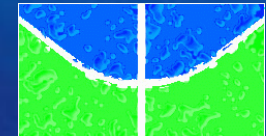




INTEGRATION OF WATER QUANTITY AND QUALITY MODELS FOR ASSESSMENT OF WATERSHED CONTAMINANT LOADS INTO TRIBUTARIES OF PARANOIA LAKE

Diana Jimena Monsalve Herrera
Conceição de Maria Albuquerque Alves
Ricardo Tezini Minoti

Programa de Pós-Graduação
em Tecnologia Ambiental
e Recursos Hídricos



Introduction

Riacho Fundo sub-basin

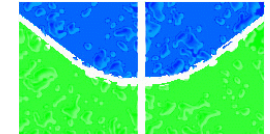
“Água DF”

Increasing
Population

Pollution

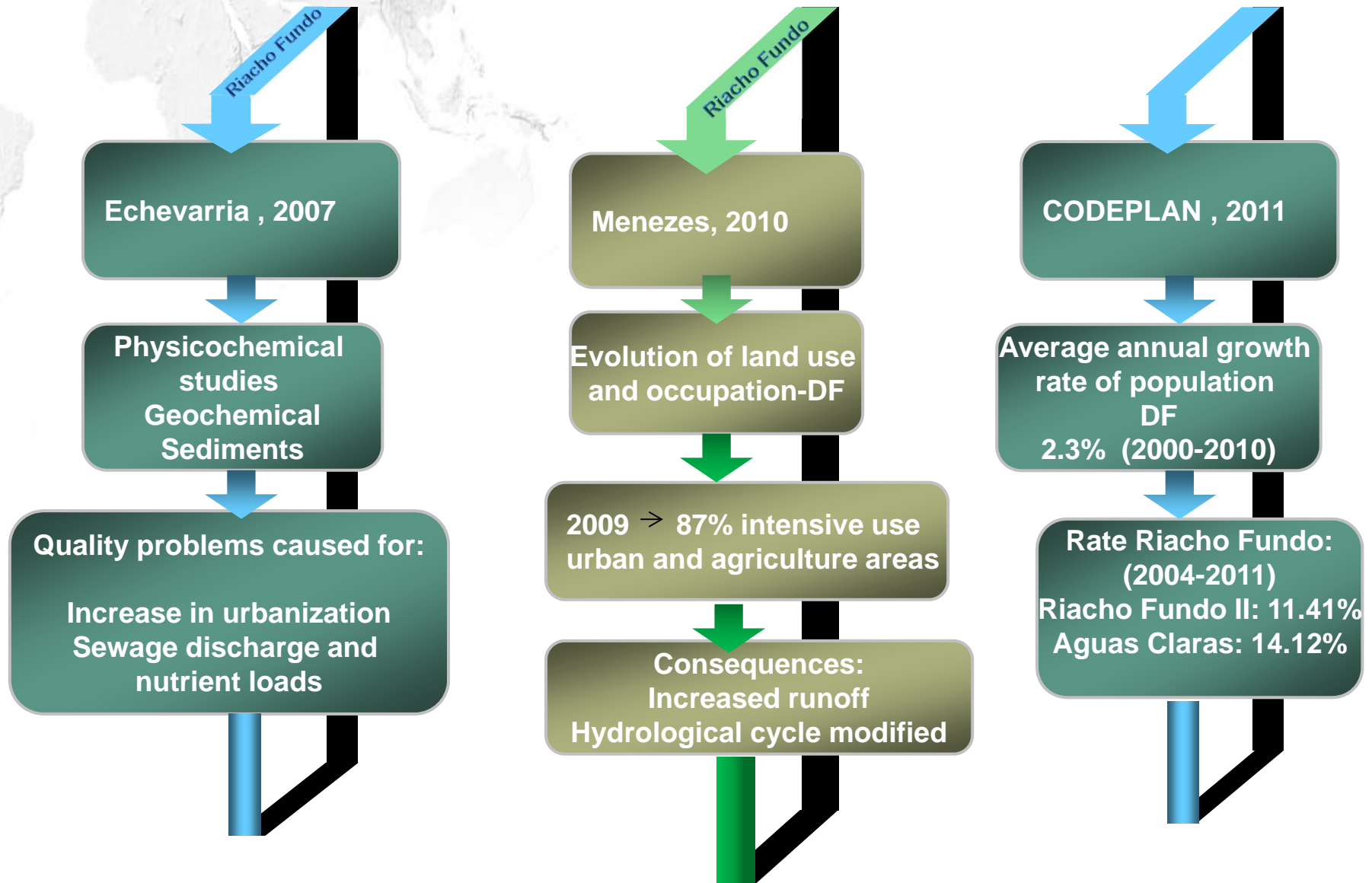
Land use
and
occupation

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Introduction



Legenda

▲ Estações de monitoramento RF-50 e 60478400

● ETE Riacho Fundo

— Hidrografia

Lago Paranoá

LABEL

■ Lago Paranoá

■ Lago Santa Maria

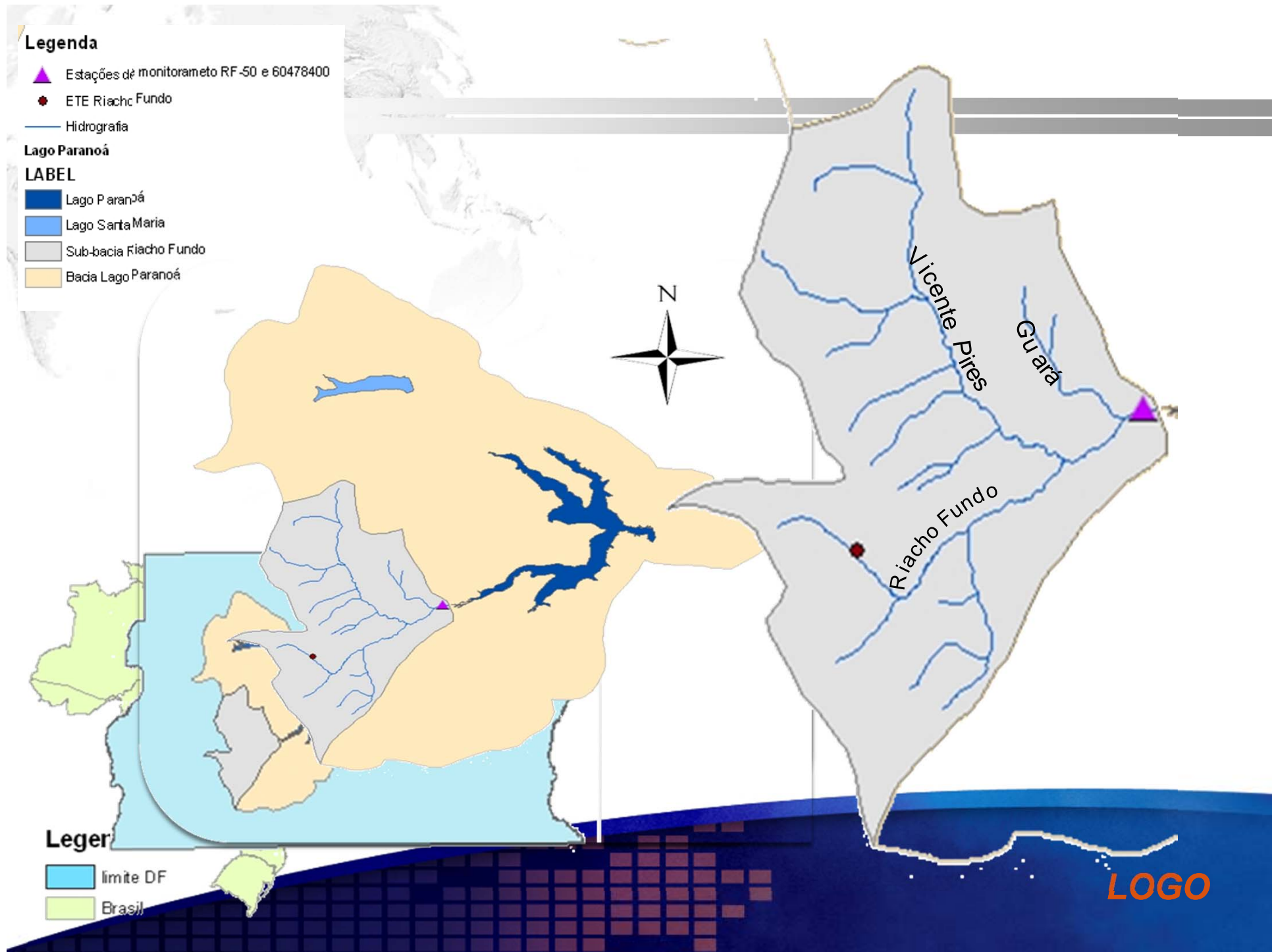
■ Sub-bacia Riacho Fundo

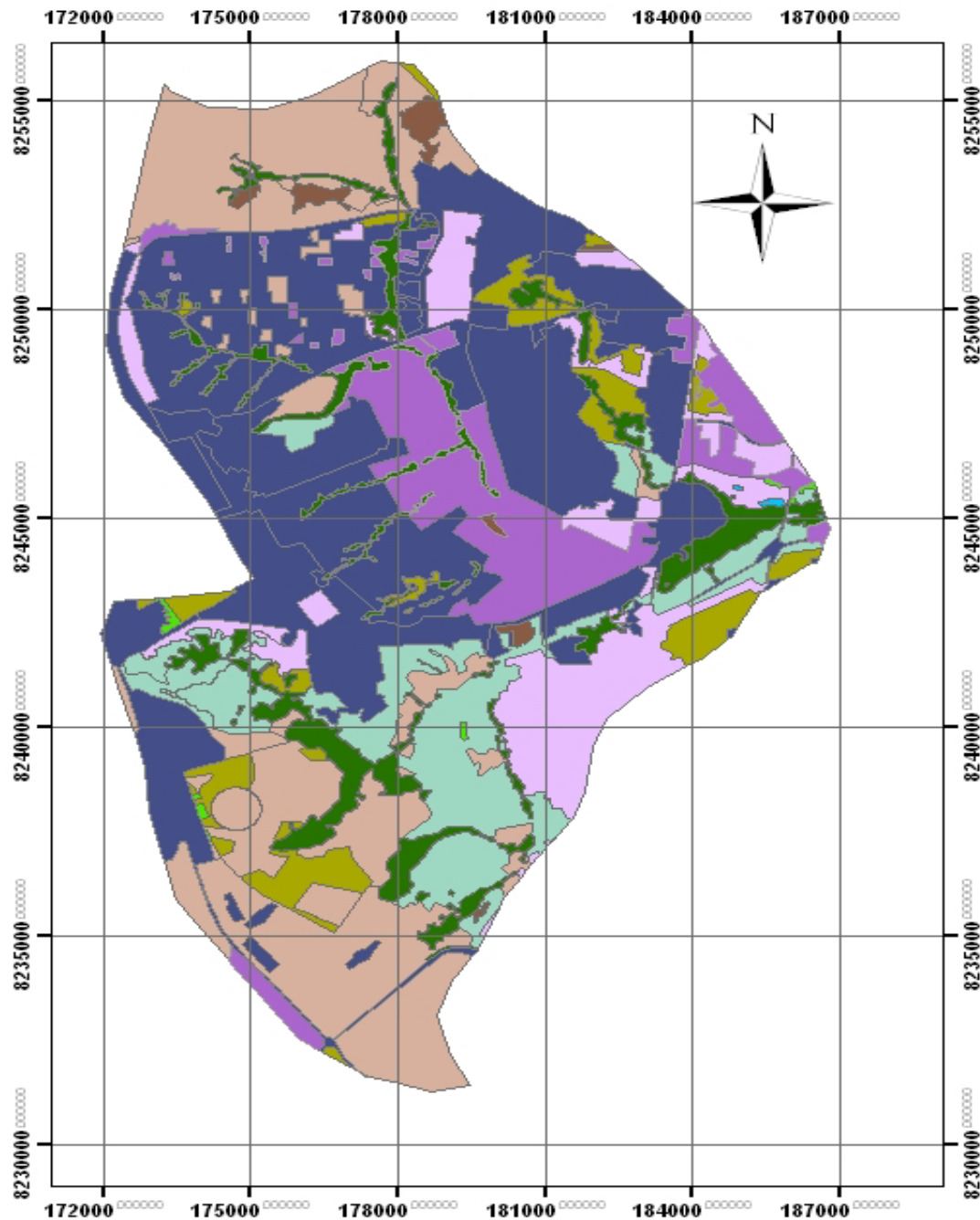
■ Bacia Lago Paranoá

Leger

■ limite DF

■ Brasil





Universidade de Brasília

Legenda

Uso de solo Riacho Fundo

-  Agricultura
-  Campo
-  Cerrado
-  Corpos d'água
-  Mata de Galeria
-  Reflorestamento
-  Solo exposto
-  Área urbana 1
-  Área urbana 2
-  Área urbana 3



