Impact of EO irrigation on LSM/HMs modelling: comparing water balance and model performance in the Po river basin

Nathaly Güiza-Villa *(nguivil@upv.edu.es), Nicolas Cortes-Torres, Félix Frances, Pallav Kumar Shrestha, Oldrich Rakovec, Ehsan Modiri, Bram Droppers, Niko Wanders, Leandro Ávila and Stefan Kollet.*

Research Group of Hydrological and Environmental Modelling (GIMHA)

Research Institute of Water and Environmental Engineering (IIAMA)

Universitat Politècnica de València (UPV), Valencia, Spain

Introduction

4DHydr

TETIS

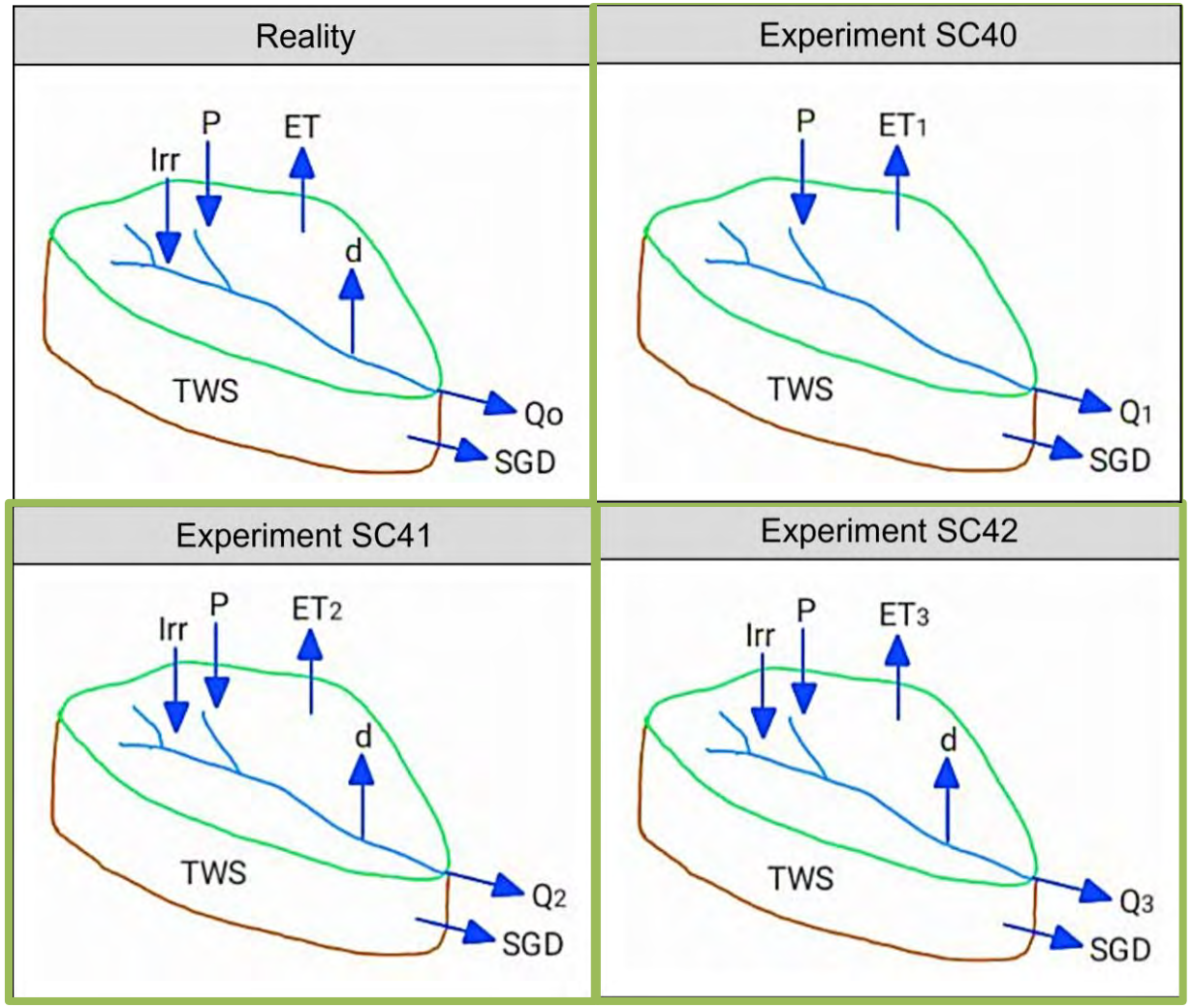
The mesoscale Hydrologic Model

mHM

PCR-GLOBWB

CLM3.5

Methods: Experiment design



