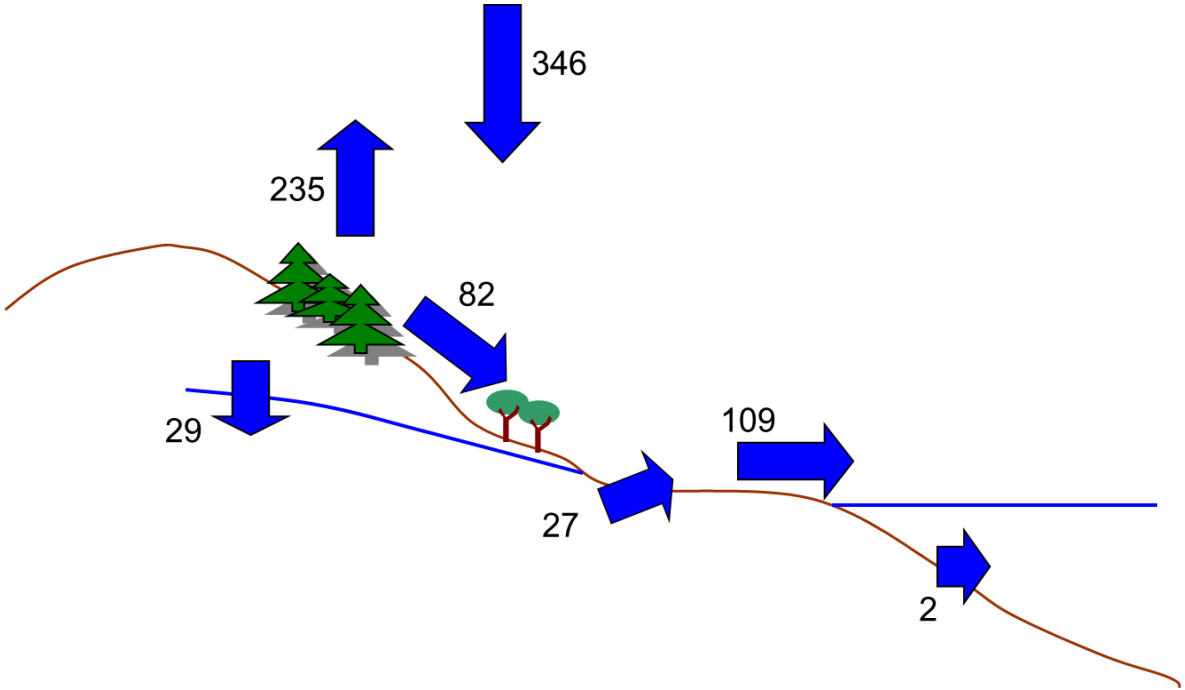
How EO irrigation products can improve water balance and model performance in the highly managed Po river basin?

Science case 4

Nathaly Güiza, Nicolás Cortés and Félix Francés - Universitat Politècnica de València

ESA Hydrology Science Cluster collocation meeting + 4DHydro workshop

Improvements in balance & modelling when using EO irrigation
Aim of this Science Case



Libro Blanco del Agua, Ministerio de Medio Ambiente (2001)

Natural balance in Spain (thousands of Hm^3/year)

