Hydrological analysis for representative small catchments in Caatinga and Cerrado biomes using SWAT

Robertson Fontes Júnior, Abelardo Montenegro, **Suzana Montenegro**, Carolyne Andrade, Ricardo Aragão, Jorge Lima

June/2017

INTRODUCTION

Research group funded by the Brazilian Agency **FINEP** focusing on **instrumentation**, **experimental measurements**, **modelling studies** and **teaching, as well as integration of research Groups** involved with experimental and representative basins of ***Semiarid Caatinga*** and ***Cerrado***

OBJECTIVE

The objective of this study was to evaluate the performance of SWAT model parameters in similar experimental basins, in order to identify dominant hydrological components in semiarid environments.

MATERIAL AND METHODS

Study Areas

Experimental and representative basins used in the analysis

1. **Alto Ipanema**
2. **Alto Mundaú**
3. **Alto Jardim**
4. **Japaratuba Mirim**

MATERIAL AND METHODS

Alto Ipanema experimental Basin

Area

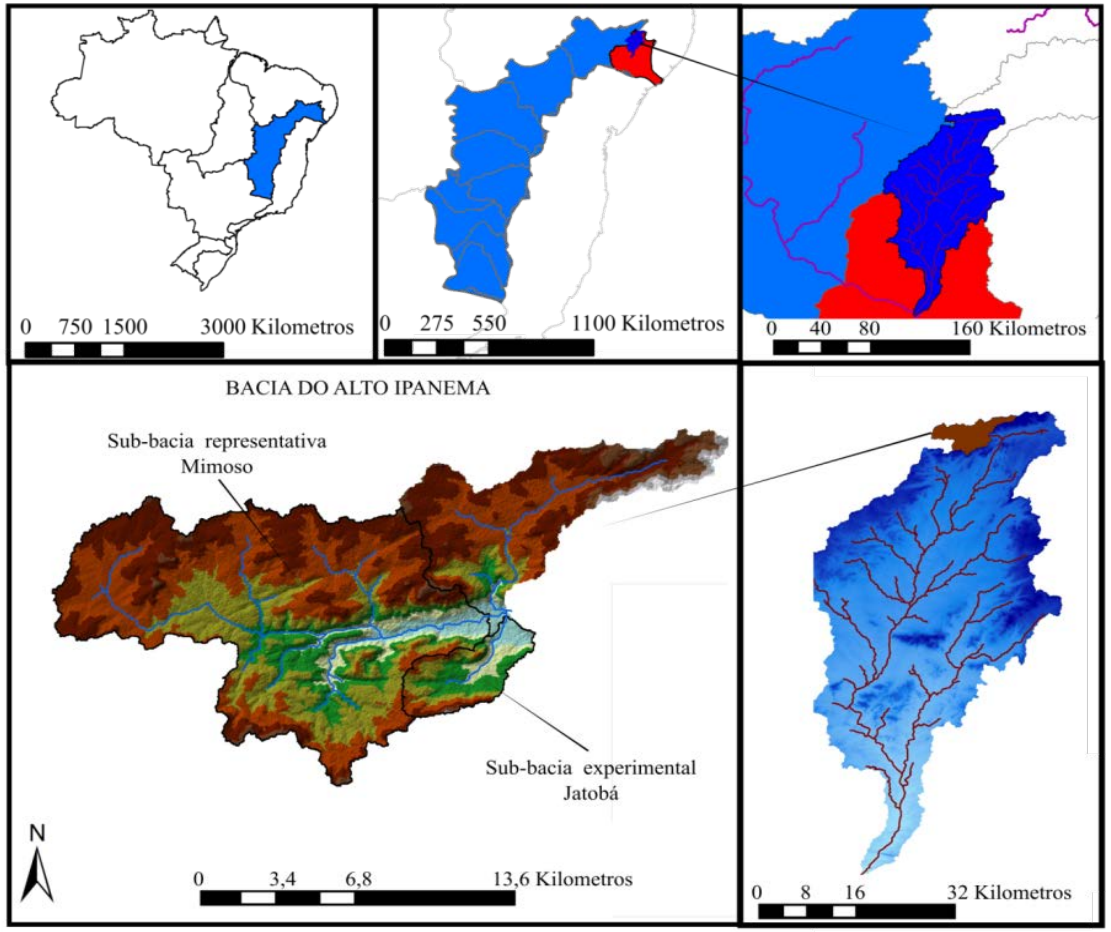
195 km²

Biome

Caatinga

Climate region

semiarid



(Fontes Júnior, 2016)

