### SWAT MODELING AT MARRECAS WATERSHED IN RIO GRANDE DO SUL, BRAZIL

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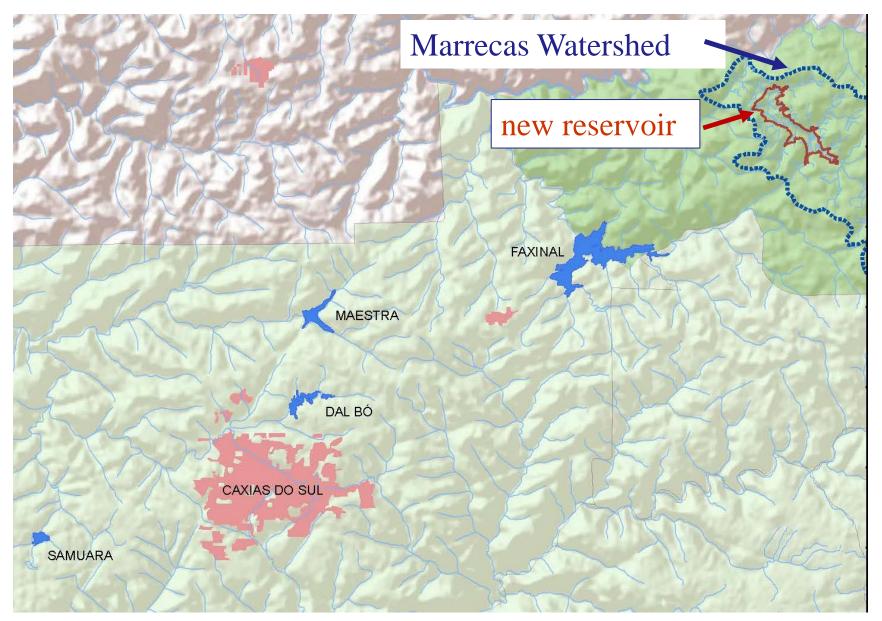


## **Enviromental Context**

• Caxias do Sul, 2nd largest city in Rio Grande do Sul

state , was facing municipal water supply shortage, as currrent supply from exisiting reservoirs (was nearing available capacity;

• water quality quality concerns (previous issues with Feitoria Reservoir);

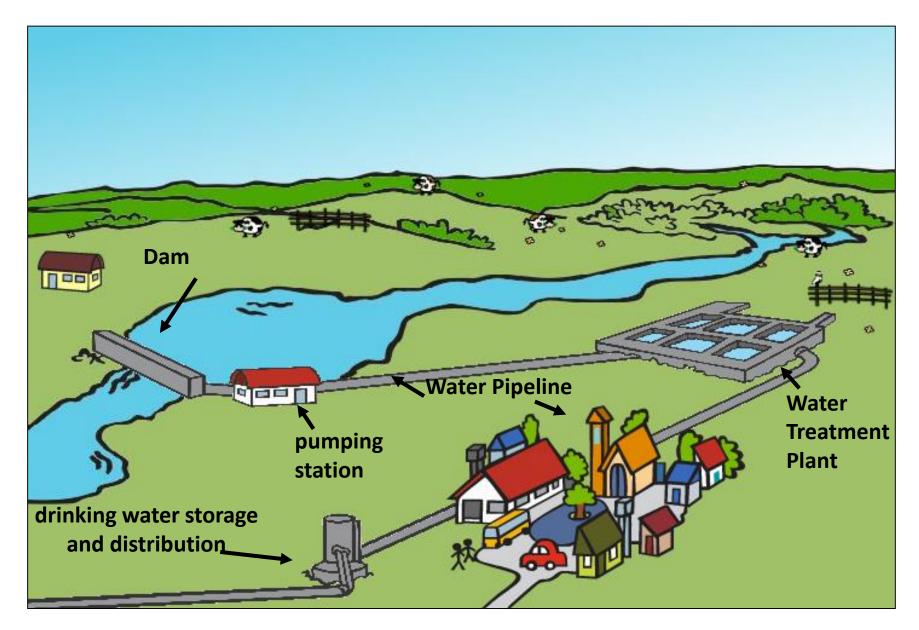


## Arroio das Marrecas (Ducks'Creek) watershed

- 5,370 ha
- subtropical (MAT 16°C)
- natural vegetation is subtropical forests and grasslands
- geology is basalt-rhyolite and soils usually shallow (Inceptisols and Ultisols, with high organic matter content)

