INTEGRATED ANALYSIS OF THE CLIMATE CHANGE EFFECTS ON WATER AVAILABILITY FOR CATCHMENT MANAGEMENT. THE CASE OF THE ÉSERA RIVER (SPAIN)

Abel Solera* (asolera@upv.es), Carlos Segura*, Gianbattista Bussi^, Andrea Momblanch* and Félix Francés*

* Research Institute Of Water And Environmental Engineering (IIAMA), Universitat Politècnica de València ^ School Of Geography And The Environment. University of Oxford

INTRODUCTION

The analysis of the **impact of climate change** on **water resources** is of primary importance in Mediterranean Areas. The expected effects are:

- Mean precipitation decrease
- Increase in its torrentiality
- Temperature increase

and on **socioeconomy**:

- Growing urban water demand
- New environmental requirements

To achieve an improved use of water resources, new and detailed studies of the impact of the climate change are needed.

The rainfall-runoff distributed conceptual model TETIS generates the discharge series considering current climate, A2 and B2 emission scenarios. These results are used as inputs for the SIMGES model for water resources planning and management to conduct a **climate change adaptation analysis**, to adopt and assess several measures based on the management of water resources.

TOOLS AND METHODS

DATA

Average values
- Precipitation: 655 mm/year
- Temperature: 6.9 ºC
- Water demands: 410 Hm³/year

Current climate S_0

Average values
- Precipitation: 571 mm/year
- Temperature: 10.7 ºC
- Demands: +0.03 Hm³/year

A2 scenario S_1

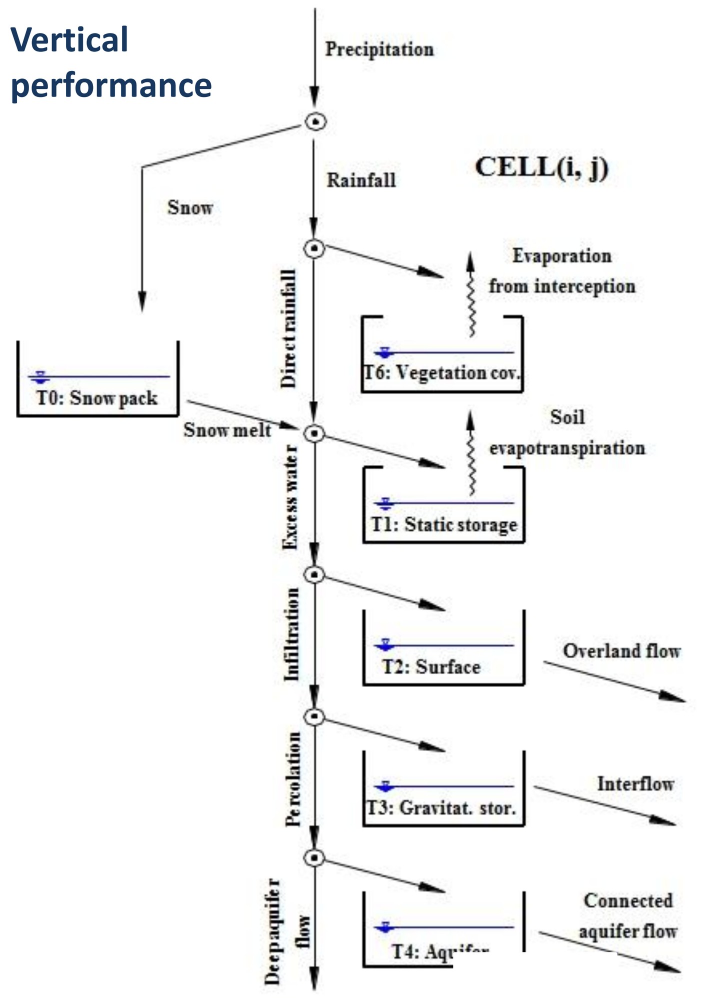
Average values
- Precipitation: 581 mm/year
- Temperature: 9.7 ºC
- Demands: +0.02 Hm³/year