Escala: 1:150,000

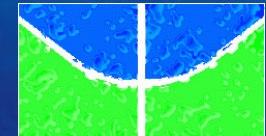
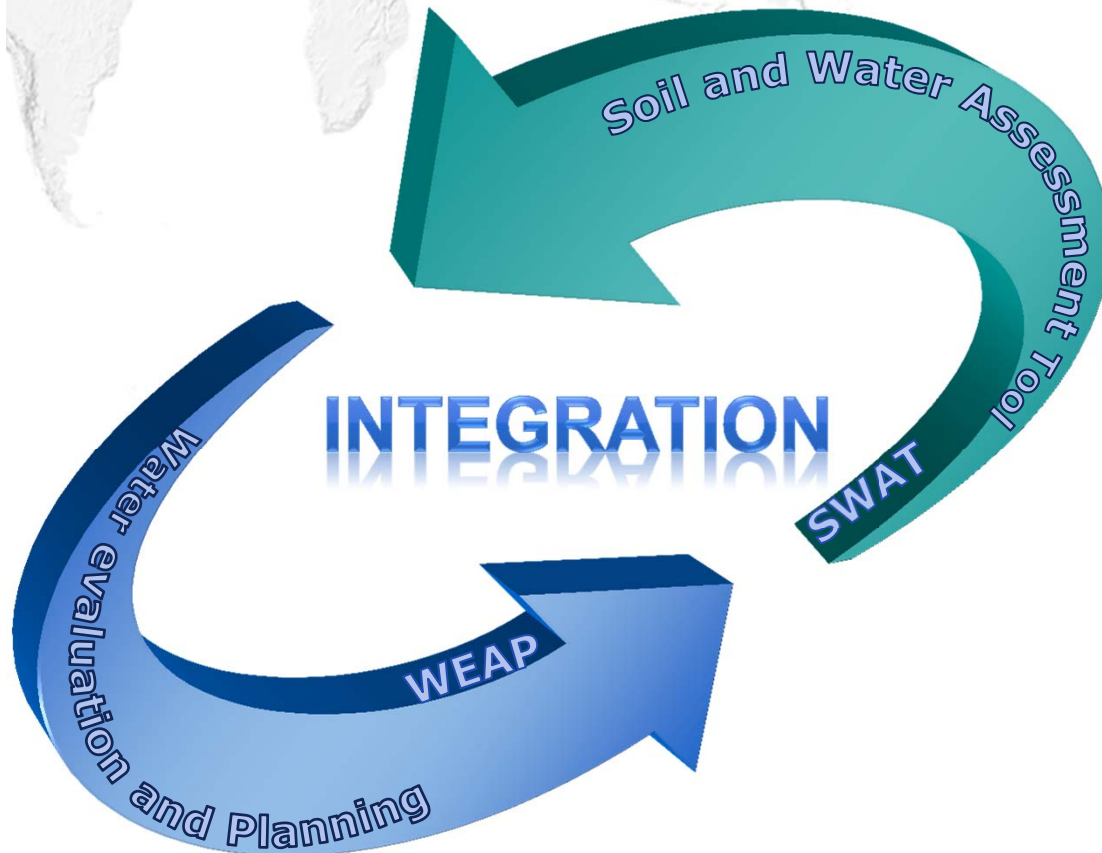
Sistema de Coordenadas: UTM
 Datum: Sirgas 2000
 Zone: 23 S
 Fonte: Menzes (2010)



Introduction

General objective

Assess the availability and quality of water in the Riacho Fundo sub-basin using the integration of SWAT and WEAP models to support the decision making, planning and management of water resources in the Federal District.





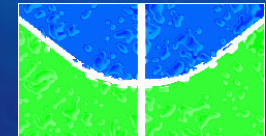
Objectives

Specific Objectives

To model hydrological processes and nutrient loads in watersheds with predominant use of urban land using the SWAT model.

To evaluate the use of WEAP as a decision support system to water resources management in the DF

To integrate SWAT and WEAP models for the simulation of water quantity and quality scenarios in the Riacho Fundo watershed.



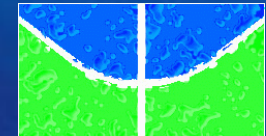


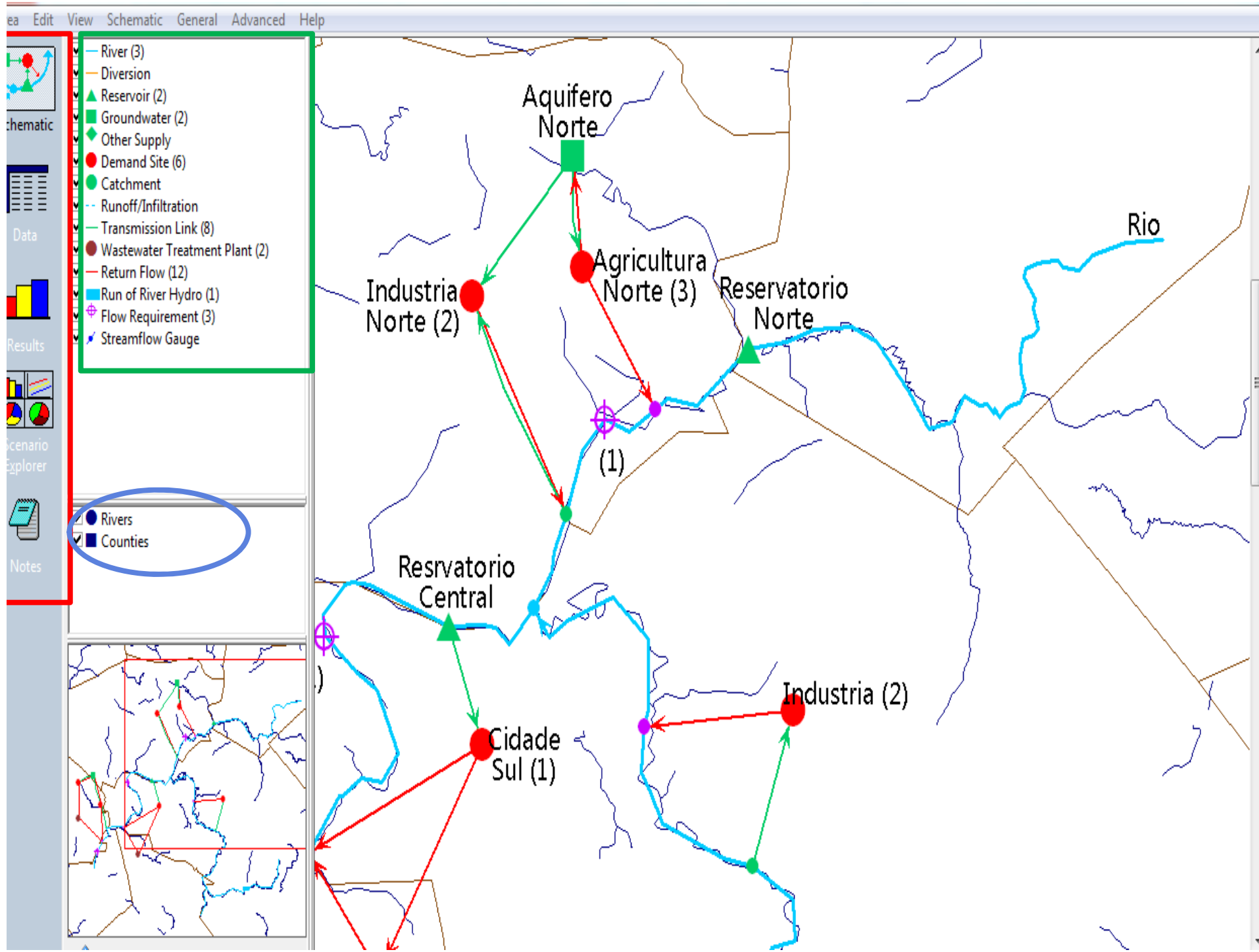
Objectives

Generate information related to the availability and quality of water in the study area from different scenarios based on land use changes, demand increase and different water treatment efficiencies of the Riacho Fundo WWTP

Specific Objectives

.....●
Evaluate the contaminant loads from Riacho Fundo basin into the Paranoá lake.







Simulation

Tool for IWRM.
Use node and link
network to represent
the WR system

Demand priorities
and
Water availability

Analysis

Future scenarios:

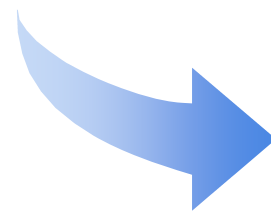
Availability
Quality
Demands
Others



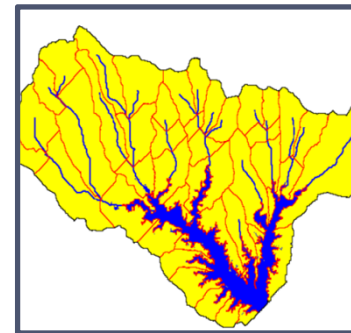
Allows the modeling of physical processes associated with the movement of water, sediment, vegetation growth cycle, nutrients, etc..

information:

climatic conditions;
soil properties;
topography, vegetation;
conditions and management practices in the basin (Neitsch, et al., 2002).



