Addressing Environmental Challenges in the Mar Menor: Simulation and Monitoring of the Albujon Watershed (SE Spain)

Virginia López Linares, Adrián López Ballesteros, Javier Senent Aparicio

Presenter: Virginia López Linares
Fundación Universitaria San Antonio

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INTRODUCTION

Southeast Spain

- Ecologically Valuable Ecosystem
- It is the largest saltwater lagoon in Europe

Nowadays it faces multiple environmental challenges → eutrophication, biodiversity loss

ANTHROPOGENIC CAUSES

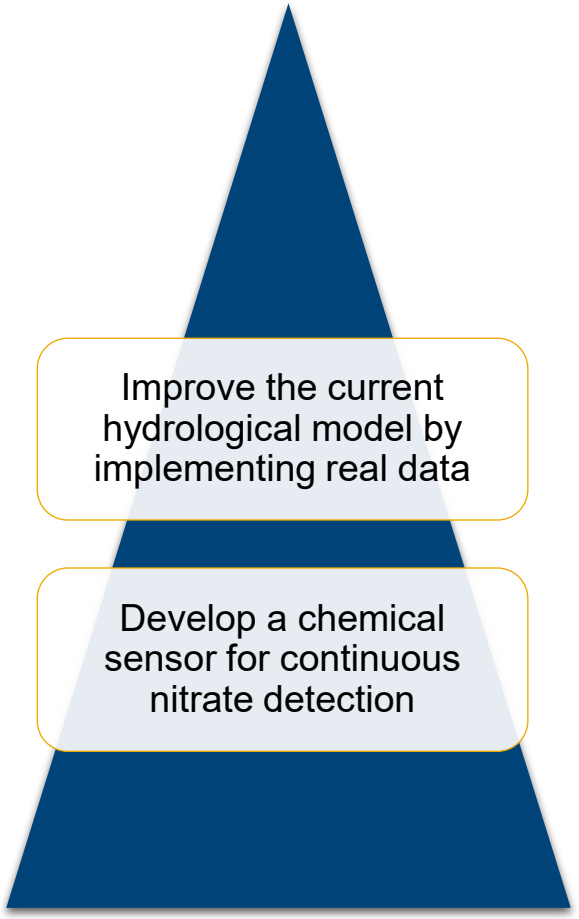
Separated from the Mediterranean Sea by La Manga del Mar Menor

STUDY AREA, OBJECTIVES AND EXPECTED IMPACT

STUDY AREA

- Main Drainage system of the Cartagena's field
- There are no permanent watercourses
- Few rainfall episodes → not enough available data

OBJECTIVES

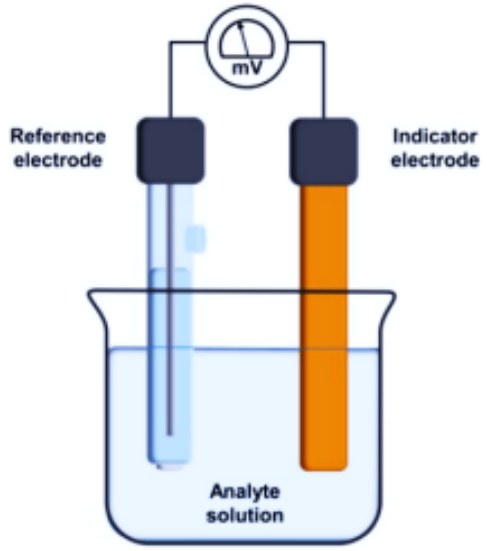


EXPECTED IMPACT

- To know real nitrates concentrations and flow rates that is drained to the Mar Menor and determine the quality of the water.
- Government will be able to implement more effective management strategies for the Cartagena´s field.

METHODOLOGY

CHEMICAL PART



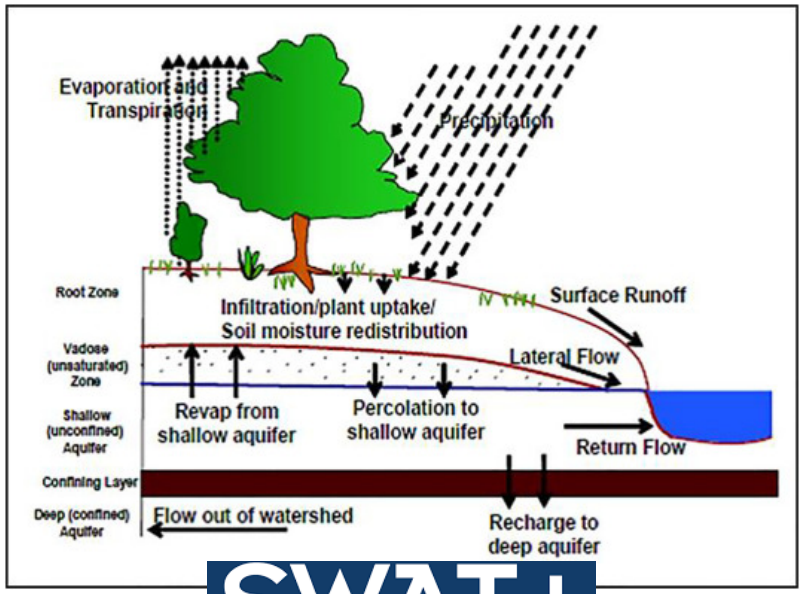
Nernst equation:

$$E_{meas} = E_{const} + \frac{RT}{z_i F} \ln (a_i)_{spl}$$

E0 = standard potential of the electrochemical cell
R = universal gas constant
T = absolute temperature
F = Faraday constant
Zi = charge of the primary ion
At = activity of the primary ion

SWAT+

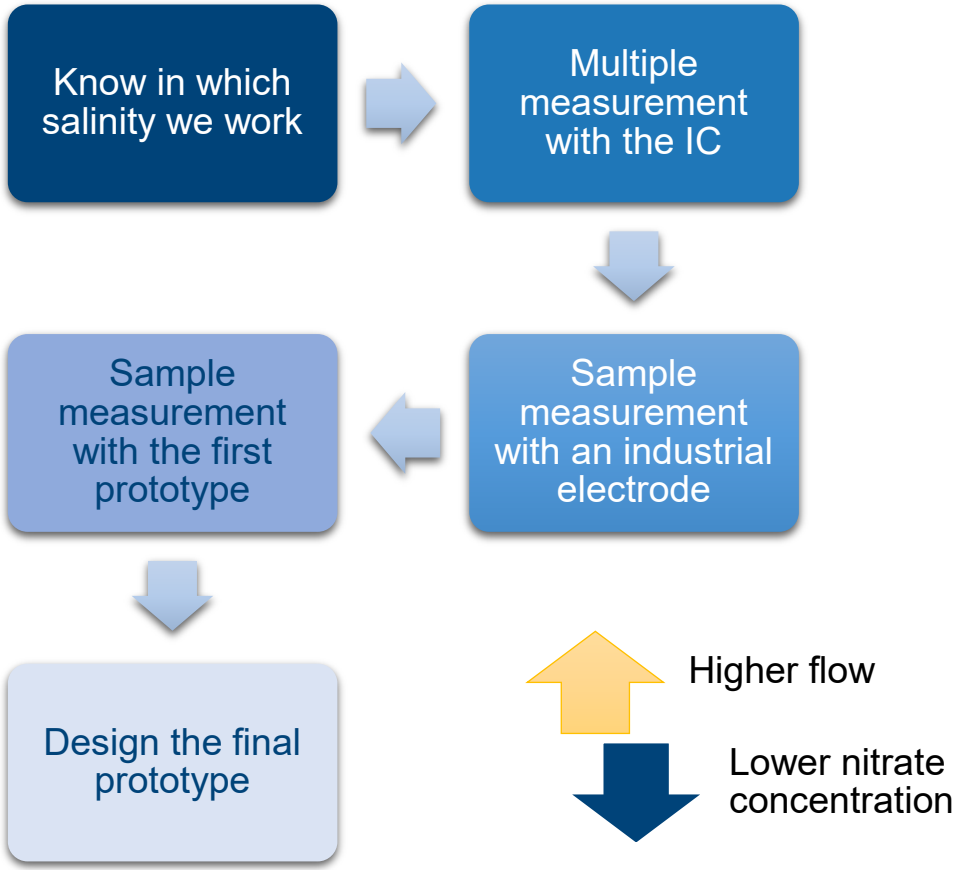
- **Evapotranspiration and soil water content** → sensing dataset: Global Land Evaporation Amsterdam Model (GLEAM)
- **Multi-objective calibration** → SWATplus-CUP program: coefficient of determination (R2), percent bias (PBIAS), Kling–Gupta efficiency (KGE) and Nash–Sutcliffe efficiency (NASH)