B2 scenario S_2

Precipitation and temperature data were provided by AEMET (S_0) and the PRUDENCE project (S_1 and S_2)

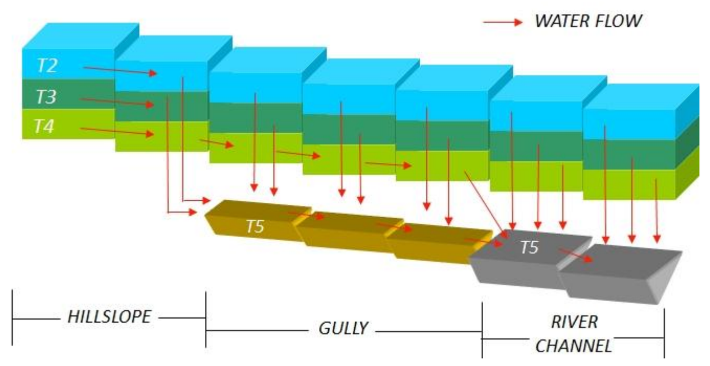
TETIS (Francés et al., 2007)

Vertical performance



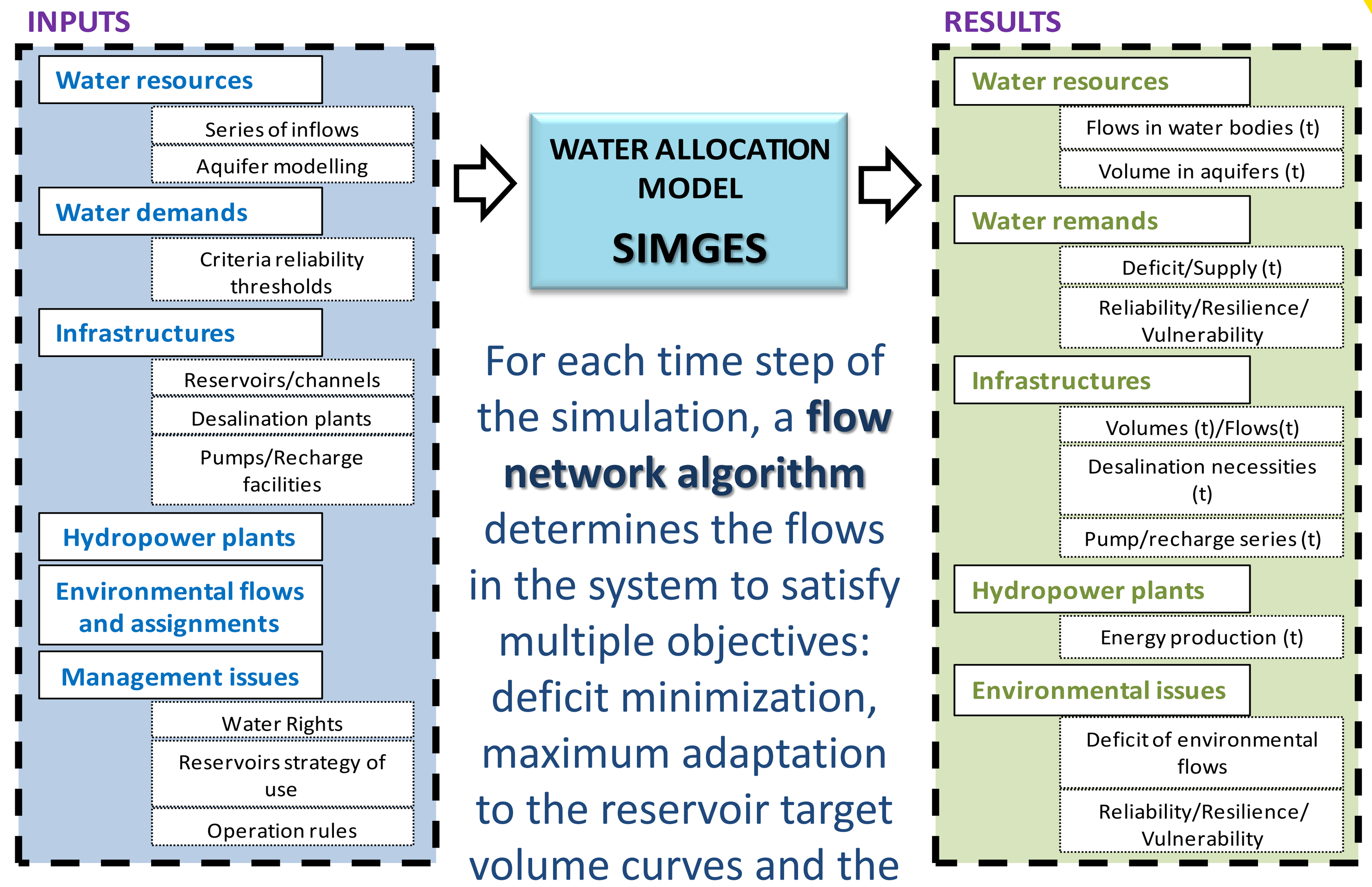
- Distributed conceptual model (tank structure) with physically based parameters
- Widely used in Spain and Latin America
- Distinction between slope, gully and channel cells
- Propagation through the geomorphologic kinematic wave
- SCE-UA automatic calibration algorithm (Duan et al., 1993)