MATERIAL AND METHODS

Alto Jardim experimental basin

Area

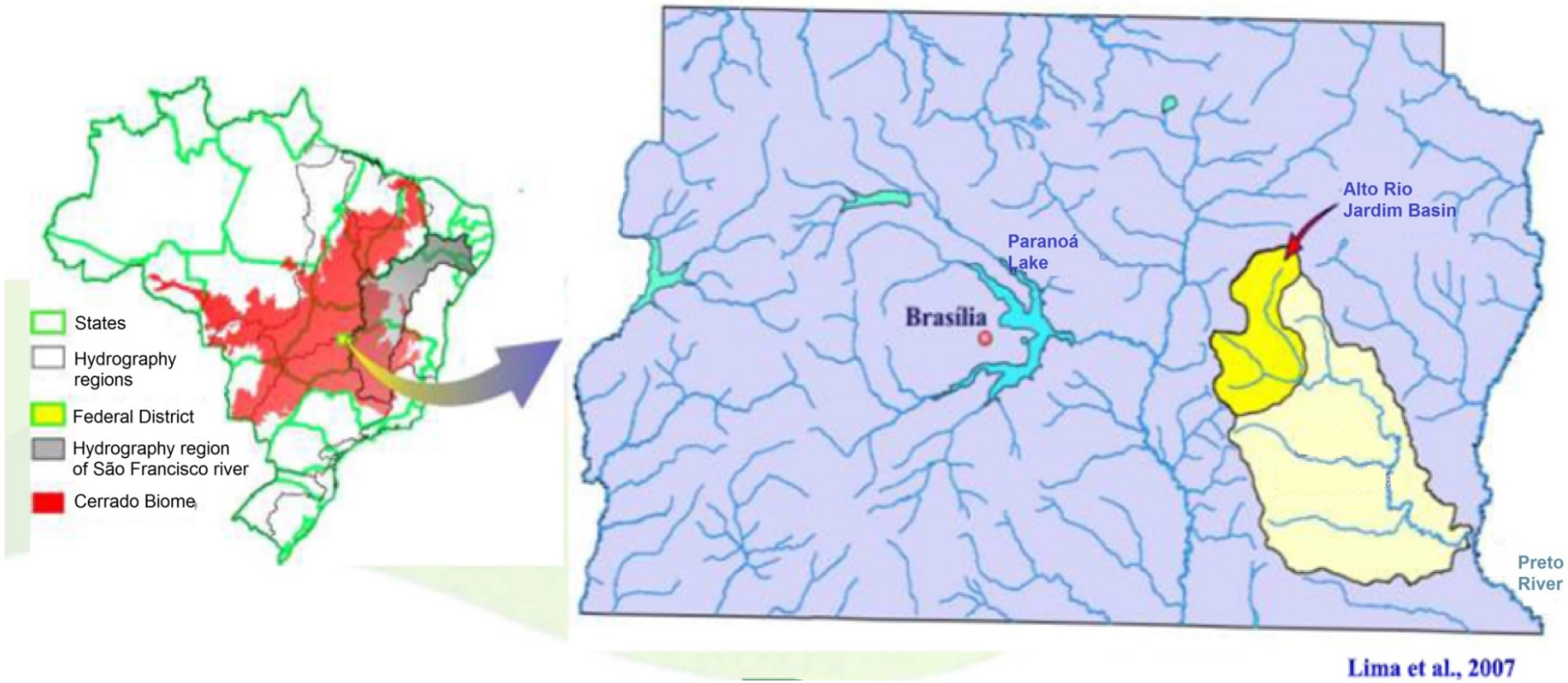
104.86 km²

Biome

Cerrado

Climate region

Tropical



MATERIAL AND METHODS