 Concrete dam built in 2012-2013, flooded 216 ha of the watershed (33 million m<sup>3</sup>), owned by
 SAMAE – municipal water utility

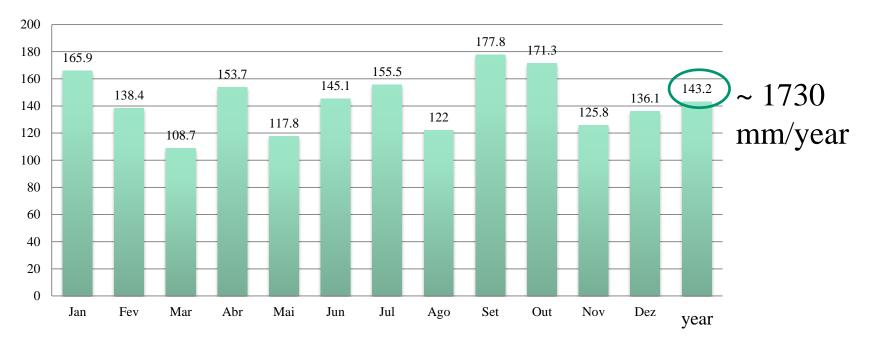




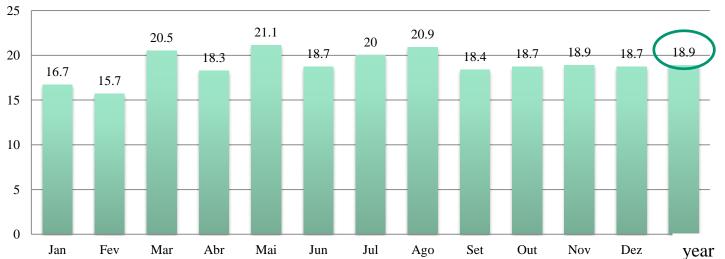
# **Data Availability**

- survey of land use and ag practices including farm chemicals;
- weather station < 20km;
- Environmental Impact Assesment, Environmental Management Plan
- geospatial database soils, DEM, land useland cover;
- Water quality data (before, during and after dam filling)

#### Monthly Rainfall (mm) - 30 year average



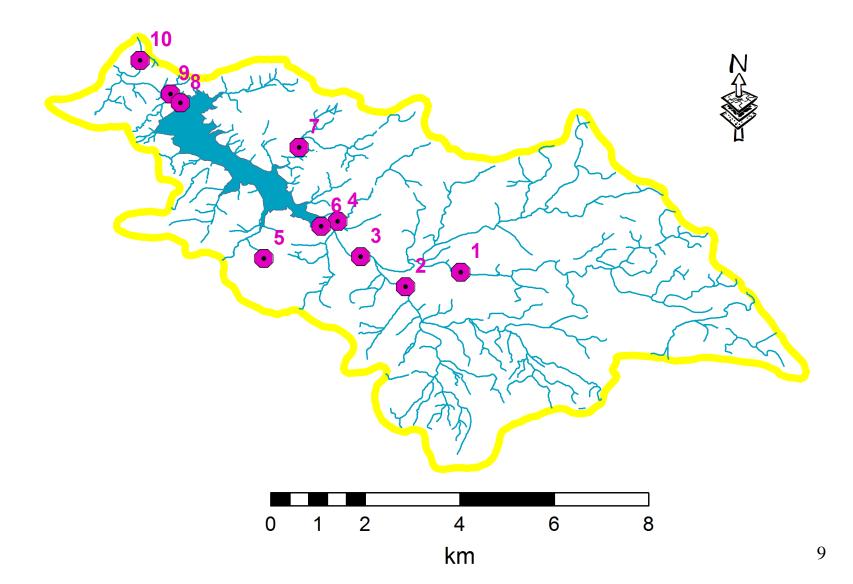
#### Days with Rainfall – 30 year average