HRU

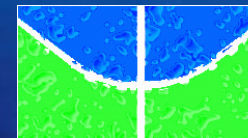




Methodology

Methodology

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Methodology



Point Pollution

NPS Pollution

Hydrology



Manual Calibration

SWAT results

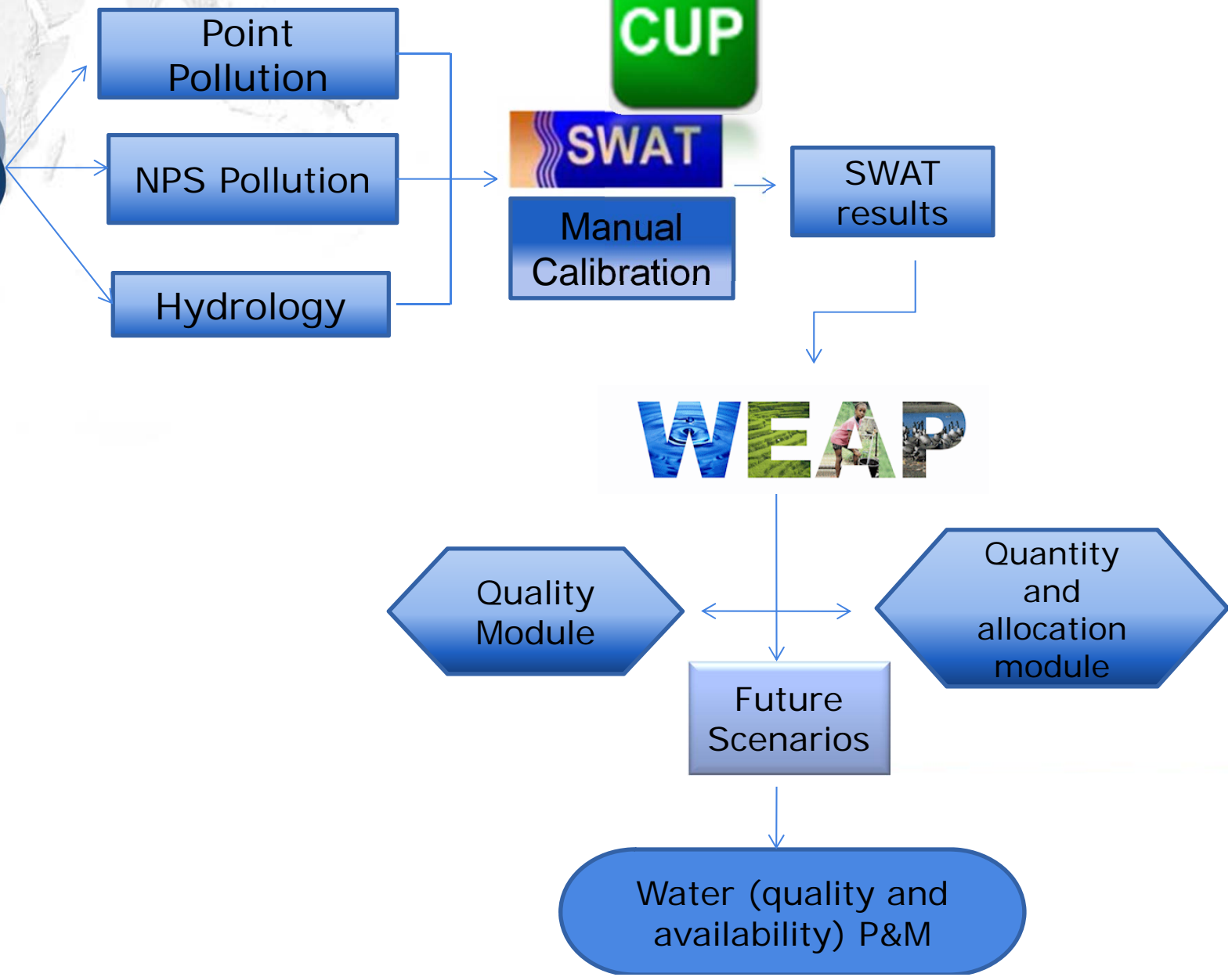


Quality Module

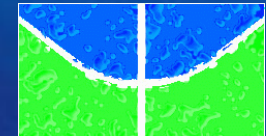
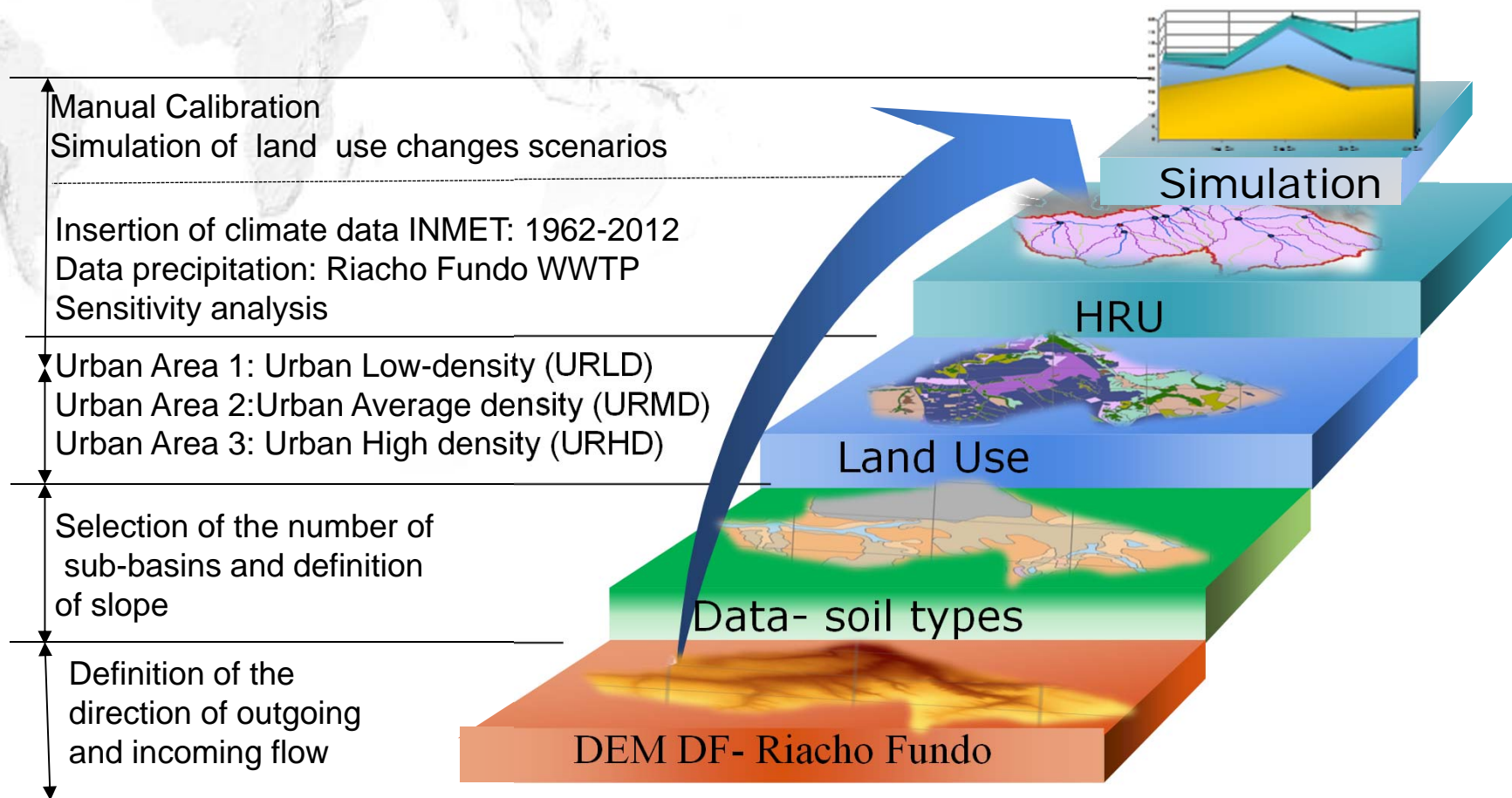
Quantity and allocation module

Future Scenarios

Water (quality and availability) P&M



Obtenção e processamento de dados para o SWAT





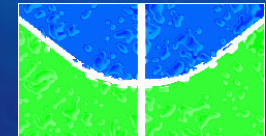
Scenarios SWAT



- Scenario 1: change of use of agricultural land to urban land uses of high urban density.



- Scenario 2: change of uses of urban low-density land for urban high density land.



Integration of SWAT and WEAP



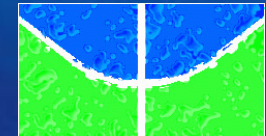
Current Account: represents the current conditions of Hydric system.

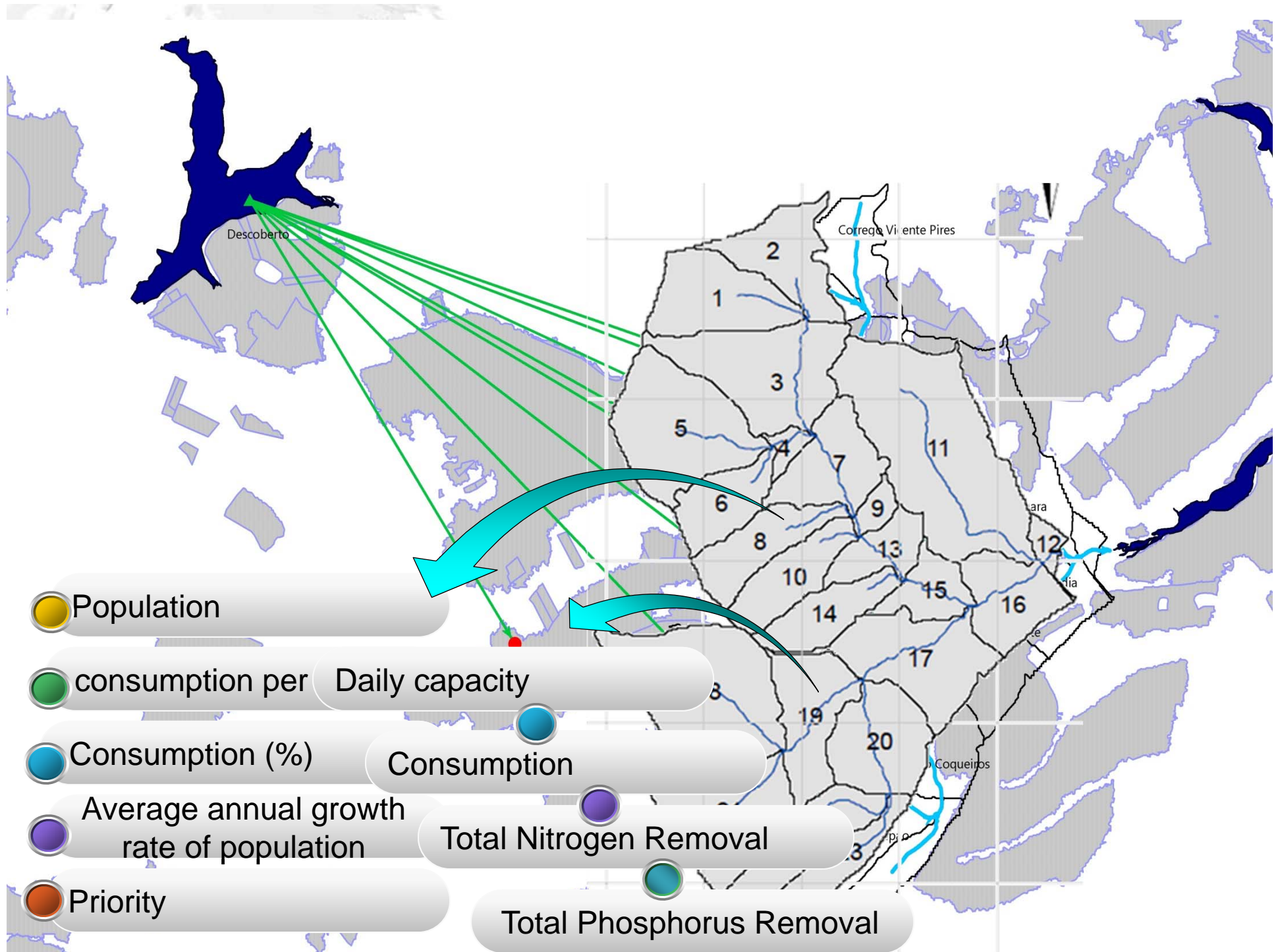


- Reference Scenario: inherits the characteristics of the current scenario and has similar evolutions the current system without intervention.



- Future scenarios: They are created to answer the question "what if?". The Reference Scenario is altered





SCENARIOS – Water Quantity Analysis

Future Scenarios

Scenario 1
weap

Scenario 2
weap

- Increase in the rate of population growth of 4.6% for the localities of Vicente Pires and Riacho Fundo II
- Increase in the rate of population growth of 4.6% for the localities of Águas Claras, Núcleo Bandeirante e Candangolândia.

Scenarios – Water Quality Analysis

Changes

Scenario 1
weap

- River flow and quality

Scenario 2
weap

- River flow and quality

Efficiency of
WWTP
Without WWTP

- 20% increase in Total Nitrogen removal- Riacho Fundo WWTP

Data used from SWAT

- River flow and quality of Scenario 1 of SWAT.
- River flow and quality of Scenario 2 of SWAT.
- Streamflow values and quality introduced in the Reference Scenario, Scenario 1 and 2.