Improvements in balance & modelling when using EO irrigation
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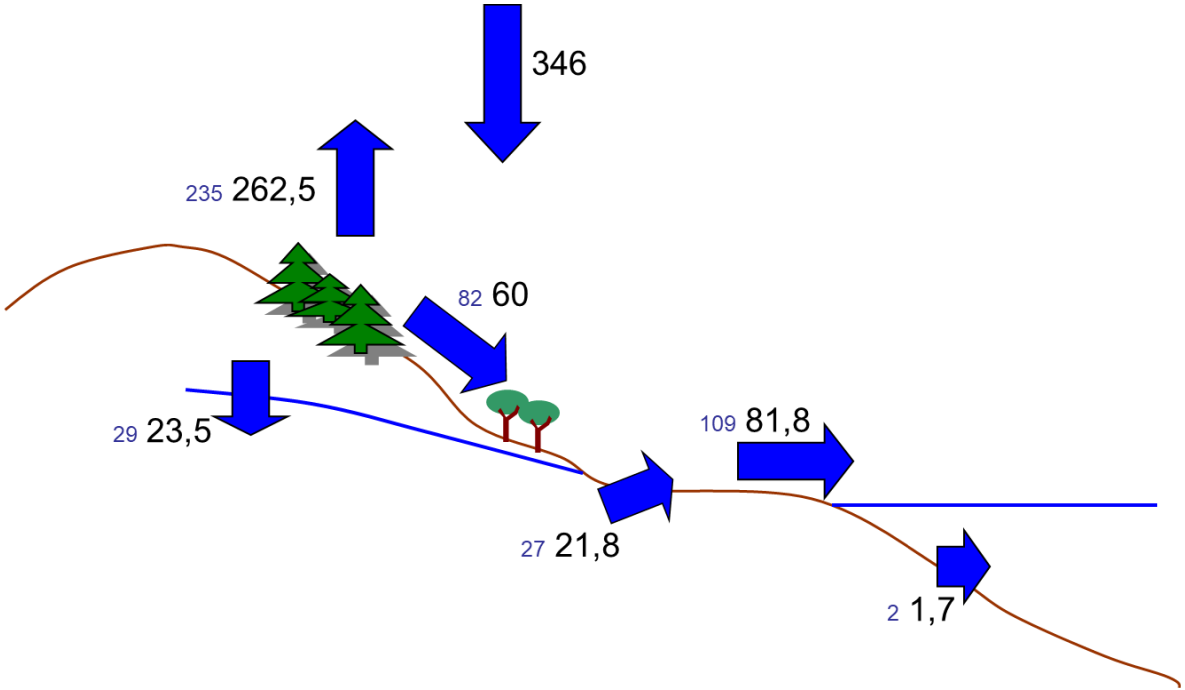


Actual balance in Spain (thousands of Hm^3/year)

Libro Blanco del Agua, Ministerio de Medio Ambiente (2001)

Improvements in balance & modelling when using EO irrigation
Aim of this Science Case

- ET is 32% of precipitation
- Irrigation is 22% of precipitation

⇒ **irrigation can significantly impact on water balance!**

⇒ **considering irrigation can improve modelling performance!**

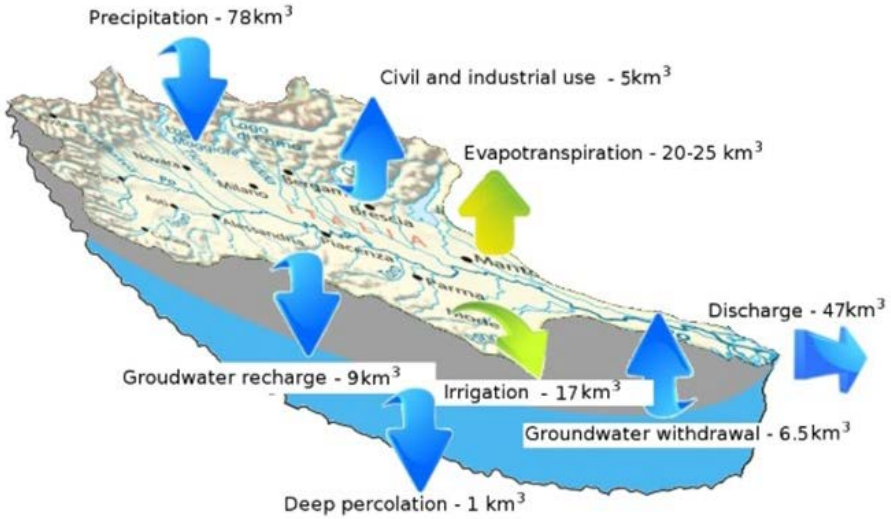


Fig. 3. Mean annual main hydrological fluxes for the Po River basin.

