2014 International SWAT Conference & Workshops

EROSION PREDICTION USING SWAT MODEL IN CÓRREGO TIJUCO WATERSHED, SÃO PAULO STATE, BRAZIL

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Introduction

The erosion process in rural areas is concern to environmental quality due to agricultural inputs, which can be pollutants if not managed properly.

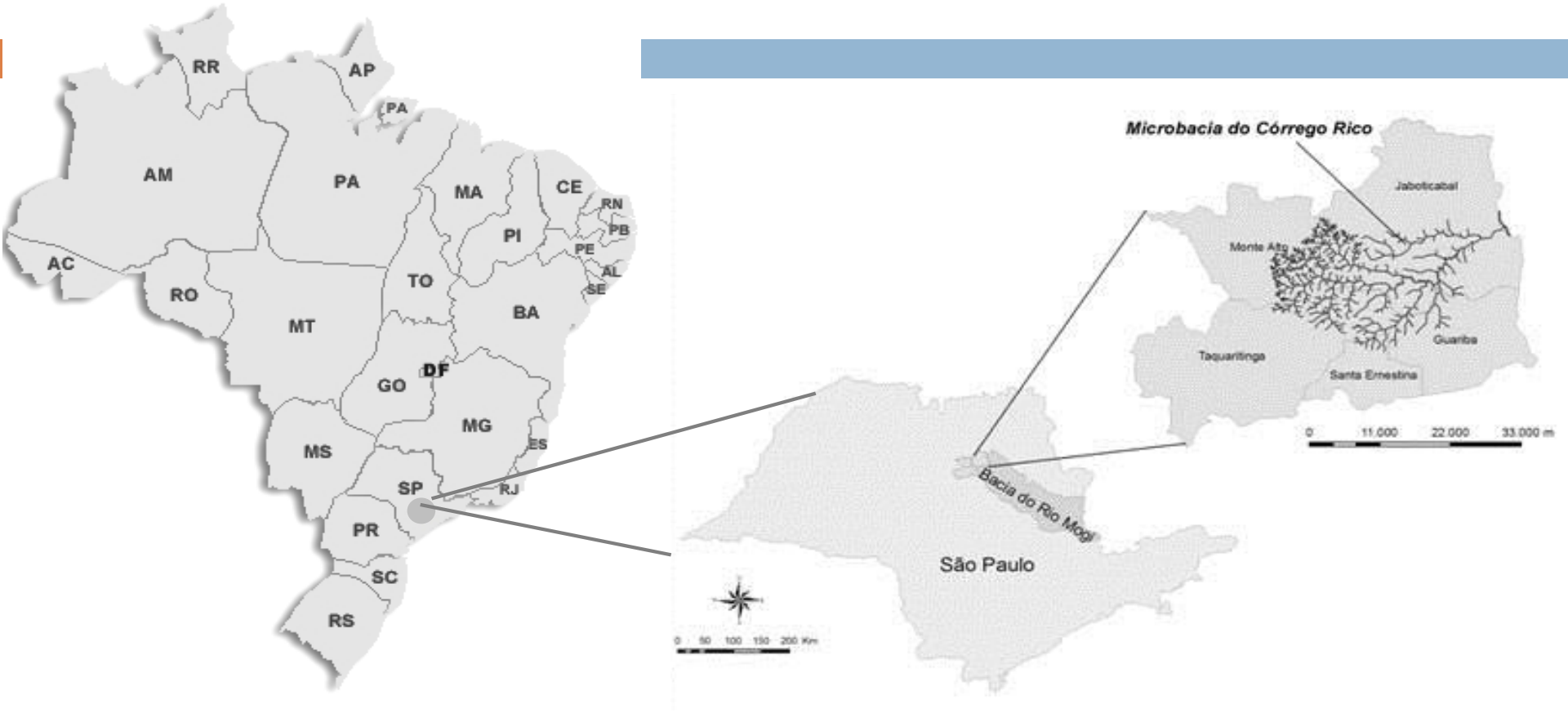
Objective

This study manly focuses to use the SWAT model to understand the erosion caused by rainfall and runoff in watershed within two soil units modeled with the Modified Universal Soil Loss Equation (MUSLE), (Williams, 1975), in Córrego Tijuco Watershed, São Paulo State, Brazil.

Material and Methods

Watershed Characterization

The Córrego Rico Watershed is located at Northeast of the State of São Paulo, Brazil (Figure 1), at the 9th unit of the Water Resource Management Units (UGRHIs) of the State Water Resource Management System and State Water Policy (SIGRH), called Pardo/Moji-Guaçu Rivers


