

ADAPTATION RESPONSES IN COMPLEX HUMAN-WATER SYSTEMS: CHALLENGES, POLICY OPTIONS, AND SWANS

C. Dionisio Pérez-Blanco

Universidad de Salamanca, Spain

TALANOA-WATER MODELING WORKSHOP

1ST APRIL 2022





WHY THIS WORKSHOP

- TALANOA-WATER adopts a **protocol-based modular framework**
 - climatic, hydro(geo)logic, agronomic, micro- and macro-economic modules integrated using **bidirectional** *soft links*.
- Sensitivity analysis, uncertainty assessment
- This is to be done in **ALL LABS**
 - But not all labs have the expertise!
 - **Interdisciplinary, multi-partner work**

AGENDA



- **Introduction** (5m). C. Dionisio Pérez-Blanco.
- **Session 1: Multi-system modeling framework - The TALANOA Approach** (40m). Presentations by Ramiro Parrado/CMCC (10m) and Arthur HraßEssenfelder/CMCC (10m) and Q&A (20m).
- **Session 2: Refinements to the TALANOA modeling approach** (20m). Presentations by Ramiro Parrado/CMCC (5 min – Model linking methods) and Dionisio Pérez-Blanco/USAL (5 min – ensembles/uncertainty), and Q&A (10min).
- **Next steps** (25 min). Discussion on (climate & policy) scenarios to be considered, models to be considered (from partners, e.g., MODFLOW), datagaps (e.g., microeconomic). Also, discuss the baseline scenarios for climatechange (input for models) [only consider IPCC scenarios – max. 2-3].



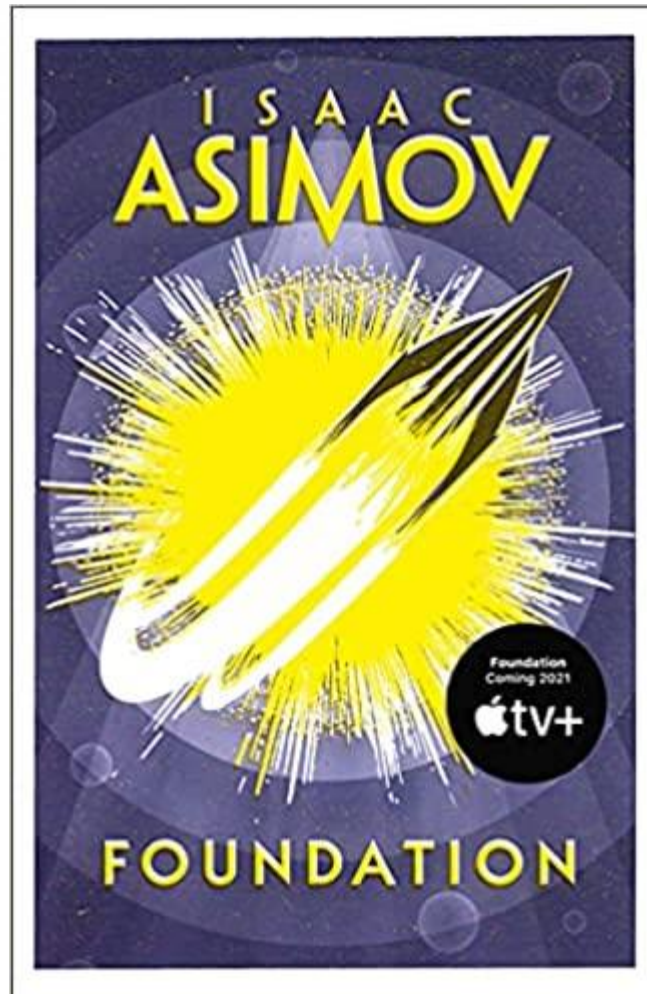
CHALLENGE 1: SYSTEM THINKING

- Policies are informed by models (e.g., river basin authorities use hydro/hydroeconomic models)
- Conventional hydro/hydroeconomic modeling:
 - Holistic (or simply hydro)
 - Human systems: piecewise exogenous benefit functions
 - misses the often complex, non-linear responses of economic agents
 - No two-way feedbacks
- **Modern hydroeconomics or Socio-hydrology:**
 - co-evolutionary dynamics of human societies and hydrologic systems
 - Two-way feedbacks
 - We want actionable models → *brand-new model* v. *add-ons*



SYSTEM THINKING IN THE ANTHROPOCENE

- Can we accurately model all systems and their interconnections?