Resolutions: 5km and 1km
Period: 2016-2021

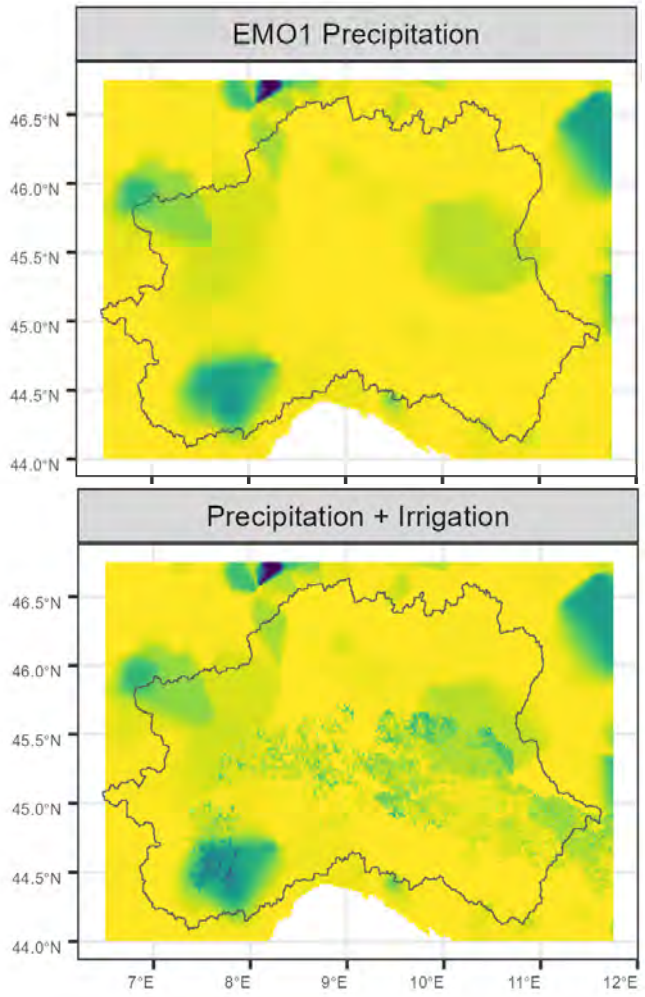
Exp. #	Experiment	Calibration variable	Evaluation variable
SC40	Po model calibrated at 5km (Exp. 20) and validated 1km grid (Exp. 21) as **baseline**	Q[1]	Q, SSM[2], ET[3], Water balance
SC41	Po model from Exp. 2* using precipitation (EMO1) + irrigation dataset, **without** calibration	-	Q, SSM, ET, Water balance
SC42	Po model from Exp. 2* using precipitation (EMO1) + irrigation data, **with** calibration	Q	Q, SSM, ET, Water balance

[1]Discharge, [2]Surface Soil Moisture and [3]Evapotranspiration

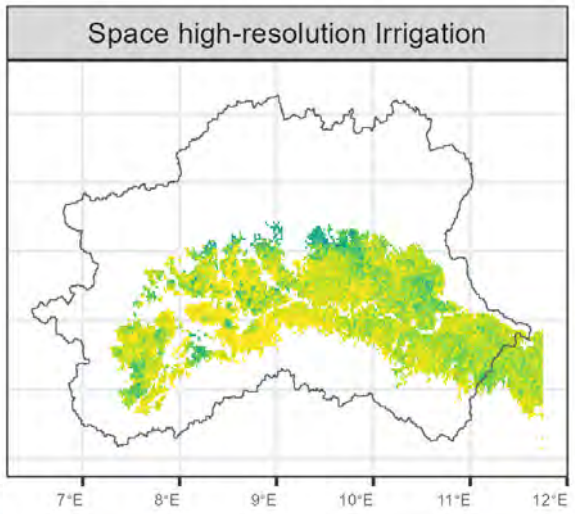
Methods: Irrigation and abstraction integration