SWAT+
SOIL & WATER ASSESSMENT TOOL

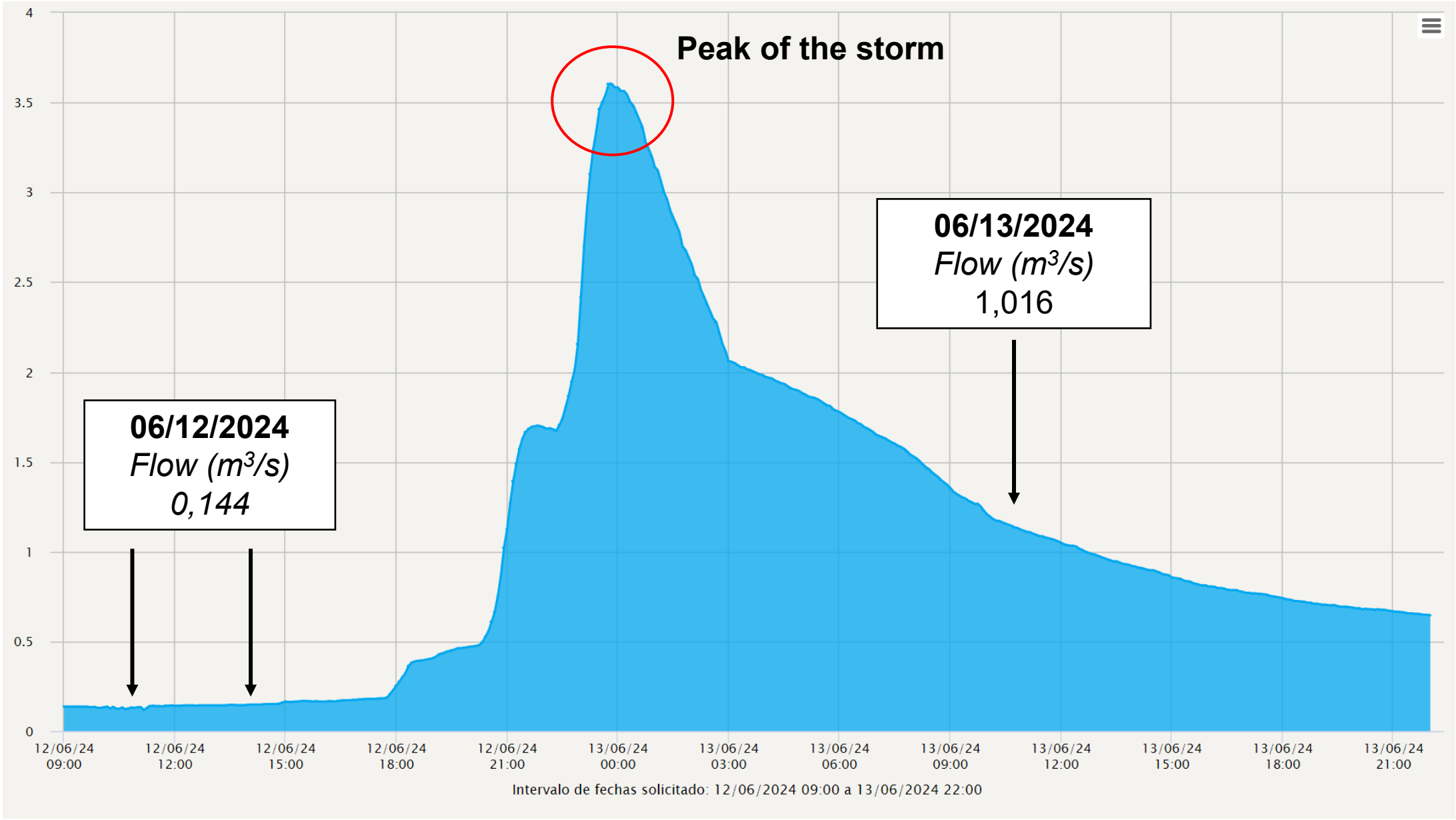
Whole project methodology

Sensor development methodology



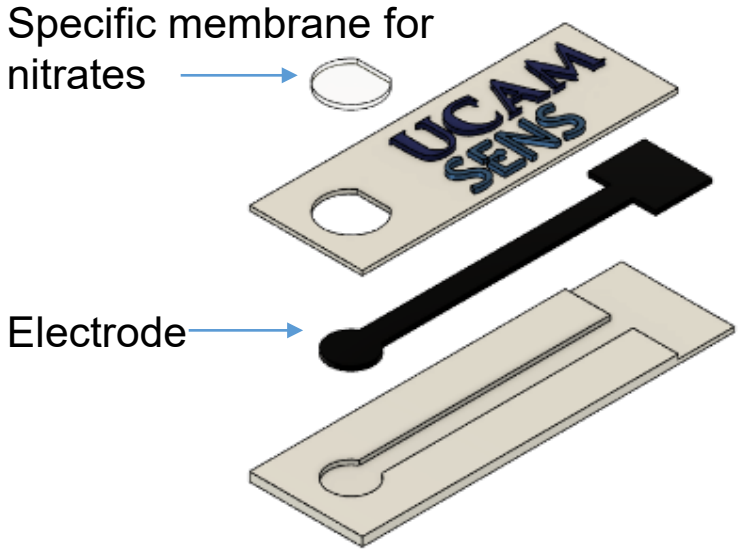
Data	Flow (m^3/s)	Rain	Cl-	NO_3^- mg/L
15/03/2024	0,111	*No*	1174,195	103,8
29/04/2024	0,152	*Yes*	970,9	61,7
06/05/2024	0,14	Yes	1165,2	86,5
12/06/2024 (12:30)	0,144	Yes	1186,6	62,4
12/06/2024 (13:30)	0,145	Yes	1122,1	59,3
13/06/2024	1,016	*Yes (storm)*	193,5	***22,7***