Montanari (2012) based on Autorita di Bacino del Fiume Po (2006)

Improvements in balance & modelling when using EO irrigation
Key questions & experiments

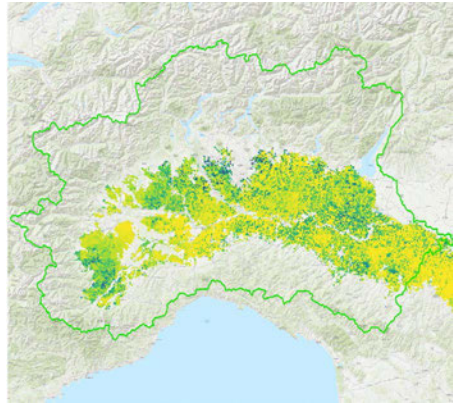
How do LSM/HMs and water balance improve when using EO information on irrigation?

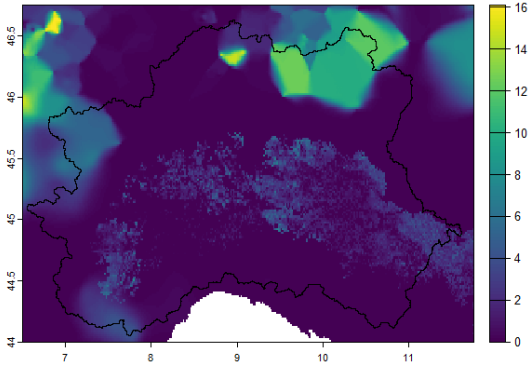
Case study: Po river basin

Exp. #	Experiment	Calibration variable	Evaluation variable
SC40 (WP5 20-21)	Po model calibrated at 5 and 1km grid (baseline)	Q	Q, SSM, ET. Water balance
SC41	Po model from Exp. 20 using precipitation (EMO1) + irrigation data, without calibration	-	Q, SSM, ET. Water balance
SC42	Po model from Exp. 20 using precipitation (EMO1) + irrigation data, with calibration	Q	Q, SSM, ET. Water balance

Improvements in balance & modelling when using EO irrigation
Available information

- **Irrigation estimates from space** ***(Dari et al, 2023)***
  - 1 km spatial resolution grid
  - From Jan. 2016 to Dec. 2021
  - Cumulative irrigation over 7 days (mm/week)
- **EMO1 precipitation plus Irrigation estimates from space** ***(Dari et al, 2023)***
  - 0.01667 degrees spatial resolution grid
  - Daily, from Jan. 2016 to Dec. 2021
- **Abstractions for irrigation are mainly (83%) from surface water**
  - Include all irrigation abstractions proportional to accumulated irrigation area in flow gauge stations. I.e. abstracting for surface runoff and base flow.





Improvements in balance & modelling when using EO irrigation
Planning

September 2024 (m15) - February 2025 (m20)

Models: TETIS, PCR-GLOBWB, mHM and GeoFrame

Date	Activity	Details	Group	Completed
September 25th	*Kick-off meeting*	*Discuss Science Case working plans and planning*	*All*	*100 %*
October 30th	*Inputs delivery*	*EO-based irrigation plus precipitation and storage protocol for additional simulations files*	*UPV*	*100 %*
November 30th	*First data delivery*	**Perform simulation Exp. SC41**	All	25 %
December 15th	Initial analysis	Analyse the impact of considering irrigation on water cycle/balance *(to have a first idea of what is happening)*	UPV	25 %
January 15th	Last data delivery	**Perform calibration and simulation Exp. SC42**	All	0%
January 31st	Initial results delivery	Analyse the impact of considering irrigation on the water cycle/balance	UPV	0%
February 15th	Final results delivery	Compare spatial results and skill scores using evaluation variables	UFZ/UU??	0%
February 28th	Report delivery	SC4 Report	UPV	0%

