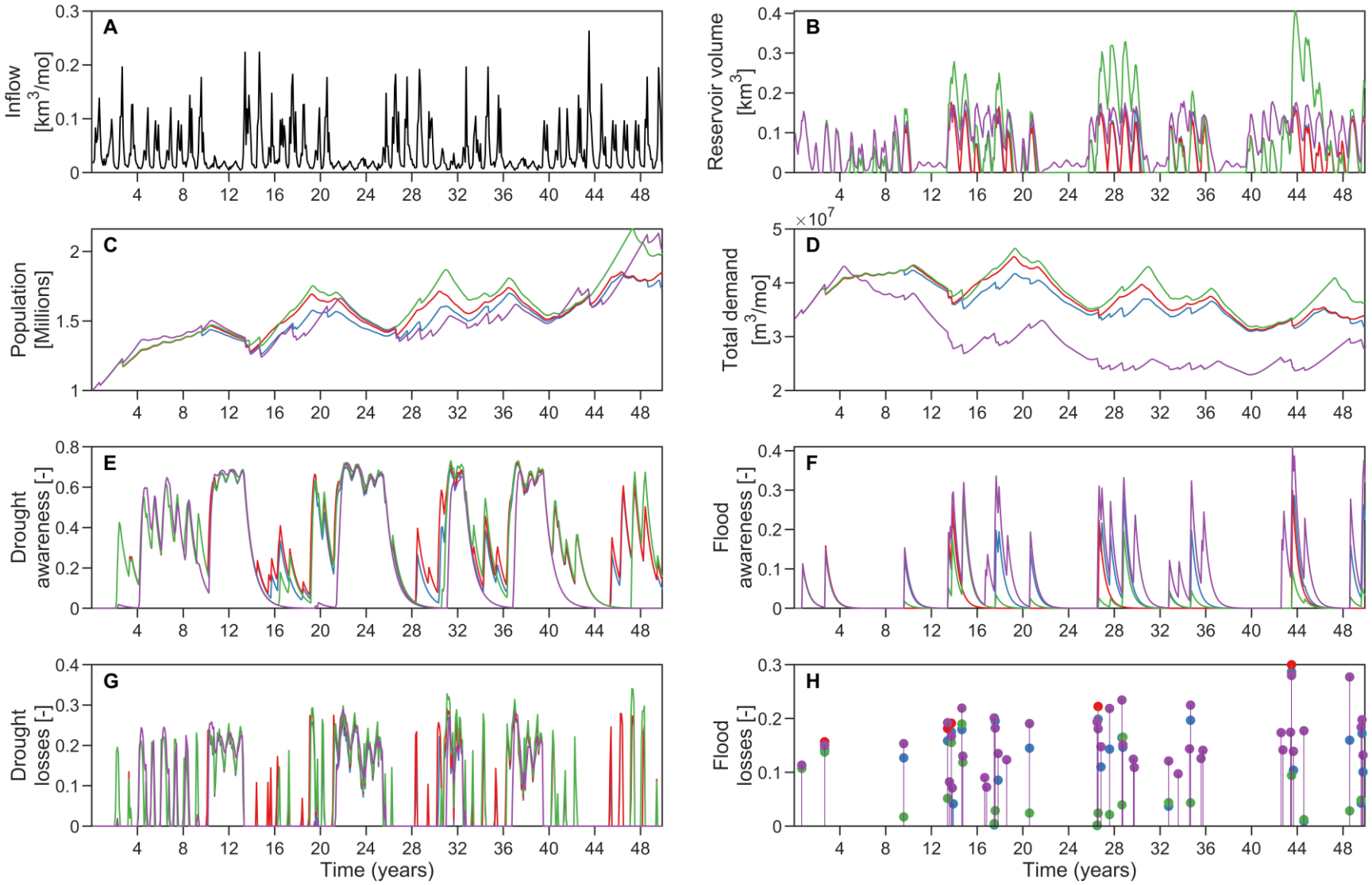
Results - Coupled models



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Conclusions

The proposed socio-hydrological model is able to capture different human-water dynamics when diverse management strategies are adopted.

Flood and drought awareness have a significant impact in the emergence of these complex dynamics.

The coupling of flood and drought systems allows to capture the sequence effect.

In conclusion, our socio-hydrological model provides a valuable explanatory tool for assessing the human-water dynamics under different drought and flood mitigation strategies.

Source: Drawing hands by Escher