Date: 2016-08-01

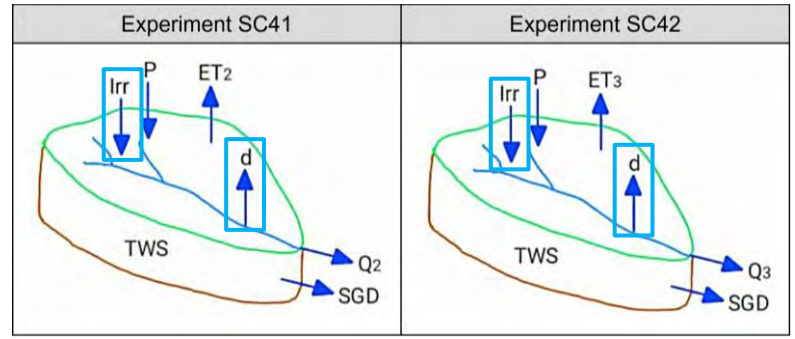
(Gomes, G. et al. 2020)



(Dari et al, 2023)



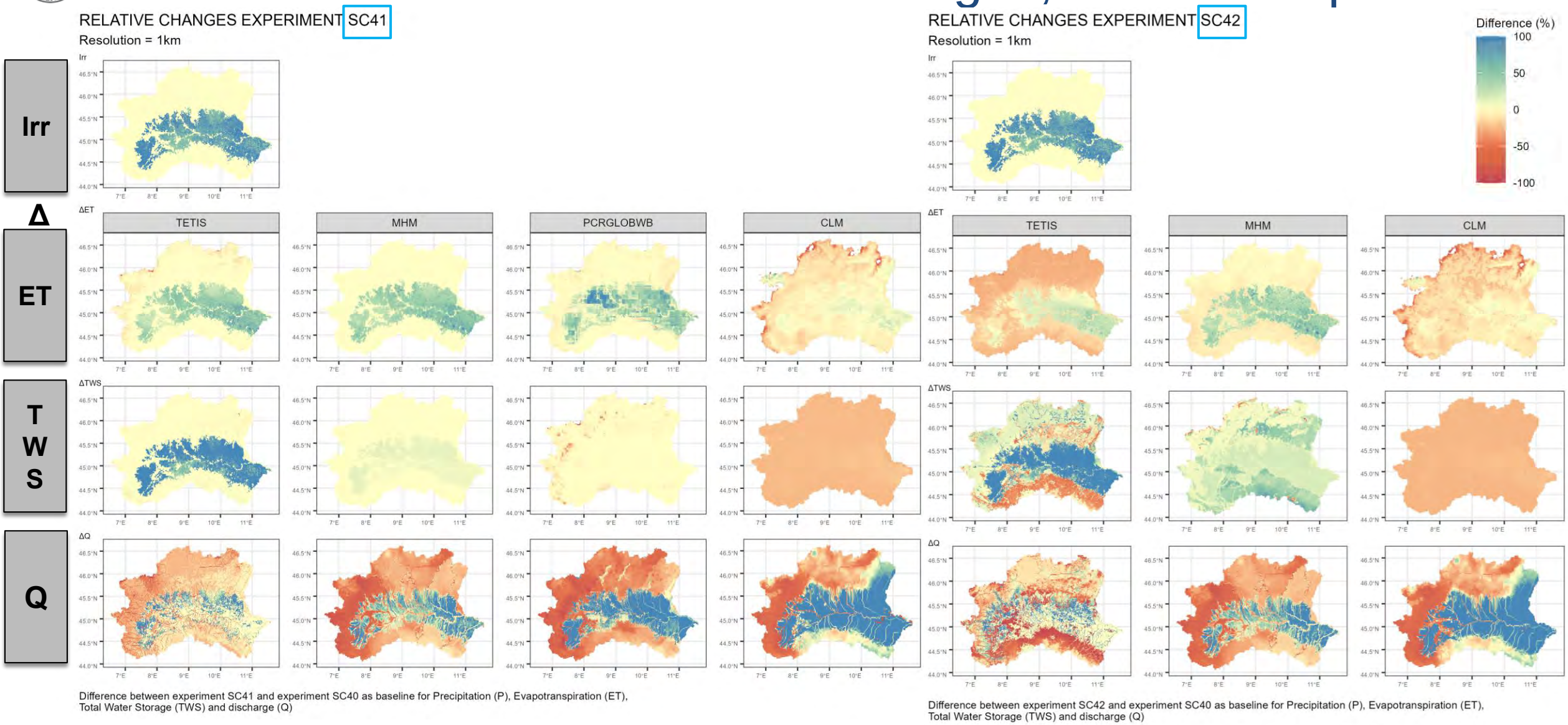
Total Po irrigation	
Volume (Hm³/year)	13,582
By basin area (mm/year)	183.40
By irrigated area (mm/year)	618.47