SCENÁRIOS – Water Quality Scenarios

SCENARIO
1 weap

SCENARIO
2 weap

Efficiency of
WWTP
Without WWTP

Assessment

**Lamparelli, 2003:
Limits: Trophic
Classification (SP)
CONAMA 357/05:**

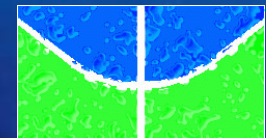


RESULTS

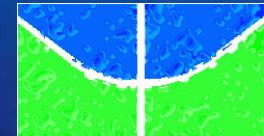
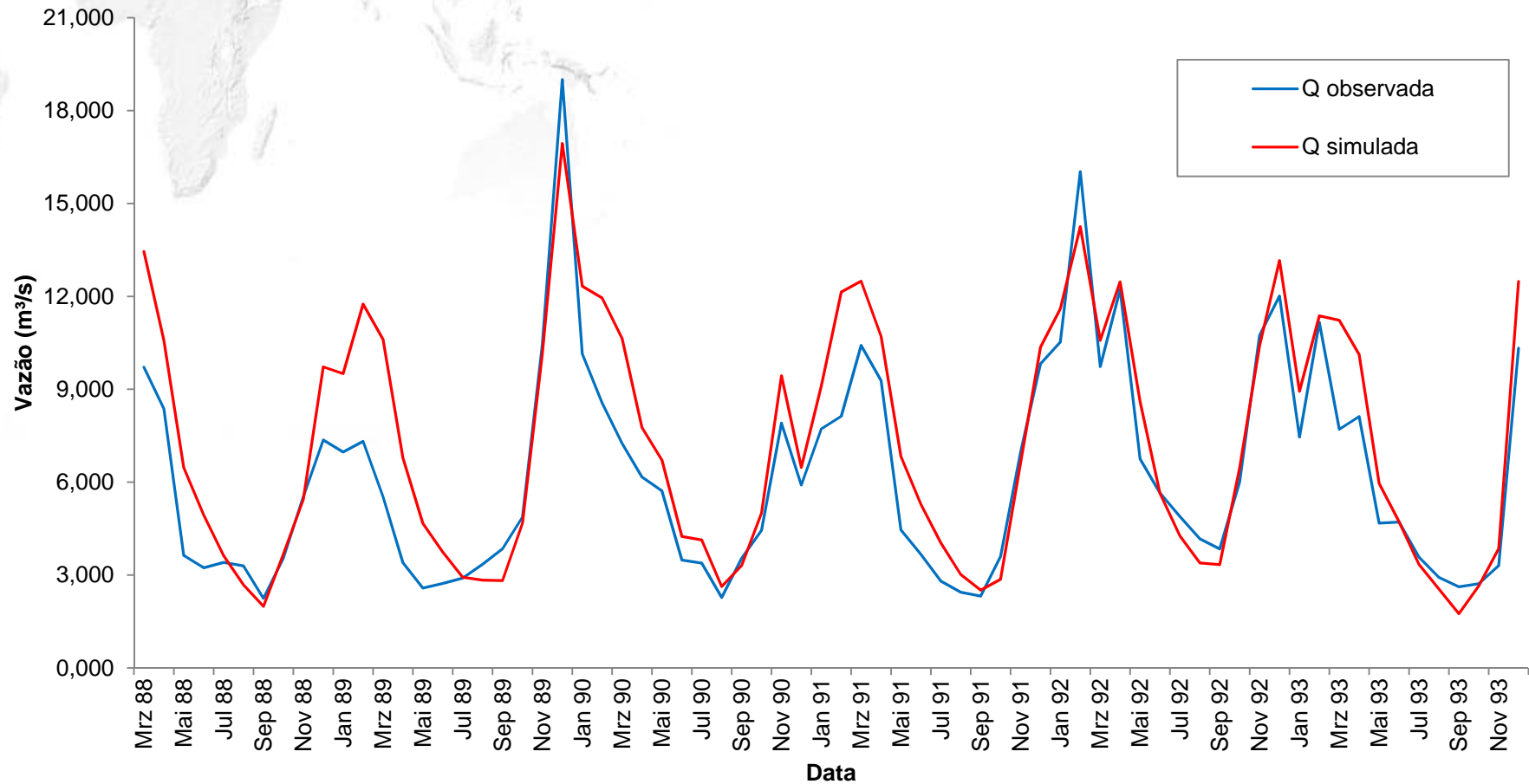
SIMULATION AND CALIBRATION WITH SWAT



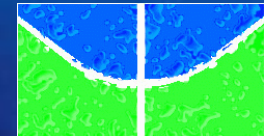
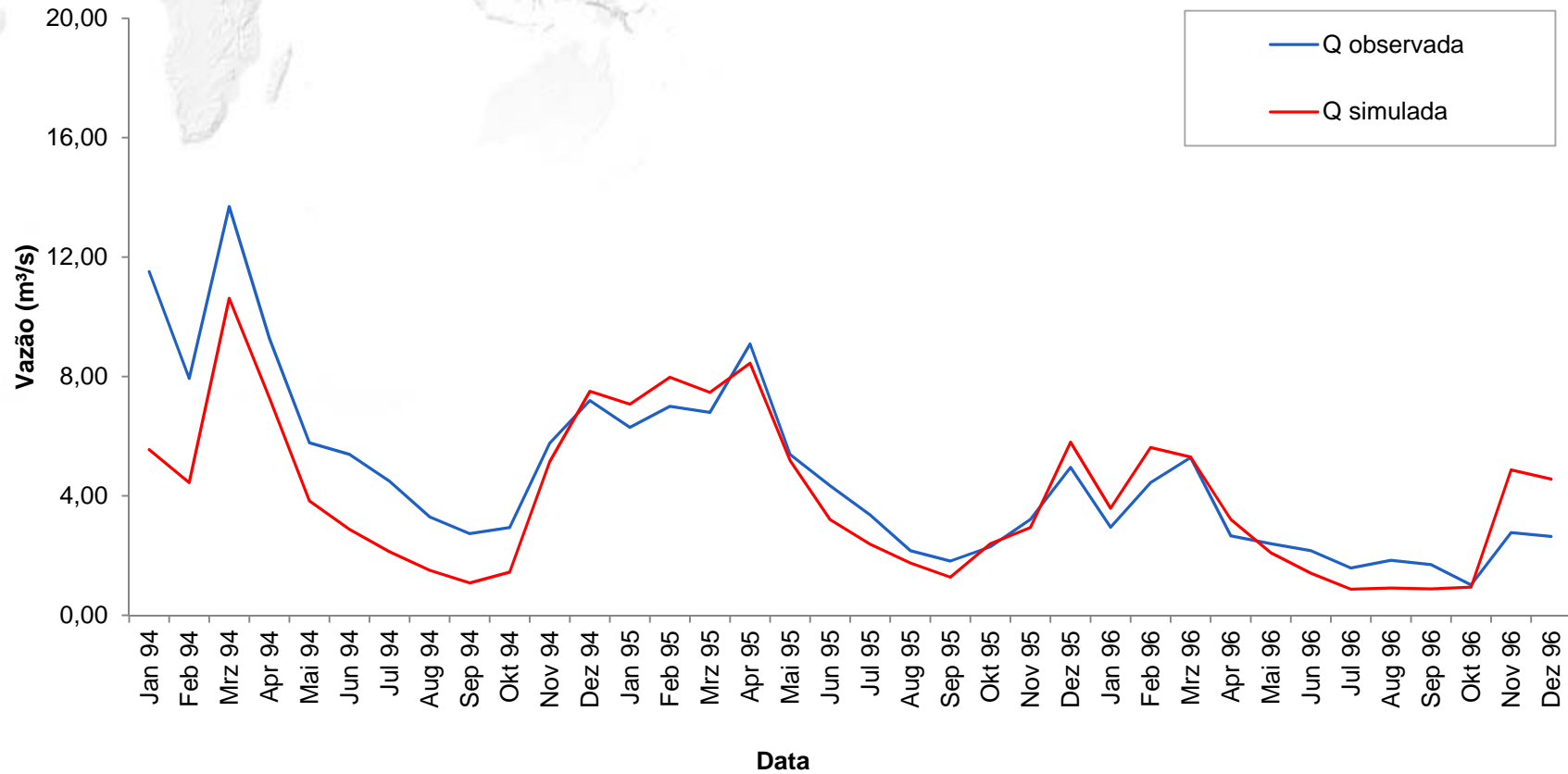
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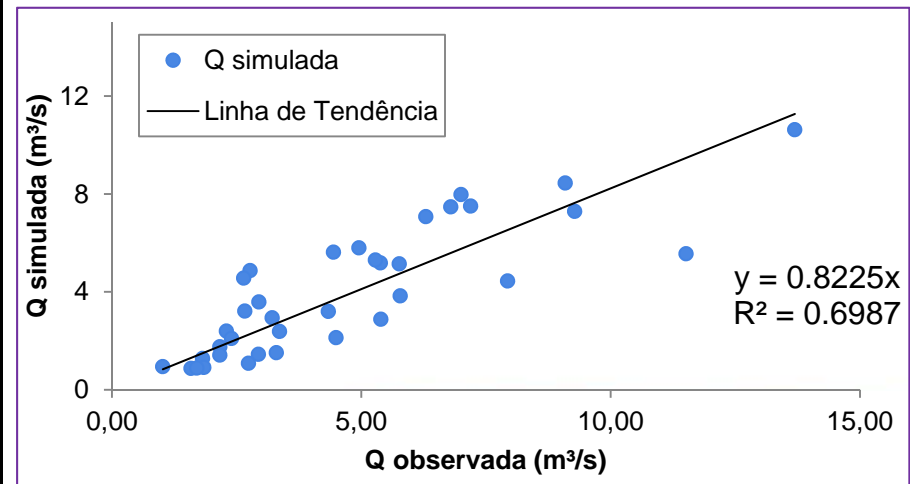
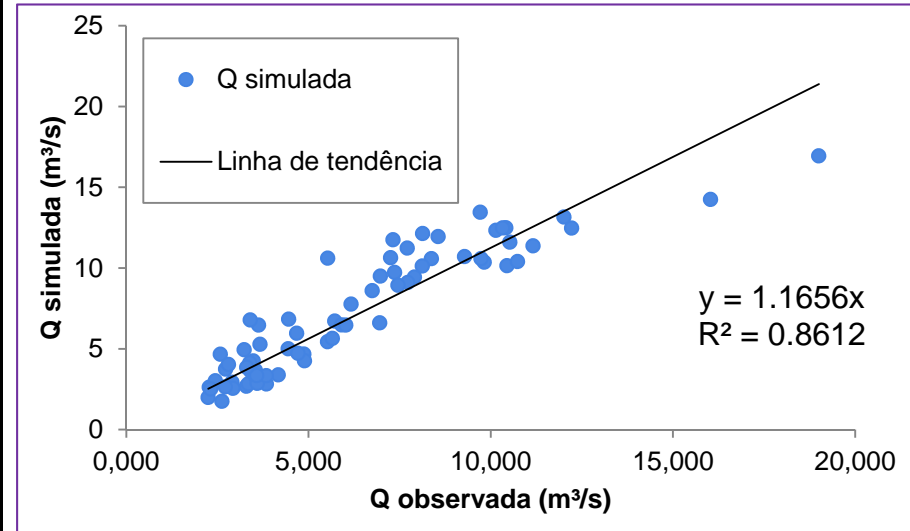
Best streamflow calibration (1988-1993)



Validation (1994-1996)

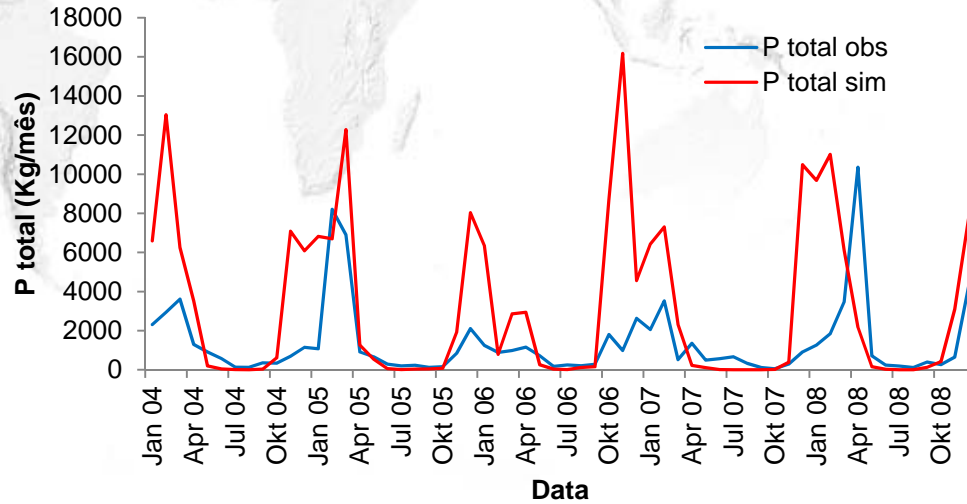


Stage	Statistics	Value	Classification Moriasi <i>et al.</i> , 2007
Calibration 1988-1993	NSE	0.73	Good
	PBIAS %	-15.63	Satisfactory
	RSR	0.51	Good
Validation 1994-1996	NSE	0.615	Satisfactory
	PBIAS %	14.48	Good
	RSR	0.62	Satisfactory

