Assessing the impact of climate and water demand changes on hydrology and water resources in the Turia river basin, Spain

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This presentation participates in OSPP

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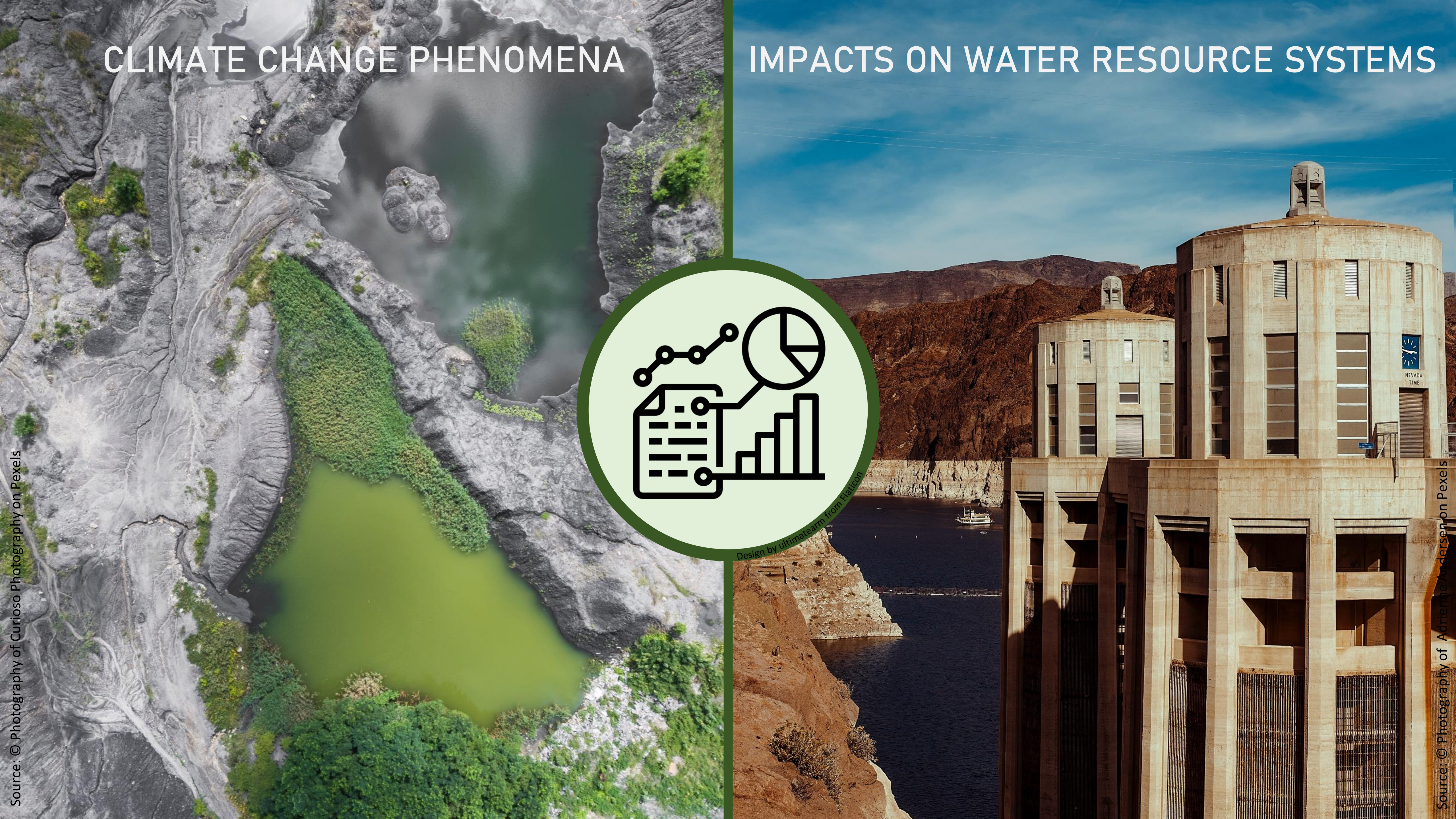
CLIMATE CHANGE PHENOMENA
IMPACTS ON WATER RESOURCE SYSTEMS
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NEVADA TIME
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IMPACTS ON WATER RESOURCE SYSTEMS

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METHODOLOGY REQUIREMENTS

CONFIDENCE IN CLIMATE MODELS

COMPLEXITY OF SYSTEMS

EXOGENOUS FACTORS

PROPOSED METHODOLOGY

CLIMATE MODEL

HYDROLOGICAL MODEL

WATER RESOURCE SYSTEM MODEL

- POTENTIAL EVAPOTRANSPIRATION (PET) ESTIMATION IMPROVEMENTS
- DUAL APPROACH PERFORMANCE EVALUATION
- MODEL PERFORMANCE PRE-EVALUATION FOR HISTORICAL EXCEPTIONAL CLIMATE CONDITIONS
- DUAL IMPACT ANALYSIS

POTENTIAL EVAPOTRANSPIRATION (PET) ESTIMATION IMPROVEMENTS

PROPOSED METHODOLOGY

MODIFICATION PROPOSED

Low information demand
Higher PET estimation accuracy

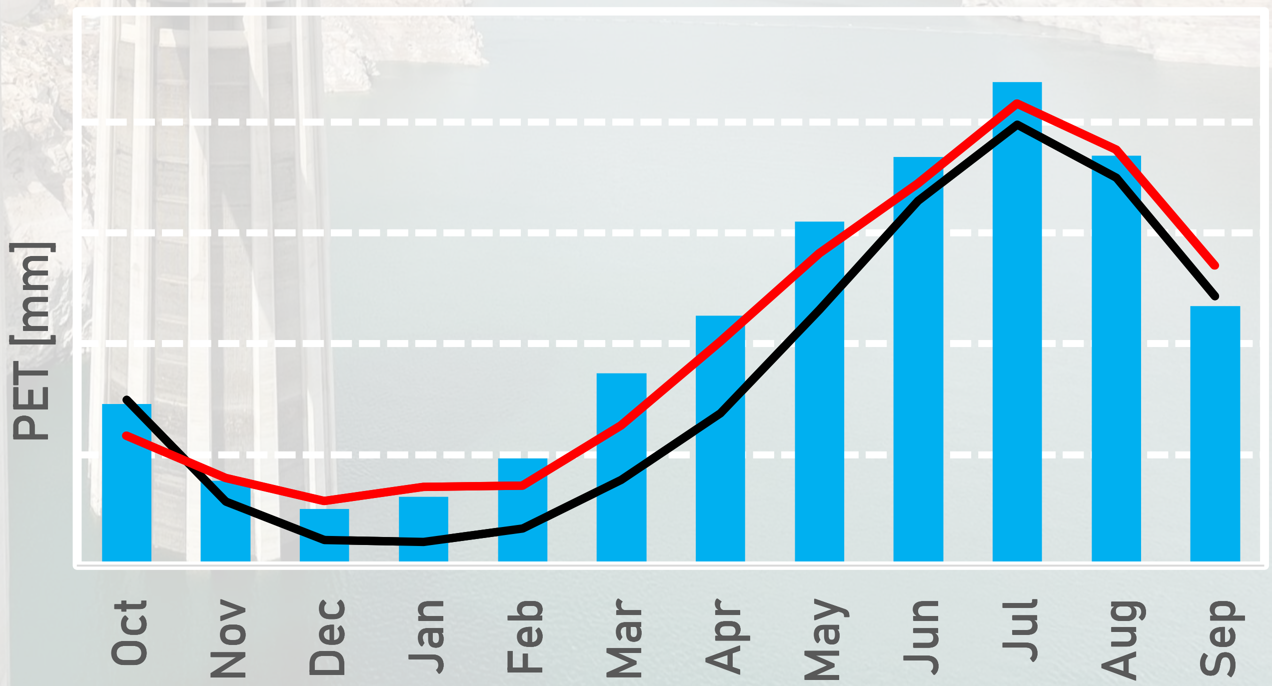
THORNTHWAITE EQ.

