# WASSERMED

## Modelling water availability and security in the Mediterranean

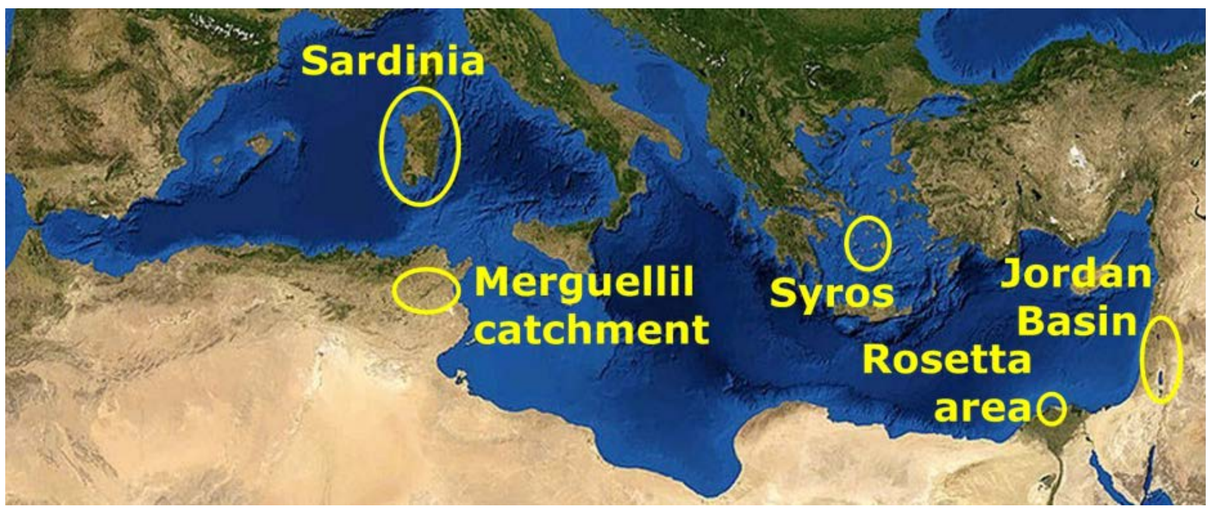
Janez Sušnik, Lydia Vamvakeridou-Lyroudia,
Dragan Savić, Zoran Kapelan

Centre for Water Systems, University of Exeter

## Background

*The Mediterranean is a water security hotspot. Water resources are being over-exploited with detrimental impacts on humans, agriculture, development opportunities and ecosystem services. Predicted global change is likely to make the situation worse. Change to water availability has consequences for food and local economies. Modelling that can reflect changes in both sectors together is required.*