Improvements in balance & modelling when using EO irrigation
TETIS initial results for SC40 and 41

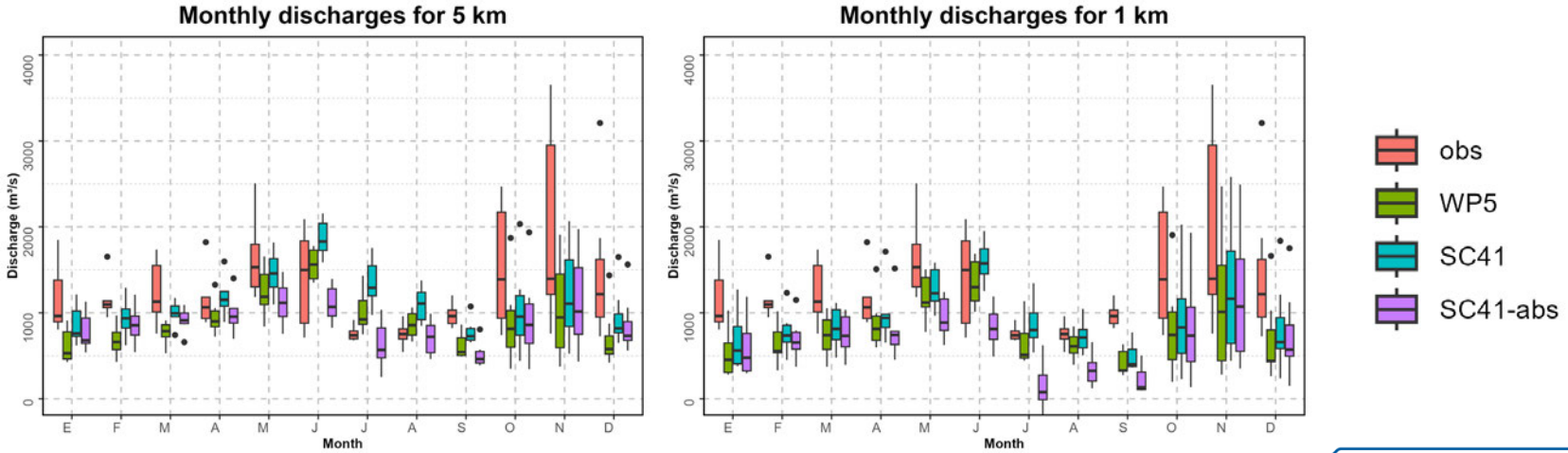
	Base Model (mm/year)		With Irrigation (mm/year)		Relative difference (%)	
Water balance item	**0.0667 deg. (5 km)**	**30 sec. (1km)**	**0.0667 deg. (5 km)**	**30 sec. (1km)**	**0.0667 deg. (5 km)**	**30 sec. (1km)**
Precipitation	957.54	973.19	1140.86	1161.51	19%	**19%**
Evapotranspiration	543.90	550.17	602.17	611.22	11%	**11%**
Surface runoff	219.31	230.30	217.36	249.69	-1%	**8%**
Aquifer recharge	203.85	190.50	313.46	290.46	54%	**52%**
Base flow	192.80	131.68	276.36	171.15	43%	**30%**
SGD *	6.46	41.85	18.11	95.57	180%	**128%**
River discharge	411.97	361.78	375.74	302.78	-9%	**-16%**

* Sea groundwater discharge

Improvements in balance & modelling when using EO irrigation
TETIS performance in SC40 and 41

Exp. #	KGE	
	5 km	1km
SC40 (WP5 20-21)	0.38	0.48
SC41 w/o abstractions	0.41	0.56
SC41 with abstractions	**0.4**	**0.45**

⇒ **Should be re-calibrated (exp SC42)**



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