Low information demand
Lower PET estimation accuracy

PENMAN-MONTEITH EQ.

High information demand
High PET estimation accuracy

$$PET = b * 16,2\left(\frac{10 * \alpha_{S-W}(T + A)^{1-\beta_{S-W}}}{I}\right)^{a}$$

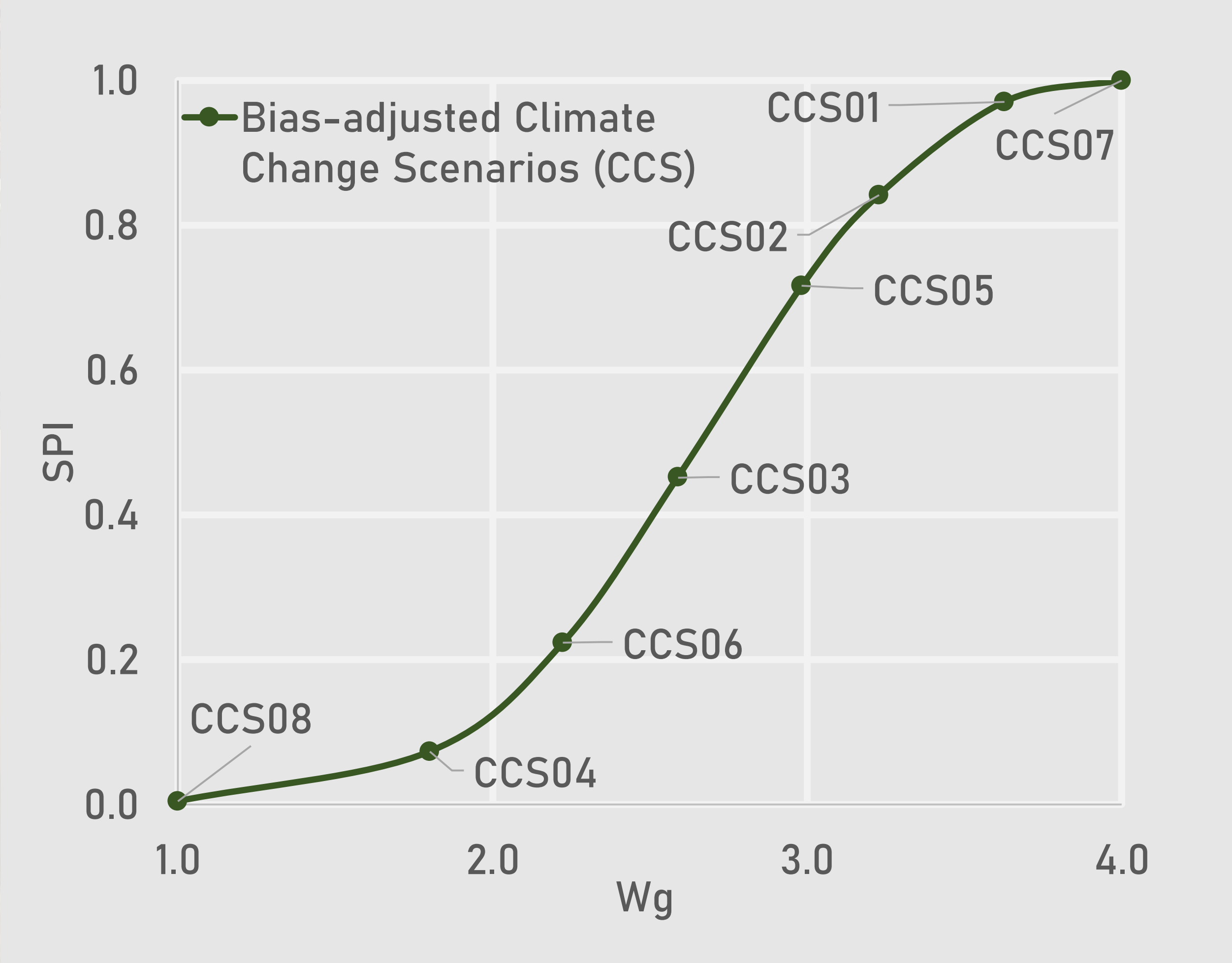


DUAL APPROACH PERFORMANCE EVALUATION

PROPOSED METHODOLOGY

Standardized Performance Index (SPI)

$$SPI(Wg_i) = P\left(\frac{Wg_i - \mu_{Wg}}{\sigma_{Wg}}\right)$$



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PROPOSED METHODOLOGY

DUAL APPROACH PERFORMANCE EVALUATION

Standardized Performance Index (SPI)

$$SPI(Wg_i) = P\left(\frac{Wg_i - \mu_{Wg}}{\sigma_{Wg}}\right)$$

Dual Performance Weight (Wg_i)