# Land Use in 2013

Stowers AND A	Grasslands	3,490
	Subtropical Forests (w/ <i>Araucaria</i> groves)	1,391
	Flooded Land (after reservoir filling)	216
	Fruit Orchards	114
	Pine ( plantations	90
A Provide a construction of the second secon	Annual grain crops	84
Just - Martin Contract	Ponds	49
	Residential Buildings	11
Cimeral Contraction of the	Farm Buildings	3.7
	Fish ponds	1.9
	Rock outcroppings	9.4
SAMAE/Polar/2013	Degraded Land	<sub>8</sub> 20.6

## Surface Water Sampling Points



# Water Quality Trends @ Marrecas Nitrate (mg/L)06/08/2007 23/07/2007 30108/2007 11/06/2007 25/06/12007 01/06/2010 15/10/2010 28/05/2011 15/07/2011 15/07/2011 15/12/2012 11/2/2012 15/02/2013 08/10/2013 20/10/2013 20/02/2014 10/2/2014

6.0

5.0

4.0

3.0

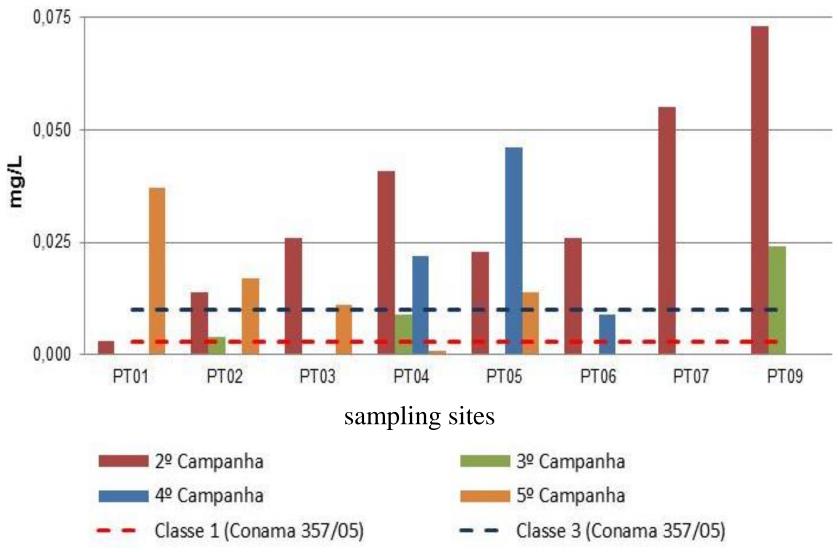
2.0

1.0

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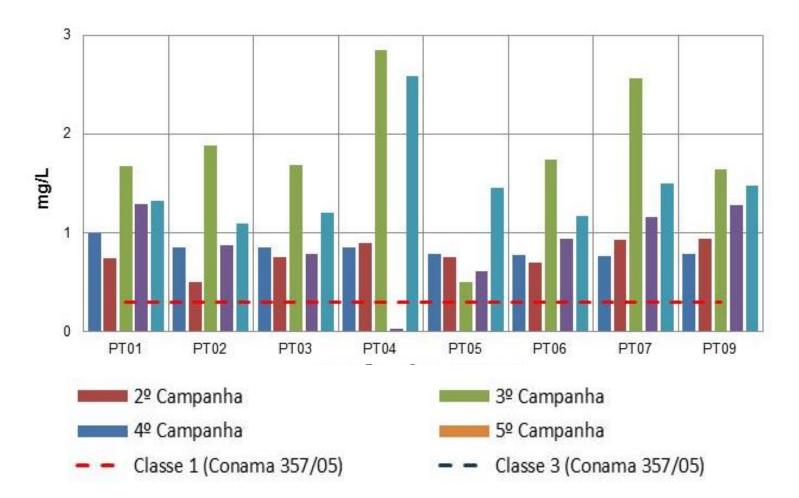
## Water Quality Trends @ Marrecas