RR
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MT
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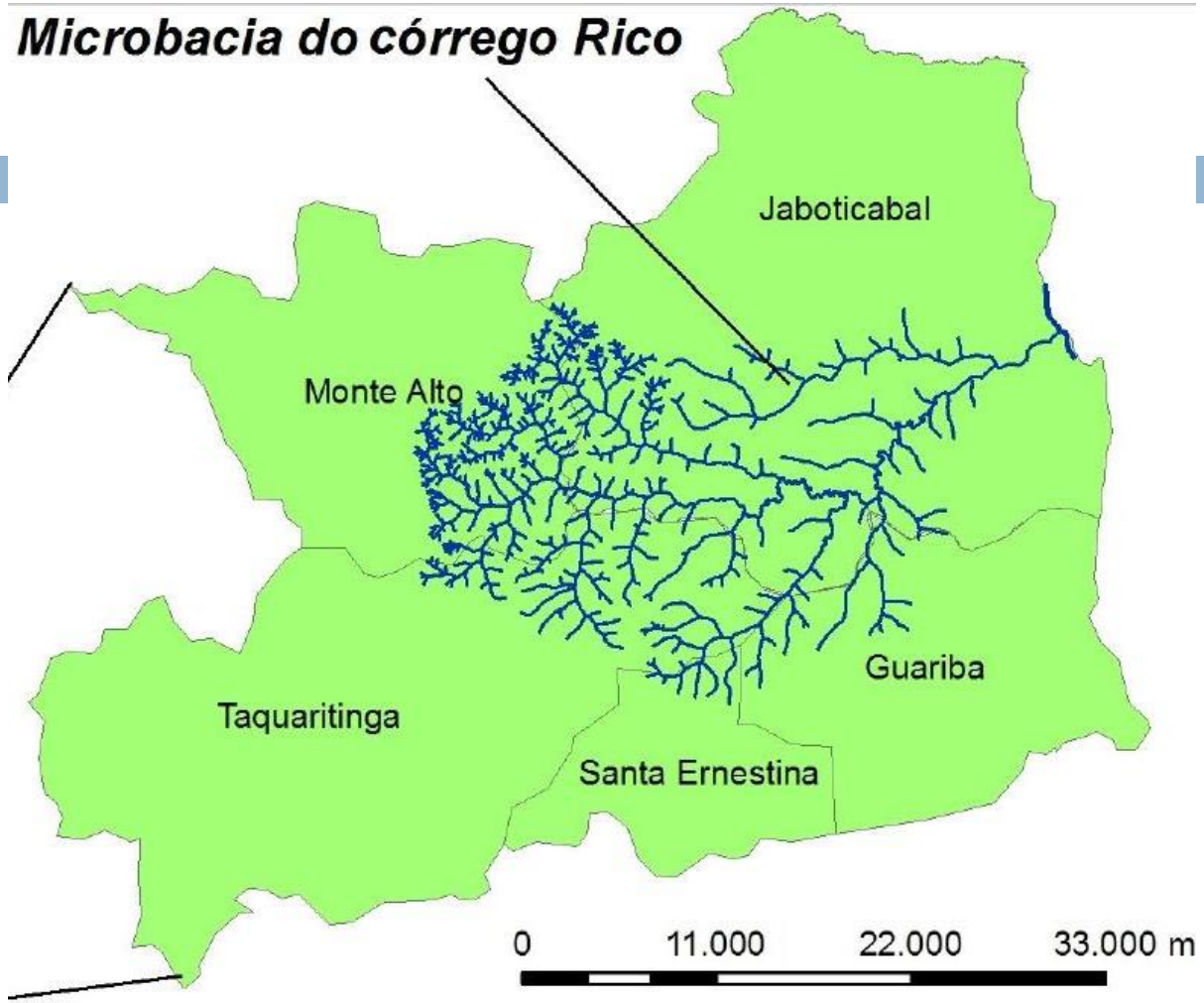
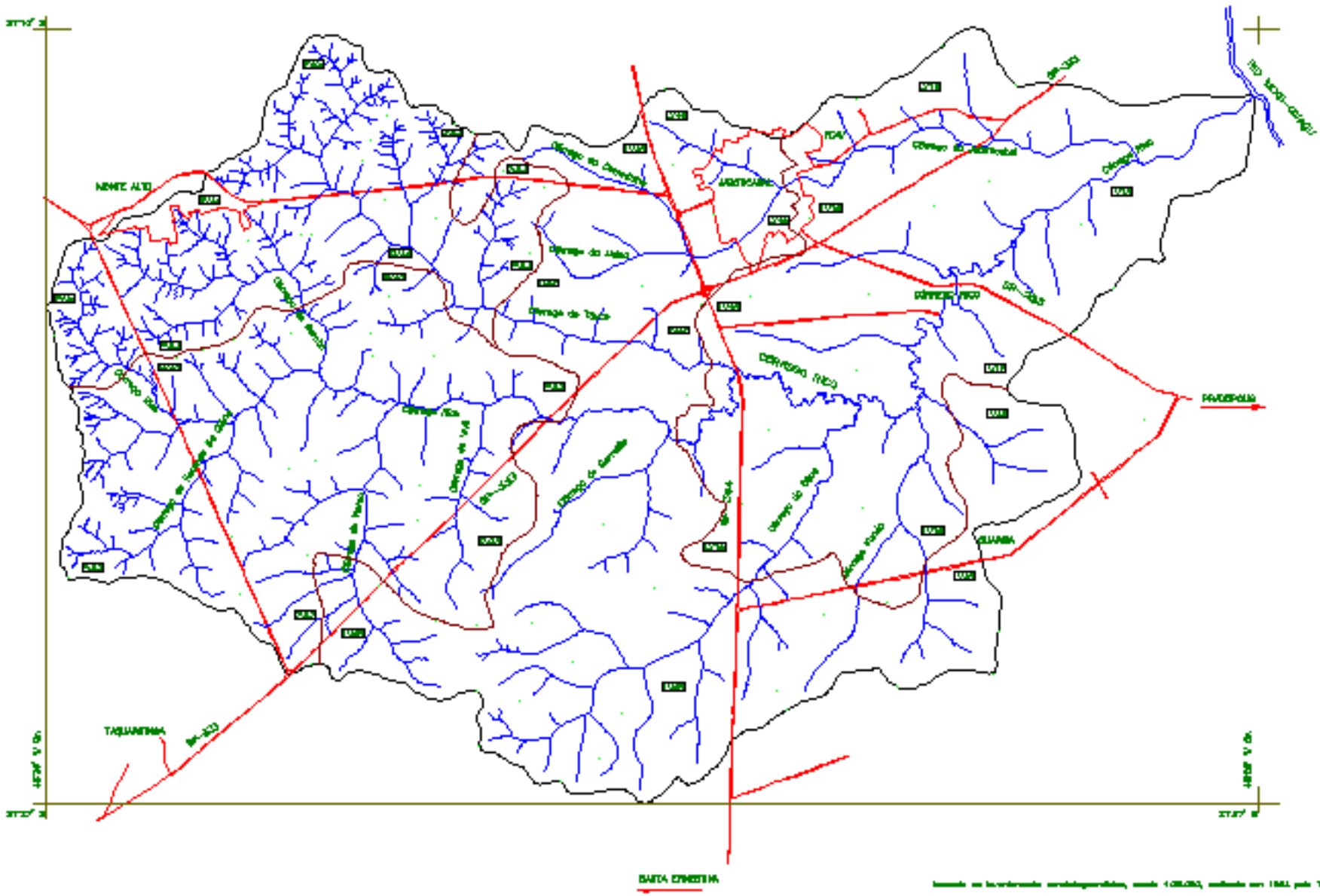
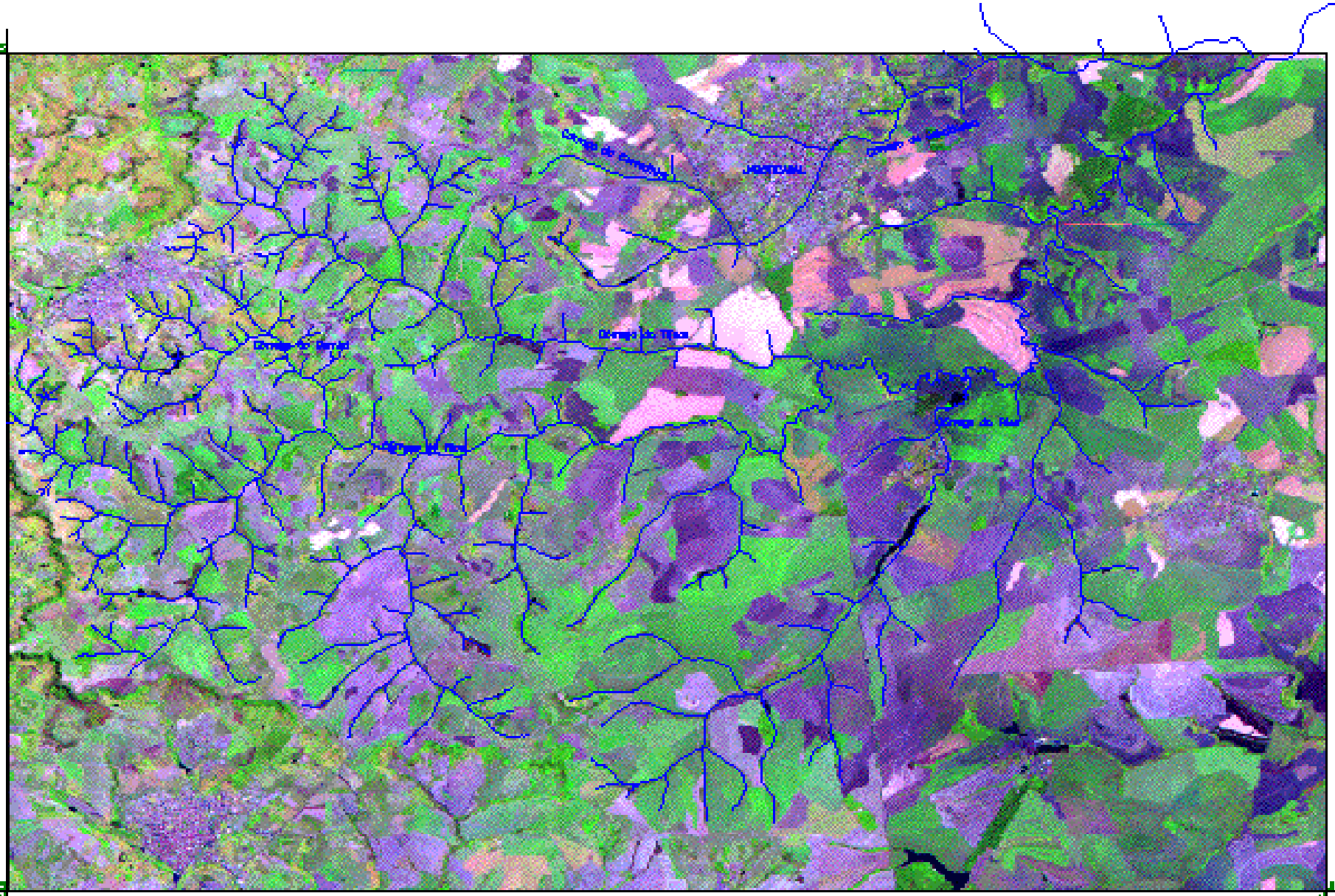