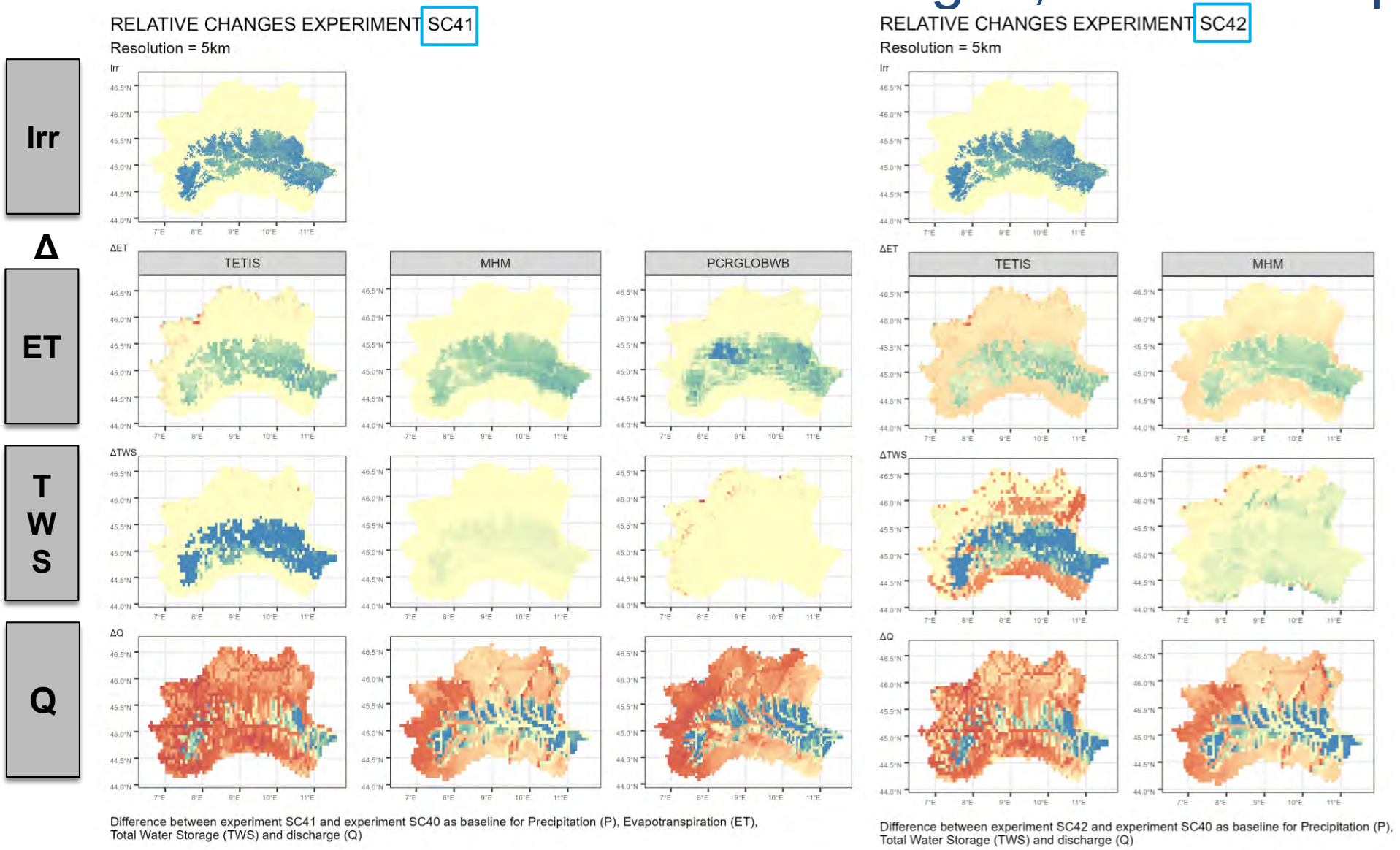
(Autorità di Bacino del Fiume Po, 2016)