Alto Mundaú Basin

Area

756 km²

Biomes

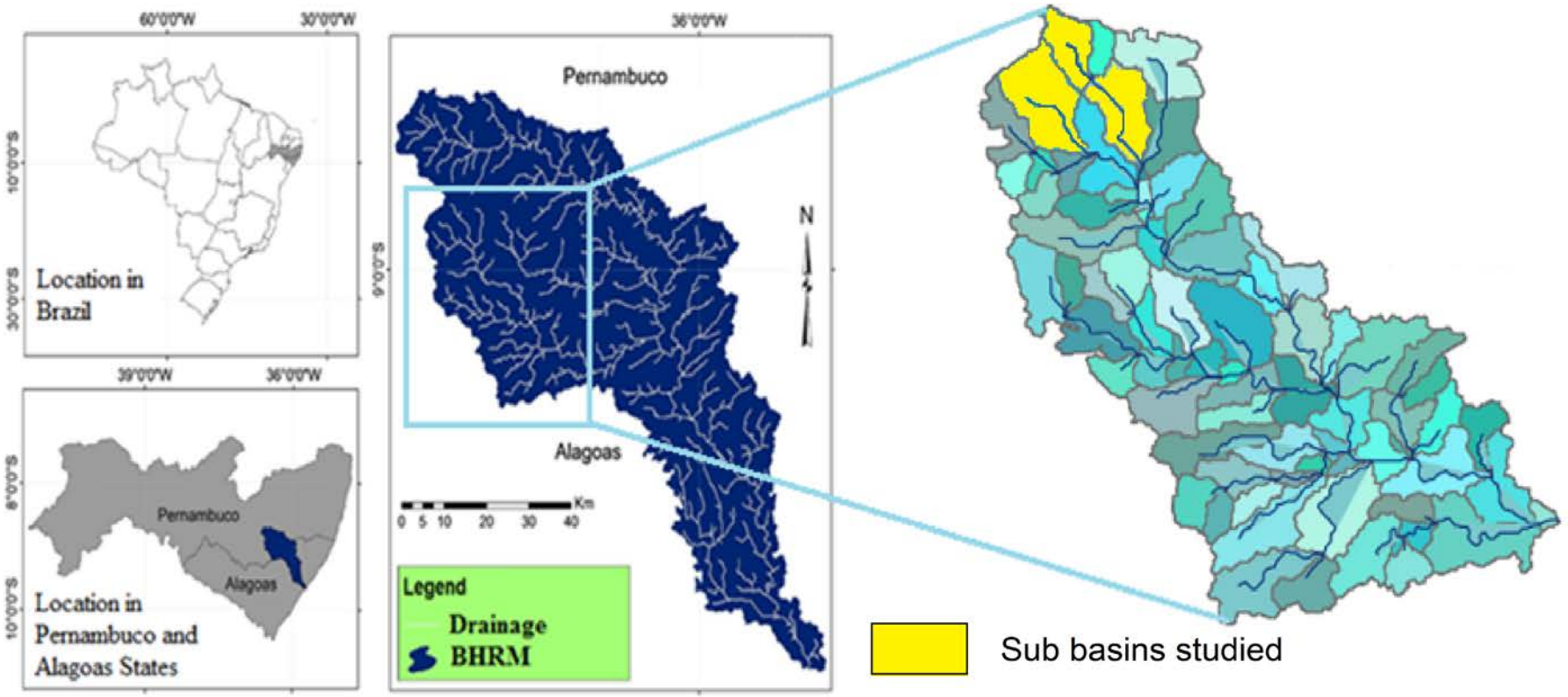
Caatinga and Atlantic Forest

Climate region

Semiarid and sub humid

Simulation Period

2002-2016 (Monthly)