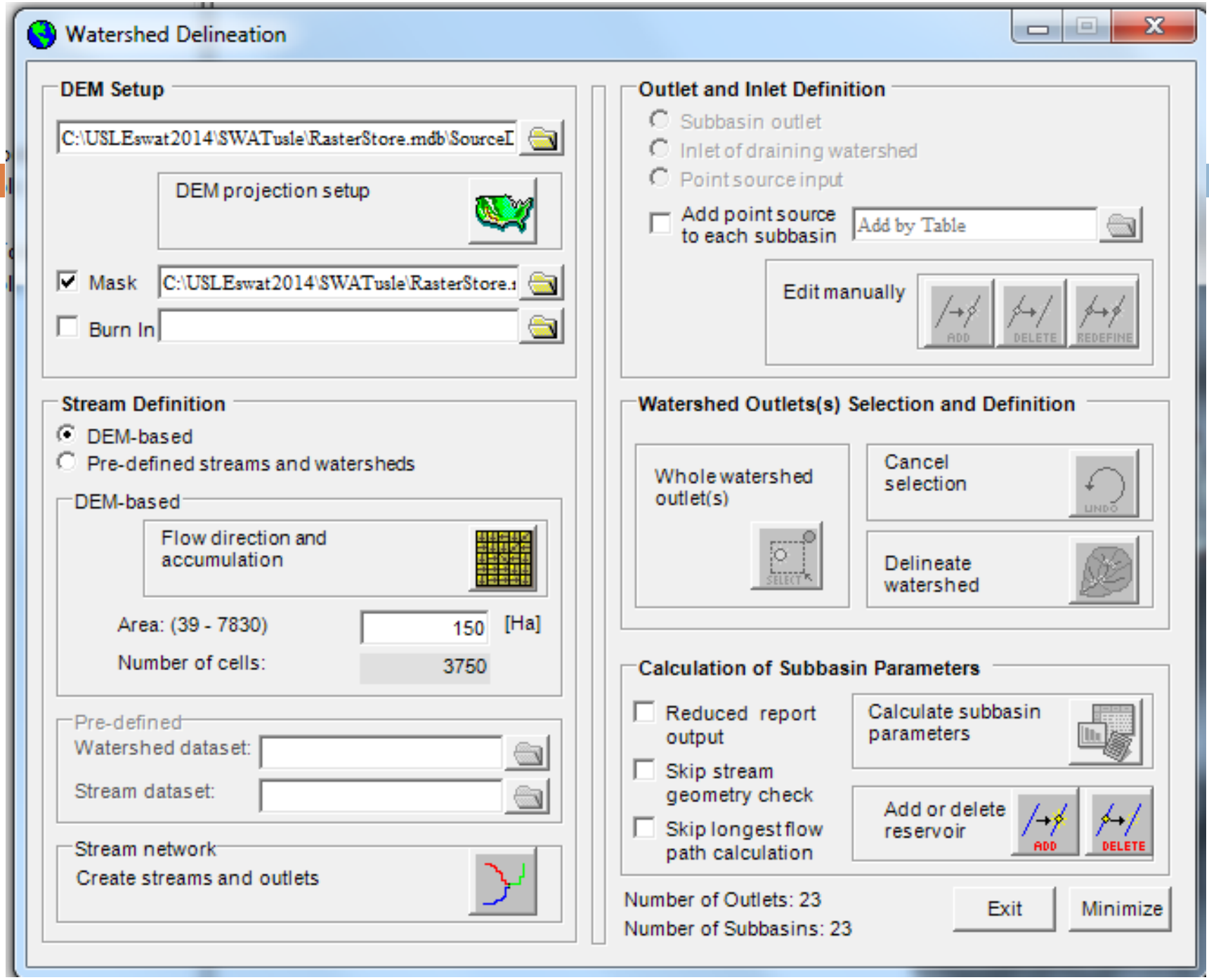
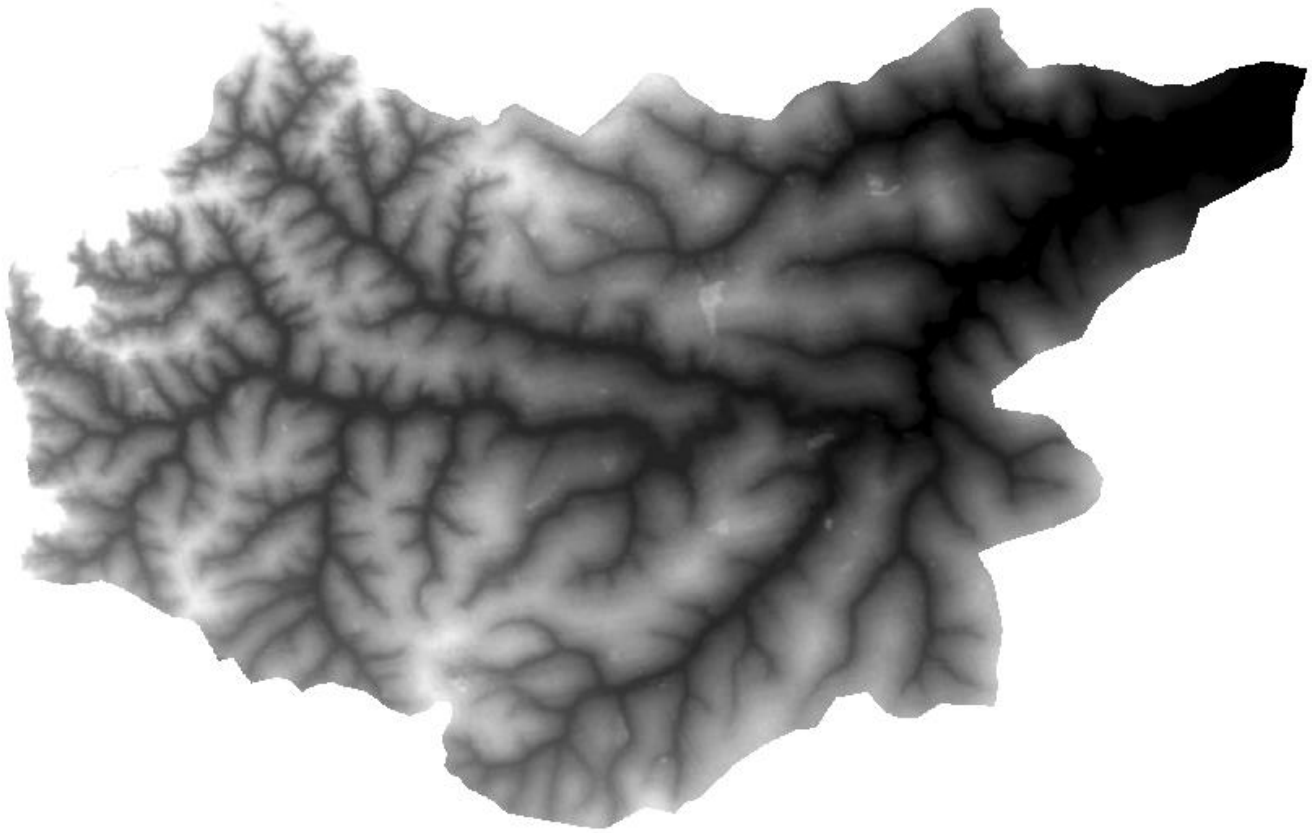
DF
MG
ES
MS
SP
RJ
PR
SC
RS
Microbacia do Córrego Rico
Jaboticabal
Monte Alto
Guariba
Taquaritinga
Santa Ernestina
0 11.000 22.000 33.000 m
Bacia do Rio Mogi
São Paulo
0 50 100 150 200 Km