Flow propagation



Francés F, Vélez JI, Vélez JJ (2007) *Split-parameter structure for the automatic calibration of distributed hydrological models*. Journal of Hydrology; 332: 226-240.

SIMGES (Andreu et al., 2007)



For each time step of the simulation, a **flow network algorithm** determines the flows in the system to satisfy multiple objectives: deficit minimization, maximum adaptation to the reservoir target volume curves and the hydropower production objectives.

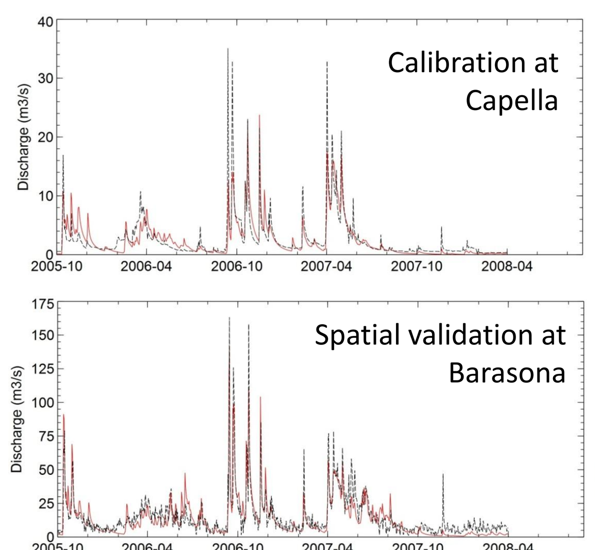
Andreu J, Solera A, Capilla J, Ferrer J (2007) *Modelo SIMGES para simulación de cuencas. Manual de usuario*. Universidad Politécnica de Valencia, España.