MATERIAL AND METHODS

Japaratuba Mirim

Area

335,4 km²

Biome

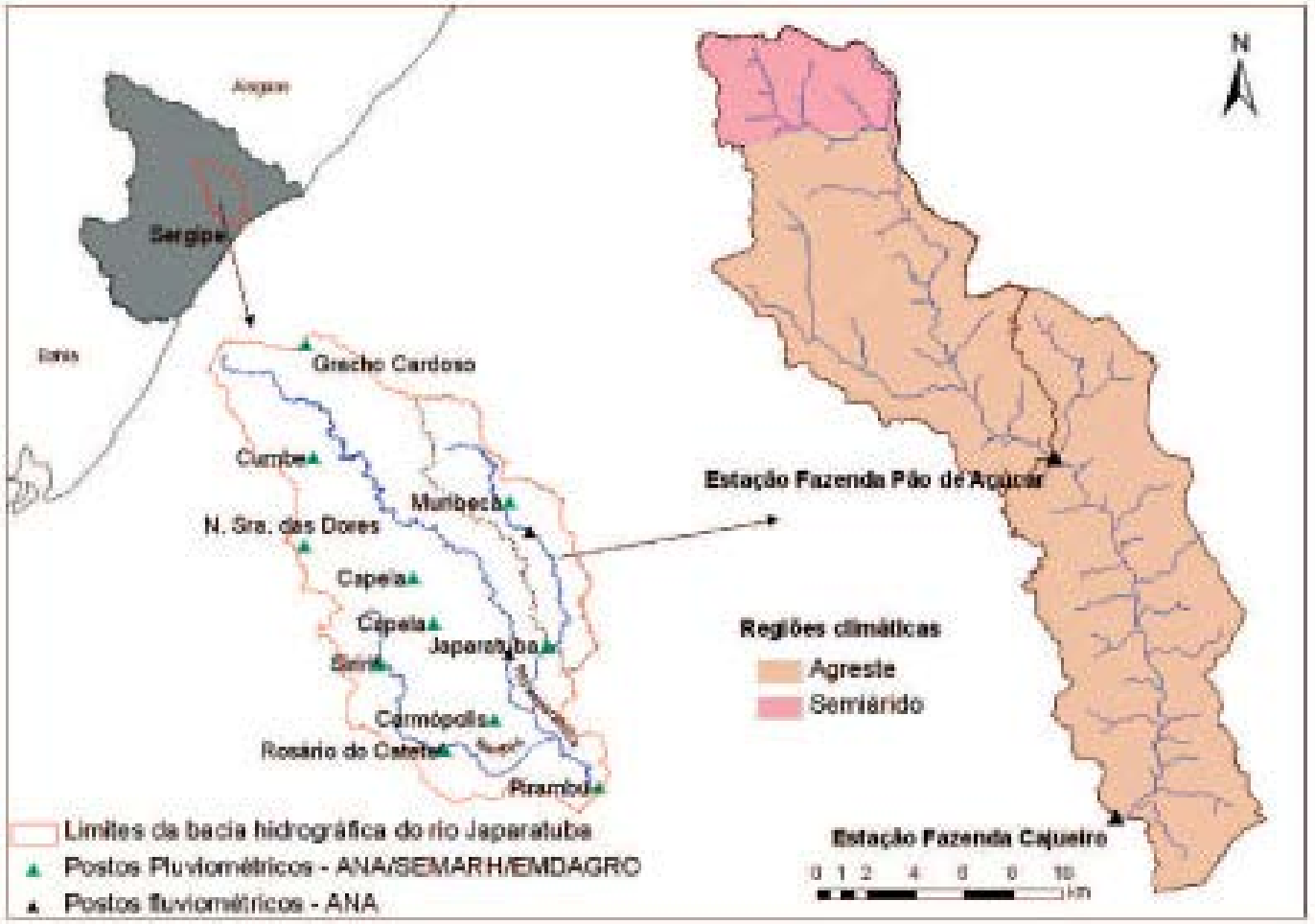
Caatinga

Climate region

Agreste and Semiarid

Simulation Period

2012 – 2016 (Monthly)



MATERIAL AND METHODS

Swat Model Parameters

Sensitivity Analysis (SWAT-CUP)

Calibration Statistics (NSE, PBIAS, R^2)

Period analyzed:

BHAI → 2002-2004

BHAM → 2003-2009

B. Japaratuba Mirim → 2005-2010

SWAT Soil & Water Assessment Tool

MATERIAL AND METHODS

Table 1. Parameters values for flow estimation using the SWAT model in the Mundaú and Japaratuba basins

Sensitivity Parameters	Min	Max
v__ALPHA_BF.gw	0.1	0.85
v__CN2.mgt	51.4	81.89
v__GWQMN.gw	0	885
v__SOL_K().sol	25	1305
v__CH_N2.rte	0.1	0.15