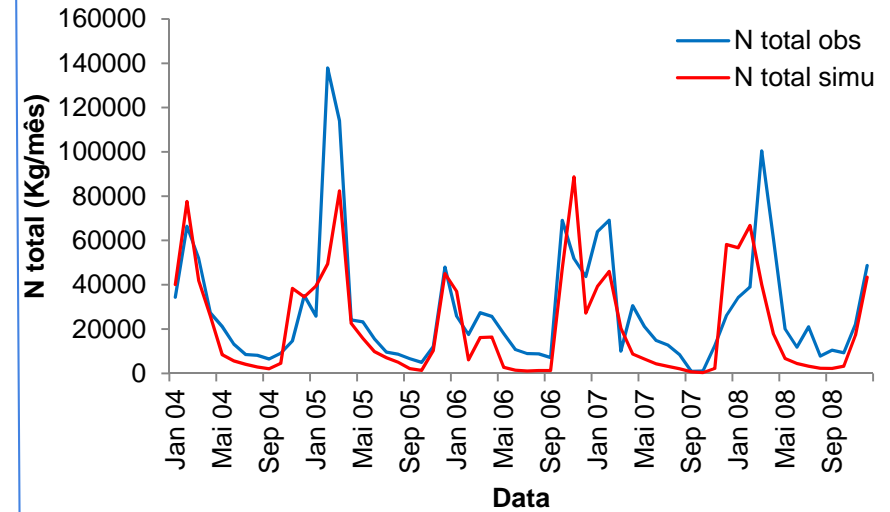


Best Calibration of Total Phosphorus and Total Nitrogen

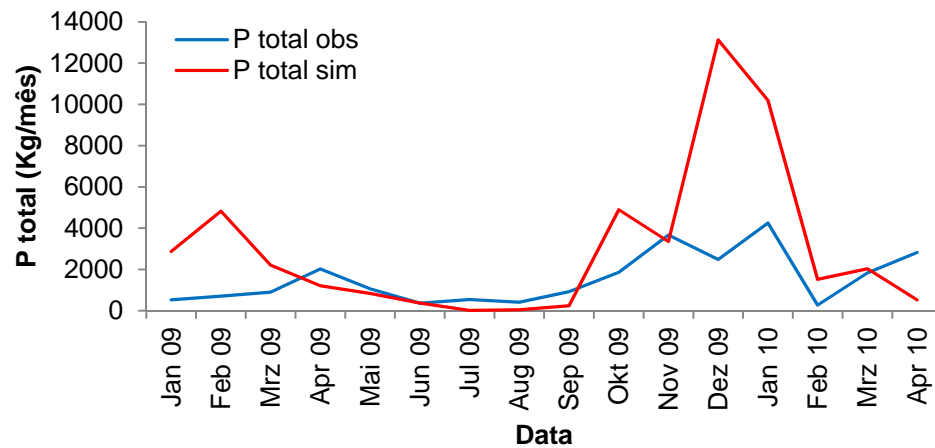
Calibration PT:



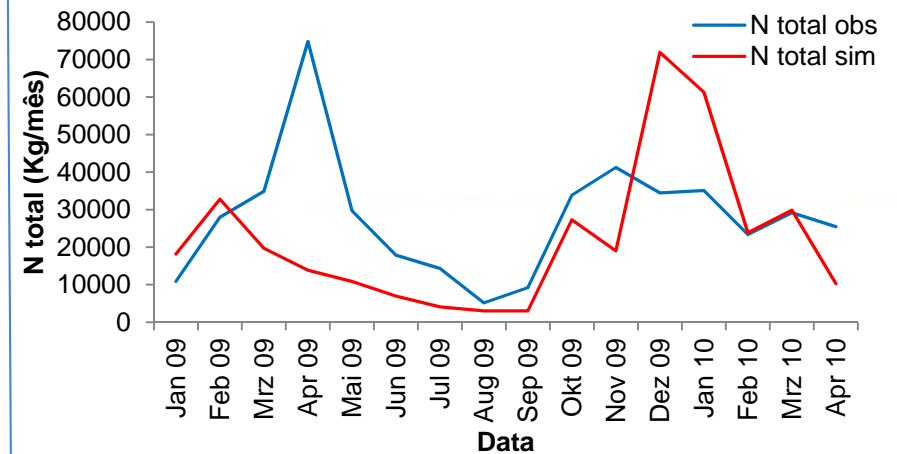
Calibration NT:



Validation PT:

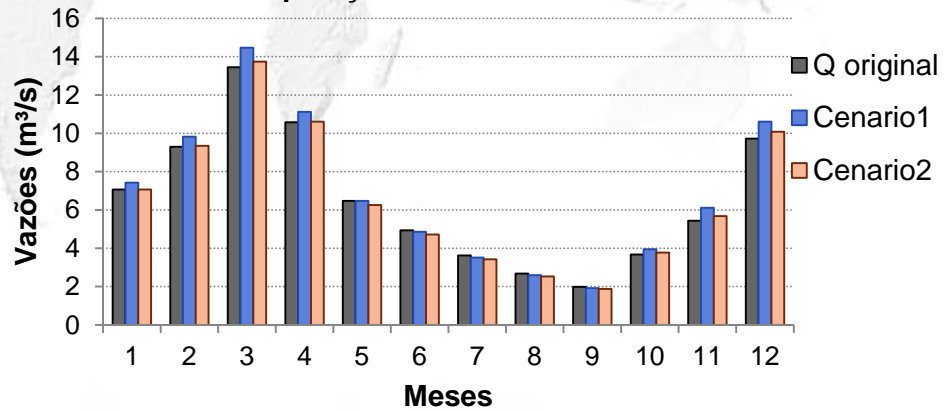


Validation NT:

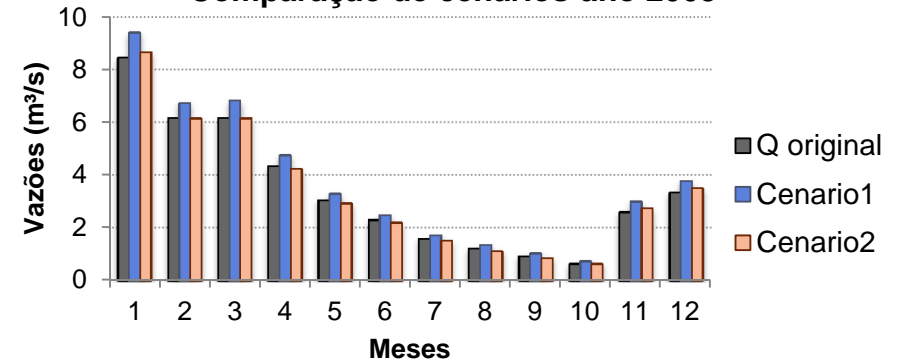


Scenários SWAT

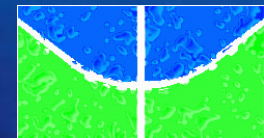
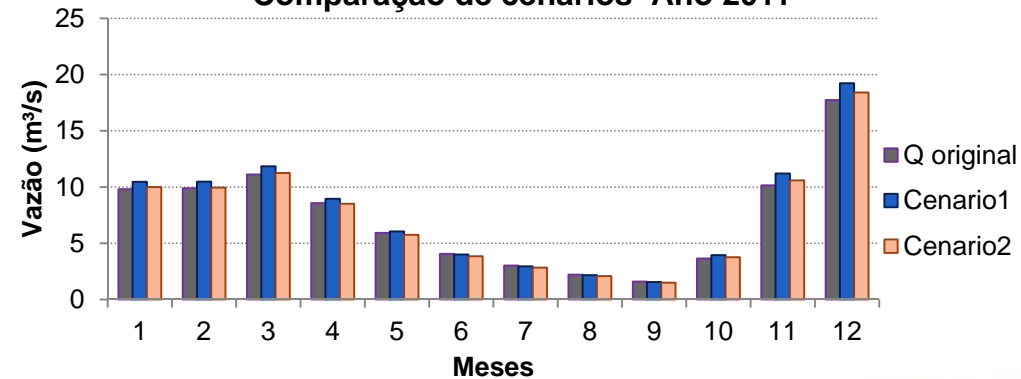
Comparação de cenários -ano 1988



Comparação de cenários-ano 2003

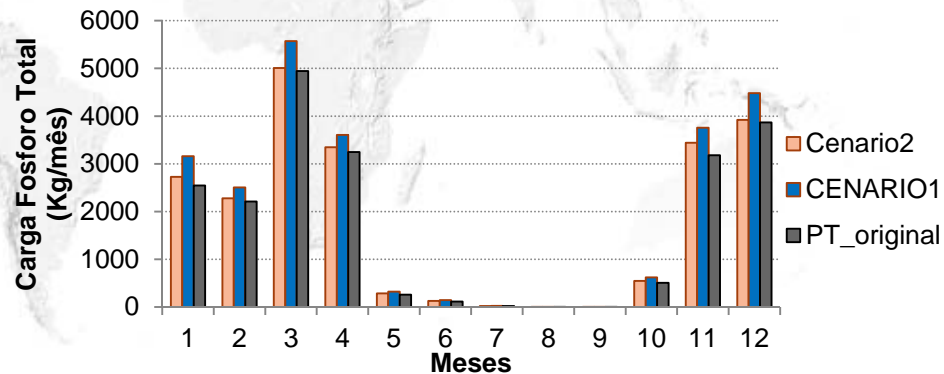


Comparação de cenários- Ano 2011

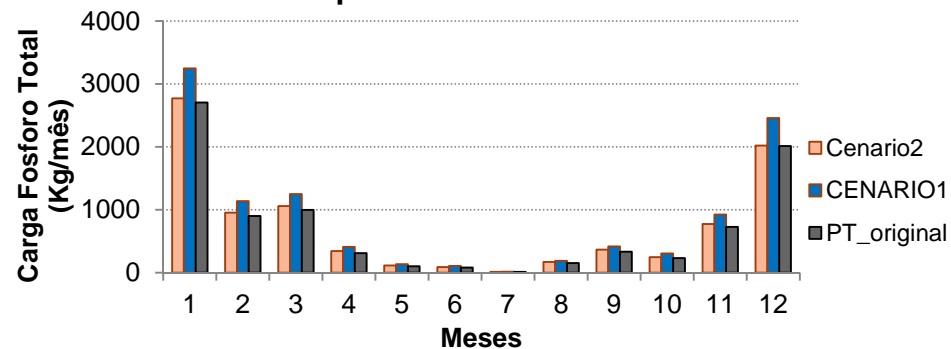


Scenários SWAT

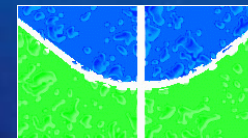
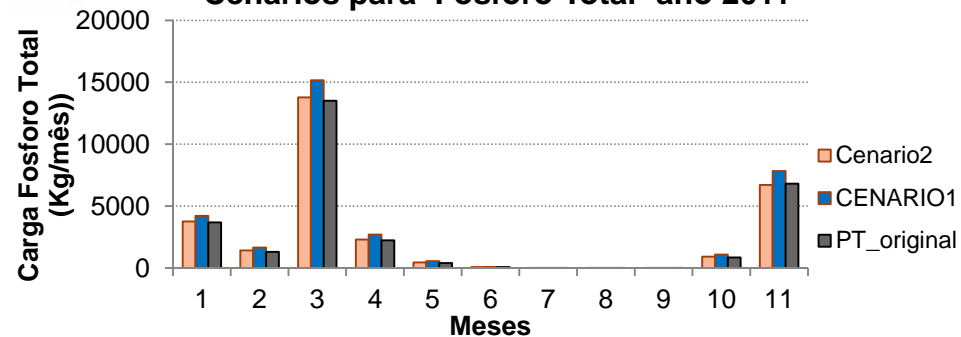
Cenários para Fósforo Total-ano 1988