Microbacia do córrego Rico
Jaboticabal
Monte Alto
Guariba
Taquaritinga
Santa Ernestina
0
11.000
22.000
33.000 m


MENTE ALTO
TAQUARITINGA
SANTA ERNESTINA
PAULÓPOLIS
GUARIBA
RIO MOGI-GUAÇU



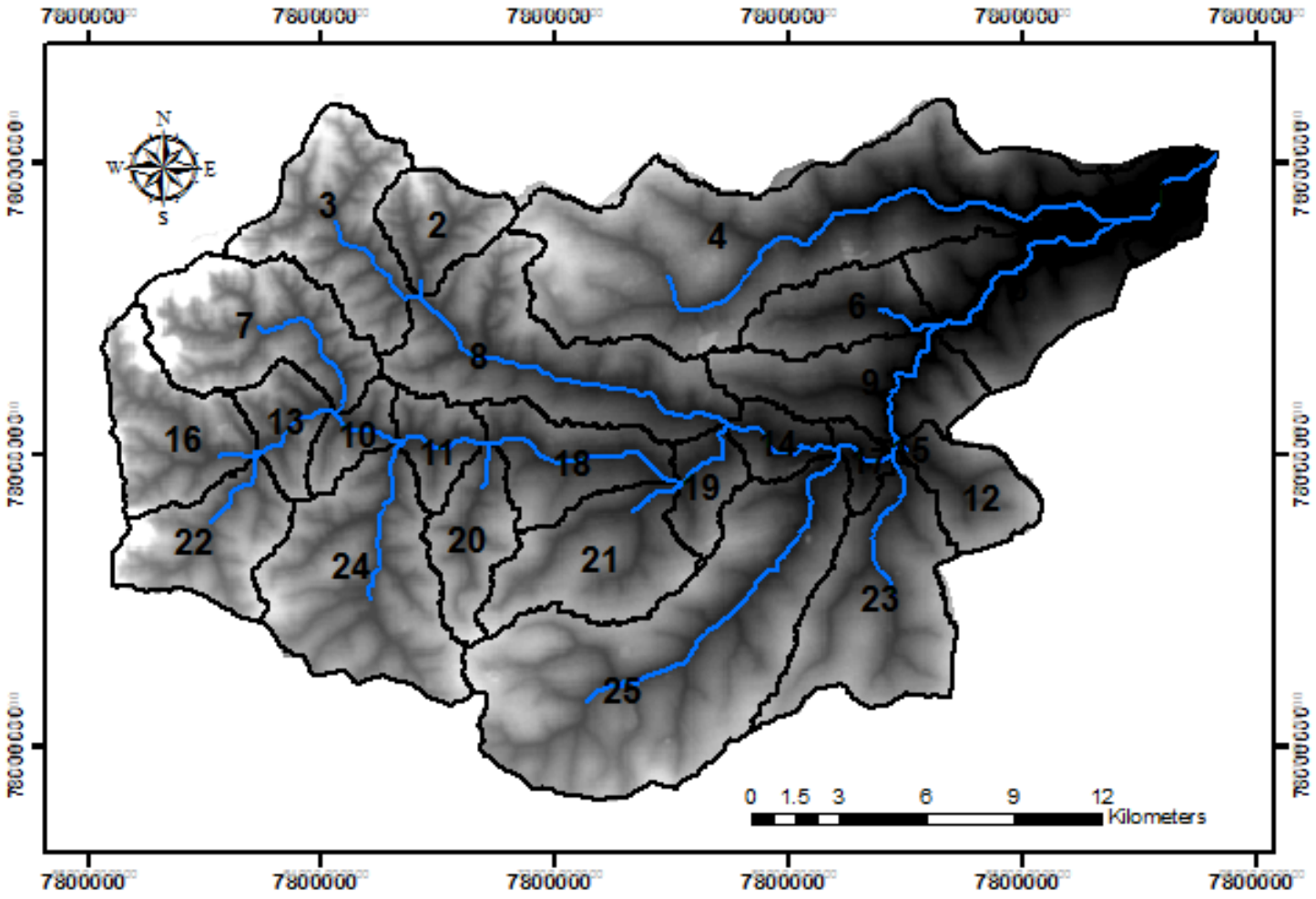

Watershed Delineation
DEM Setup
C:\USLEswat2014\SWATusle\RasterStore.mdb\SourceD
DEM projection setup
Mask
C:\USLEswat2014\SWATusle\RasterStore.
Burn In
Stream Definition
DEM-based
Pre-defined streams and watersheds
DEM-based
Flow direction and accumulation
Area: (39 - 7830)
150
[Ha]
Number of cells:
3750
Pre-defined
Watershed dataset:
Stream dataset:
Stream network
Create streams and outlets
Outlet and Inlet Definition
Subbasin outlet
Inlet of draining watershed
Point source input
Add point source to each subbasin
Add by Table
Edit manually
ADD
DELETE
REDEFINE
Watershed Outlets(s) Selection and Definition
Whole watershed outlet(s)
SELECT
Cancel selection
UNDO
Delineate watershed
Calculation of Subbasin Parameters
Reduced report output
Skip stream geometry check
Skip longest flow path calculation
Calculate subbasin parameters
Add or delete reservoir
ADD
DELETE
Number of Outlets: 23
Number of Subbasins: 23
Exit
Minimize



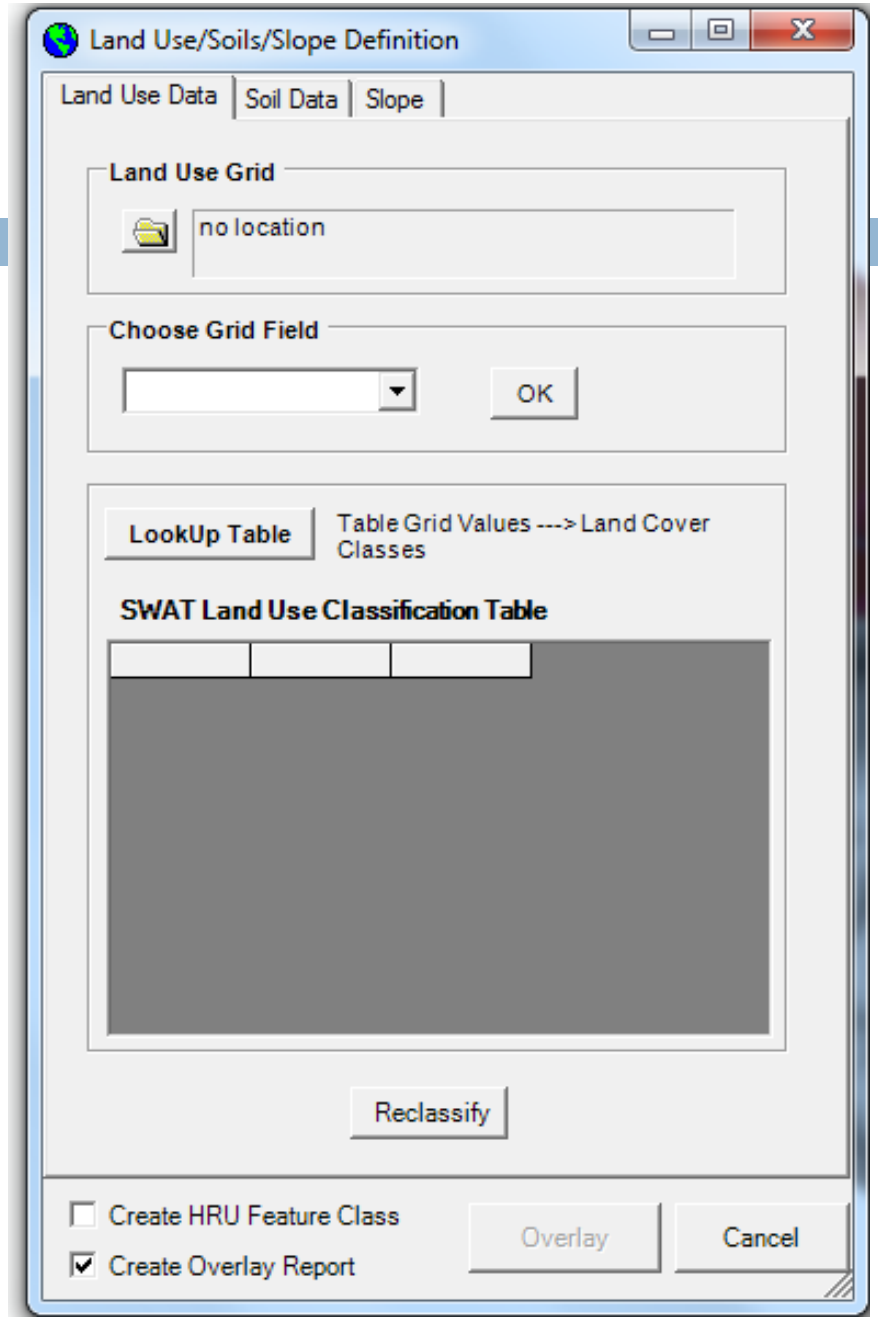
- Image of SF-22 map provided by EMBRAPA (MIRANDA, 2005).