$$Wg_i = W_{Cli_i} + W_{SCS_i}$$

Climate Performance Weight

$$W_{Cli_i} = W_{T_i} + W_{A_i} + W_{P_i}$$

Streamflow Change Signal Performance Weight

$$W_{SCS_i}$$

Performance Weighting

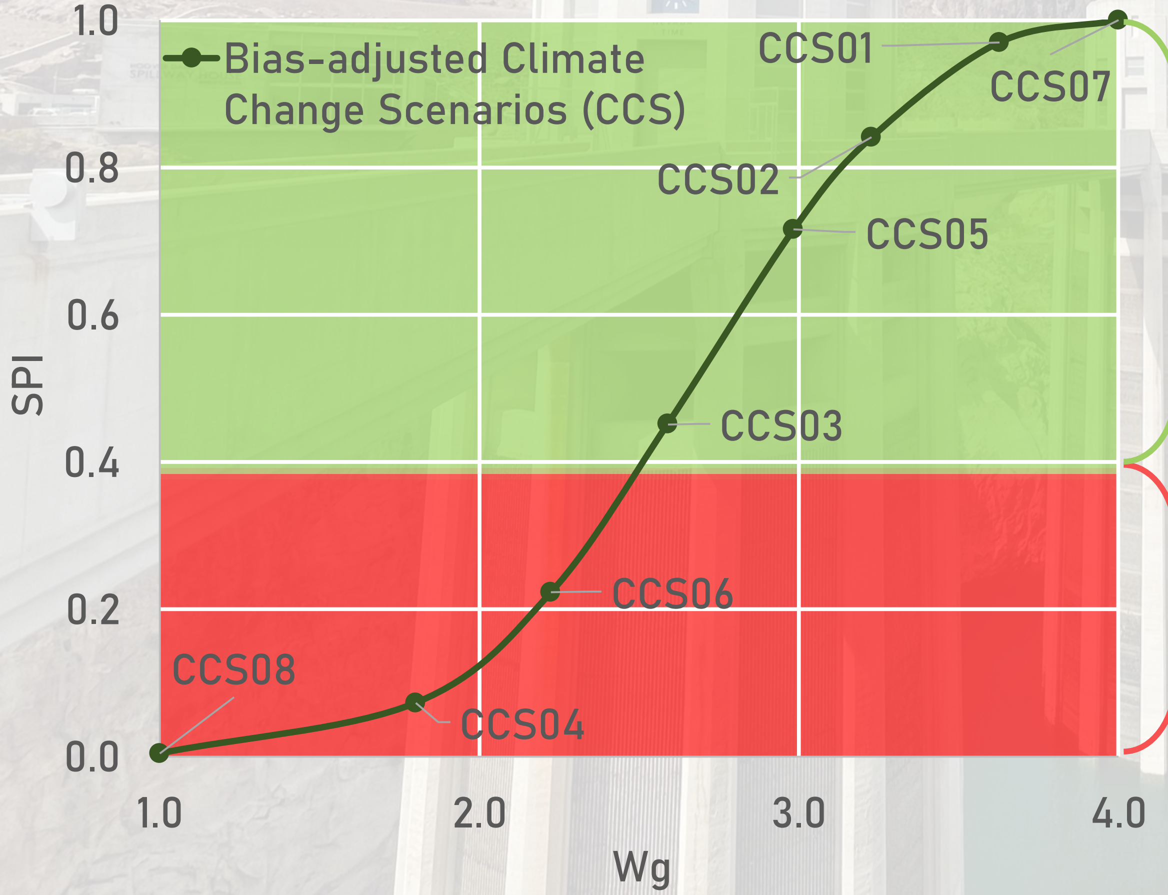
$$W_{Variable_i} = 1 - \frac{RMSE_{Var_i} - min\left[RMSE_{Var_i}\right]_{i=1}^{i=n}}{max\left[RMSE_{Var_i}\right]_{i=1}^{i=n} - min\left[RMSE_{Var_i}\right]_{i=1}^{i=n}}$$

PROPOSED METHODOLOGY

DUAL APPROACH PERFORMANCE EVALUATION

Standardized Performance Index (SPI)

$$SPI(Wg_i) = P\left(\frac{Wg_i - \mu_{Wg}}{\sigma_{Wg}}\right)$$



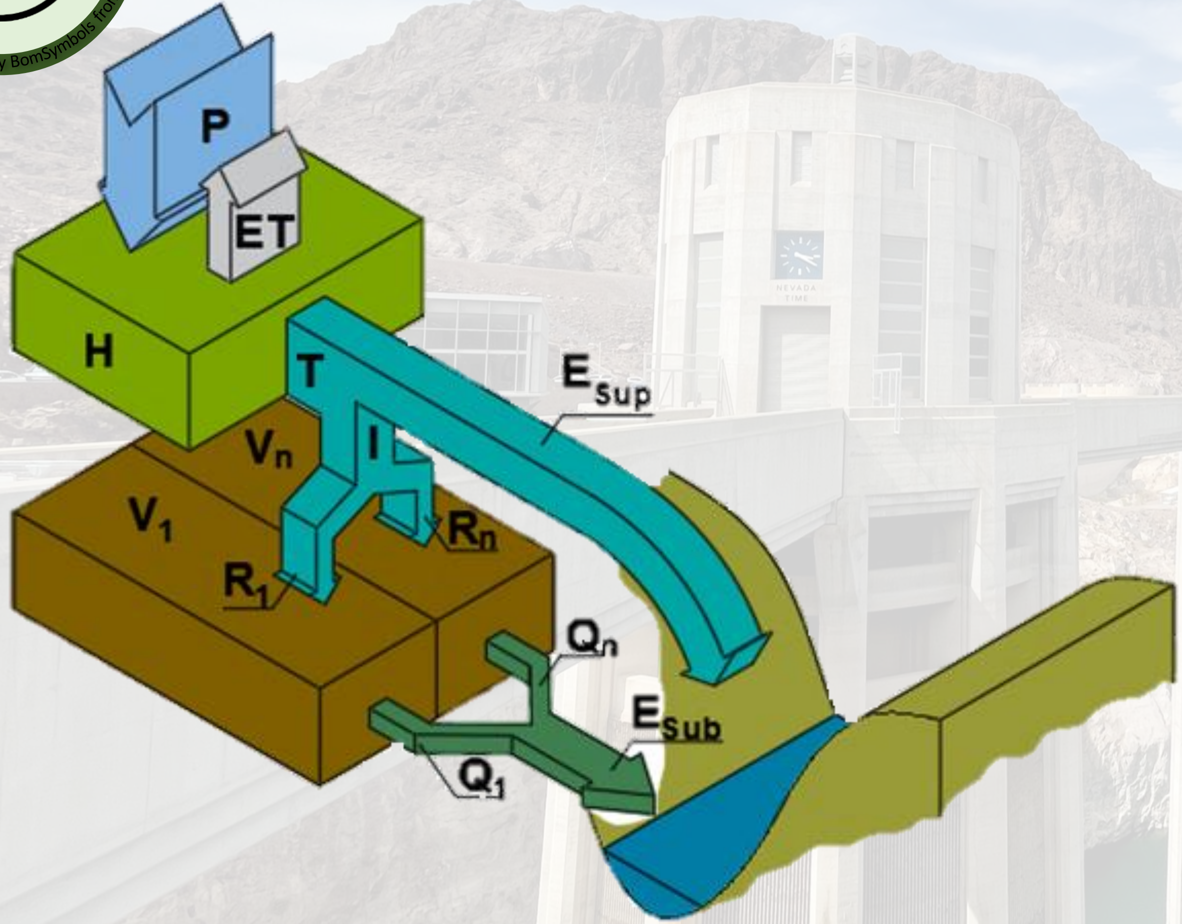
Impact Assessment' Adequate Range

Minimum Performance Threshold (MPT)