FLOW VARIABILITY



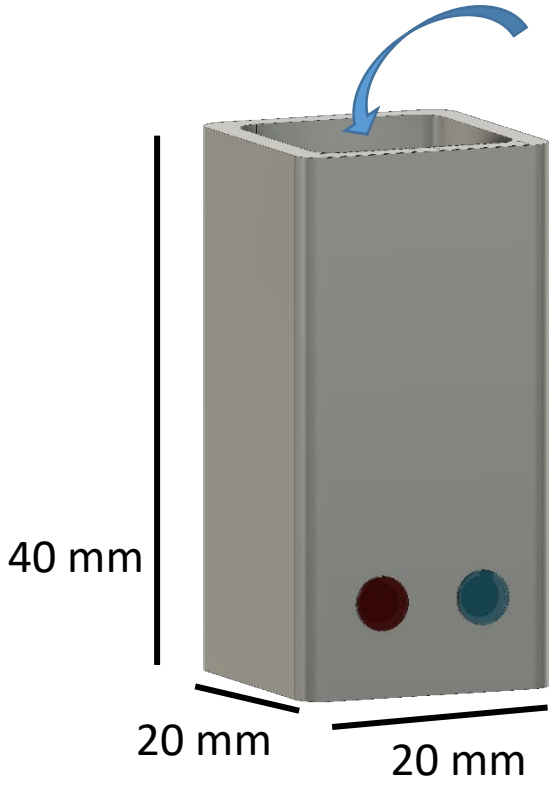
SENSOR DEVELOPMENT

FIRST PROTOTYPE

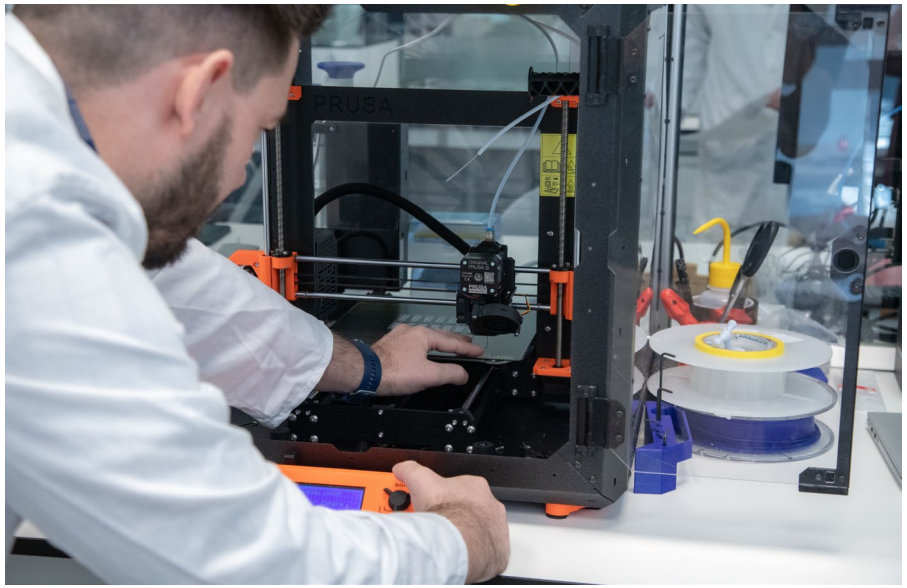


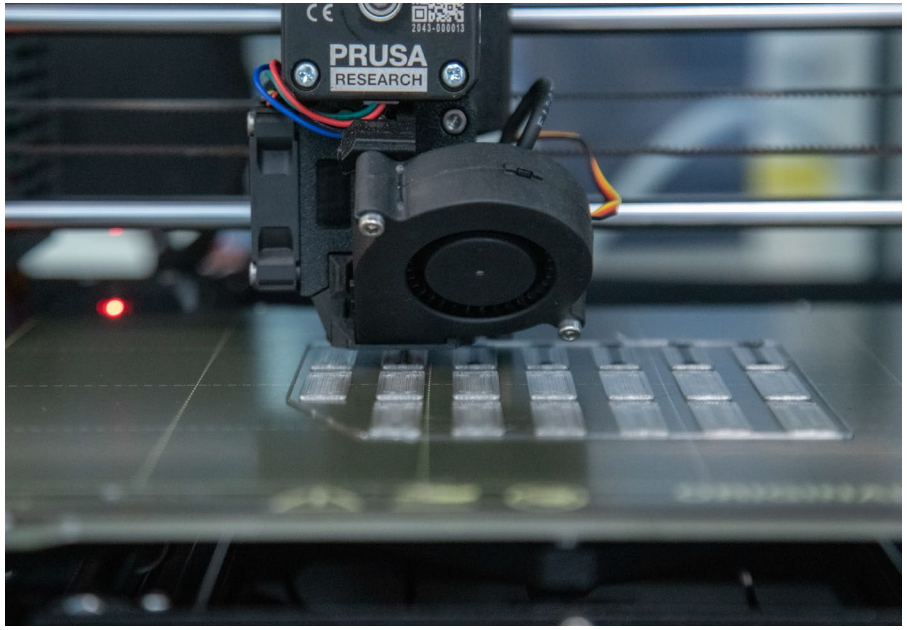
- Tested with water samples from Albujon
- Validation by Ion Chromatography

