ASSESSING HYDROLOGICAL PROCESSES PERFORMANCE OF SWAT ON A SMALL FORESTED WATERSHED.

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Small or/and forested:

- **Kaur et al (2004)**
- **Veith et al (2005)**
- **Parajuli (2010)**
- **Zabaleta et al (2013)**
- **Zhou et al (2011)**

- Small (4.6 km^2) and forested (80 %) watershed.

- Not first time using SWAT in the same watershed (Zabaleta et al., 2013)

Main objectives:

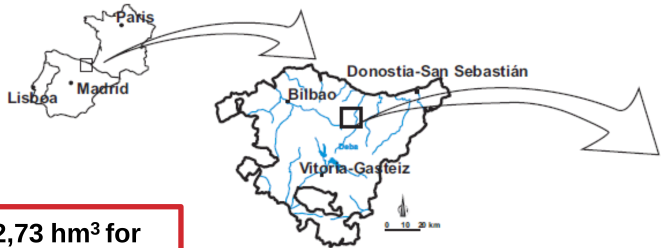
1) assess whether it is possible or not to obtain good results in the outlet along with a good approximation of the water contribution from different parts of the watershed.

2) Surface runoff/base flow contribution and temporal distribution in the outlet

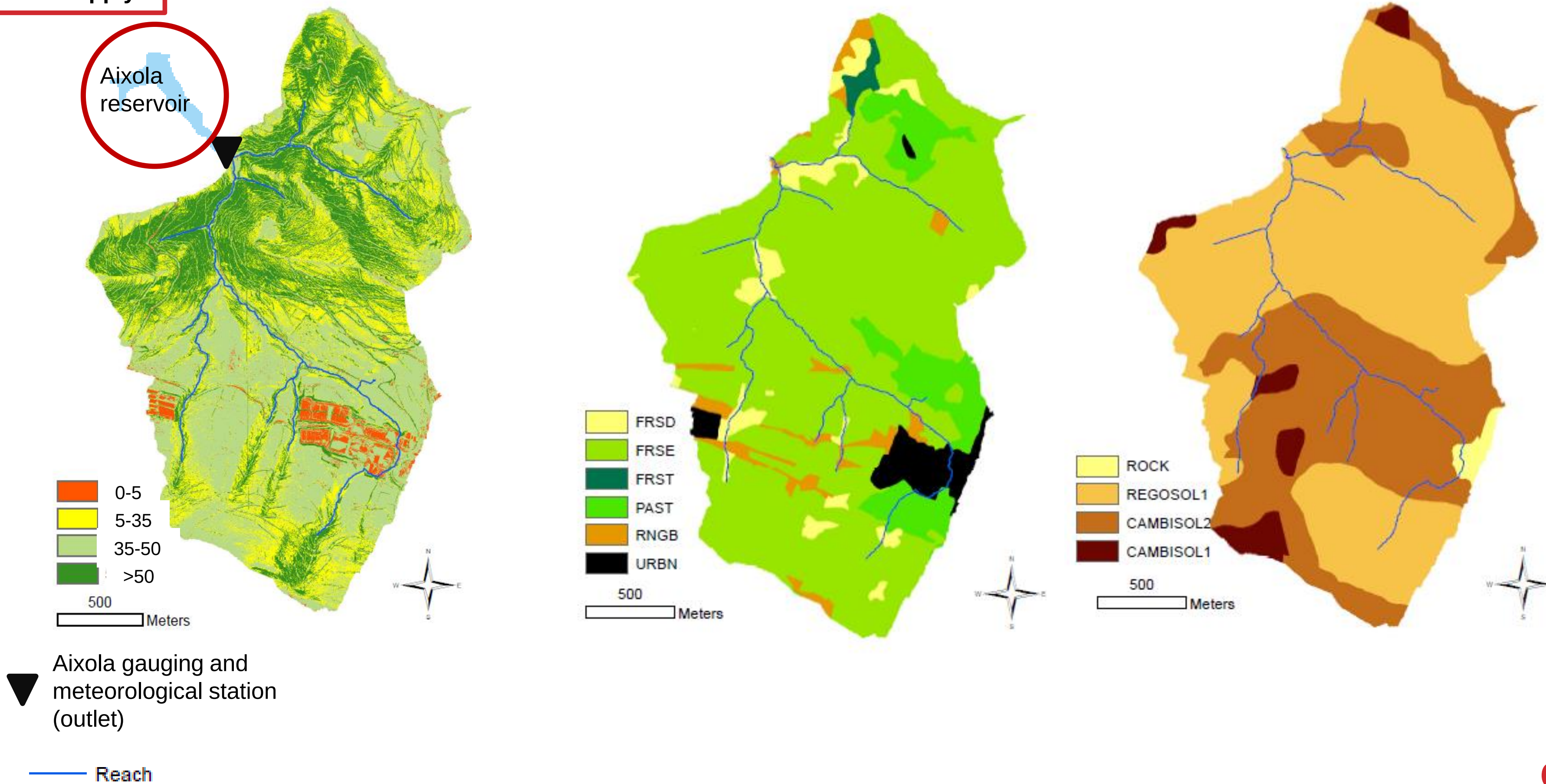
- Kaur, R., O. Singh, R. Srinivasan, S.N. Das, and K. Mishra. 2004. Comparison of a subjective and a physical approach for identification of priority areas for soil and water management in a watershed: A case study of Nagwan watershed in Hazaribagh District of Jharkhand, India. Environ. Model. Assess. 9(2):115-127.
- Veith, T. L., A. N. Sharpley, J. L. Weld, and W. J. Gburek. 2005. Comparison of measured and simulated phosphorus losses with indexed site vulnerability. Trans. ASAE 48(2):557-565.
-Parajuli, P. B. (2010). Assessing sensitivity of hydrologic responses to climate change from forested watershed in Mississippi. *Hydrological Processes, 24*(26), 3785-3797. doi:10.1002/hyp.7793
- Zabaleta, A., Meaurio M., Ruiz E. & Antigüedad I. (2013). Simulation climate change impact on runoff and sediment yield in a small watershed in the Basque Country, northern Spain. Journal of Environmental Quality doi: 10.2134/jeq2012.0209
-Zhou, G., Wei, X., Wu, Y., Liu, S., Huang, Y., Yan, J. Liu, X. (2011). Quantifying the hydrological responses to climate change in an intact forested small watershed in southern china. *Global Change Biology, 17*(12), 3736-3746.