Cenários para Fósforo Total-ano 2003

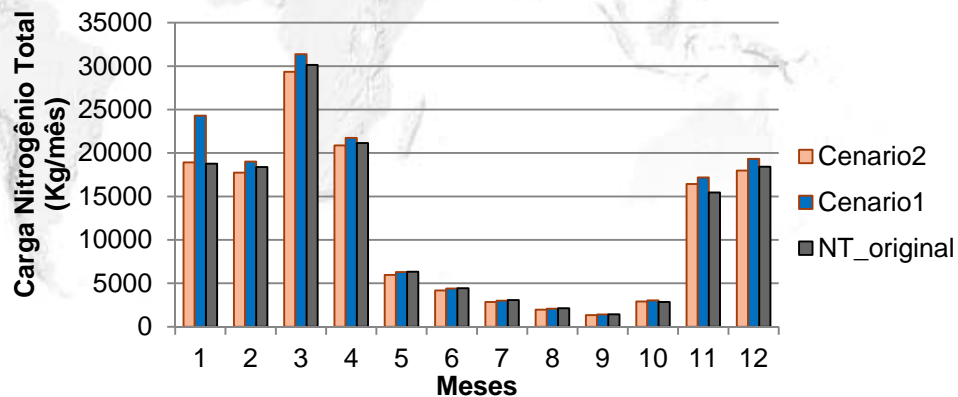


Cenários para Fósforo Total- ano 2011

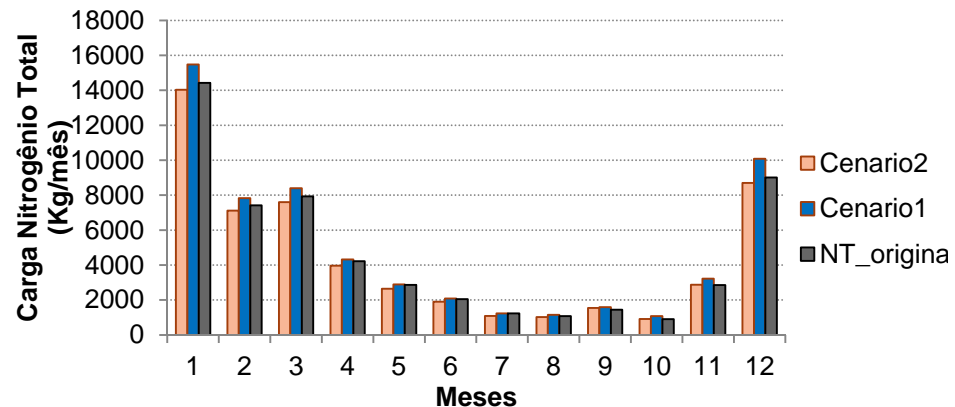


Scenários SWAT

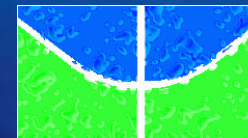
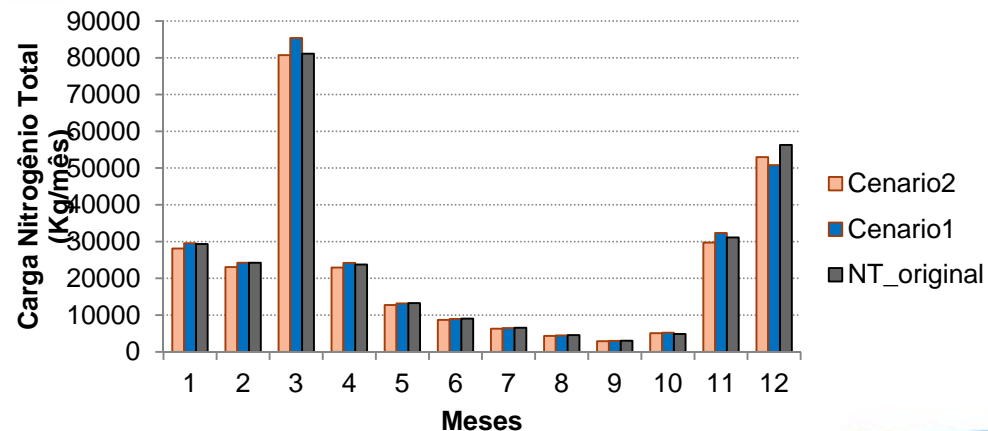
Cenários para Nitrogênio Total-ano 1988



Cenários para Nitrogênio Total-ano 2003




Cenários para Nitrogênio Total-ano 2011



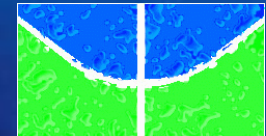


Results

Integration of SWAT and WEAP models



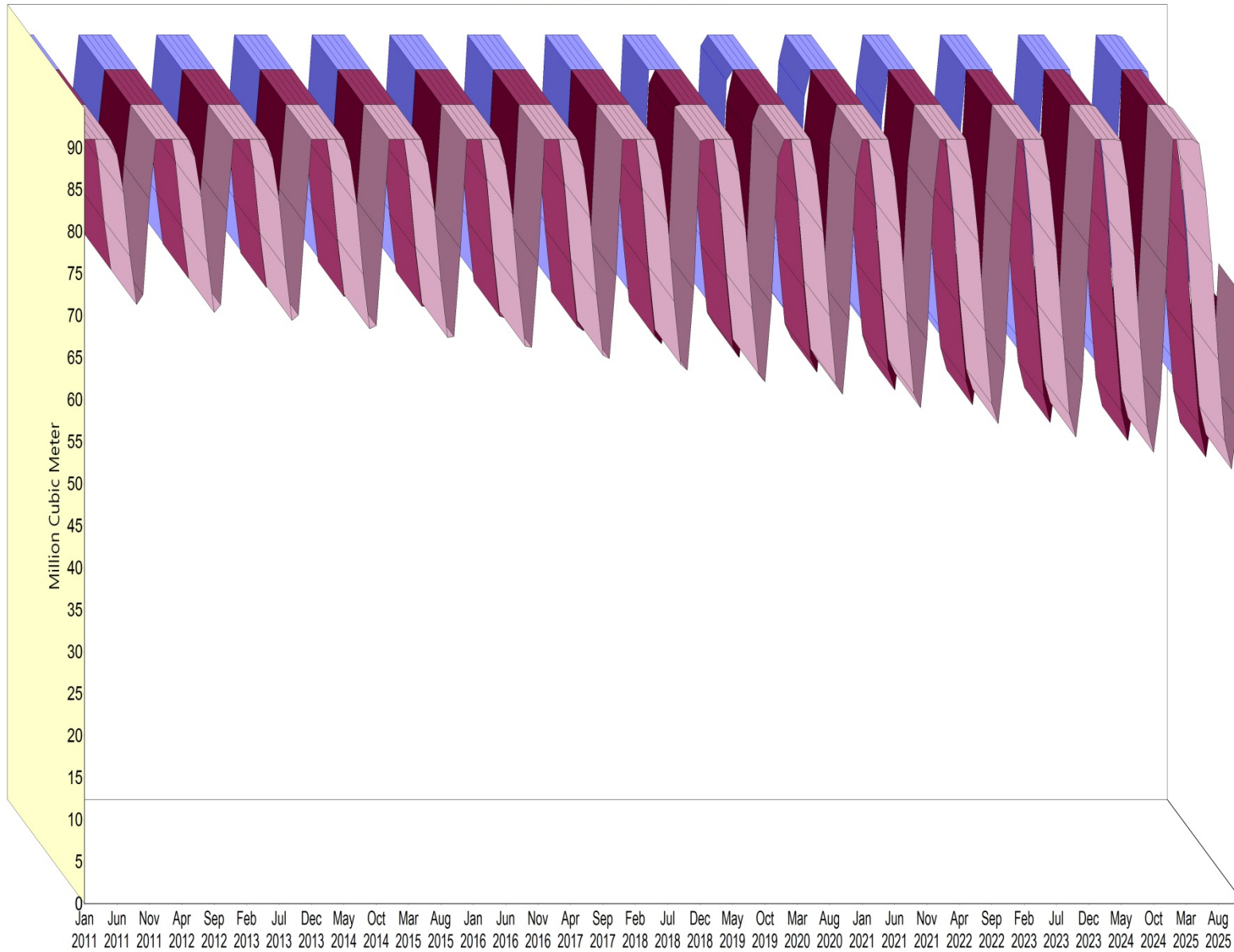
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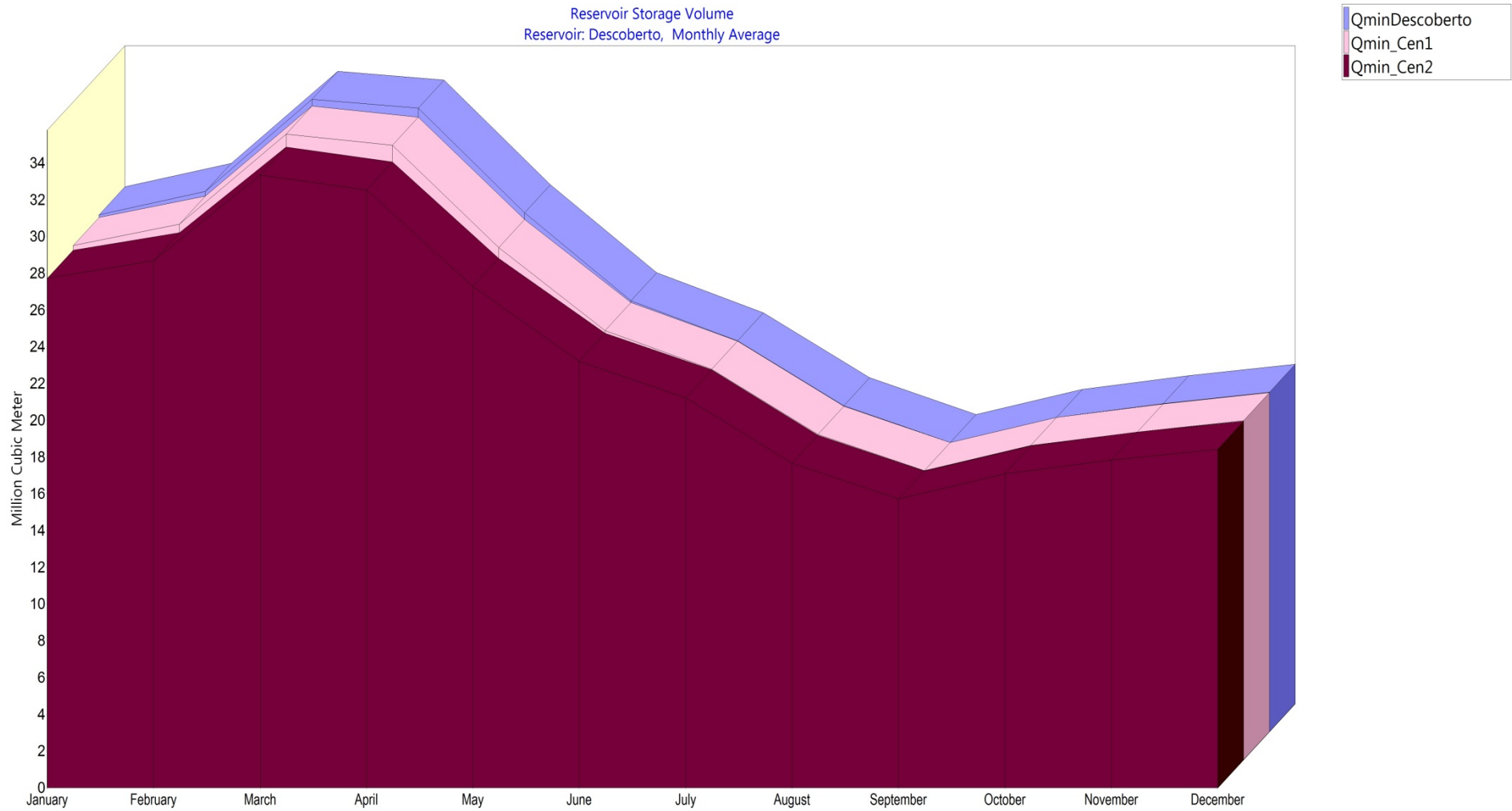
Storage Lake Descoberto

Reservoir Storage Volume
Reservoir: Descoberto, All months (12)