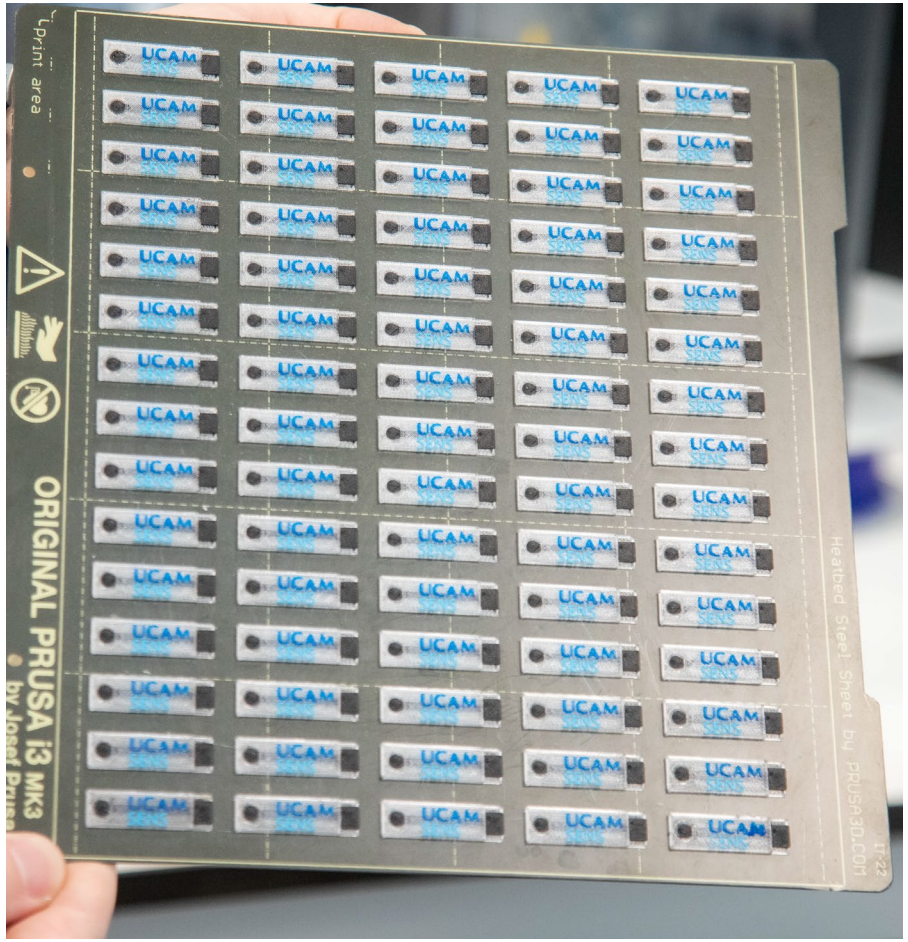
FINAL PROTOTYPE



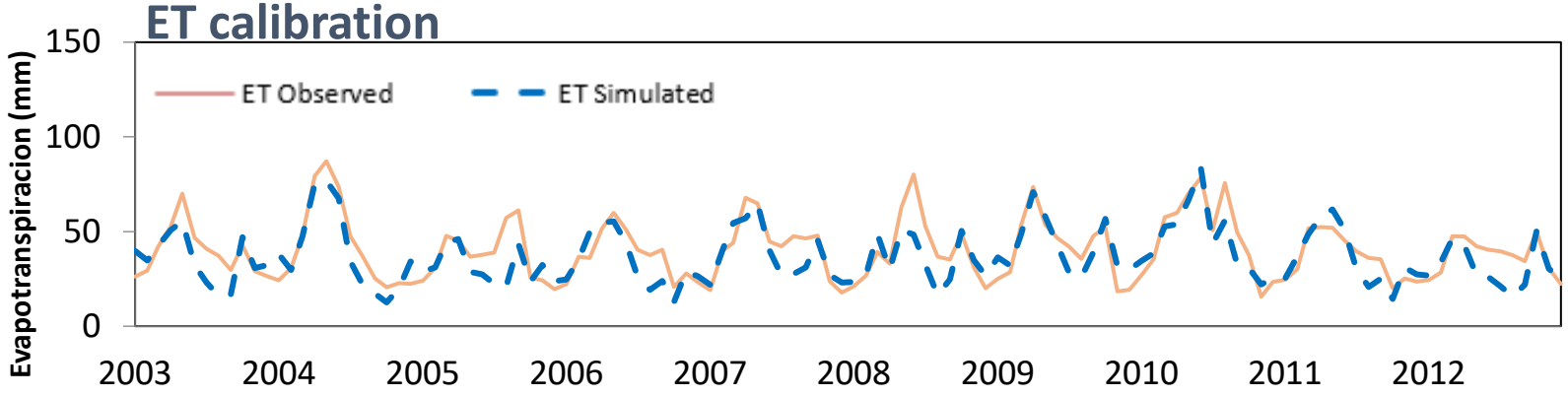
Full sensing device composed by nitrate-selective sensor, electronic board and communication system.