RESULTS AND DISCUSSION

Table 2. Representation of the water balance in the studied basins

Hydrological information	Alto Ipanema	Alto Jardim	Mundaú
Biome	Caatinga	Cerrado	Caatinga/ Pasture
Area (km²)	195	105	4,126
Precipitation (mm/ year)	738	1,100	1,118
Surface Runoff (mm/ year)	103	2.94	171.29
Lateral flow (mm/ year)	88.56	27.10	1.23
Percolation to shallow aquifer (mm/ year)	76.04	30.04	357.94
Revap from shallow aquifer (mm/ year)	72.44	69.96	26.14
Recharge to deep aquifer (mm/ year)	4	-	17.9
Average Curve Number	81.89	-	76.66
Evaporation and Transpiration (mm/ year)	546.12	-	593.6
Potential Evaporation and Transpiration (mm/ year)	1,591	-	1,309.6

RESULTS AND DISCUSSION

Table 4. Parameter values obtained from the calibration by the SWAT model for the runoff simulation

Parameter	Mundaú	Japaratuba Mirim
CN2 (dimensionless)	-0.05	-1.70
RCHRG_DP (fraction)	0.0033	0.48591
GWQMN (mm)	3,665.33	-
ALPHA_BF (days)	0.01	0.521
GW_DELAY (days)	320	429.16,
ESCO (dimensionless)	0.94	0.476
SOL_AWC (mm/mm)	0.01	0.435
SHALLST (mm)	-	1,216
SURLAG (hours)	-	4.488

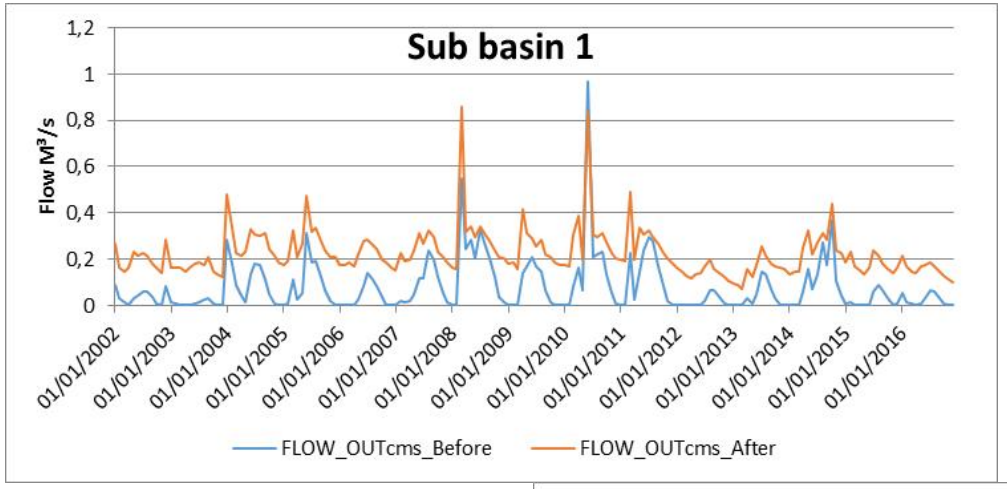
RESULTS AND DISCUSSION

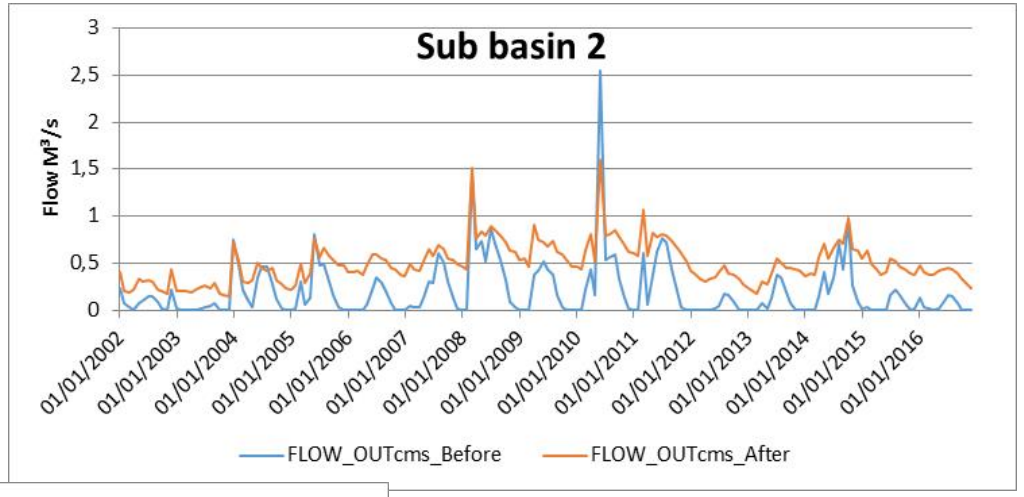
Table 5. Statistical indexes to evaluate the performance of the SWAT model in the two studied basins, before and after using parameters from the monitored basins