DEM

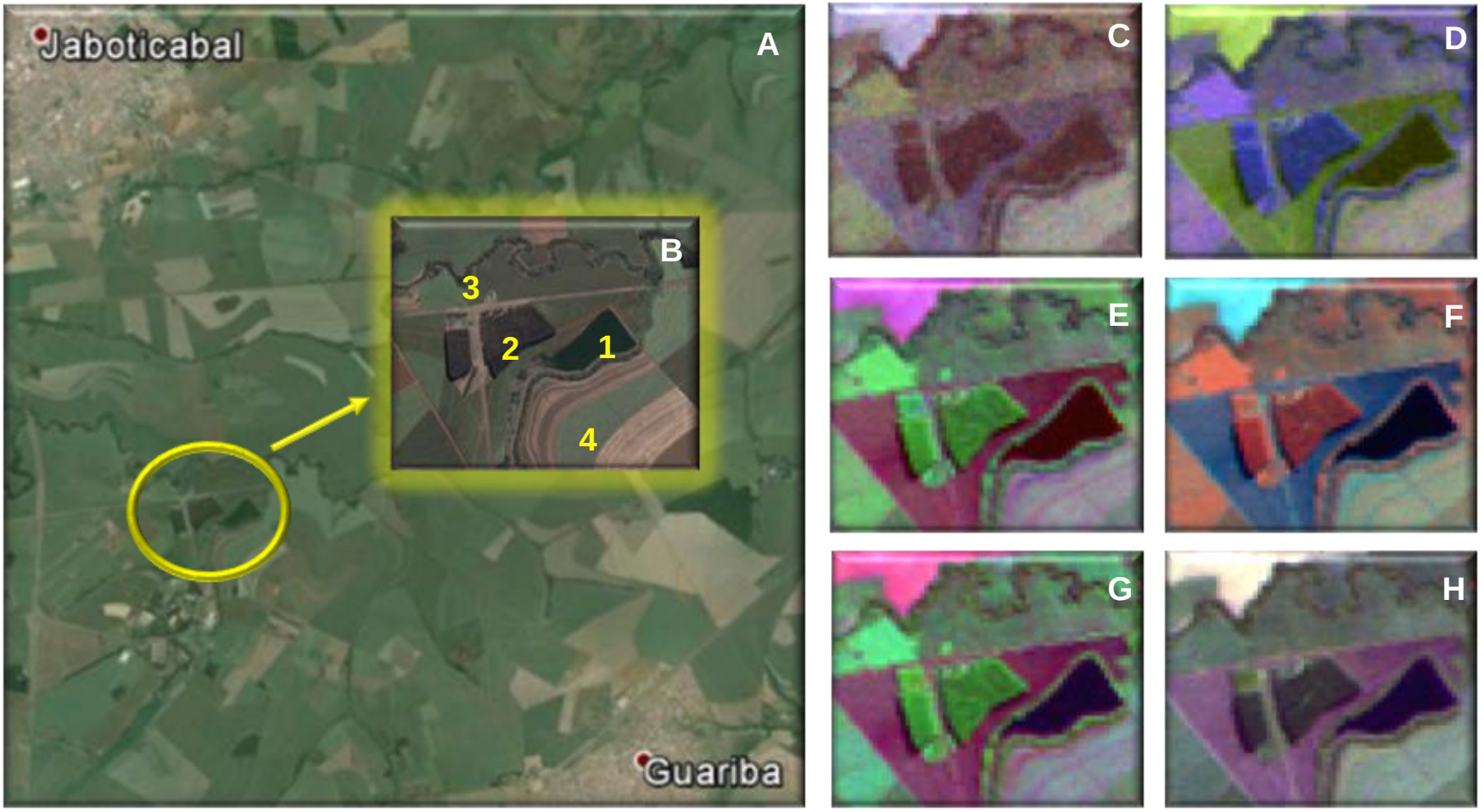
- The original DEM SRTM was interpolated to 20 meters of spatial resolution using a *spline* filter and the projection coordinate system was converted to SIRGAS 2000.



The watershed modeling tool selected for identifying the stream network was the Soil and Water Assessment (SWAT) model [4].


Land Use/Soils/Slope Definition
Land Use Data
Soil Data
Slope
Land Use Grid
no location
Choose Grid Field
OK
LookUp Table
Table Grid Values ---> Land Cover Classes
SWAT Land Use Classification Table
Reclassify
Create HRU Feature Class
Create Overlay Report
Overlay
Cancel

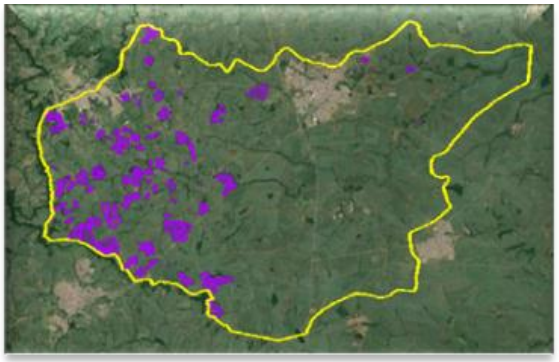
Land Use

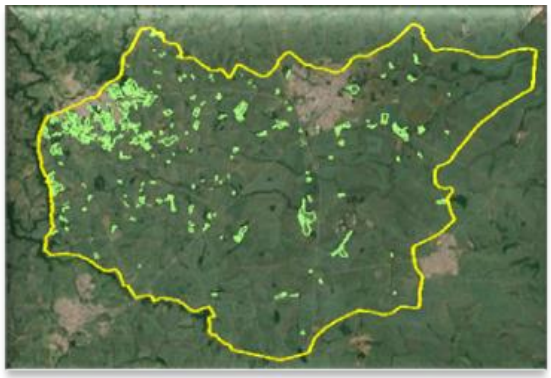


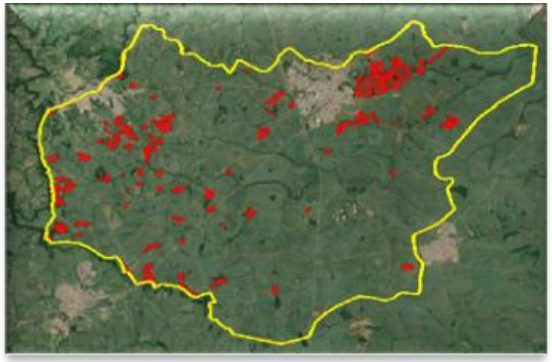
Satellite Image

Watershed Divisor

Drainage net







Land Uses:

Fruits

Sugar cane

Forest

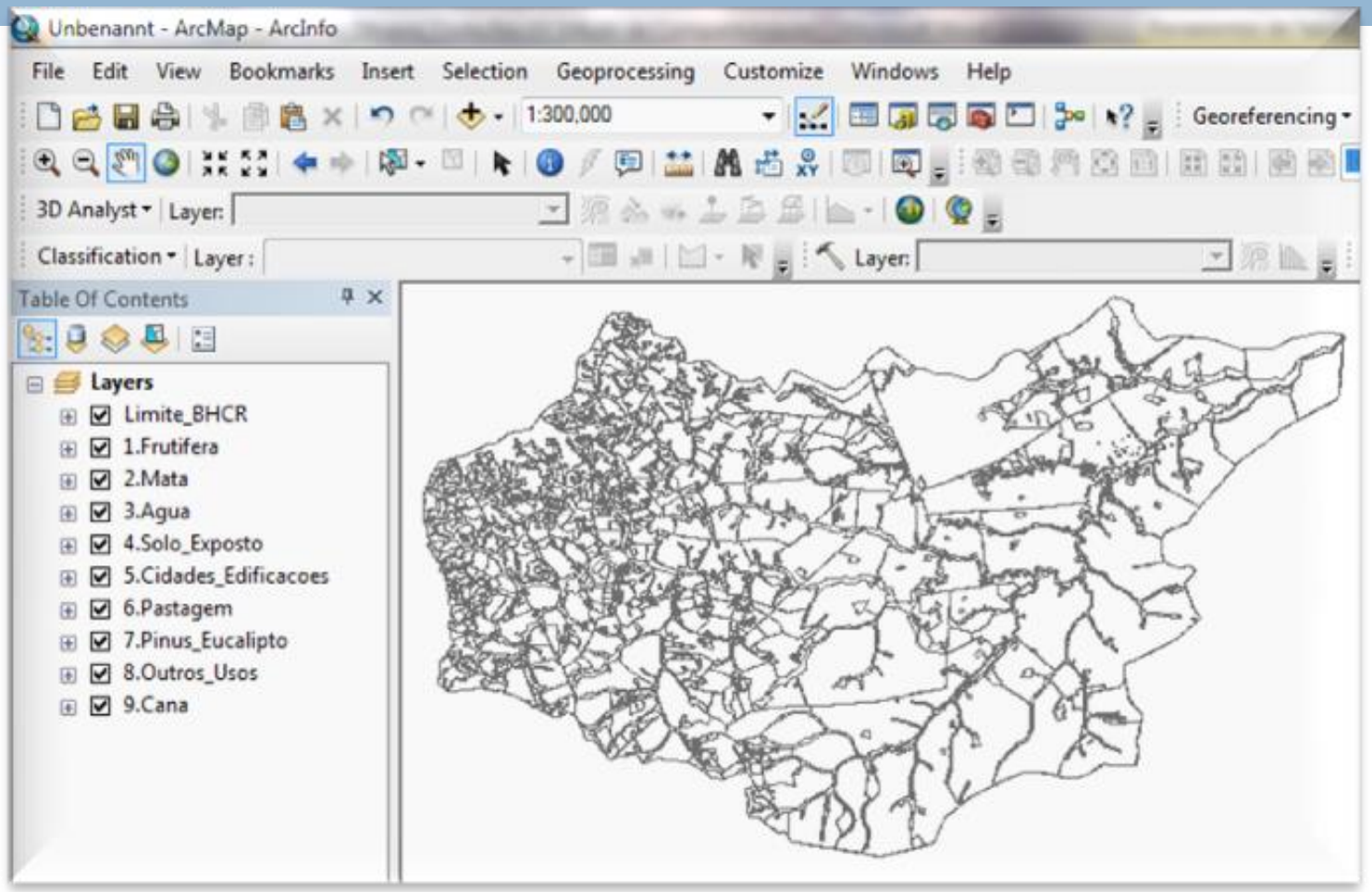
Pasture

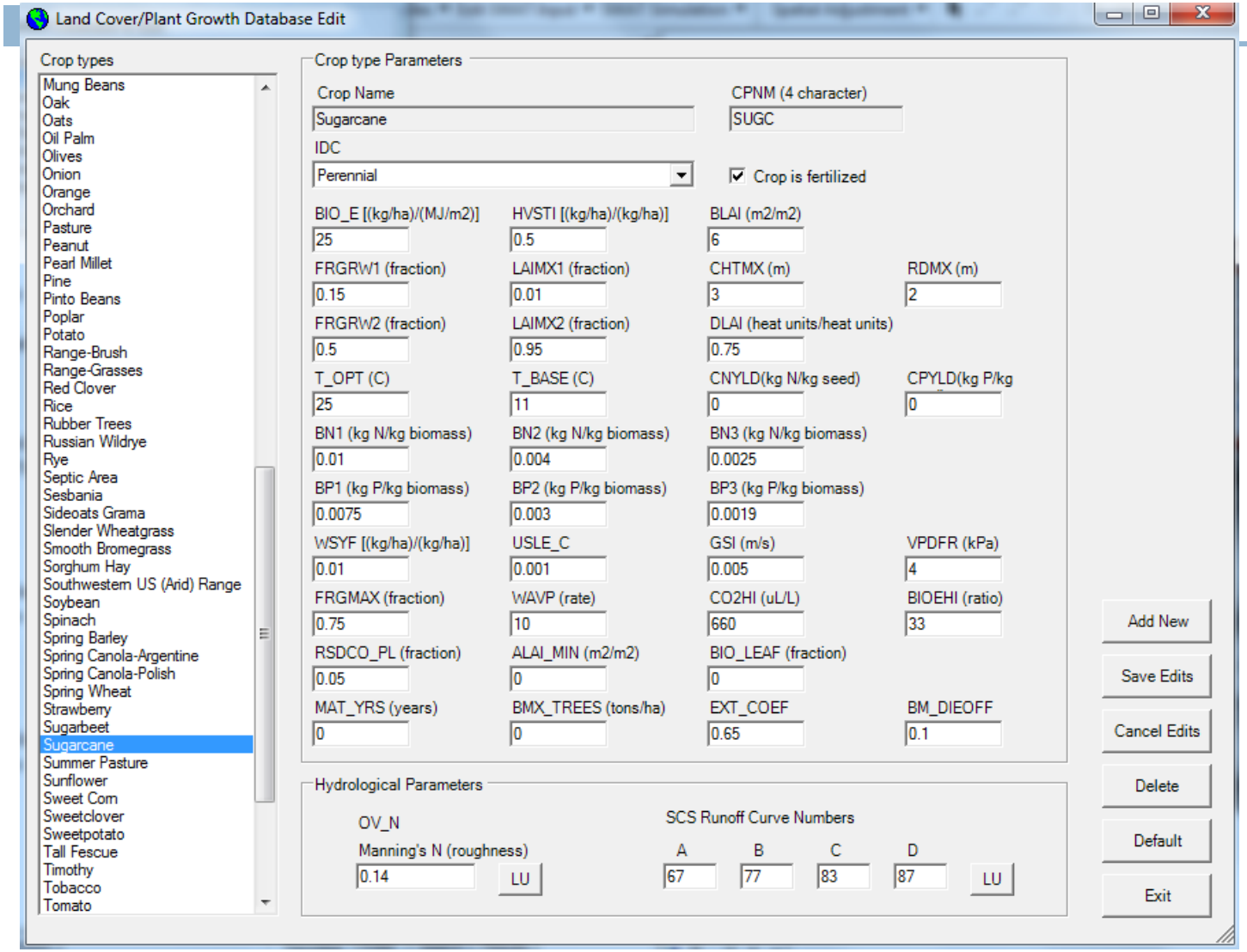
Pinus

Urban Areas

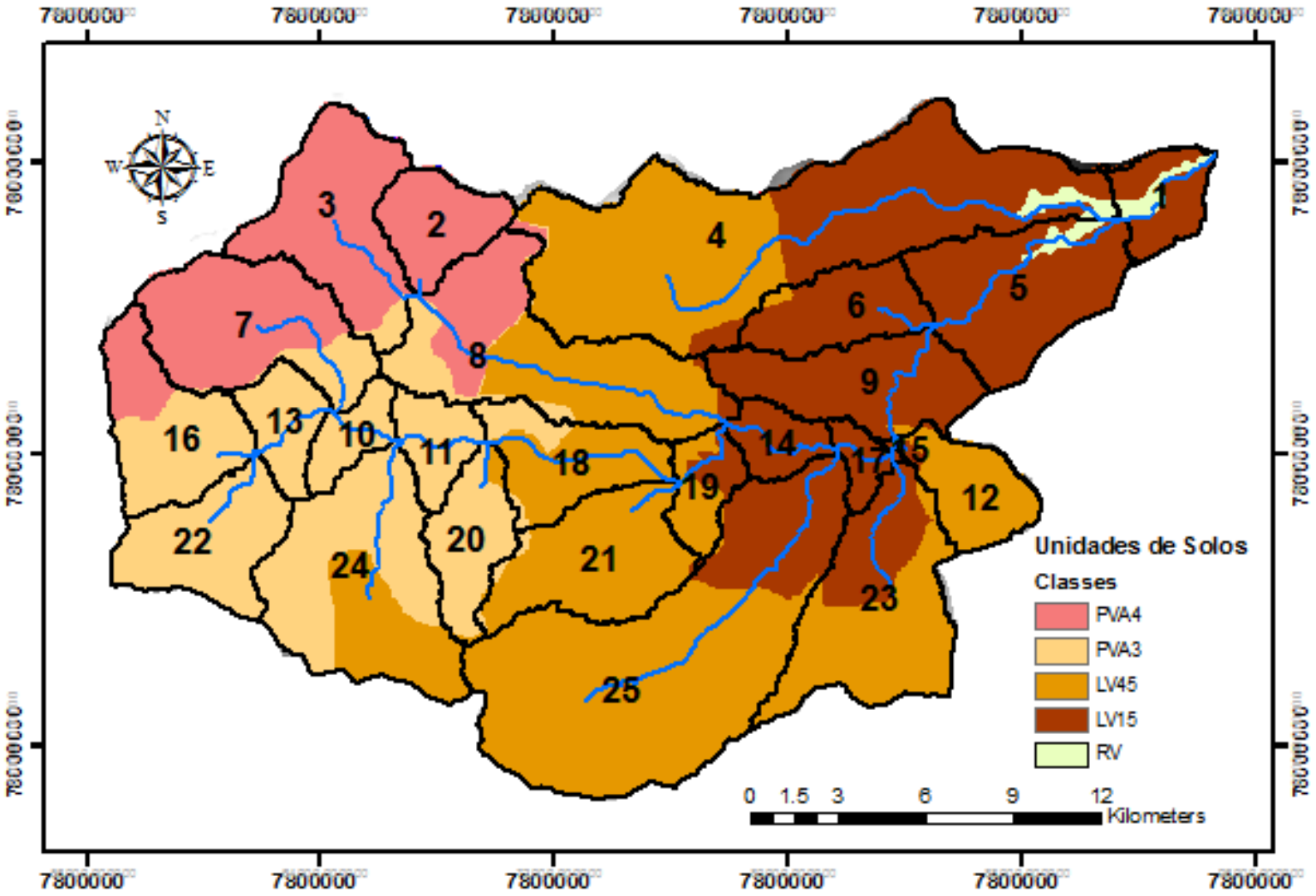
Other uses

Nº	Classes	Total poligonos	Area (m^2)	%
1	Frutifera	184	23,271,146.07	4.0
2	Mata	263	69,617,036.28	12.0
3	Agua	214	2,182,042.42	0.4
4	Solo_Exposto	53	1,480,046.42	0.3
5	Cidade/Edificacoes	489	39,945,967.76	6.9
6	Pastagem	274	18,115,698.84	3.1
7	Pinus_Eucalipto	35	2,787,118.53	0.5
8	Outros_Usos	114	17,655,521.32	3.1
9	Cana	290	403,682,334.42	69.8
	TOTAL	1916	578,736,912.06	100.0


Unbenannt - ArcMap - ArcInfo
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:300,000
Georeferencing
3D Analyst
Layer:
Classification
Layer:
Layer:
Table Of Contents
Layers
Limite_BHCR
1.Frutifera
2.Mata
3.Agua
4.Solo_Exposto
5.Cidades_Edificacoes
6.Pastagem
7.Pinus_Eucalipto
8.Outros_Usos
9.Cana


Land Cover/Plant Growth Database Edit
Crop types
Mung Beans
Oak
Oats
Oil Palm
Olives
Onion
Orange
Orchard
Pasture
Peanut
Pearl Millet
Pine
Pinto Beans
Poplar
Potato
Range-Brush
Range-Grasses
Red Clover
Rice
Rubber Trees
Russian Wildrye
Rye
Septic Area
Sesbania
Sideoats Grama
Slender Wheatgrass
Smooth Bromegrass
Sorghum Hay