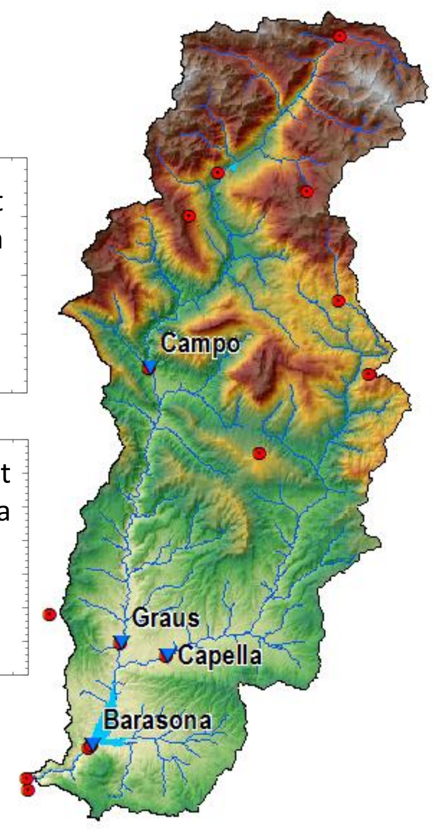
RESULTS ANALYSIS

HYDROLOGY

Calibration and validation

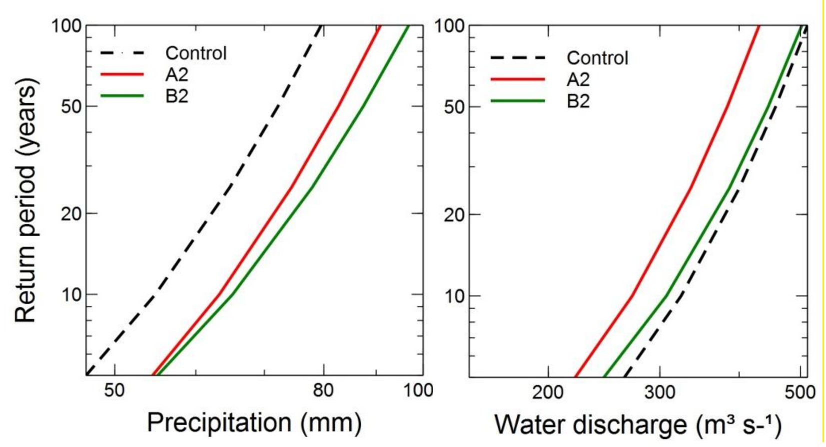
Station	Calibration period Nash-Sutcliffe	Calibration period Volume error %	Validation period Nash-Sutcliffe	Validation period Volume error %
Capella	0.720	-6%	0.686	-39%
Graus	0.581	-28%	0.704	-61%
Campo	0.294	-44%	0.455	-35%
Barasona	0.708	-10%	0.529	-22%





Climate change impact analysis

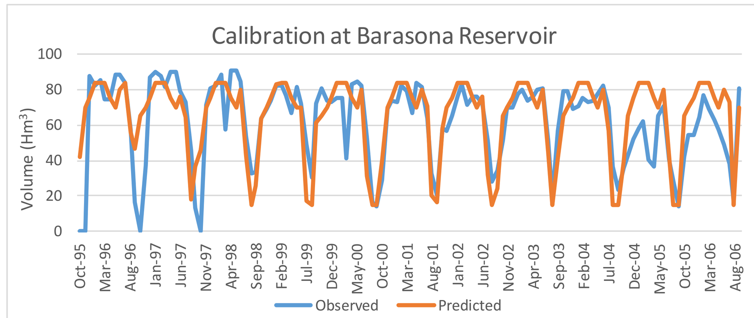
Variable	S_0	S_1	S_2	Variation S_1 vs. S_0	Variation S_2 vs. S_0
Soil saturation (%)	66%	50%	52%	-25%	-21%
Snowpack (eq. mm)	0.573	0.288	0.334	-50%	-42%
Water yield (Hm³/year)	594	372	395	-37%	-33%