Phenols

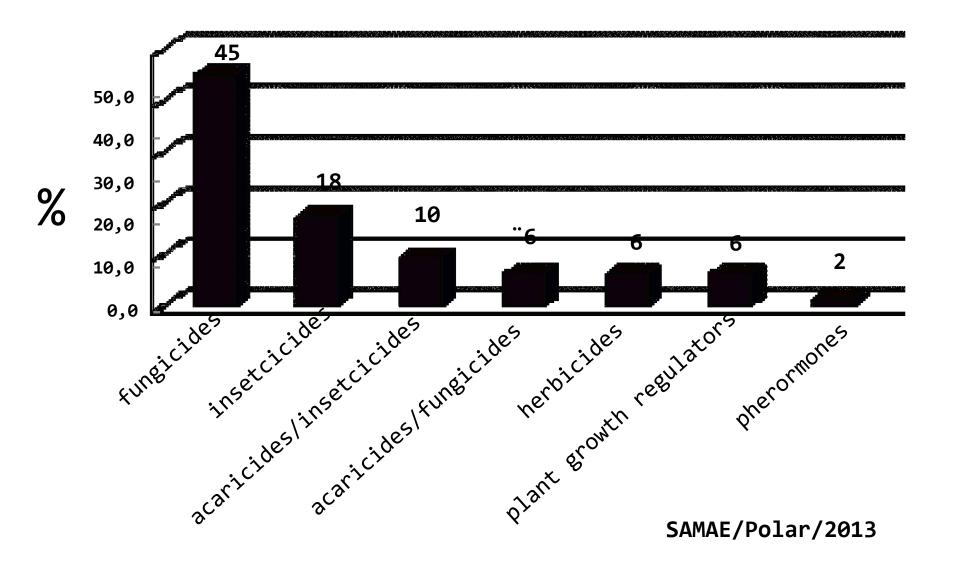


### Water Quality Trends @ Marrecas

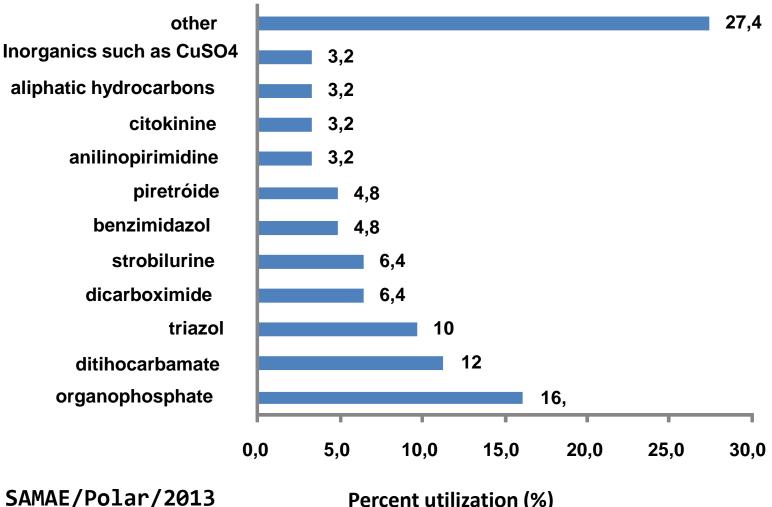
Iron



## Farm Chemicals by Type



# Farm Chemical Use



Percent utilization (%)