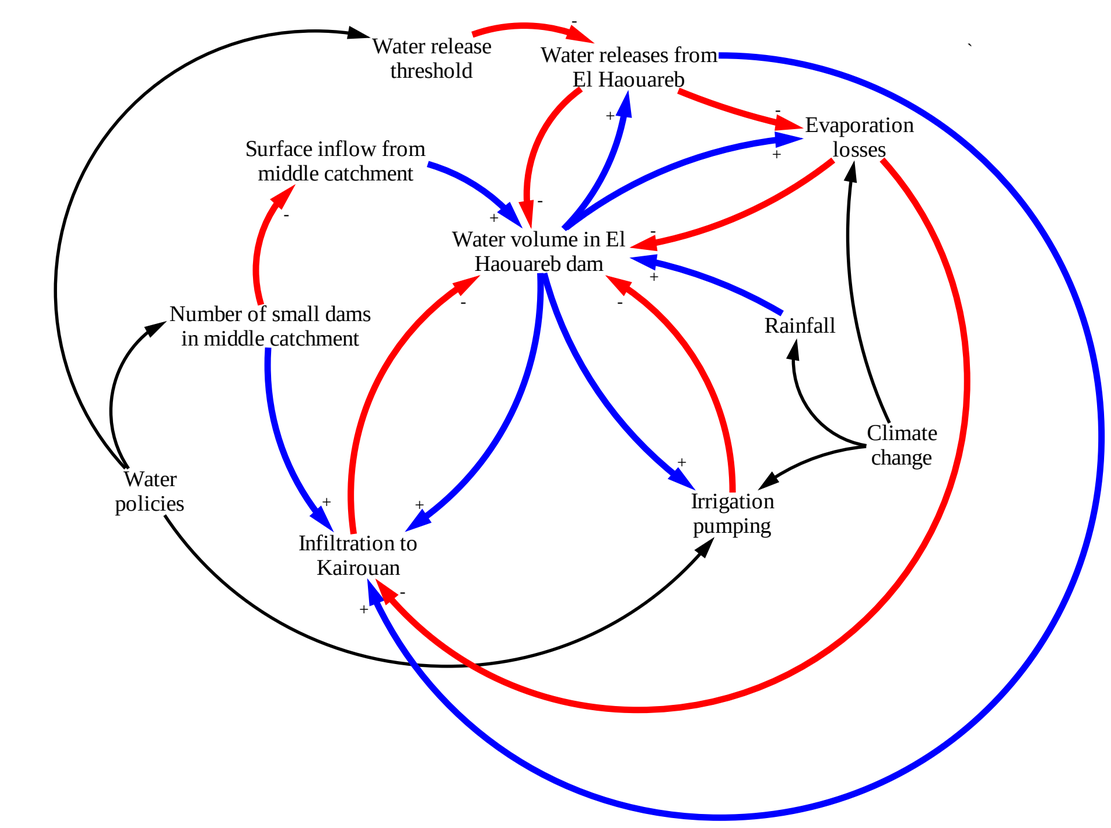
*Better modelling of Mediterranean water systems is critical for resource allocation and mitigation planning. The EC FP7 project WASSERMed (www.wassermed.eu) is examining water-related security threats in five case studies (see map).*




*Map of southern Europe highlighting the WASSERMed study sites*

## Modelling method

*System Dynamics Modelling (SDM) was used in four of the case studies. for its ability in modelling complex systems characterised by feedback and delay. SDM uses the concepts of stocks (that store material), flows (that move material into and out of stocks) and converters (that alter the rate of flow) to create feedback-driven models. The feedback relationships between model elements are summarised in causal-loop diagrams that show how the elements interact. These guide development of the final simulation model(s).*



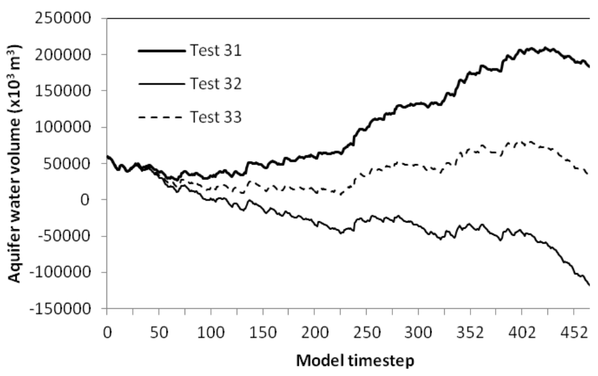

*Causal loop diagram showing the feedback relationships between system elements in a sub-model of the Tunisian SDM. Blue arrows represent positive feedbacks, red arrows represent negative feedbacks. Black arrows show external factors that influence system behaviour.*

## Major results

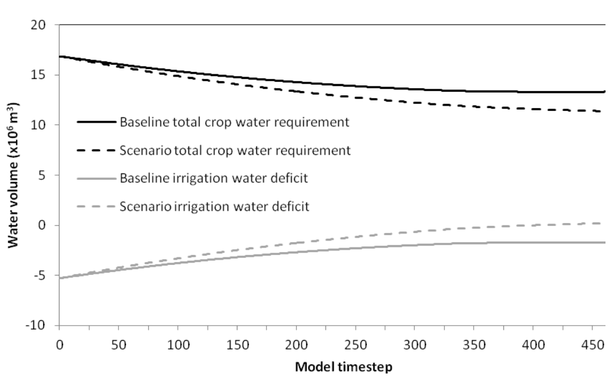
*Water is being (nearly) over-exploited in all of the case studies. Under climate-change, the current situation is expected to get worse. A do-nothing scenario is not recommended.*