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Relative changes, model comparison



Relative changes, model comparison

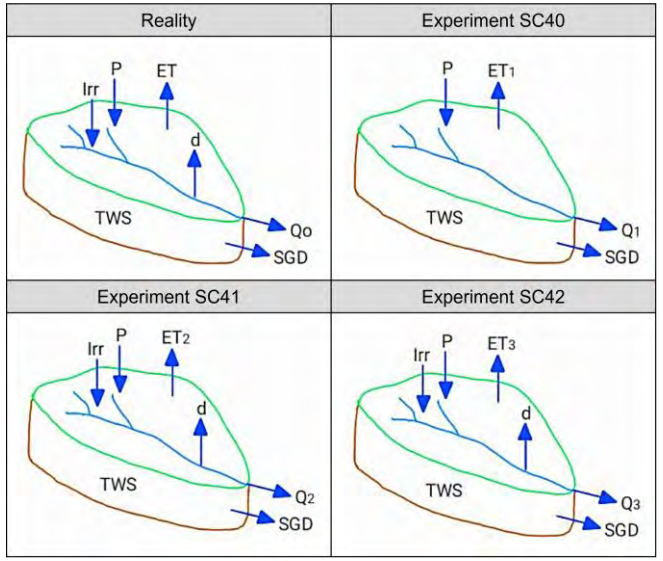


UNIVERSITAT POLITÈCNICA DE VALÈNCIA

Water balance (mm/year)