STUDY AREA

PCP: 1480 mm
T: 12ºC
Discharge: 0.092 $m^3\ s^{-1}$



2,73 hm^3 for water supply

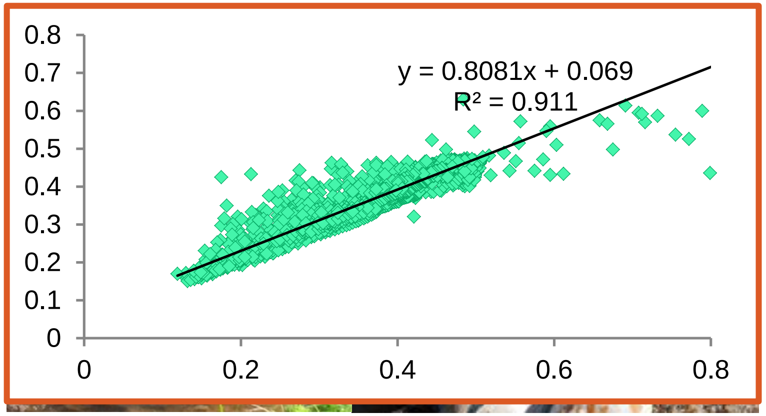


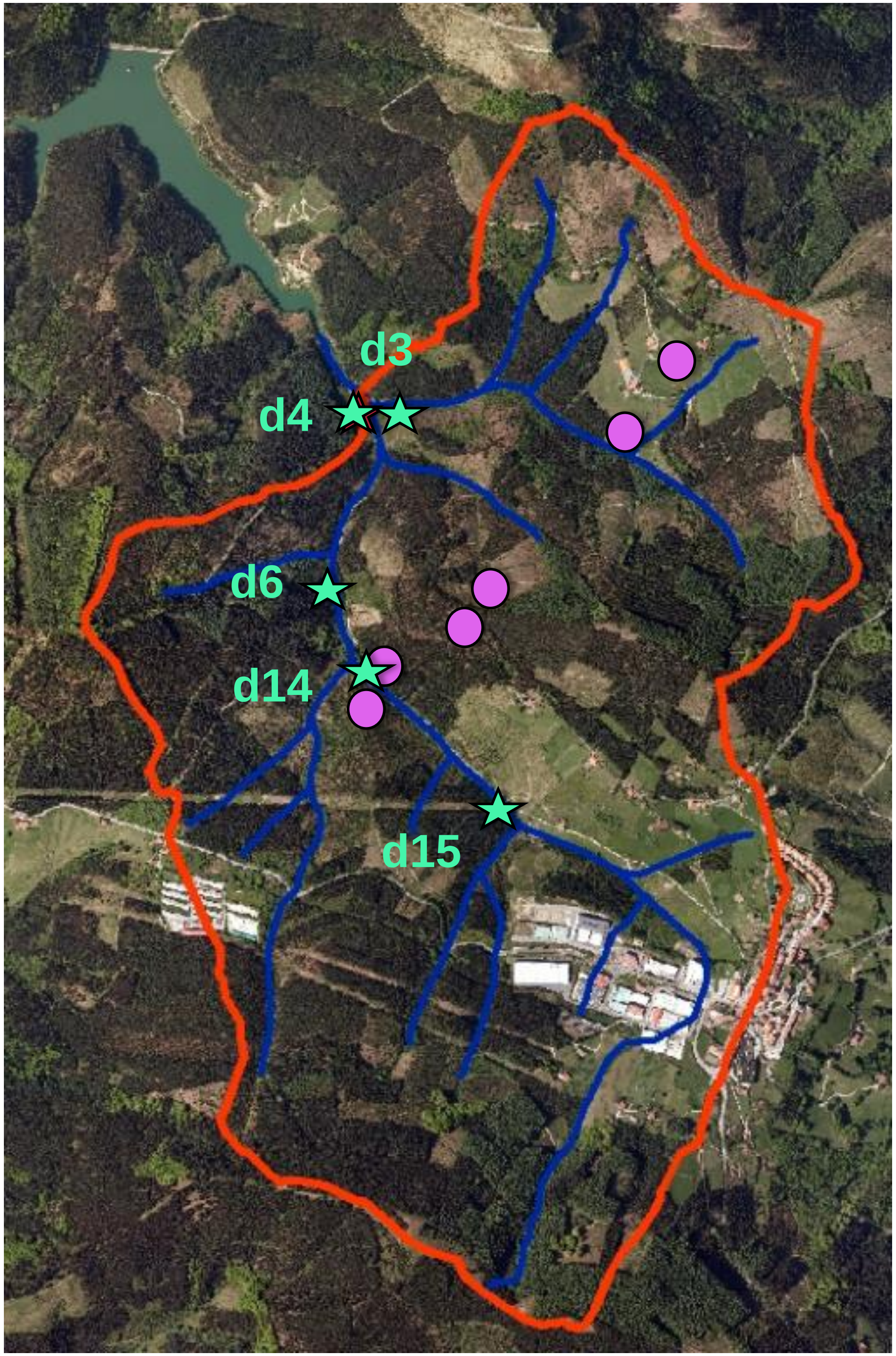
NEW DATA

- **Piezometers**

  - New soil properties: depth, texture and organic matter.
  - New soil map.

- **Divers (Electrical conductivity):**