#### Short term

evaluate data needs for SWAT simulations

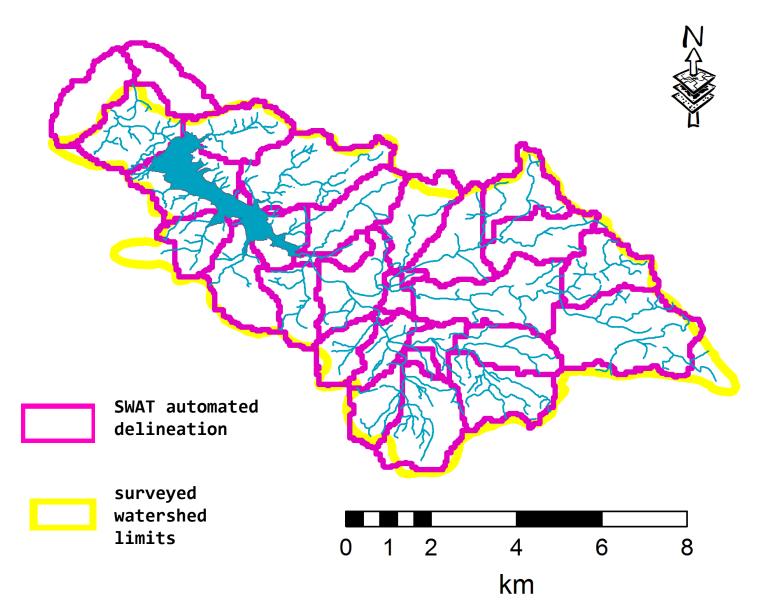
### Long term

- Calibrate and validate SWAT @Marrecas watershed to assist monitoring and long term planning watershed management.
- Variables of interest: sediment, N, P, farm chemicals.

# Initial ArcSWAT application

• ArcSWAT build 612 (for ArcGIS 10.2) runs SWAT 2012.

## SWAT watershed delineation



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## HRU Analysis

HR HR	ULandUseSoilsReport.txt - Note	pad				
<u>Eile E</u> dit F <u>o</u> rmat <u>V</u> iew <u>H</u> elp						
SWAT model simulation Date: 7/23/2014 12:00:00 AM Time: 00:00:00 MULTIPLE HRUs LandUse/Soil/Slope OPTION THRESHOLDS : 5 / 0 / 0 [%] Number of HRUs: 253 Number of Subbasins: 33						
	Area [ha]	Area[acres]				
Watershed	5968.1734	14747.6550				
LANDUSE:	Area [ha]	Area[acres]	%Wat.Area			
Range-Grasses> RNGE	4099.4518	10129.9503	68.69			
Forest-Mixed> FRST	837.0986	2068,5125	14.03			
Forest-Evergreen> FRSE	524.3990	1295.8162	8.79			
Agricultural Land-Generic> AGRL	22.1571	54.7512	0.37			
Wetlands-Mixed> WETL	415.2566	1026.1197	6.96			
Range-Brush> RNGB	19.9924	49.4023	0.33			
Orchard> ORCD	49.8179	123.1026	0.83			
SOILS:						
ABRAM	371.1028	917.0137	6.22			
DUANE	2237.8055	5529.7293	37.50			
LIVINGSTON	427.7081	1056.8880	7.17			
WEIDER	86.2112	213.0322	1.44			
MASSENA	53.4799	132.1516	0.908			
HOOSIC	105.6757	261.1299	1.77			
<						