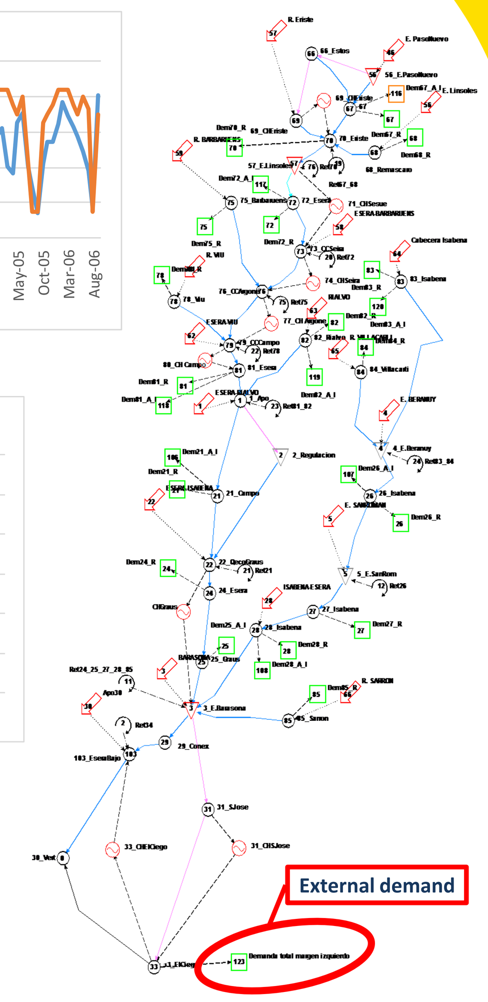


WATER MANAGEMENT

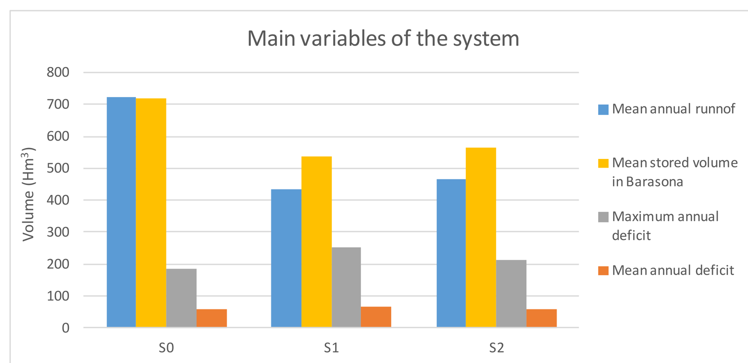
Calibration and validation

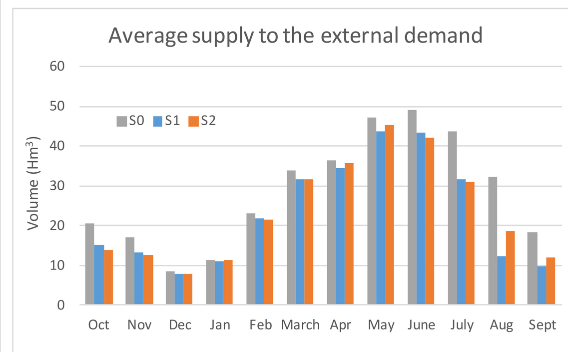
Indicator	Calibration	Validation
Pearson	0.724	0.701
Nash-Sutcliffe	0.458	0.344





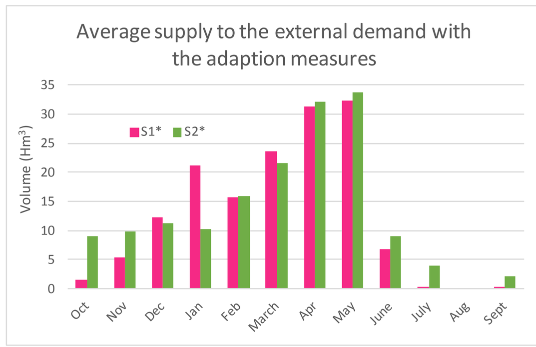
Climate change impact analysis





Climate change adaption measures

The management measure consists in prioritising the supply to internal demands with respect to the external demand



	Mean annual deficit	Maximum annual deficit
S1 - S1*	6.32%	9.15%
S2 - S2*	5.03%	9.95%

CONCLUSIONS

TETIS results pointed out that a **global decrease in water yield** is devised, being around **37% and 33%** for scenarios **A2 and B2** respectively.

The main variables of the system are affected by climate change. The main impacts occur on the volume stored in the Barasona reservoir and on the maximum annual supply deficits.

The **climate change adaption measure** performed with SIMGES resulted in the **reduction of the supply deficits** to the demands in the system, harmonising all figures with the legal requirements for human supply.

ACKNOWLEDGMENTS

We would like to thank the Spanish Ministry of Economy and Competitiveness for funding the project SCARCE (Consolider-Ingenio 2010 CSD2009-00065)