  - April 2011 d4
  - October 2011: d3, d14, d15
  - December 2012: d6



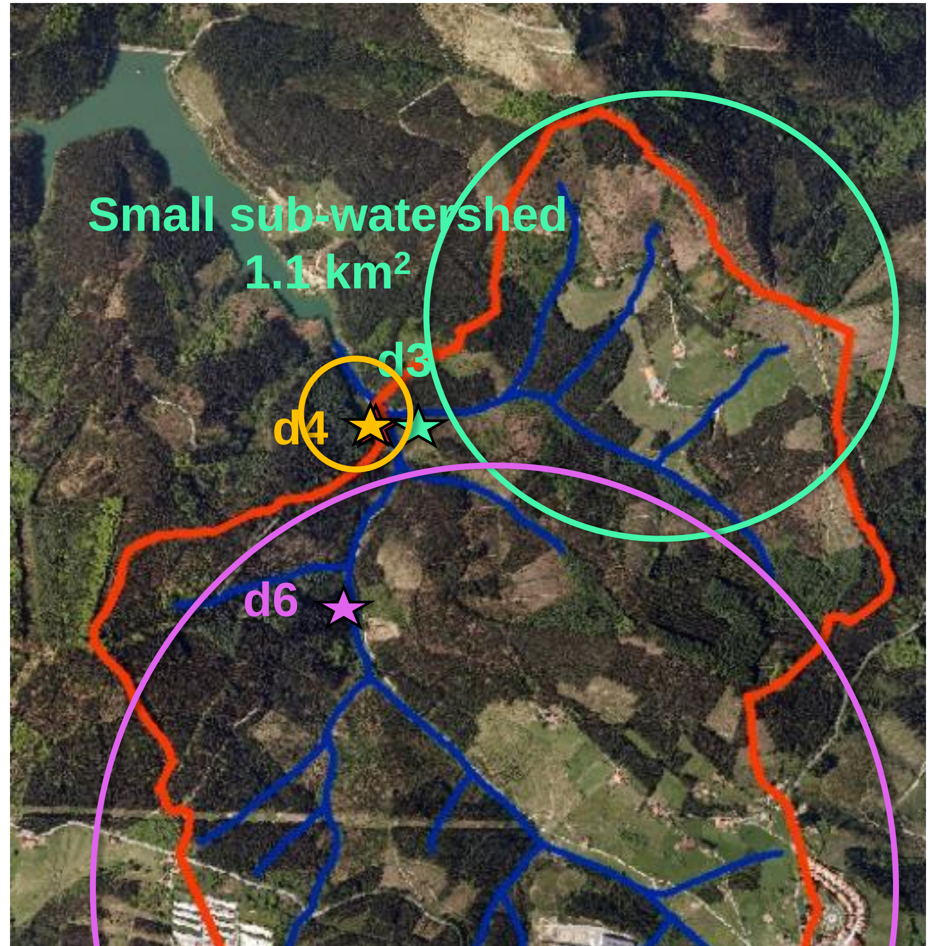


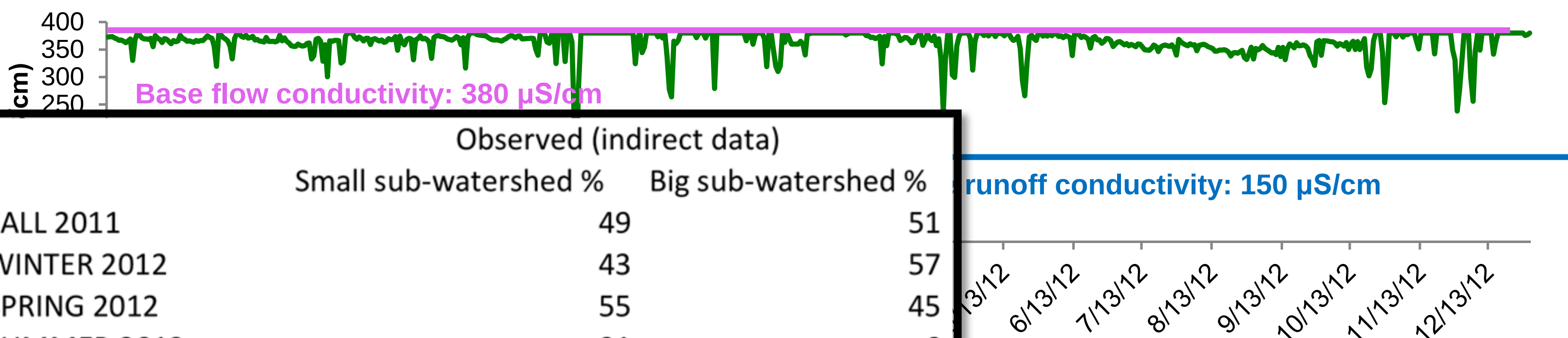
NEW DATA

- **Electrical conductivity (EC):**

  - **Contribution main sub-watersheds➔** mass balance with EC d3, d6, d4 and Q gaugin station (1/10/2011-31/12/2012)