Impact Assessment' Undesirable Range

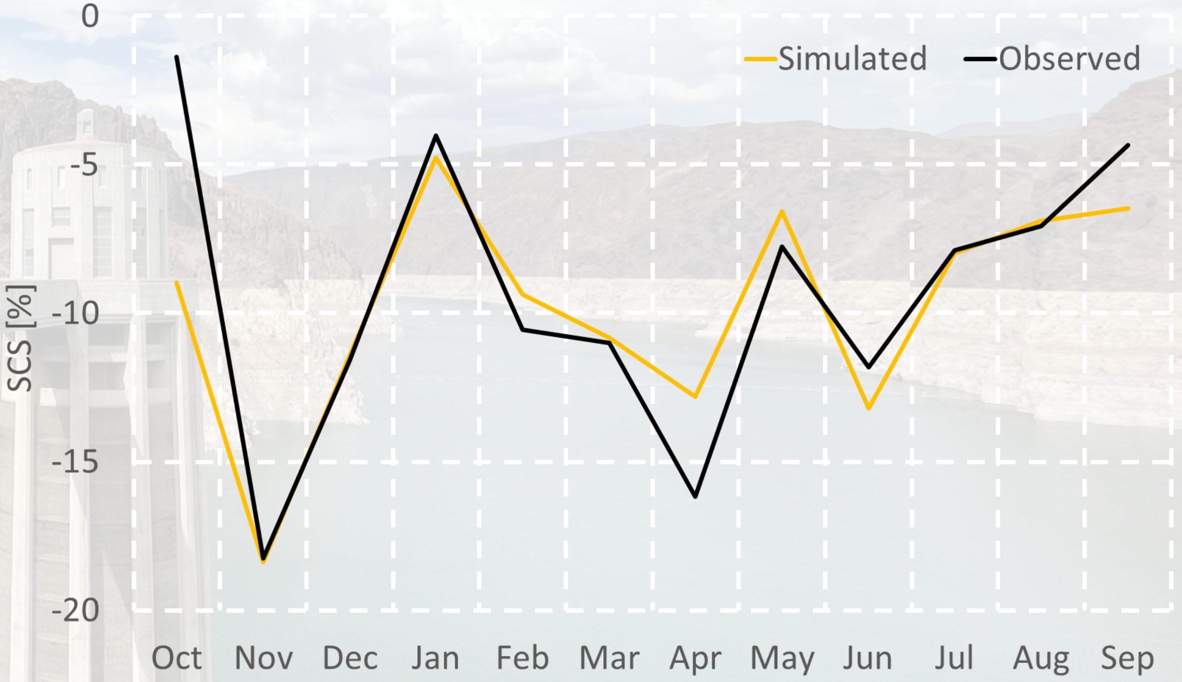
PROPOSED METHODOLOGY

MODEL PERFORMANCE PRE-EVALUATION



Conceptual Hydrological Model

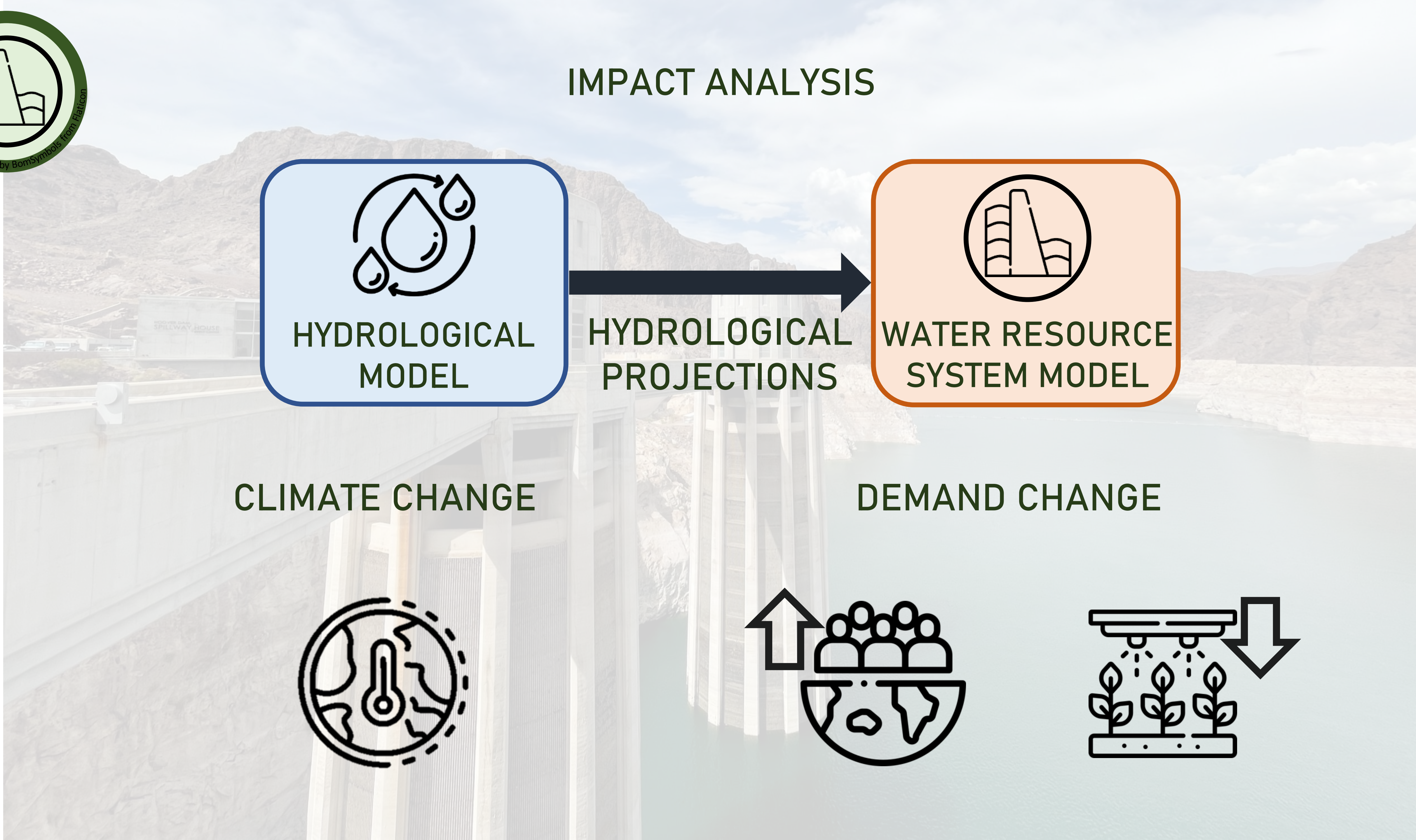
SCS between two historical periods



Historical exceptional climate

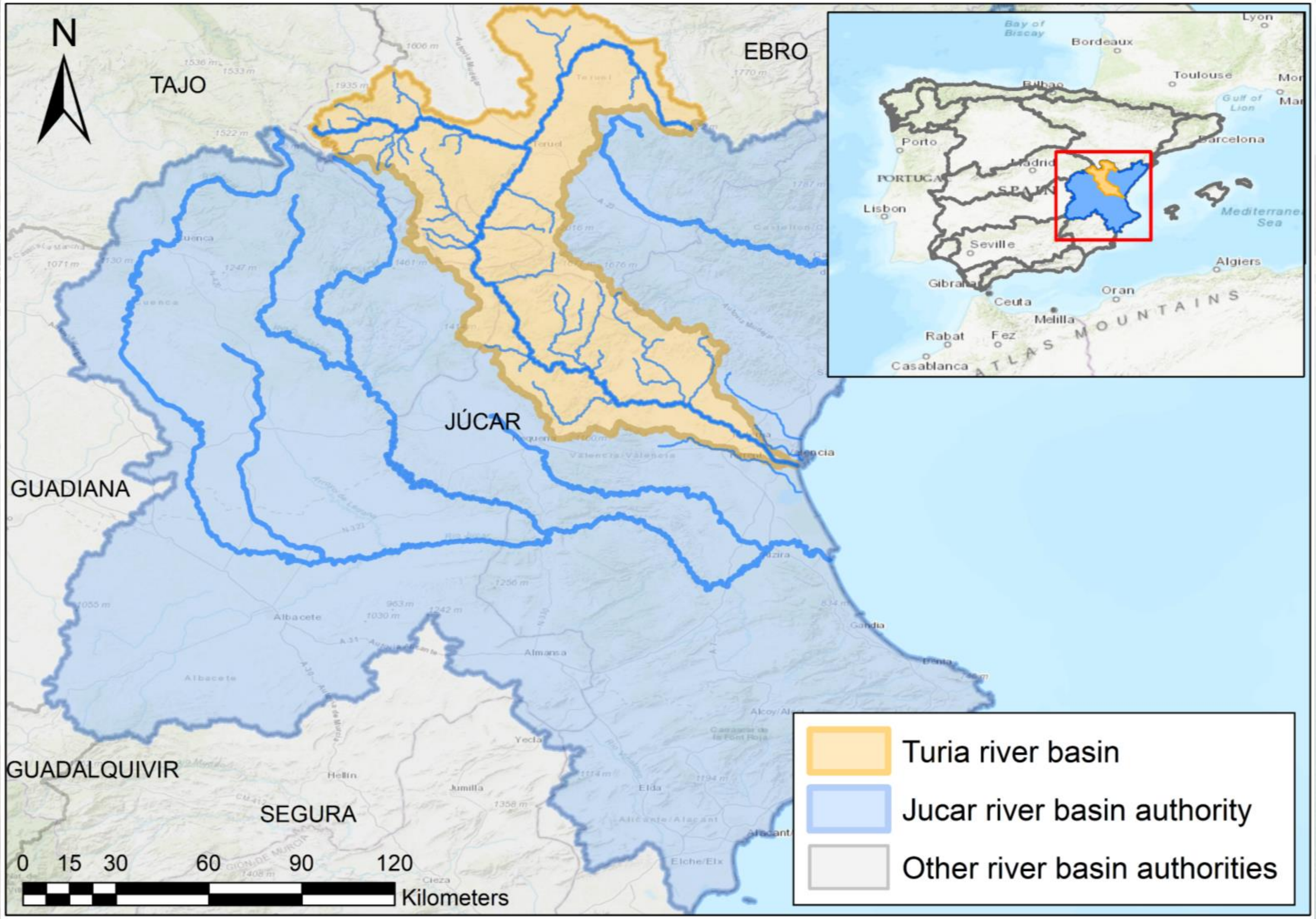
Climate condition
10 driest years
10 wettest years
10 hottest years
10 coldest years

PROPOSED METHODOLOGY