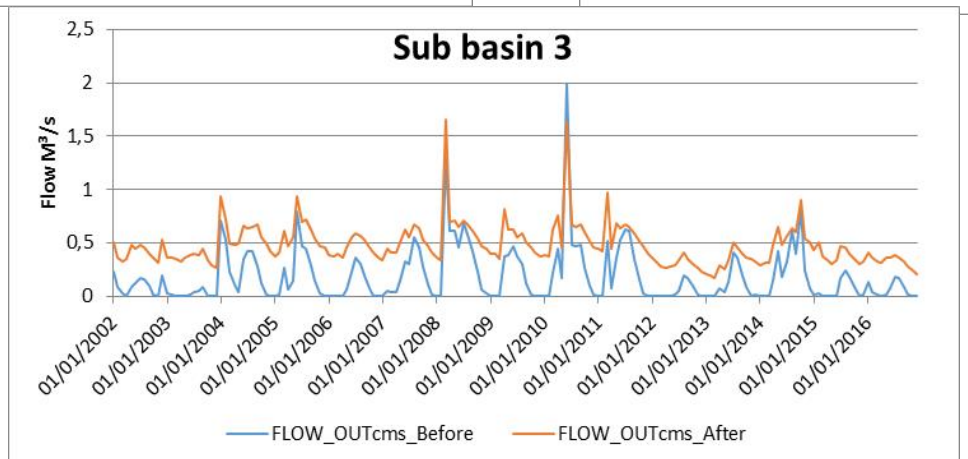
	MUNDAÚ BASIN		Japaratubá Mirim BASIN	
	Before	After	Before	After
Variable	Flow_out_	Flow_out_	Flow_out_	Flow_out_
p-factor	0.96	0.56	0.25	0.97
r-factor	2.24	0.64	1.77	7.35
R2	0.63	0.73	0.61	0.59
NS	0.62	0.73	-17.52	0

RESULTS AND DISCUSSION

Figure 1. Hydrographs of the surface runoff in the Mundaú basin before and after the use of the sensitive parameters for Alto Jardim and Alto Ipanema.