## Initial SWAT Run

•	Setup	o and Run SWAT N	lodel Simulation	- <b>-</b> ×
Period of Simulation Starting Date : 1/1/20	07	Ending Date : 1/1.	/2010	
Rainfall Sub-Daily Timestep Timestep: Rainfall Distribution	<ul> <li>✓ Minutes</li> </ul>	Printout Settings Daily Yea Monthly NYSKIP Print Soil Nutrient		utput 🔽 Print Soil Storage
<ul> <li>Skewed normal</li> <li>Mixed exponential</li> </ul>	ArcS	Print Water Qualit	y Output 🔄 Print Snow Out V Print WTR Outp	
SWAT.exe Version ③ 32-bit, debug ○ 32- ○ 64-bit, debug ○ 64- ○ Custom (swatUser.exe	<b>i</b> SWAT r	un successful.		✓ Limit HRU Output
		ОК	Setup SWAT Run	Run SWAT Cancel

# Some input data to check...

Q	C:\SWATMARRECAS\SWATMARR.mdb _ t					- 0	
File Edit V	output.std - Notepad 🗕 🗖 🗙						
: 🗋 🔗 🖬 🥞	File Edit Format View Help					Ŧ	
Table (	1 SWAT Jun 11 2014 VER 2012/Rev 627				0/ (	0/ 0	
Table Of Contents	General Input/Output section (file.cio): 8/1/2014 12:00:00 AM ARCGIS-SWAT interface	e AV					
	Number of years in run: 4 Area of watershed: 59.682 km2						
	1 SWAT Jun 11 2014 VER 2012/Rev 627						
	General Input/Output section (file.cio): 8/1/2014 12:00:00 AM ARCGIS-SWAT interface AV						
	Annual Summary for Watershed in year 1 of s	simulation					
	UNIT PERCO	TILE		WATER SED	NO3 NO3	3 NC	
	TIME PREC SURQ LATQ GWQ LATE	Q SW	ET	PET YIELD YIELD	SURQ LAT	-	
	(mm) (mm) (mm) (mm) (mm)	(mm) (mm)	(mm)	(mm) (mm) (mm)		(	
	1******************* 646.92 86.42 930.09	0.00 113.75	57.62	88.95***********	1.75 2.34		
	2************** 791.69 462.96 1133.36	0.00 113.99	46.14	47.86************	0.27 0.10		
	3**************************************	0.00 114.88	48.67	48.95******91496.43	0.33 0.02		
	4*************************************	0.00 115.28	28.64	28.64******97297.45	0.27 0.02		
	5**************************************	0.00 115.75	22.53	22.53*******90001.93	0.03 0.02		
	6*************************************	0.00 115.45	17.51	17.57******73500.94	0.01 0.02		
	7**************************************	0.00 115.88	12.56	12.68******89401.30	0.00 0.03		
	8**************************************	0.00 116.30	19.40	20.12******61014.01	0.00 0.02		
	9**************************************	0.00 116.29	4.42	7.22******83203.77	0.08 0.02	2 0.1	

## Possible solution?

input.std - Notepad	_ 🗆 🗙
File Edit Format View Help	
SWAT Jun 11 2014 VER 2012/Rev 627	^
General Input/Output section (file.cio):	
8/1/2014 12:00:00 AM ARCGIS-SWAT interface AV	
Number of years in run: 4	
Area of watershed: 59.682 km2	
Random number generator cycles: 0, use default numbers	
Initial random number seed: wet/dry day prob 748932582	
Initial random number seed: radiation 1948832765	
Initial random number seed: precipitation 857034417	
Initial random number seed: 0.5 hr rainfall 67377721	
Initial random number seed: wind speed 366304404	
Initial random number seed: irrigation 1094585182	
Initial random number seed: relative humidity 1767585417	
Initial random number seed: max temperature 608439319	
Initial random number seed: min temperature 592757081	
Precipitation data used in run:	
Multiple gages simulated for watershed	
Temperature data used in run:	
Multiple gages simulated for watershed	
PET method used. Perman-Monteith	
Rainfall/Runoff/Routing Option:	
Daily rainfall data	~
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# Input Data Challenges

- no streamflow gages in watershed yet, however there is some flow info from dam spillway and pumping station intake and reservoir storage;
- Key water quality parameters with sparse sampling (quarterly);