METHODOLOGY APPLYING

THE TURIA RIVER BASIN, SPAIN



6200 km^2

1 658 681 pop.

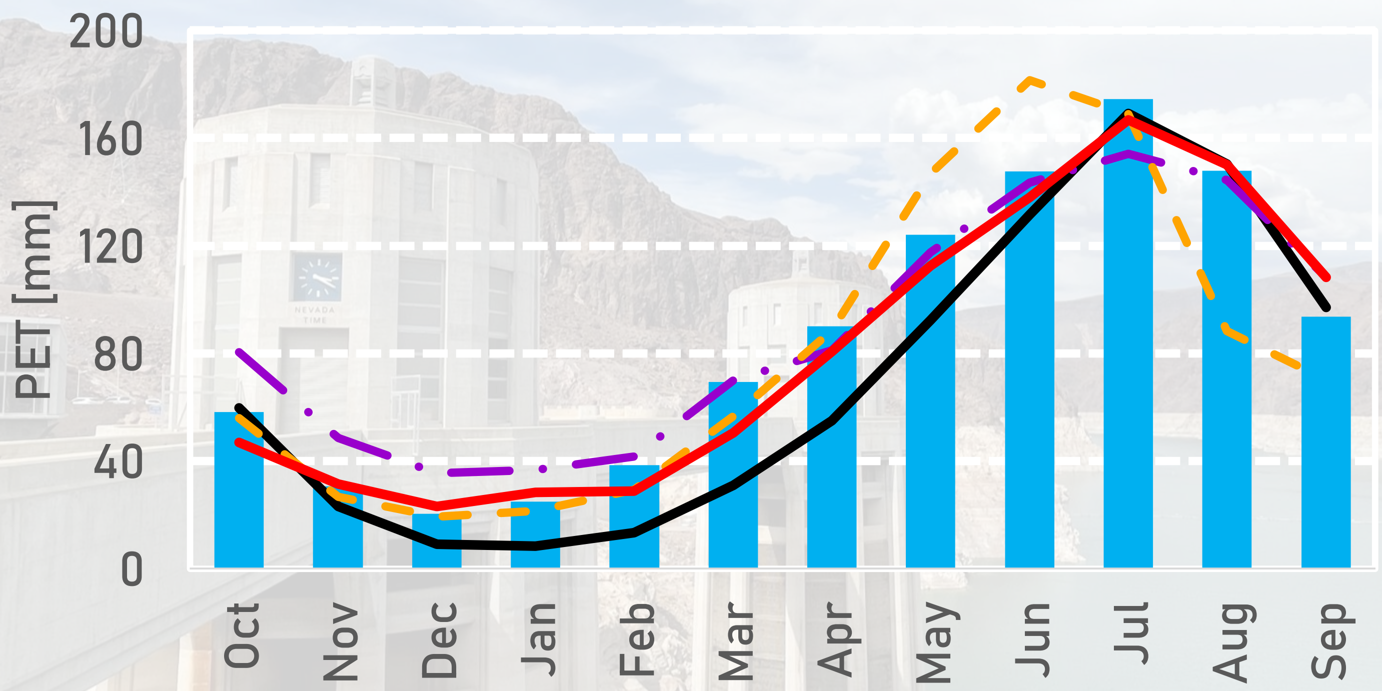
33 000 ha

329 hm^3/year

Arquillo de San Blas
Benagéber
Loriguilla

RESULTS AND CONCLUSIONS

PET ESTIMATION



Methodology		NSE	r	RMSE
Thornthwaite (1948)		0.82	0.96	22.00
De Camargo, et al (1999)		0.89	0.95	17.20
Marcos, et al (2017)		0.78	0.93	24.60
Modification proposed		0.93	0.97	14.30
Penman-Monteith (1998)		Reference		