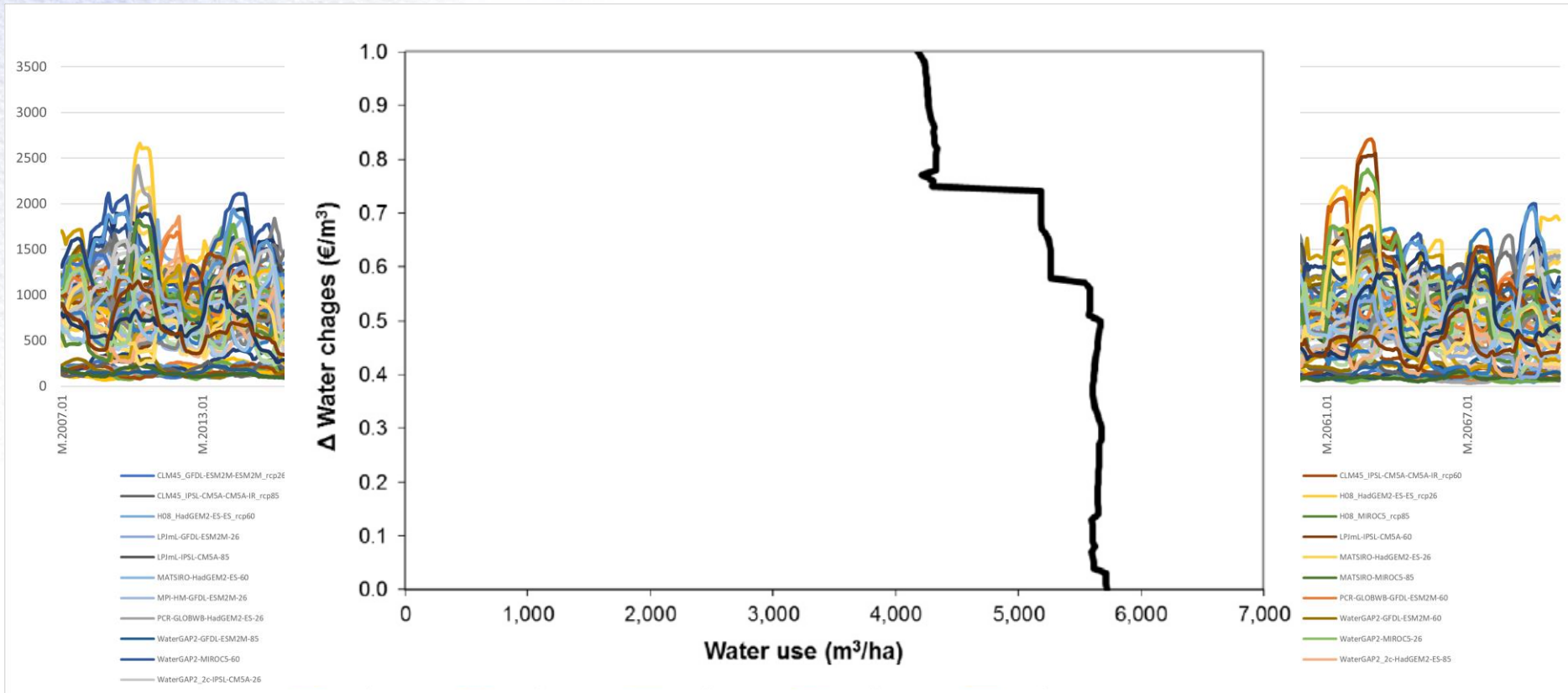


CHALLENGE 2: UNCERTAINTY

All models (and scenarios) are wrong, but some are useful

- System thinking and modeling is inextricably linked to **uncertainty**
 - **White swans:** we know all plausible futures and their probability
 - **Grey swans:** we know all plausible futures, but ignore their probability
 - Can be addressed through modeling: scenario uncertainty, ensembles
 - **Black swans:** We ignore some plausible futures
 - Cannot be addressed with conventional modeling tools. Requires heuristics, complex system thinking, expert judgement -> deep understanding of the problem
- Under uncertainty, we should not prioritize efficient outcomes through point prediction – but rather **robust outcomes through ensembles**