  - Conductivity mass balance (CBM) to **separate de streamflow** in the gaugin station (13/4/2011-31/12/2012).

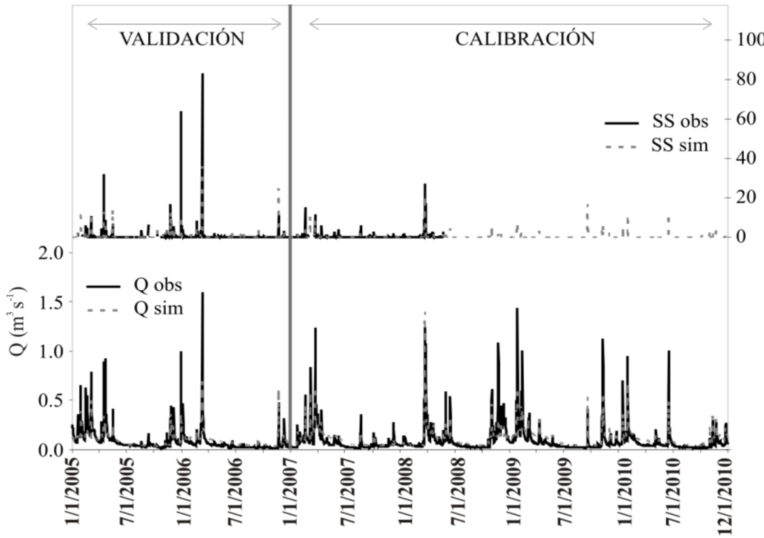




	Observed (indirect data)	
	Small sub-watershed %	Big sub-watershed %
FALL 2011	49	51
WINTER 2012	43	57
SPRING 2012	55	45
SUMMER 2012	91	9
FALL 2012	57	43

PREVIOUS RESEARCH

- Outlet (gaugin station):

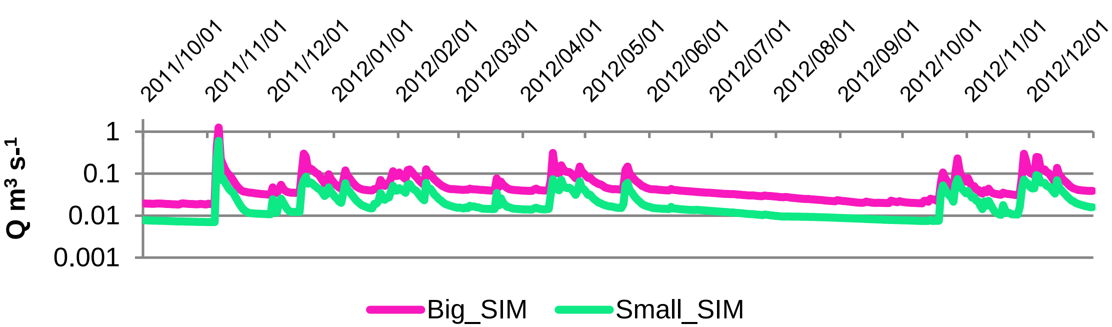


	calibration		validation	
	flow	sediment	flow	sediment
NSE	0.62	0.56	0.6	0.54
R^2	0.81	0.76	0.85	0.80
PBIAS	-16	47	2	42
RSR	0.62	0.66	0.64	0.68

- 80 % Base flow
- 20 % surface runoff

- Good statistical results for the outlet.
- Similar surface runoff/base flow contribution.

- Contribution main sub-watersheds:

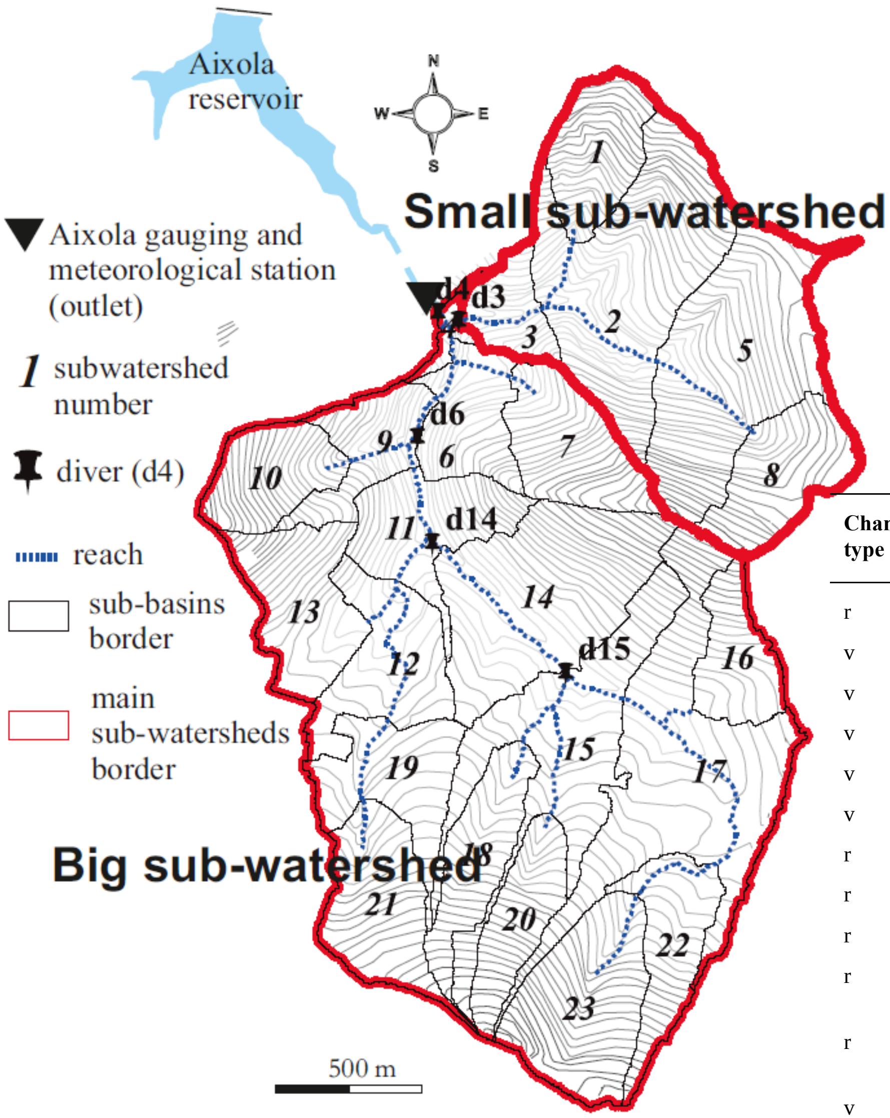


	Simulated	
	Small sub-watershed %	Big sub-watershed %
FALL 2011	27	73
WINTER 2012	27	73
SPRING 2012	26	74
SUMMER 2012	26	74
FALL 2012	28	72