Southwestern US (Arid) Range
Soybean
Spinach
Spring Barley
Spring Canola-Argentine
Spring Canola-Polish
Spring Wheat
Strawberry
Sugarbeet
Sugarcane
Summer Pasture
Sunflower
Sweet Corn
Sweetclover
Sweetpotato
Tall Fescue
Timothy
Tobacco
Tomato
Crop type Parameters
Crop Name
Sugarcane
CPNM (4 character)
SUGC
IDC
Perennial
Crop is fertilized
BIO_E [(kg/ha)/(MJ/m2)]
25
HVSTI [(kg/ha)/(kg/ha)]
0.5
BLAI (m2/m2)
6
FRGRW1 (fraction)
0.15
LAIMX1 (fraction)
0.01
CHTMX (m)
3
RDMX (m)
2
FRGRW2 (fraction)
0.5
LAIMX2 (fraction)
0.95
DLAI (heat units/heat units)
0.75
T_OPT (C)
25
T_BASE (C)
11
CNYLD(kg N/kg seed)
0
CPYLD(kg P/kg
0
BN1 (kg N/kg biomass)
0.01
BN2 (kg N/kg biomass)
0.004
BN3 (kg N/kg biomass)
0.0025
BP1 (kg P/kg biomass)
0.0075
BP2 (kg P/kg biomass)
0.003
BP3 (kg P/kg biomass)
0.0019
WSYF [(kg/ha)/(kg/ha)]
0.01
USLE_C
0.001
GSI (m/s)
0.005
VPDFR (kPa)
4
FRGMAX (fraction)
0.75
WAVP (rate)
10
CO2HI (uL/L)
660
BIOEHI (ratio)
33
RSDCO_PL (fraction)
0.05
ALAI_MIN (m2/m2)
0
BIO_LEAF (fraction)
0
MAT_YRS (years)
0
BMX_TREES (tons/ha)
0
EXT_COEF
0.65
BM_DIEOFF
0.1
Hydrological Parameters
OV_N
Manning's N (roughness)
0.14
LU
SCS Runoff Curve Numbers
A
B
C
D
67
77
83
87
LU
Add New
Save Edits
Cancel Edits
Delete
Default
Exit