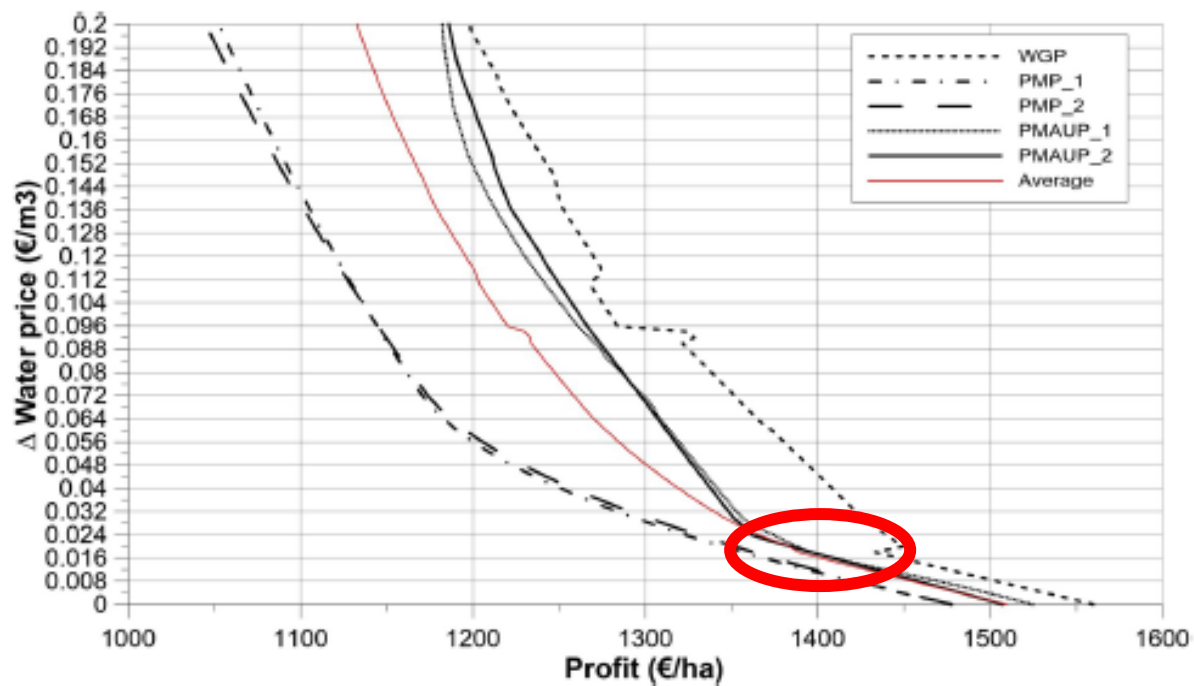
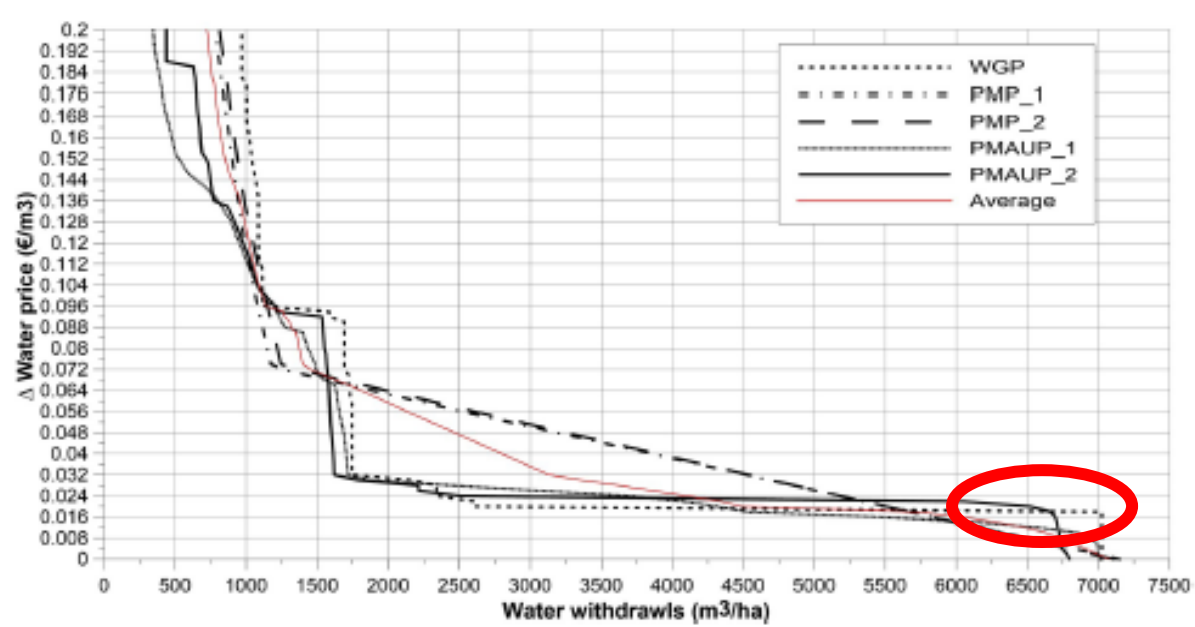
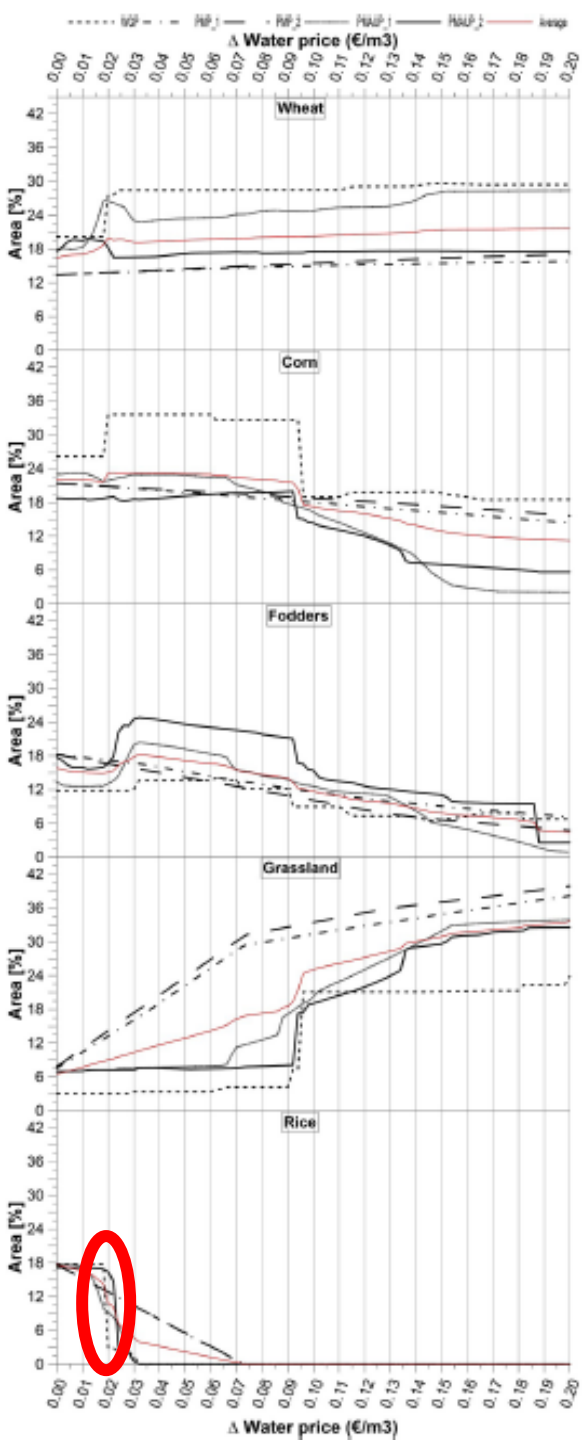
UNCERTAINTY IN HYDROLOGY/CLIMATE V. UNCERTAINTY IN SOCIOECONOMICS





ENSEMBLES & ROBUSTNESS - WHEN WE KNOW WE DO NOT KNOW

- Piedmont Region aims to deploy a charging instrument towards full cost recovery...
- ...but it is concerned on the impact that higher prices may have on some agricultural systems – mostly historical rice fields (potential *disproportionate cost*?)
- We need to find the water price that “breaks” the agricultural system – and make sure we avoid it! (**robust**)
 - We use an ensemble to that end (micro ensemble coupled with hydro)





CONCLUSIONS



THE QUEST FOR ACTIONABLE SCIENCE

- Understanding human-water and human-human systems dynamics demands socio-hydrology-inspired science (two-way feedbacks)
- Model hierarchies: consolidative yet *flexible*
 - Opens up for exploring new sources of uncertainty
 - 1) multi-system framework design (protocols)
 - 2) parameters and structural uncertainties (modules)
- Coupled with scenario discovery & ensemble methods can help build a large dataset of plausible futures so to:
 - Sample uncertainty
 - And identify robust policies



Thank you