- Big sub-watershed ± 50 % more contribution

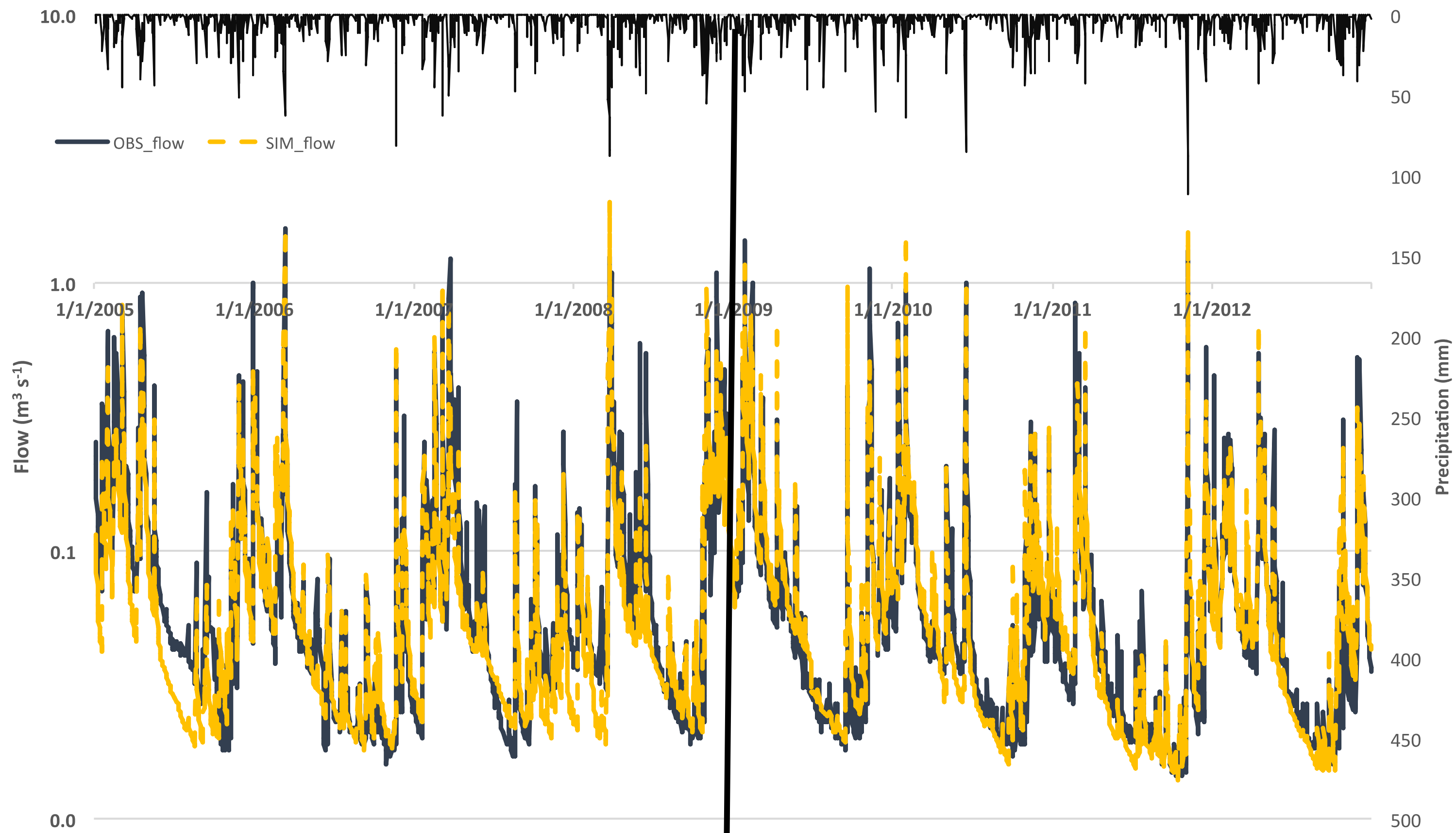
NEW PROJECT

- ArcSWAT 2012.10.0.9
- 23 sub-basins
- 150 HRU



Change type	Parameter name	Description	Flow	
			Small	Big
r	CN2.mgt	Curve number for moisture condition II	↑10%	No change
v	CH_K2.rte	Main channel conductivity	52	7
v	SURLAG.bsn	Surface runoff lag coefficient	1	1
v	ALPHA_BF.gw	Baseflow alpha factor	0.005	0.015
v	CANMX.hru	Maximum canopy storage	5	10
v	GW_REVAP.gw	Groundwater “revap” coefficient	0.05	0.15
r	SOL_K.sol	Saturated hydraulic conductivity	No change	No change
r	SOL_AWC.sol	Available water capacity of the soil layer	↑22%	No change
r	SOL_BD.sol	Moist bulk density of first soil layer	1.7	No change
r	ELEV.sub	Elevation at the centre of the elevation band	450	No change
r	ELEV_FR.sub	Fraction of sub-basin area within the elevation band	1	No change
v	LAT_TTIME.hru	Lateral flow travel time	82	3.57
v	OV_N.hru	Manning’s *n* value for overland flow	0.1	0.6