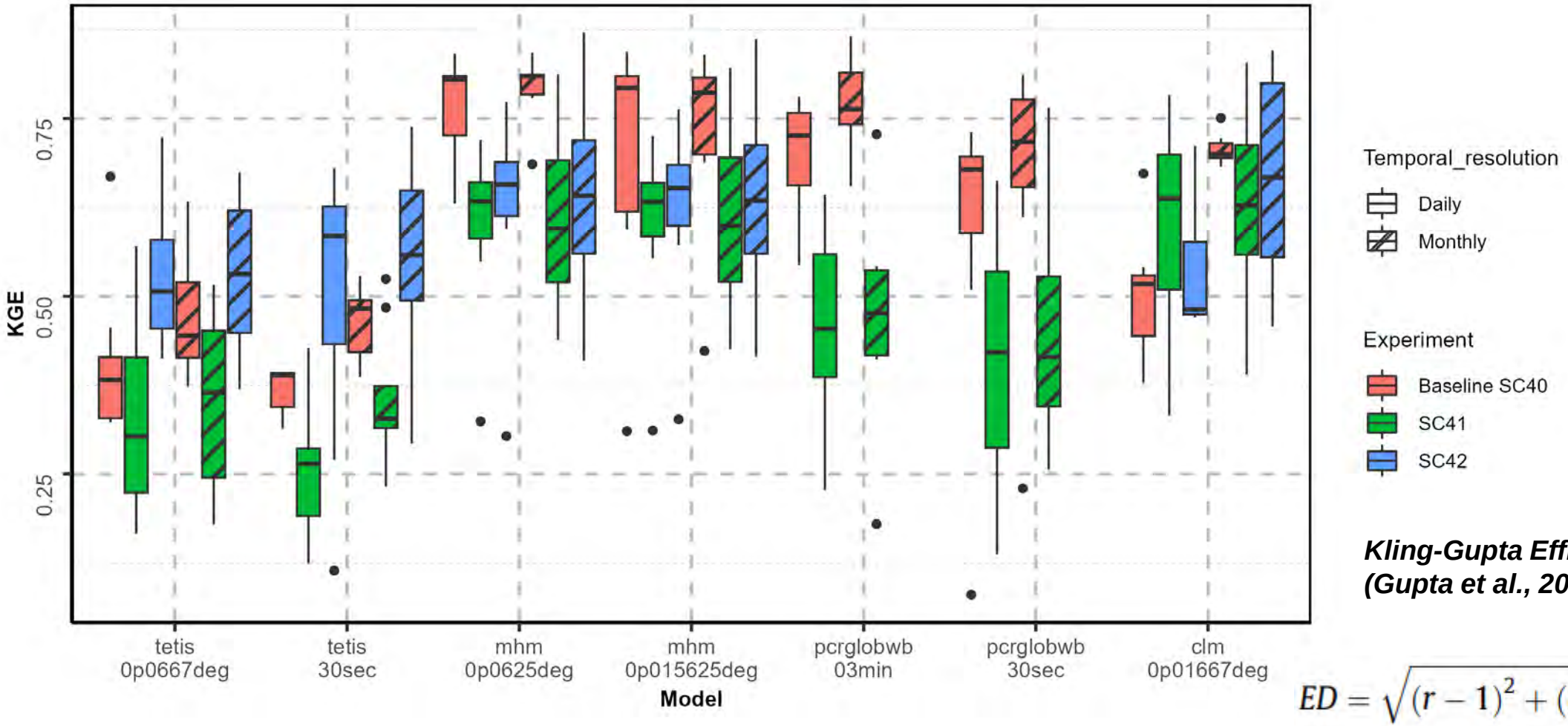
	TETIS			mHM			PCR-GLOBW		CLM3.5		
	SC40	SC41	SC42	SC40	SC41	SC42	SC40	SC41	SC40	SC41	SC42
ET[1]	550.4	613.0	477.1	487.3	552.5	527.6	509.7	587.2	514.9	495.5	463.6
Q[2]	364.6	283.6	423.3	484.3	454.6	439.7	419.9	643.2	565.2	515.3	501.5
SGD[3]	41.9	95.6	0.0	-	-	-	-	-	-	-	-
ΔTWS/Δt[4]	17.2	24.0	53.3	9.3	13.6	13.9	9.5	51.2	7.6	13.8	22.2

[1]*Evapotranspiration*
[2]*Discharge,*
[3]*Sea groundwater discharge*
[4]*Total Water Storage change as the difference of final value and start value between the number of years.*



Model performance

DISCHARGE



Kling-Gupta Efficiency metric (KGE) (Gupta et al., 2009; Kling et al., 2012)