CLIMATE CHANGE SCENARIOS ASSESSMENT

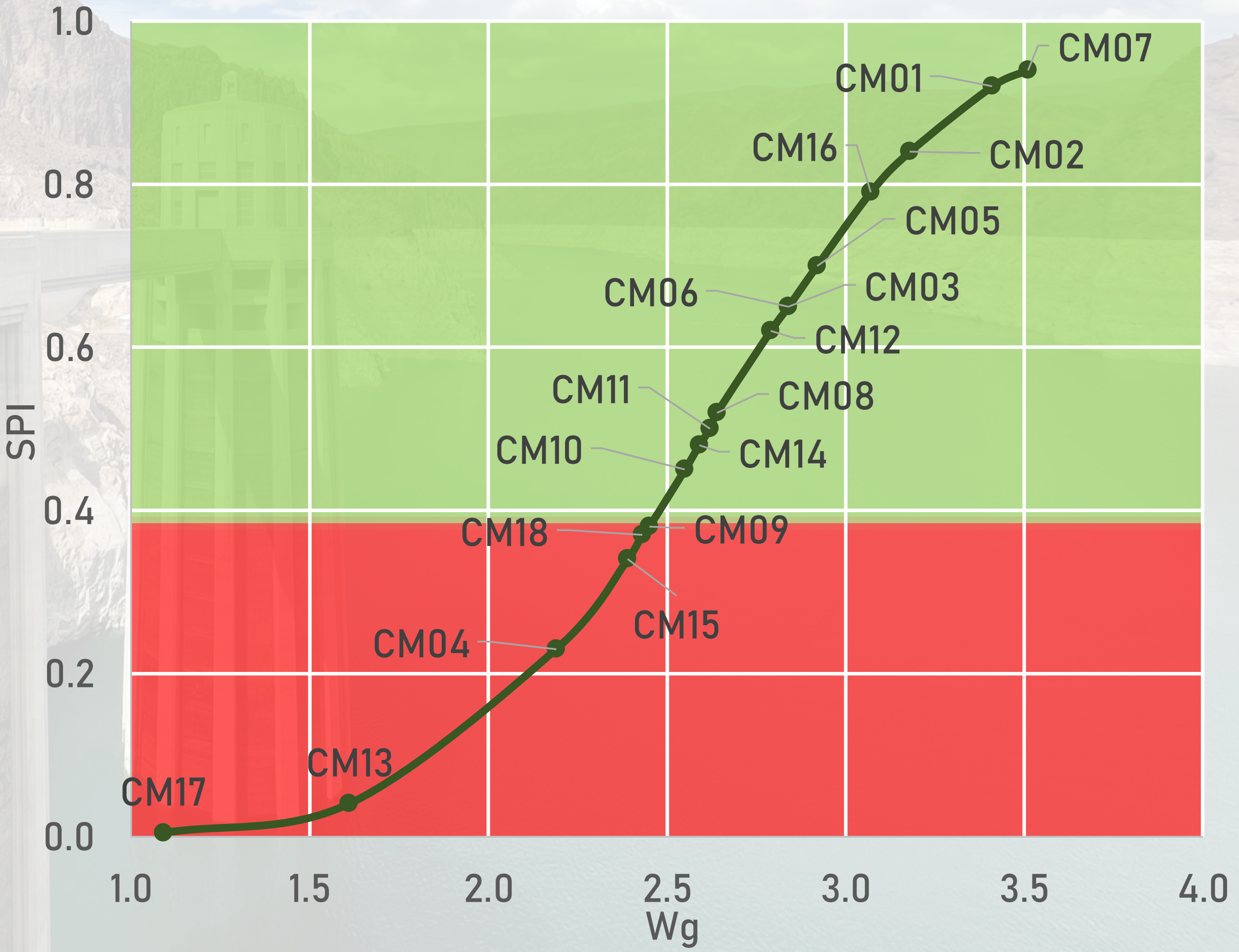
RESULTS AND CONCLUSIONS

Design by BomSymbols from Flaticon

RCP 4.5 & RCP 8.5 (AR5)