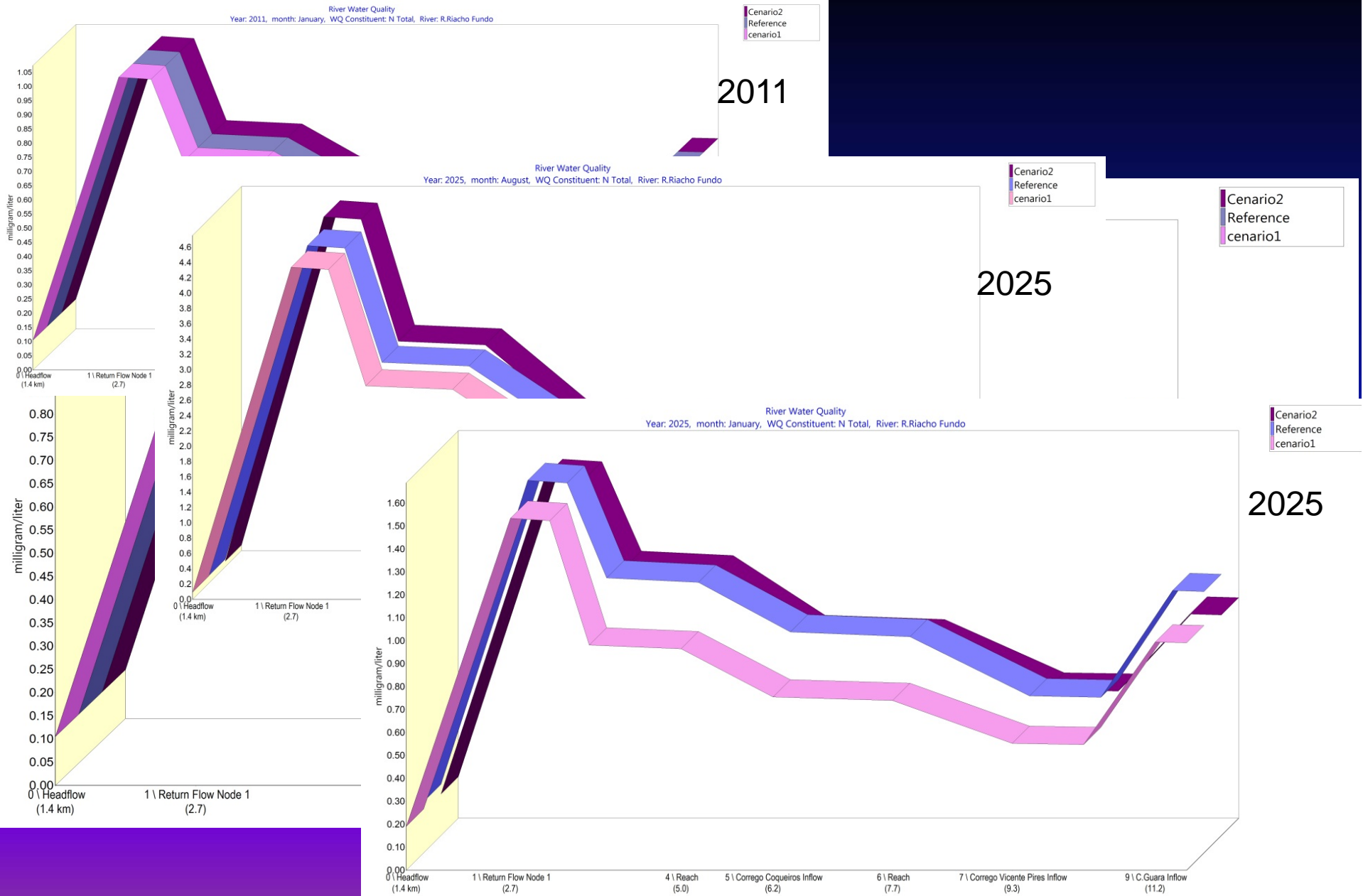
- Cenário de Referência
- Cenário 2
- Cenário1



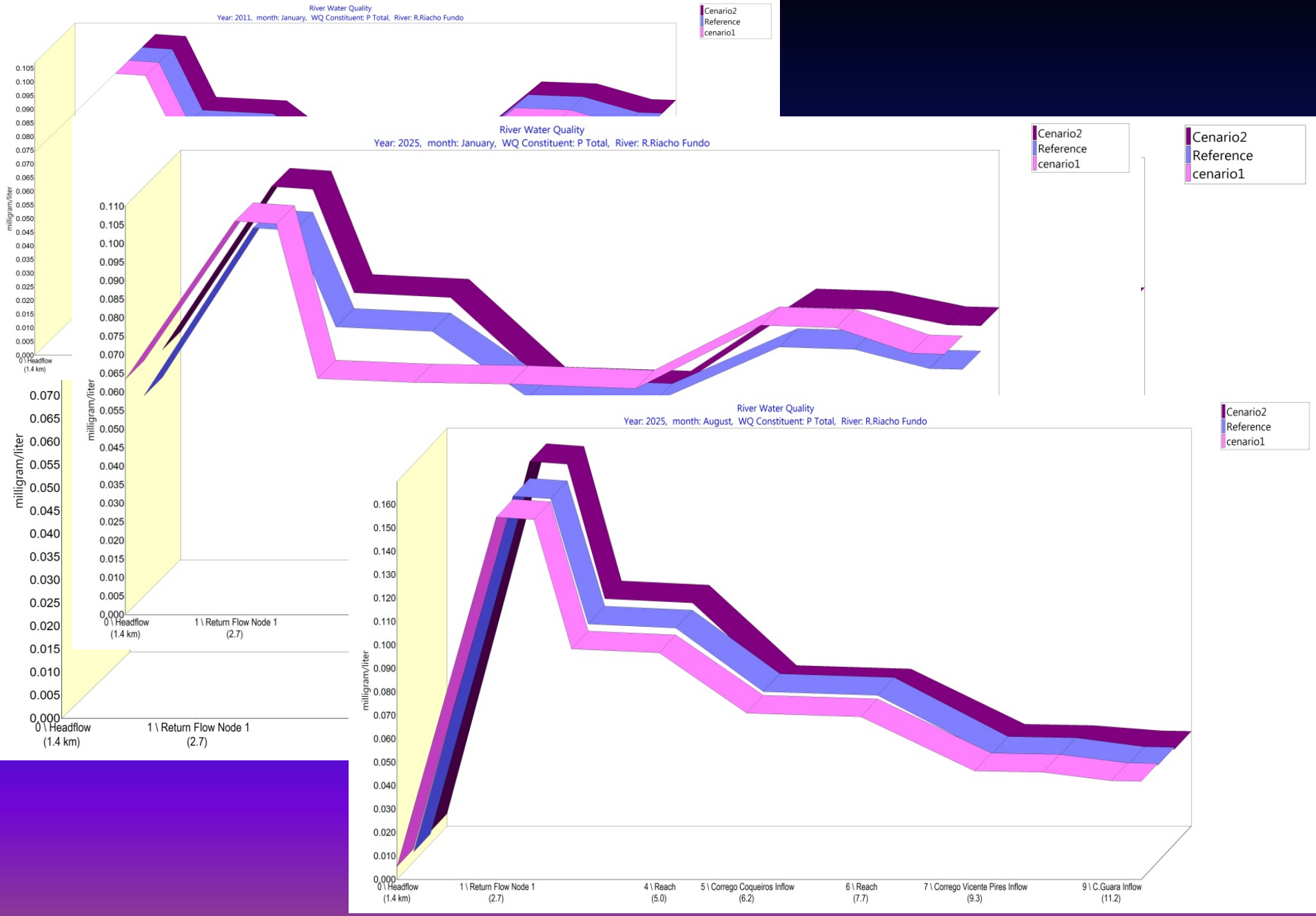
Storage Descoberto Lake - monthly average