RESULTS OUTLET



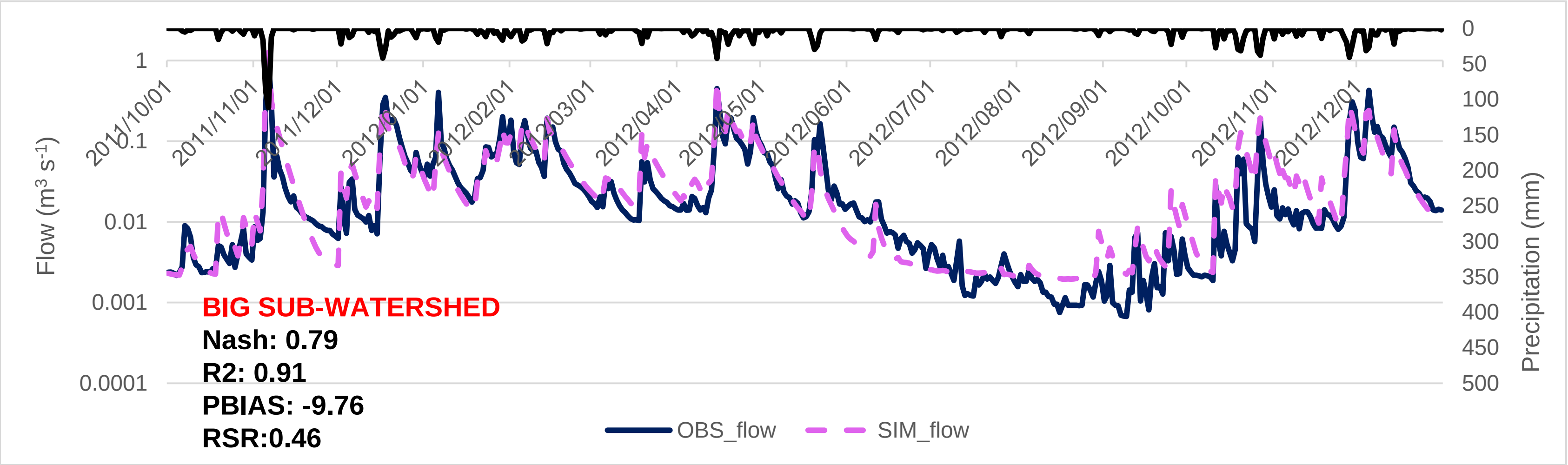
Validation

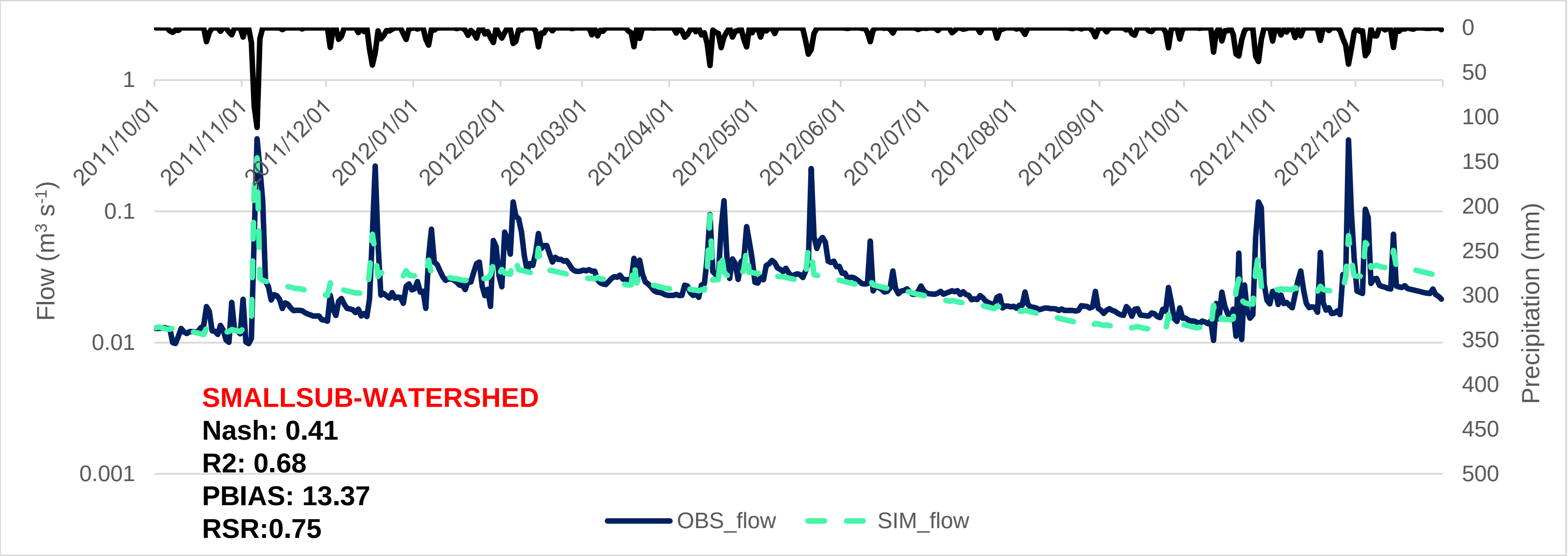
Nash: 0.62
R2: 0.8
PBIAS: 15.45
RSR: 0.62

Calibration

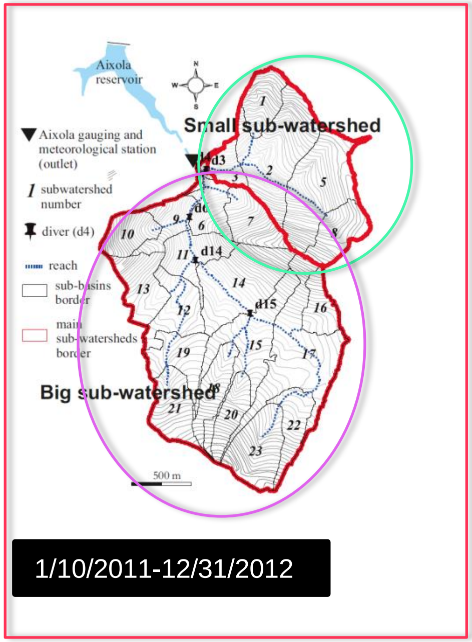
Nash: 0.75
R2: 0.87
PBIAS: -2.48
RSR: 0.5