PRUSA

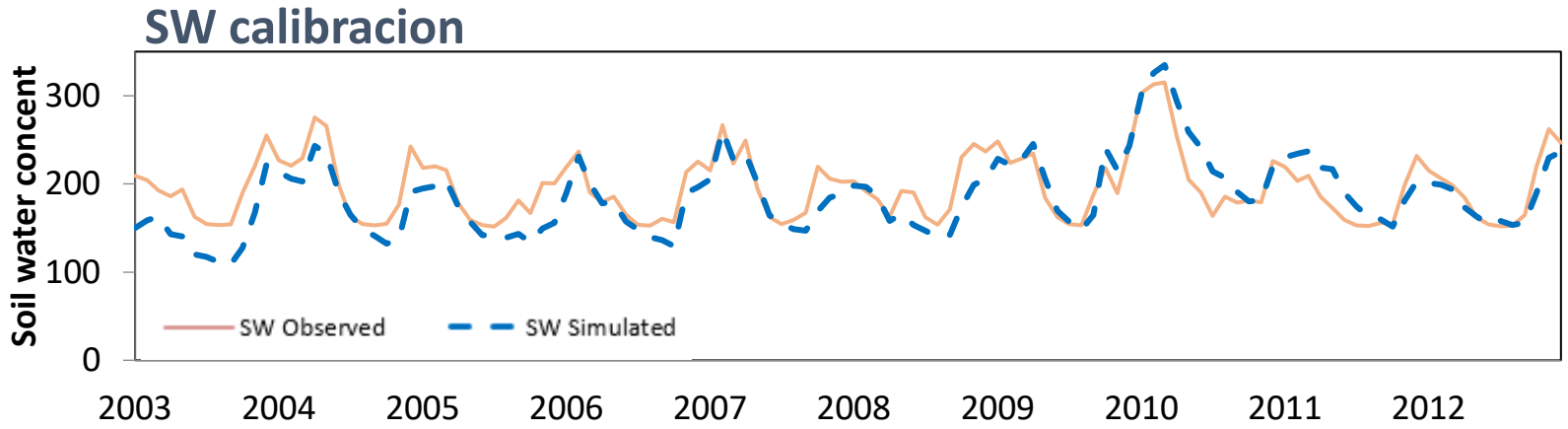

PRUSA
RESEARCH


Print area
UCAM
ORIGINAL PRUSA i3 MK3
Heatbed Steel Sheet by PRUSA3D.COM

RESULTS: CALIBRATION



- **ET: R2= 0.63; NSE= 0.55; PBIAS= 9.48; KGE= 0.76**



- **SW: R2= 0.67; NSE= 0.5; PBIAS= 5.42; KGE= 0.76**

PARAMETERS USED FOR CALIBRATION

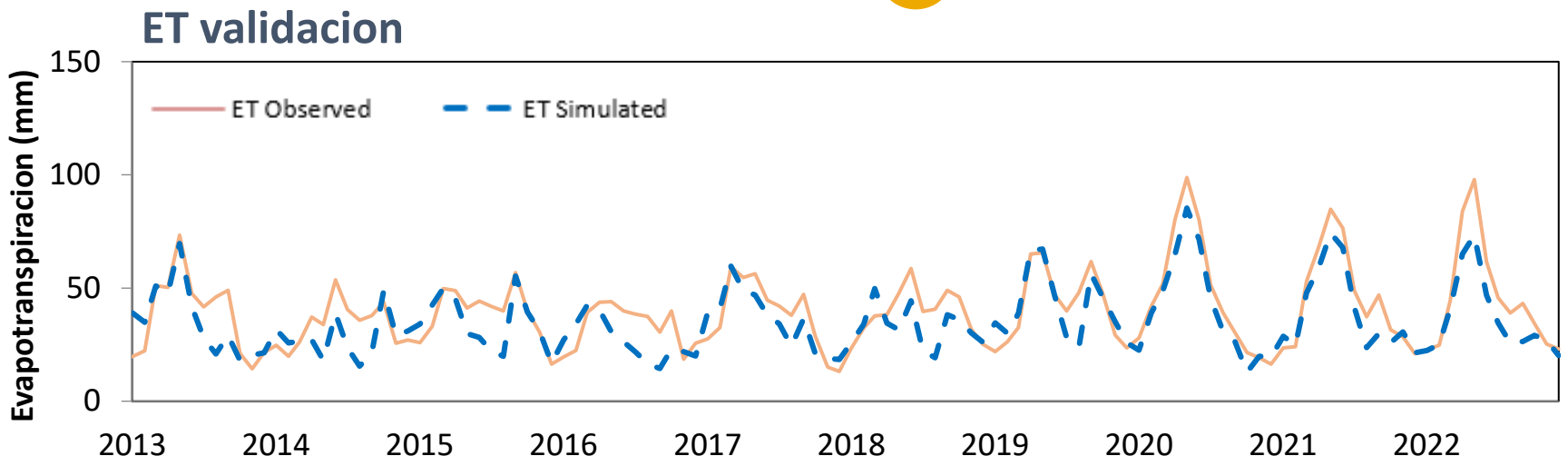
Lopez-ballesteros et al (2023)

- r__cn2.hru → 0.06815 - 6.815
- v__esco.hru → 0.5722
- v__epco.hru → 0.1306
- r__AWC().sol → 0.267 - 26.7
- r__BD().sol → 0.0147 - 1.47
- v__perco.hru → 0.81855