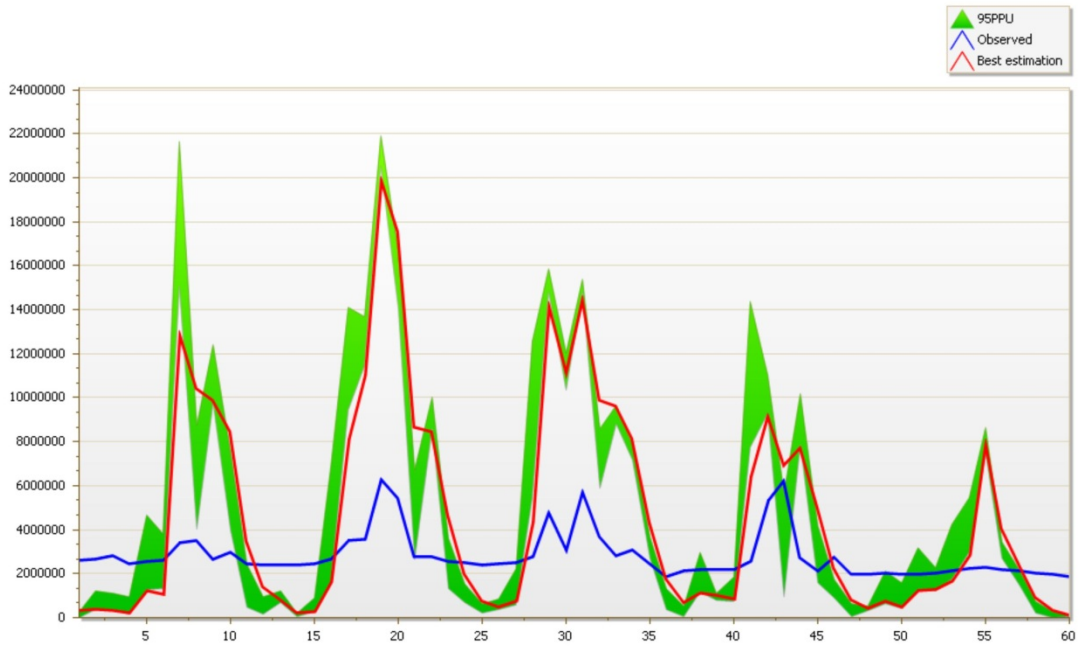




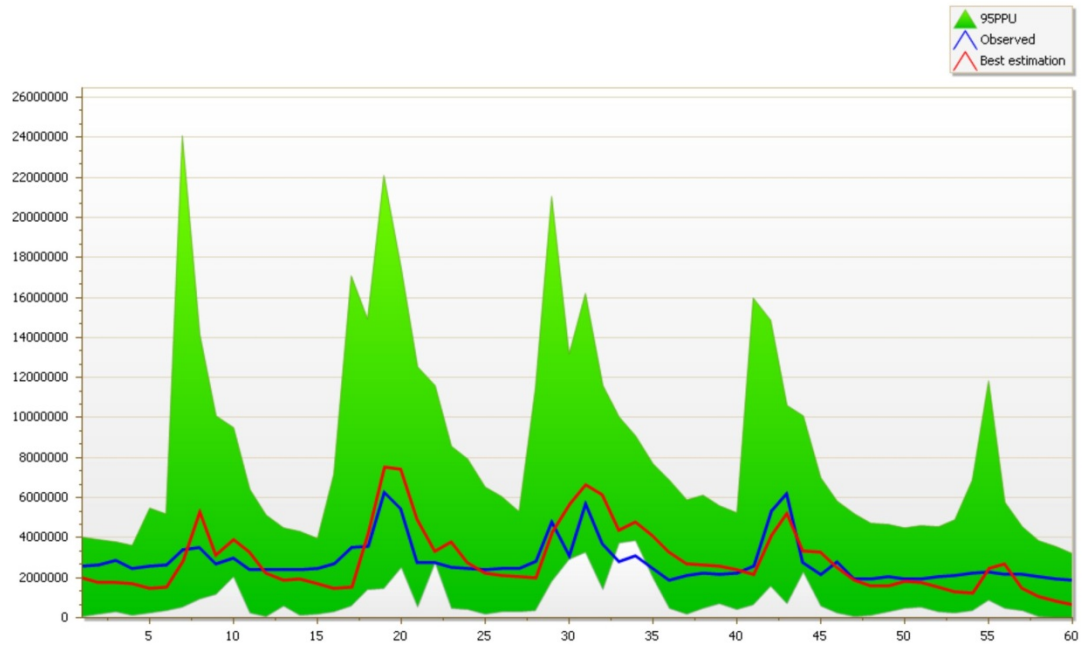
RESULTS AND DISCUSSION

Figure 2. Hydrographs of the Japaratuba Mirim basin runoff before and after the use of the sensitive parameters for Alto Jardim and Alto Ipanema basins.

BEFORE



AFTER



CONCLUSIONS

Regionalisation in hydrology has been constantly applied to predict hydrologic processes in ungauged or poorly gauged catchments;

The use of the sensitive parameters from the Alto Ipanema and Alto Jardim basins as input values for calibration in the Upper Mundaú and Japaratúba Mirim Basins improved the estimates of the surface runoff;

Results will be useful for planning new instrumentation installation and data assimilation technologies in the selected basins

ACKNOWLEDGMENTS