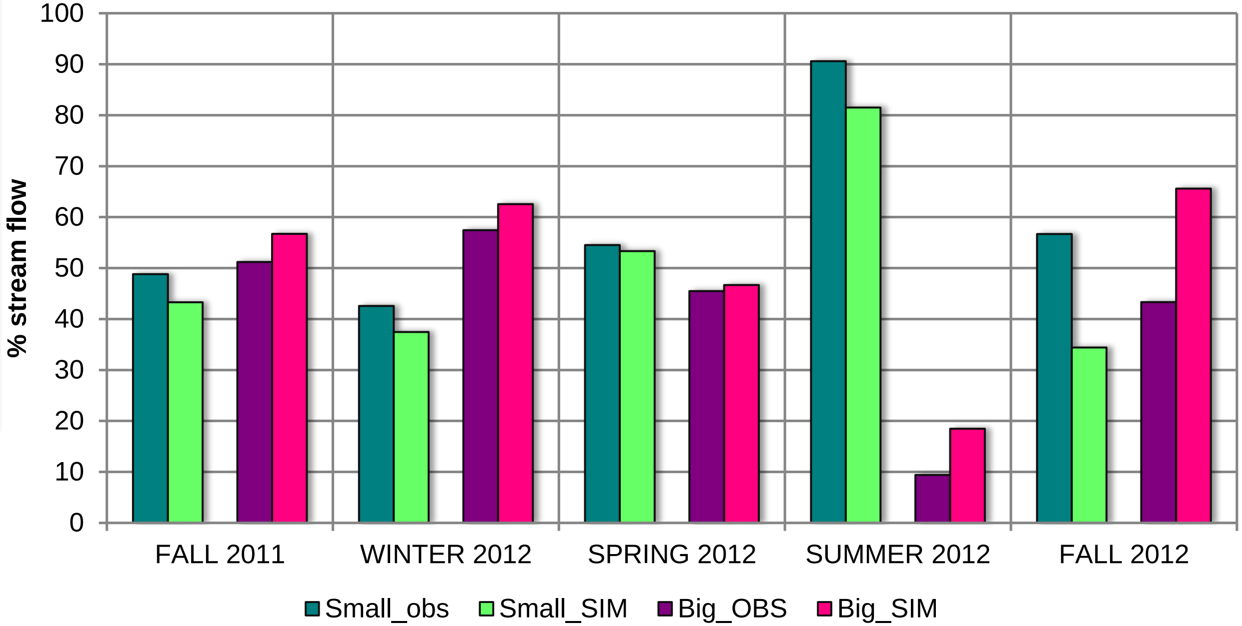
CONTRIBUTION FROM SUB-WATERSHEDS





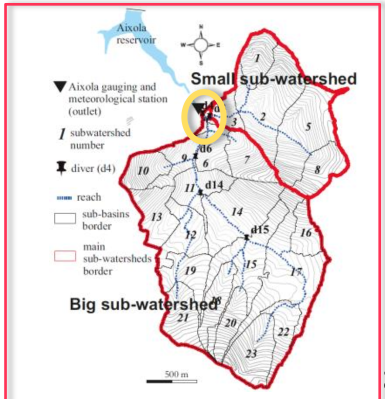
CONTRIBUTION FROM SUB-WATERSHEDS





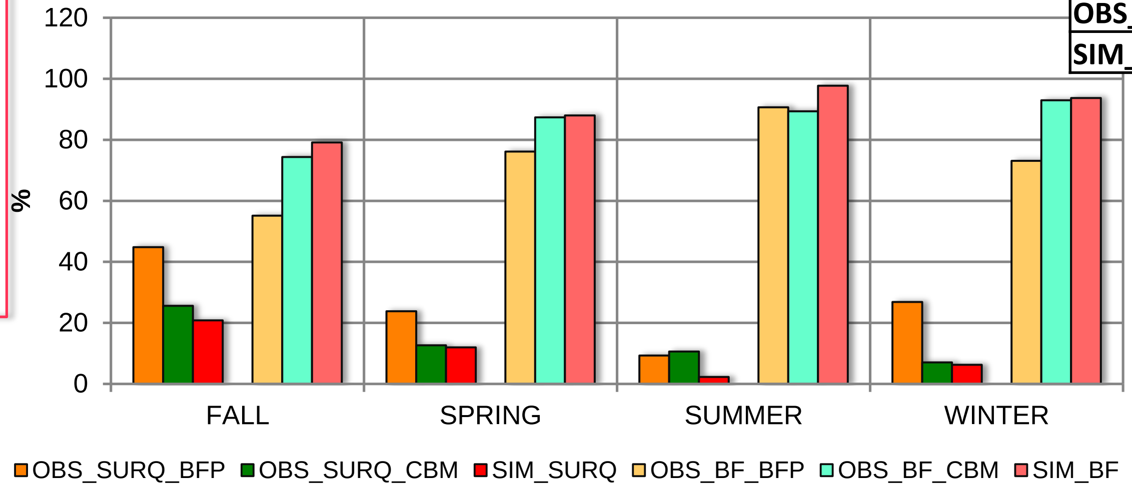
	Observed (L s^{-1})			Simulated (L s^{-1})		
	Outlet	Small sub-watershed	Big sub-watershed	Outlet	Small sub-watershed	Big sub-watershed
FALL 2011	75.49	29.48	67.10	84.80	26.76	57.70
WINTER 2012	94.44	37.29	51.26	90.17	32.30	57.43
SPRING 2012	83.65	39.62	51.84	77.53	30.71	46.45
SUMMER 2012	21.50	19.47	1.82	19.85	16.24	3.60
FALL 2012	75.31	35.73	47.18	80.60	28.09	52.22

SURFACE RUNOFF/ BASE FLOW CONTRIBUTION



4/13/2011-12/31/2012

OBS_SURQ_BFP	31
OBS_SURQ_CBM	16
SIM_SURQ	13
OBS_BF_BFP	69
OBS_BF_CBM	84
SIM_BF	87



L s^{-1}

	OBS	SIM	OBS_SURQ_BFP	OBS_SURQ_CBM	SIM_SURQ	OBS_BF_BFP	OBS_BF_CBM	SIM_BF
FALL	74.86	81.78	33.58	19.10	17.03	41.28	55.68	64.75
SPRING	58.61	52.46	13.96	7.34	6.29	44.65	51.20	46.17
SUMMER	21.89	20.19	2.04	2.25	0.46	19.85	19.56	19.73
WINTER	93.82	89.47	25.22	6.47	5.62	68.61	87.22	83.85

CONCLUSIONS

- **SUB-WATERSHEDS CONTRIBUTION:**
  - Although good results can be achieve for the outlet (Zabaleta et al., 2013) this not mean that hydrological processes inside the watershed have a good performance because the previous research did not simulate well the main sub-watershed contribution.
  - New data: very good results for the daily stream flow in the outlet and the big sub-watershed, no so good for the small one. Good seasonal results; important contribution of small sub-watershed in all the seasons but mostly in summer and spring.
- **SURFACE RUNOFF/BASE FLOW CONTRIBUTION**
  - Surface runoff/base flow contribution was always good performance.
  - CBM method and SWAT simulation: similar results; base flow 80 %. Graphical method (Base flow filter program): 70 % base flow.

Field data enables to evaluate if hydrological process simulate the model are adequate for the studied watershed

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THANK YOU FOR YOUR ATTENTION!

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