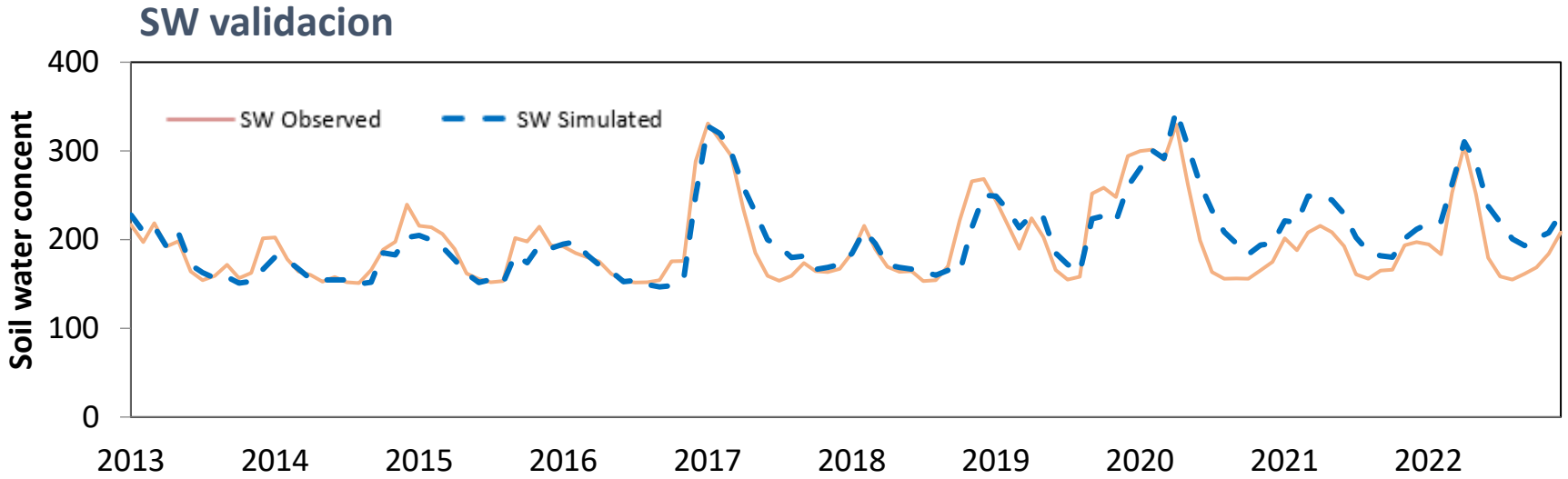
Most sensitive parameters

MONTHLY CALIBRATED

RESULTS: VALIDATION

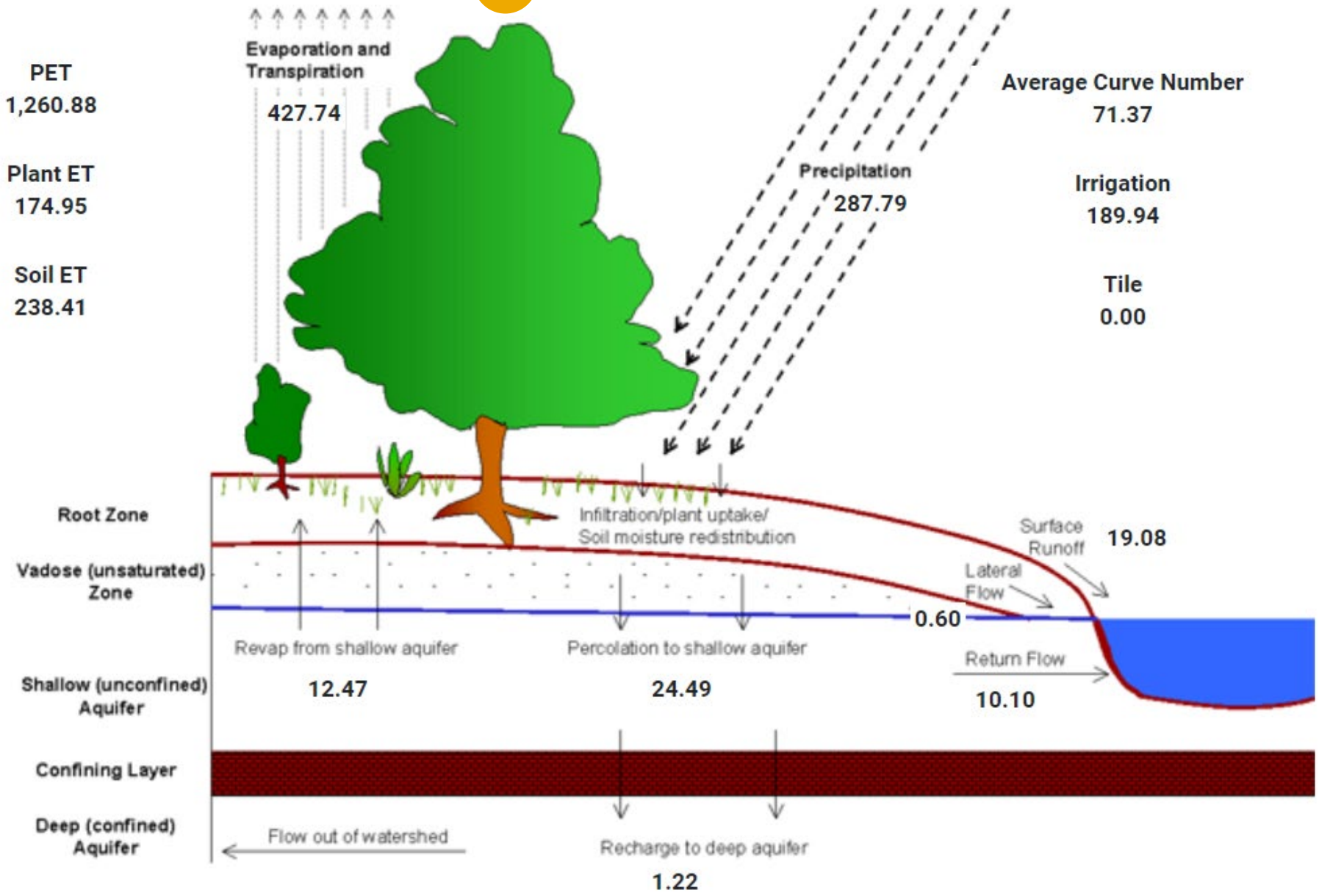


- **ET: R2= 0.7; NSE= 0.62; PBIAS= 12.64; KGE= 0.75**



- **SW: R2= 0.73; NSE= 0.69; PBIAS= -3.48; KGE= 0.84**

RESULTS: WATER BALANCE



All Units mm

CONCLUSIONS

- Chemical sensors are a low cost way to obtain real data
- Having continuous data will improve the actual hydrological model
- The model presented here will serve as a basis for updating as observed data becomes available.

THANK YOU FOR YOUR ATTENTION

UCAM SENS

ESTRELLA DE LEVANTE Fundación

Hydro MRLab