$$KGE = 1 - ED$$

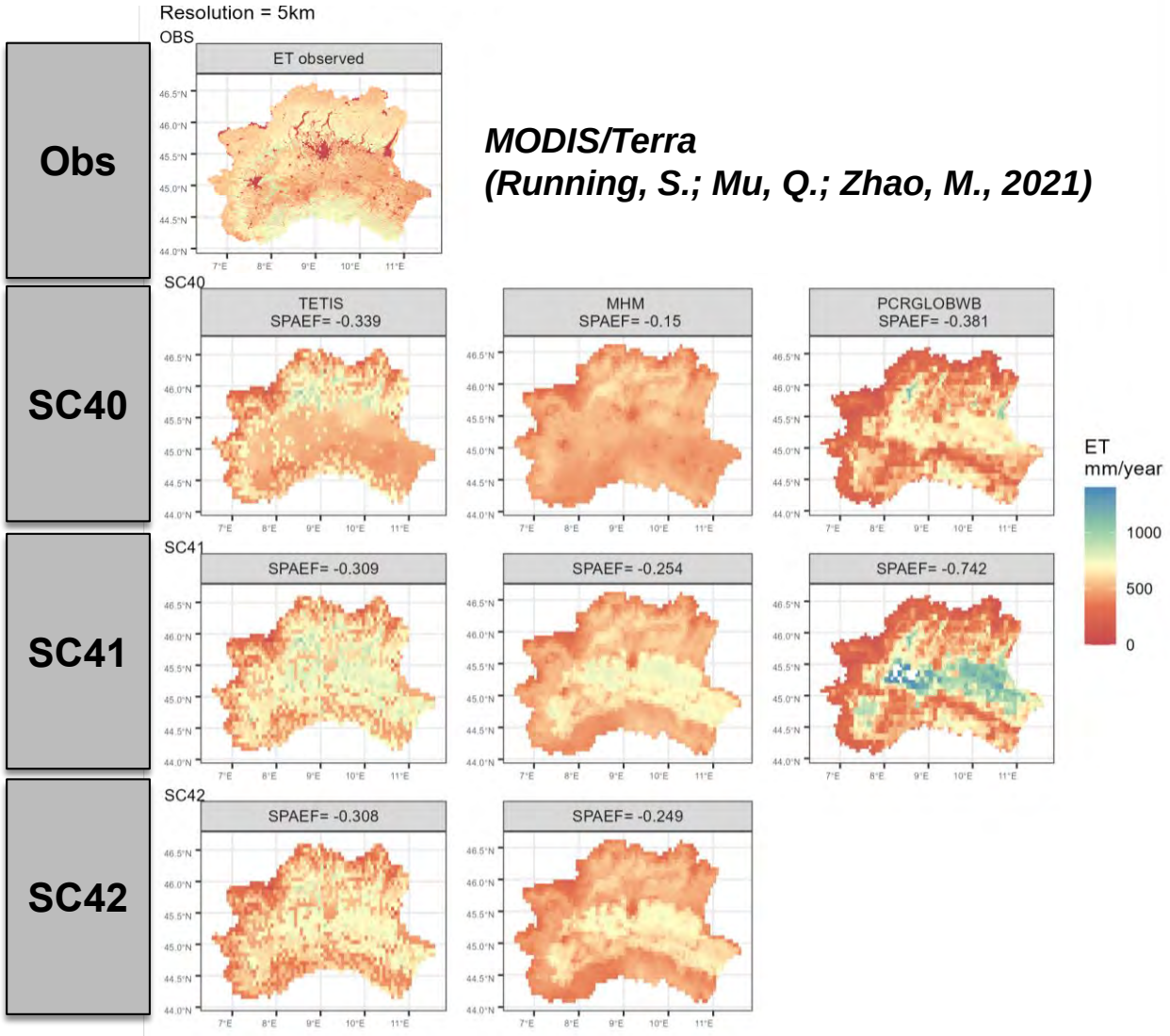
$$ED = \sqrt{(r-1)^2 + (\alpha-1)^2 + (\beta-1)^2}$$