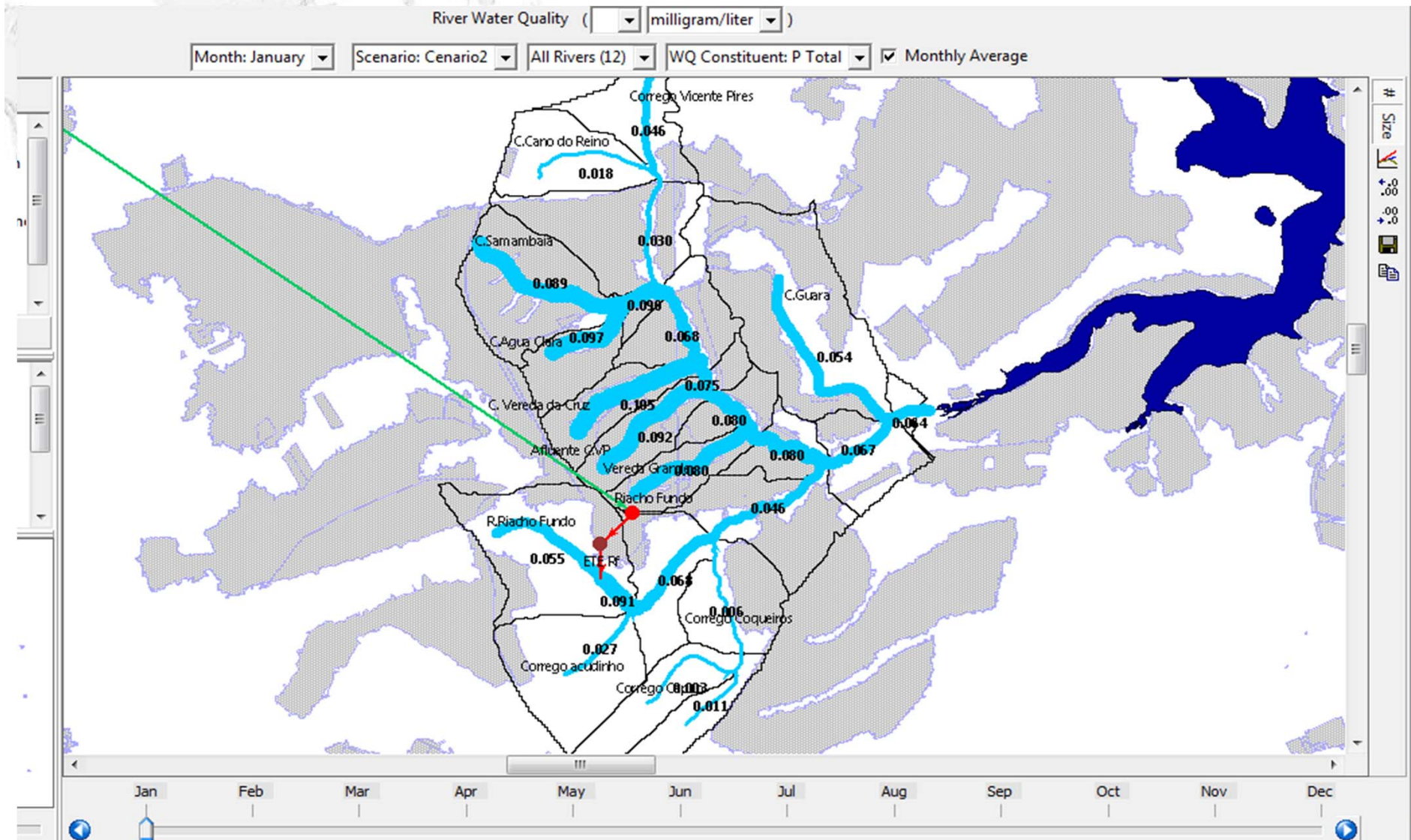
Behavior of NT , river Riacho Fundo



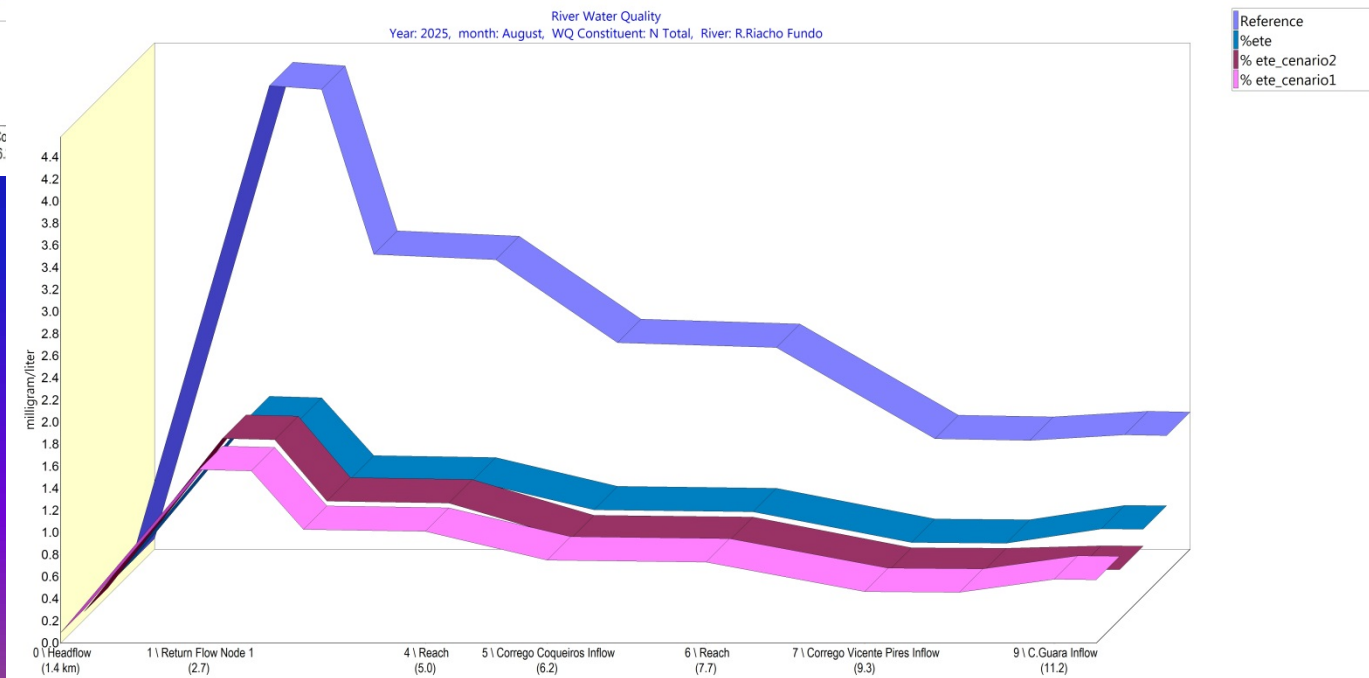
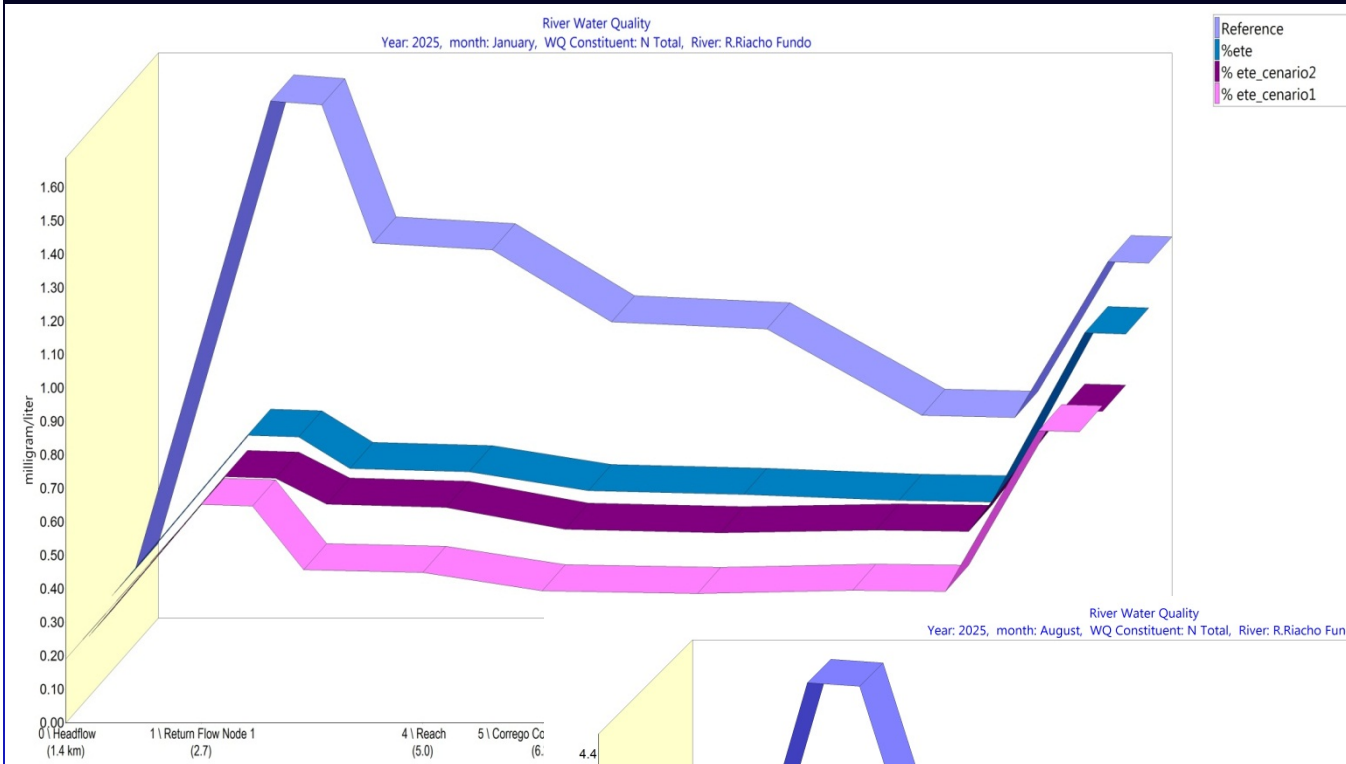
Behavior of the PT in the river Riacho Fundo



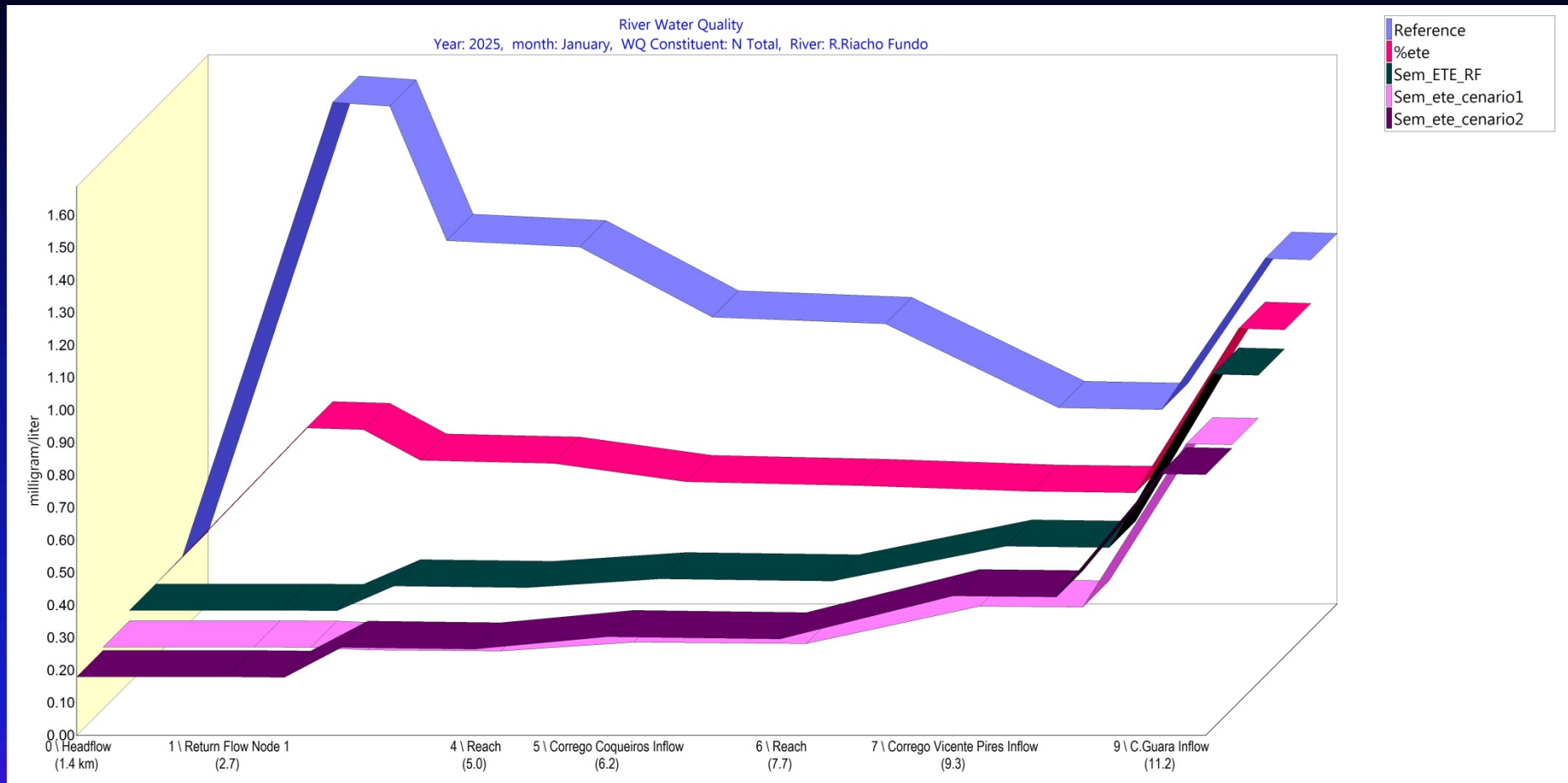
Nutrient	Maximum value Node WWTP (mg/L)	Value in the outlet basin	Scenario
NT	6.68	1.68	2
PT	0.23	0.12	2



Behavior of NT, Scenario changes in the efficiency of WWTP Riacho Fundo

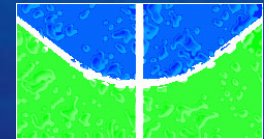


Behavior of NT , Scenario Without WWTP Riacho Fundo



Conclusions

The integration of SWAT and WEAP provides good results in the case of simulation of water quality. Since the WEAP can not simulate diffuse pollution, SWAT is a very useful model that provides this kind of results in a detailed way, and it consider all the features of the basin as land use, management, soil type, among others.

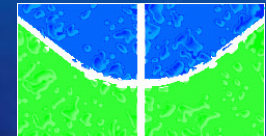


Conclusions

Integration of models depends on the level of detail of the study

SWAT provides very detailed simulations of hydrology and quality

The integration SWAT-WEAP needs a defined approach to establish a link between changes in land use in SWAT and the rate of population growth in the demand nodes in WEAP

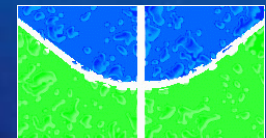


Conclusions

The WWTP node (WEAP) showed the highest concentrations especially for the Nitrogen, but the contribution of the tributaries helped on the reduction of the concentrations along the Riacho Fundo River.

The presence of phosphorus was mainly affected by the sediment loads from the watershed. The final concentration at the outlet of the basin approached the regulated limit defined by the CONAMA Resolution 357/05, showing the vulnerability of the lake.

The NT and PT values in sub-basin outlet classified the water source as meso-eutrophic, representing intermediate levels of productivity

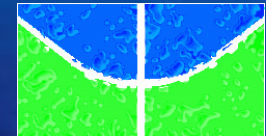




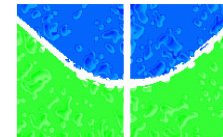
Conclusions

The scenario without release of treated sewage from the WWTP Riacho Fundo, showed good results in improving the quality of the river

The scenario increasing the NT removal efficiency of the WWTP Riacho Fundo reported significant improvement in the water quality of the River Riacho Fundo



Acknowledgements



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Thank You



Best Calibration of Total Phosphorus

Add your company slogan

Stage	Statistics	Value	Classification (Moriasi et al. , 2007)
Calibração 2004-2008	NSE	-3.43	unsatisfactory
	PBIAS %	-133.8	unsatisfactory
	RSR	2.10	unsatisfactory
Verificação 2009-2010	NSE	-7.31	unsatisfactory
	PBIAS %	-95.88	unsatisfactory
	RSR	2.88	unsatisfactory

- Low efficiency in the simulation
- Overestimation of simulated loads
- High dispersion of data.

Best Calibration of Total Nitrogen

Stage	Statistics	Value	Classification (Moriasi et al. , 2007)
Calibração 2004-2008	NSE	0.45	unsatisfactory
	PBIAS %	24.70	Very Good
	RSR	0.73	unsatisfactory
Verificação 2009-2010	NSE	-0.85	unsatisfactory
	PBIAS %	20.47	Very Good
	RSR	1.36	unsatisfactory

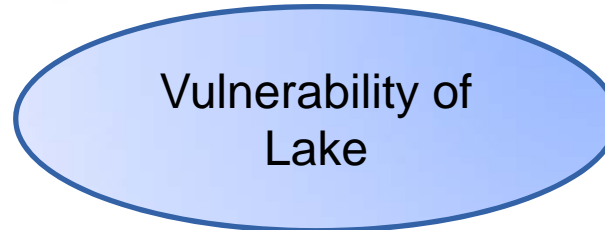
- Low efficiency in the simulation
- Underestimation of simulated loads
- High dispersion of data
- Better results than the PT.

Conclusions

Add your company slogan

Based on the results obtained from WEAP about Descoberto Lake, it was observed that the reservoir has the capacity to supply the towns that currently make use of this water.

Decreased storage



Important!! take care of water sources