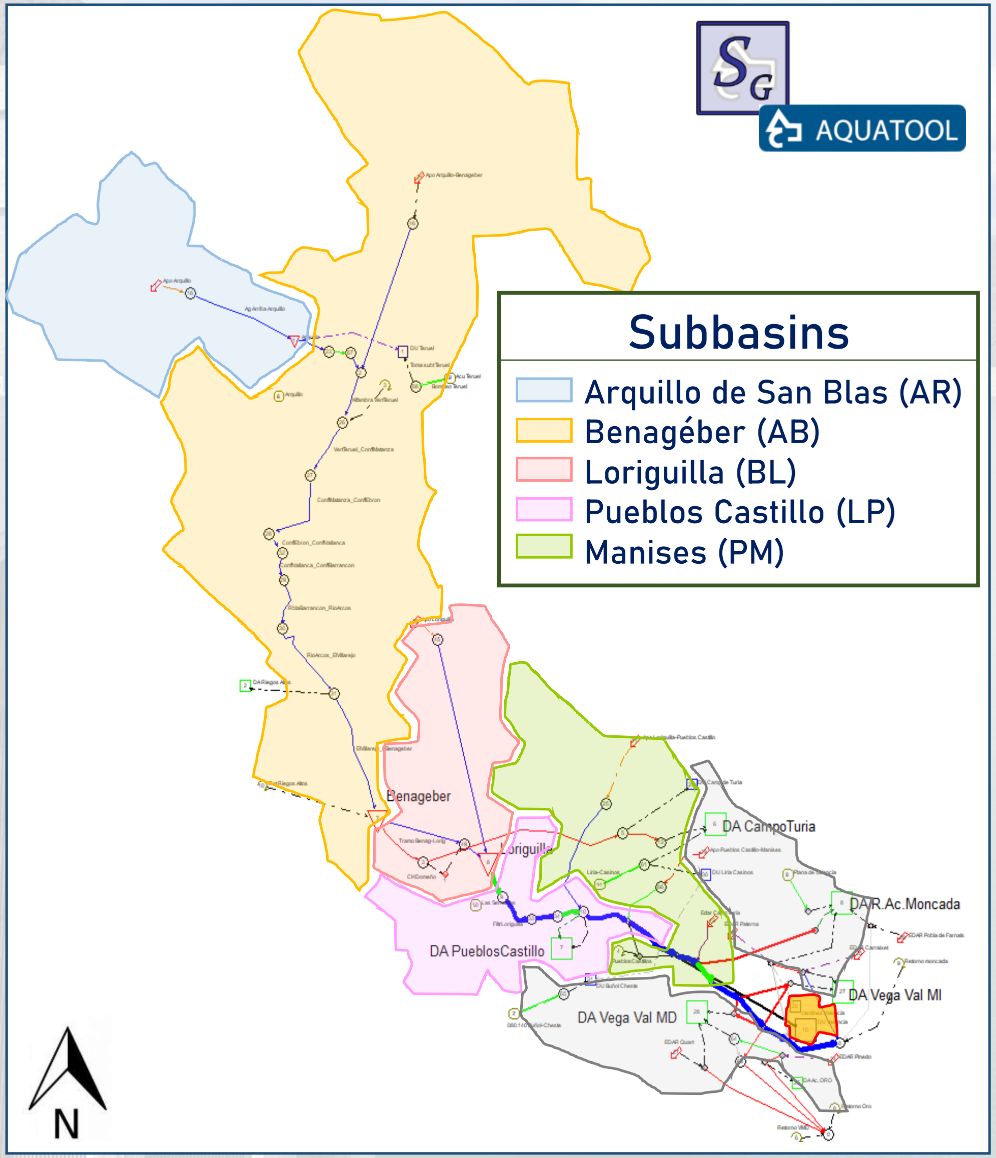
WCRP CORDEX

Model ID	GCM	RCM	Wg	SPI
CM07	CCCma-CanESM2	SMHI-RCA	3.51	0.94
CM01	MPI-ESM	CLMcom-CCLM	3.41	0.92
CM02	ICHEC-EC-Earth	DMI-HIRHAM	3.18	0.84
CM16	NOAA-ESM2M	SMHI-RCA	3.07	0.79
CM05	MPI-ESM	MPI-REMO R1	2.92	0.70
CM03	ICHEC-EC-Earth	KNMI-RACMO	2.84	0.65
CM06	MPI-ESM	MPI-REMO R2	2.84	0.65
CM12	MIROC5	SMHI-RCA	2.79	0.62
CM08	CNRM-C5	SMHI-RCA	2.64	0.52
CM11	IPSL-CM5A	SMHI-RCA	2.62	0.50
CM14	MPI-ESM	SMHI-RCA	2.59	0.48
CM10	ICHEC-EC-Earth	SMHI-RCA	2.55	0.45
CM09	CSIRO-Mk3	SMHI-RCA	2.45	0.38
CM18	CNRM-C5	CNRM-ALADIN	2.43	0.37
CM15	NCC-NorESM1	SMHI-RCA	2.39	0.34
CM04	MOHC-HadGEM2	KNMI-RACMO	2.19	0.23
CM13	MOHC-HadGEM2	SMHI-RCA	1.61	0.04
CM17	IPSL-CM5A	INERIS-WRF	1.09	0.00