$$\beta = \mu_s / \mu_o$$

UNIVERSITAT POLITÈCNICA DE VALÈNCIA

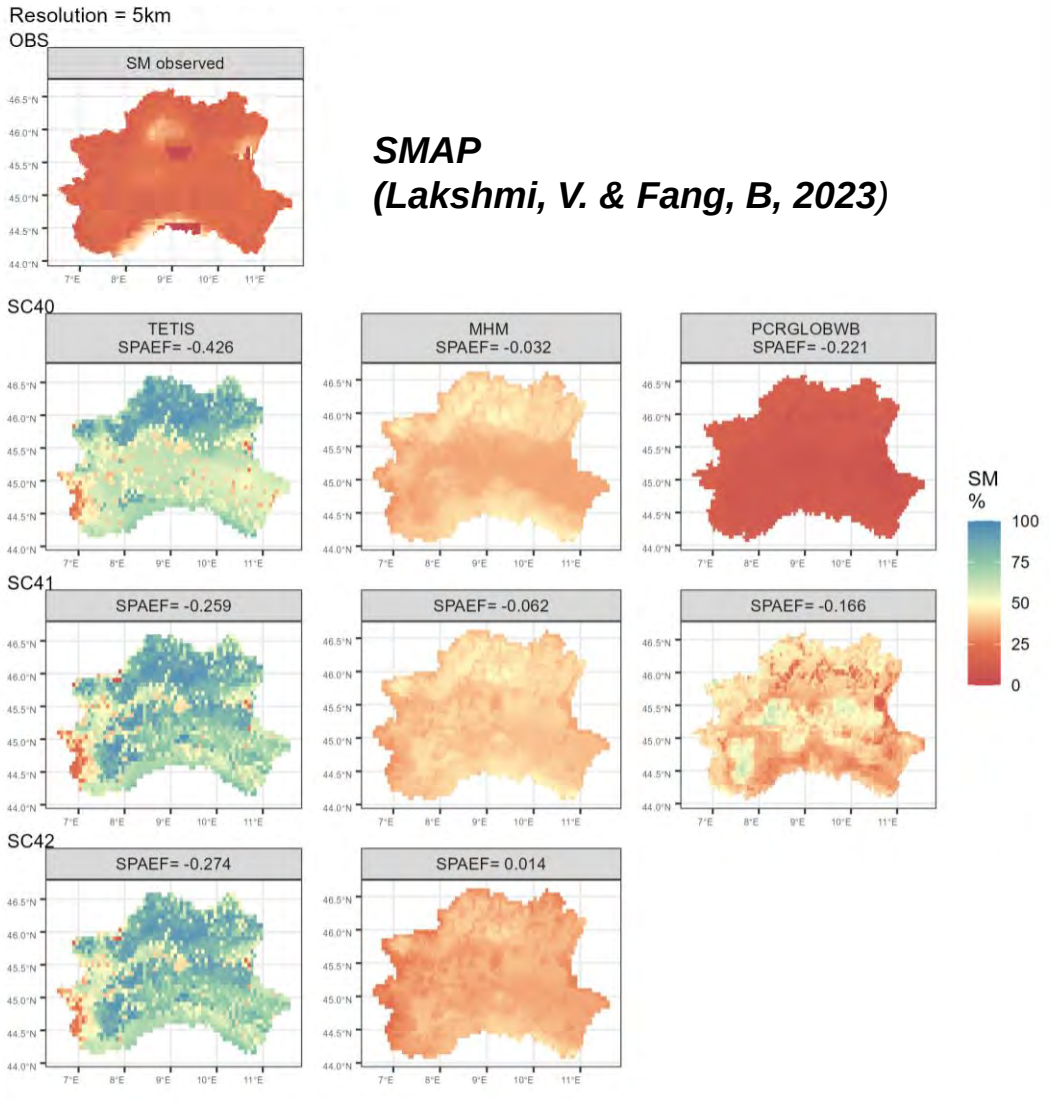
Model performance

EVAPOTRANSPIRATION



MODIS/Terra
(Running, S.; Mu, Q.; Zhao, M., 2021)

SURFACE SOIL MOISTURE



SMAP
(Lakshmi, V. & Fang, B, 2023)

Conclusions

- The inclusion of EO-based irrigation on LSM/HMs modelling changes the water balance. This could suggest an overall improvement.
- When irrigation is included and the calibration process is performed, the ability of the model to reproduce observed discharge improves.
- Results of evapotranspiration and surface soil moisture, shows an inconsistency compared to observed spatial patterns. However, the incorporation of irrigation appears to demonstrate a capacity to enhance spatial performance.

Thanks for your attention

Nathaly Güiza-Villa *(nguivil@upv.edu.es), Nicolas Cortes-Torres, Félix Frances, Pallav Kumar Shrestha, Oldrich Rakovec, Ehsan Modiri, Bram Droppers, Niko Wanders, Leandro Ávila and Stefan Kollet.*

This study was funded by the Spanish Ministry of Science and Innovation through the research project TETISPREDICT (PID2022-141631OB-I00), and Project 4dhydrology - hyper resolution (4DHYDRO), ESA Contract No. 4000141141/23/I-EF.

https://gimha.upv.es/

Research Group of Hydrological and Environmental Modelling (GIMHA)
Research Institute of Water and Environmental Engineering (IIAMA)
Universitat Politècnica de València (UPV), Valencia, Spain