*What-if testing of policy scenarios showed that improvements can be made. Water surplus may be achieved, occasionally through relatively simple measures which may not encounter much local opposition.*

*Policies may take years to show beneficial effects. Strategic-term plans are required. High-impact, short-term change should not be expected.*




*Potential policy impacts on water resources in Kairouan, Tunisia*

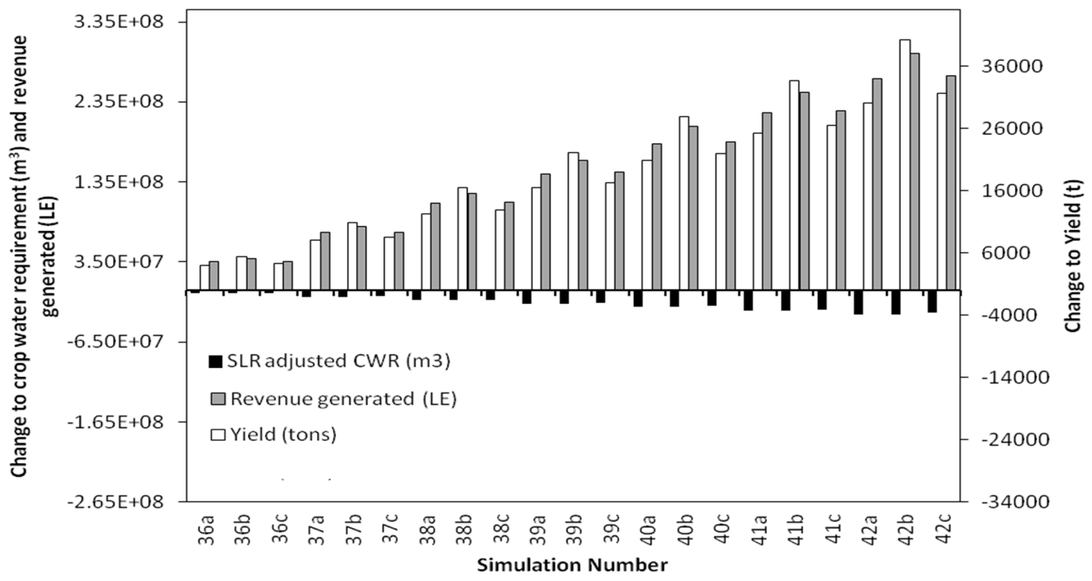



*Impacts on water resources in Jordan resulting from cropping pattern alterations*

## Lessons

*There is no Mediterranean-wide policy solution for overcoming the water-related security threats being faced, which while common between case studies, have considerably different impacts.*

*Some policy measures are applicable across the region, others are location-specific. 'Cornerstone' policies should not be implemented in isolation. The risk to water resources and development in the event of underperformance is too great. Multiple policies a) introduce redundancy and; b) amplify the effects of other policies, bringing about the best chance for a water-secure, sustainable future across the Mediterranean.*




*Potential policy impacts in the agricultural sector on the water resources, crop yield and agricultural revenue in Rosetta, Egypt. Results are relative to a 'do-nothing' scenario.*

## Further reading

*Sušnik J., Vamvakeridou-Lyroudia L.S., Savić D.A., Kapelan Z. 2012. Integrated System Dynamics Modelling for water scarcity assessment: case study of the Kairouan region. Science of the Total Environment 440: 290-306. doi: 10.1016/j.scitotenv.2012.05.085*

*Sušnik J., Molina J-L., Vamvakeridou-Lyroudia L.S., Savić D.A., Kapelan Z. In Press. Comparative analysis of System Dynamics and Object-Oriented Bayesian Networks Modelling for water systems management. Water Resources Management. 27(3): 819-841. doi: 10.1007/s11269-012-0217-8*

*Sušnik J., Vamvakeridou-Lyroudia L.S., Savić D.A., Kapelan Z. Accepted. Integrated modelling of a coupled water-agricultural system using system dynamics. Journal of Water and Climate Change.*

University of Exeter
College of Engineering, Mathematics and Physical Sciences