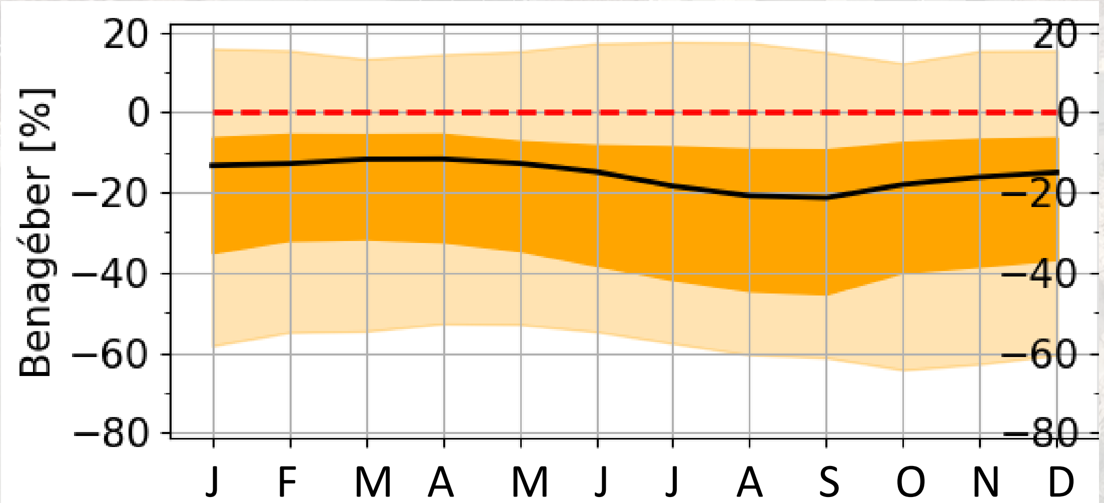
RESULTS AND CONCLUSIONS

IMPACT ANALYSIS – WATER RESOURCES SYSTEM MODEL

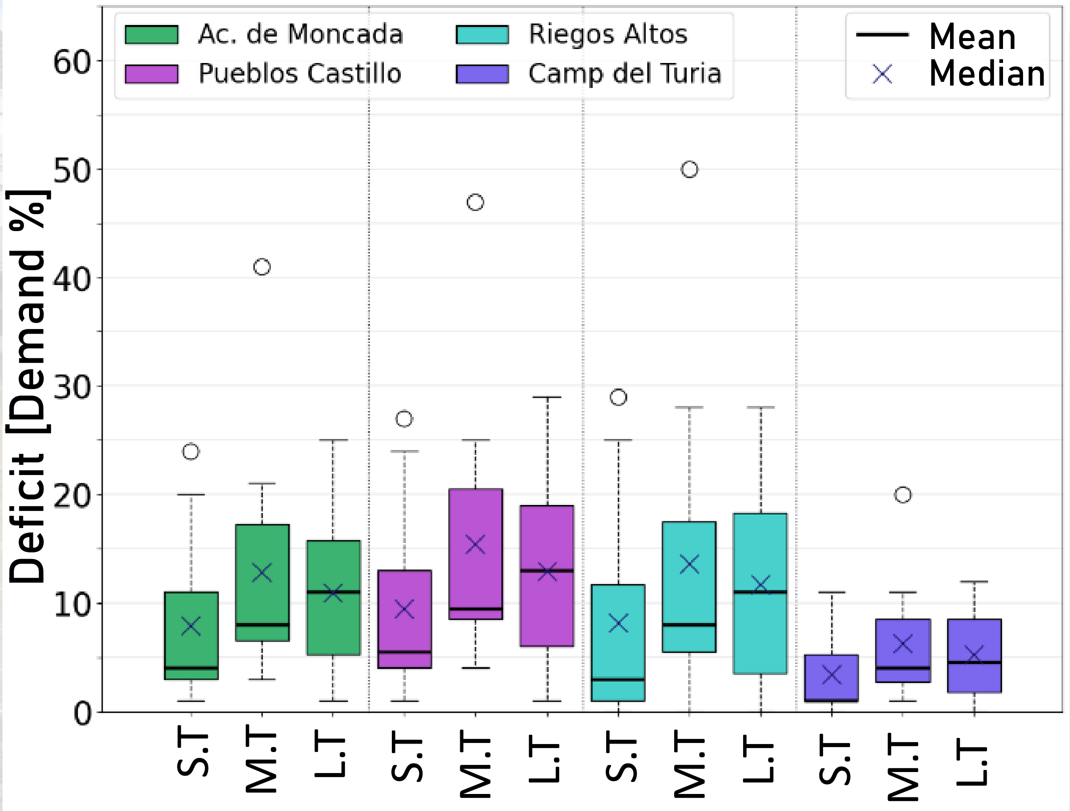


IMPACT ANALYSIS – CLIMATE CHANGE APPROACH

RESULTS AND CONCLUSIONS



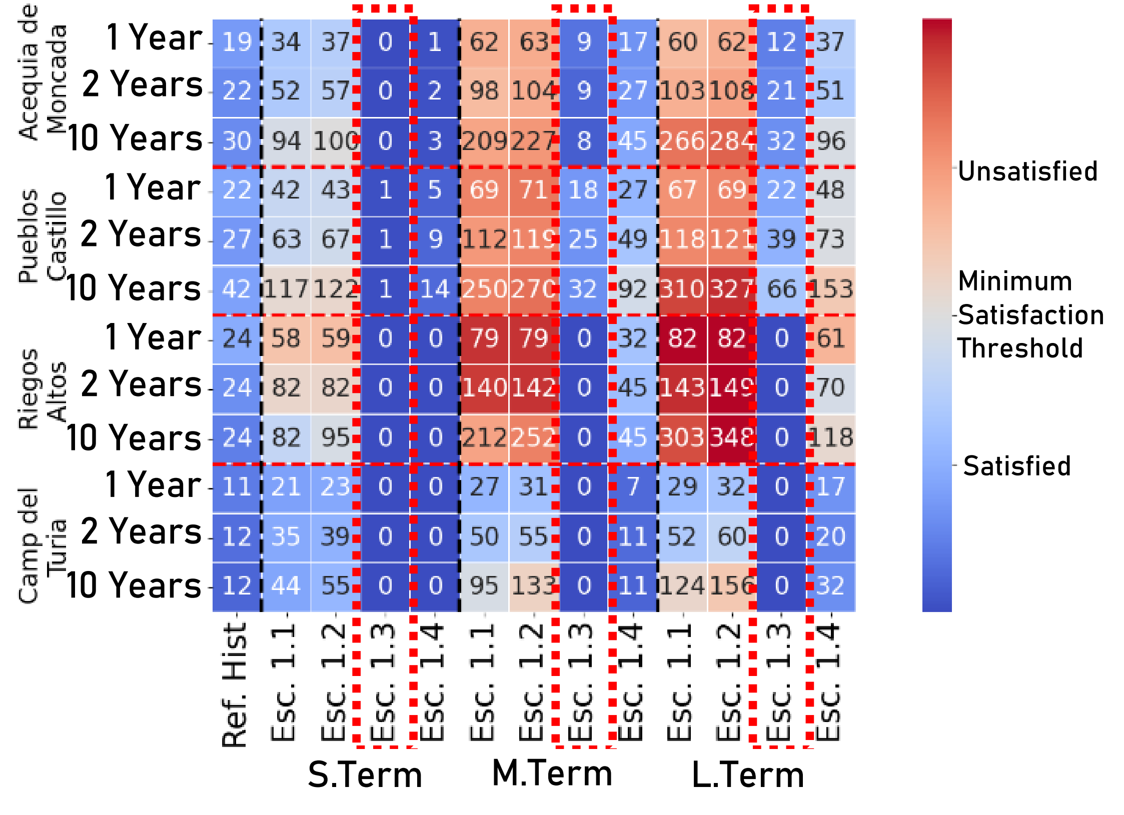
MONTHLY MEAN STORAGE DECREASES



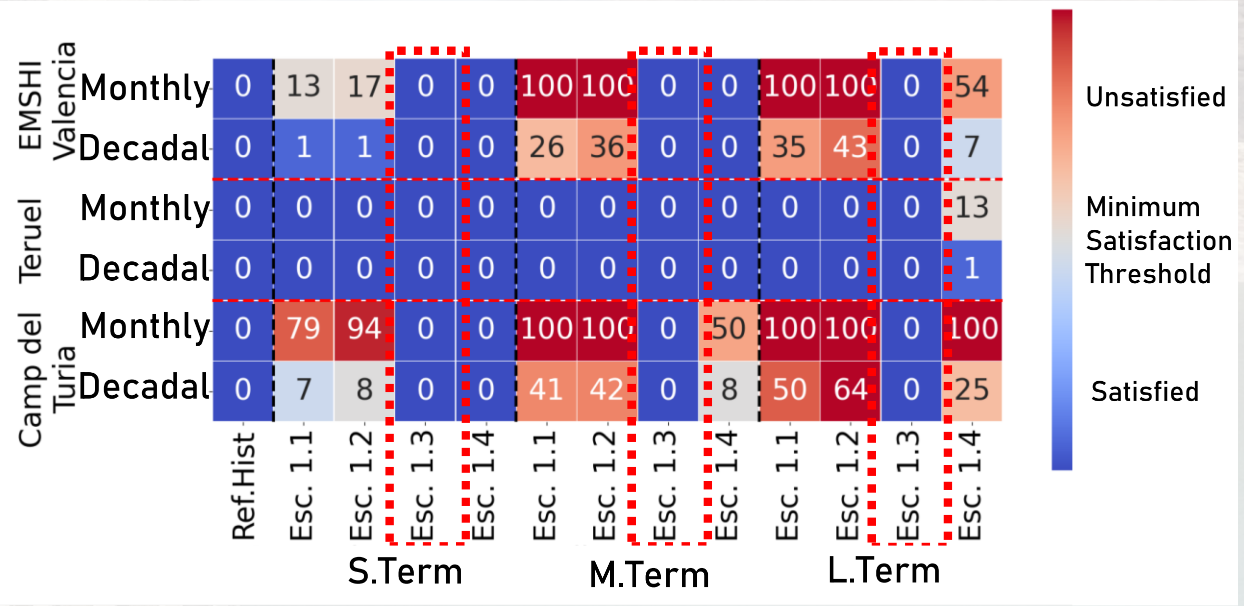
ANUAL MEAN AGRICULTURAL DEFICITS INCREASE

IMPACT ANALYSIS – DEMAND CHANGE APPROACH

RESULTS AND CONCLUSIONS



Improved irrigation efficiencies measure



AGRICULTURAL DEMAND FULFILMENT LEVEL

URBAN DEMAND FULFILMENT LEVEL

Acces to abstract

EGU General Assembly 2022

THANKS

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