Soil


N
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3
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16
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15
12
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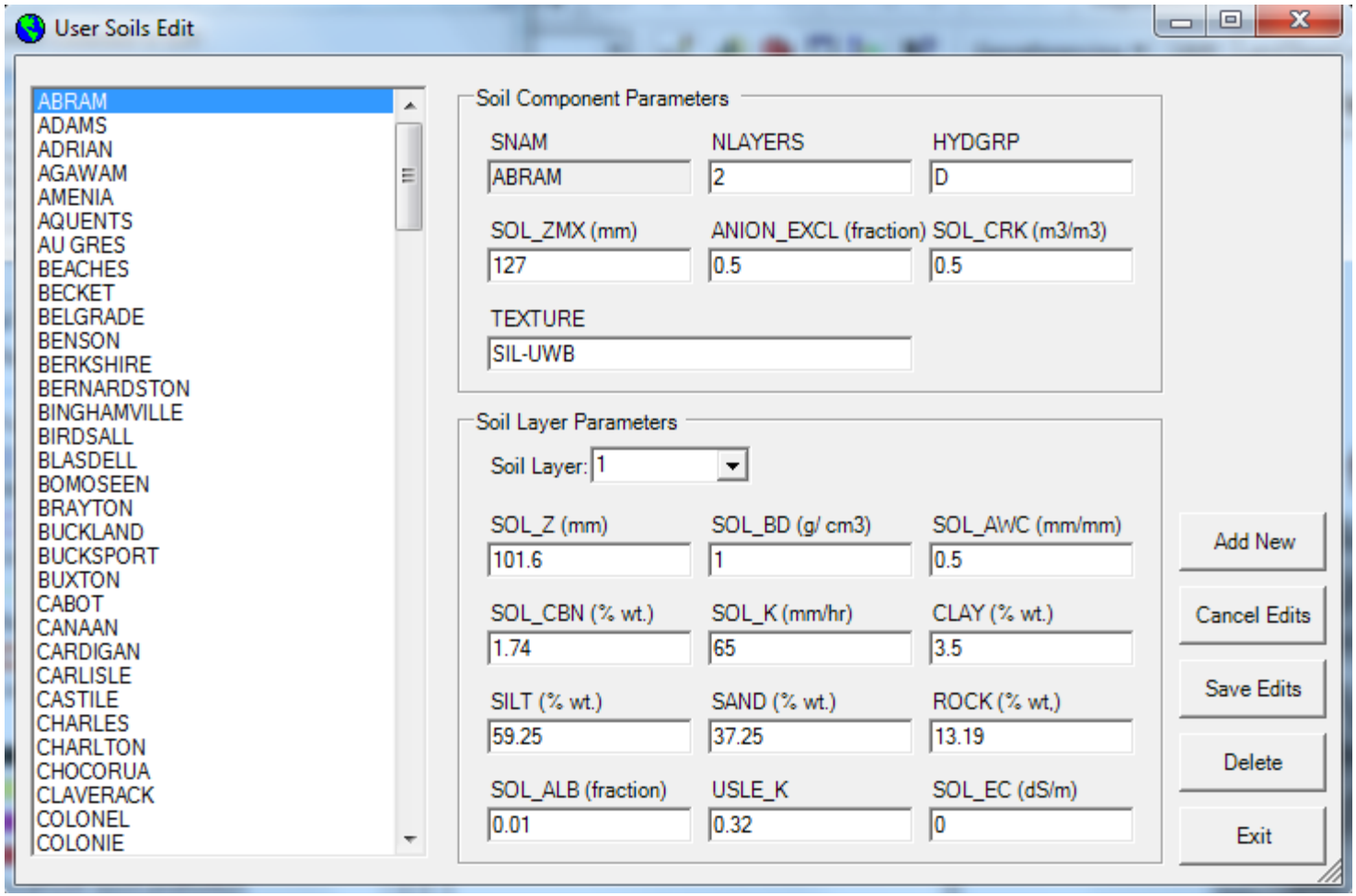
25
Unidades de Solos
Classes
PVA4
PVA3
LV45
LV15
RV
0 1.5 3 6 9 12
Kilometers


User Soils Edit
ABRAM
ADAMS
ADRIAN
AGAWAM
AMENIA
AQUENTS
AU GRES
BEACHES
BECKET
BELGRADE
BENSON
BERKSHIRE
BERNARDSTON
BINGHAMVILLE
BIRDSALL
BLASDELL
BOMOSEEN
BRAYTON
BUCKLAND
BUCKSPORT
BUXTON
CABOT
CANAAN
CARDIGAN
CARLISLE
CASTILE
CHARLES
CHARLTON
CHOCORUA
CLAVERACK
COLONEL
COLONIE
Soil Component Parameters
SNAM
ABRAM
NLAYERS
2
HYDGRP
D
SOL_ZMX (mm)
127
ANION_EXCL (fraction)
0.5
SOL_CRK (m3/m3)
0.5
TEXTURE
SIL-UWB
Soil Layer Parameters
Soil Layer:
1
SOL_Z (mm)
101.6
SOL_BD (g/ cm3)
1
SOL_AWC (mm/mm)
0.5
SOL_CBN (% wt.)
1.74
SOL_K (mm/hr)
65
CLAY (% wt.)
3.5
SILT (% wt.)
59.25
SAND (% wt.)
37.25
ROCK (% wt.)
13.19
SOL_ALB (fraction)
0.01
USLE_K
0.32
SOL_EC (dS/m)
0
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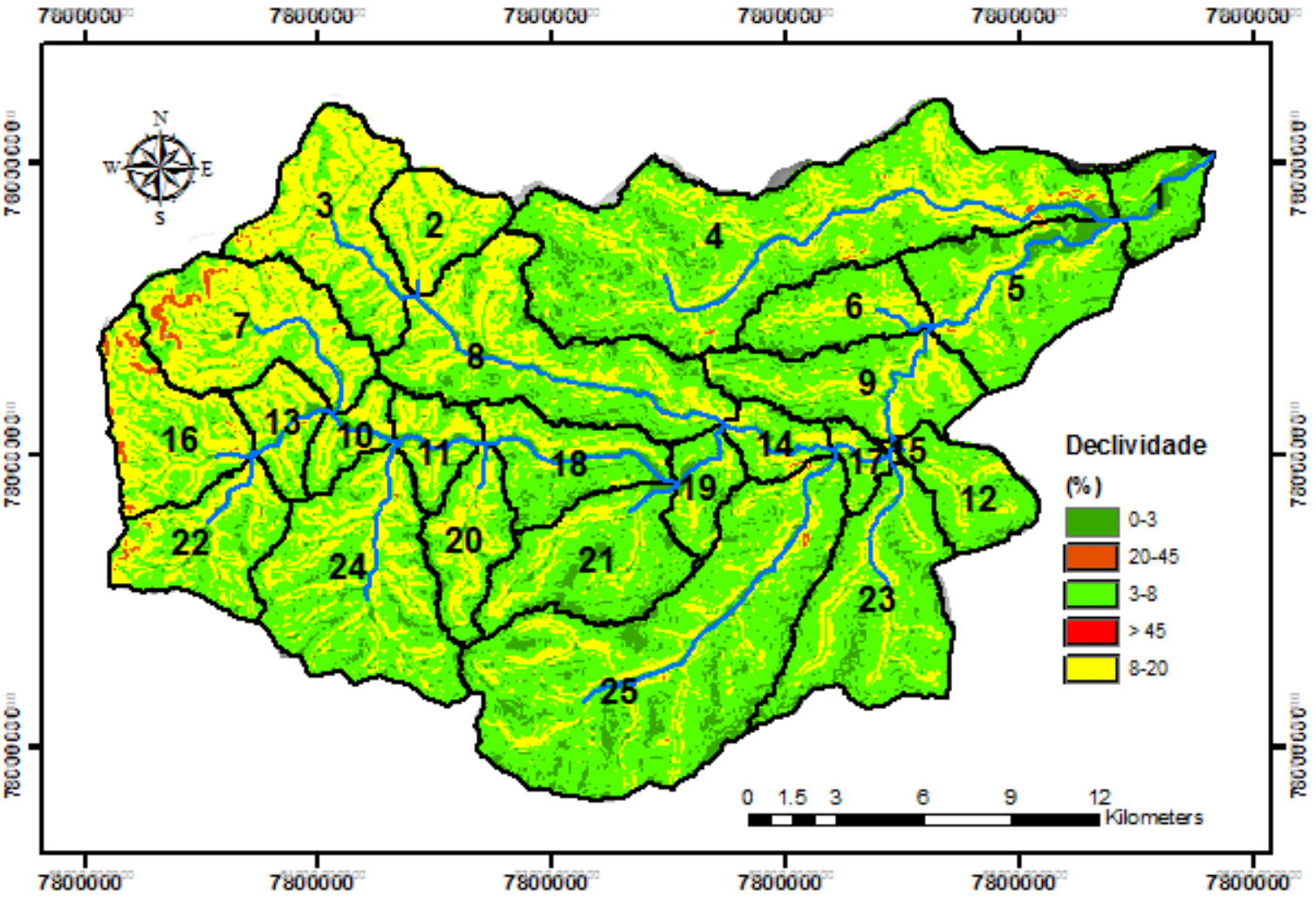
Cancel Edits
Save Edits
Delete
Exit

Slope


7800000
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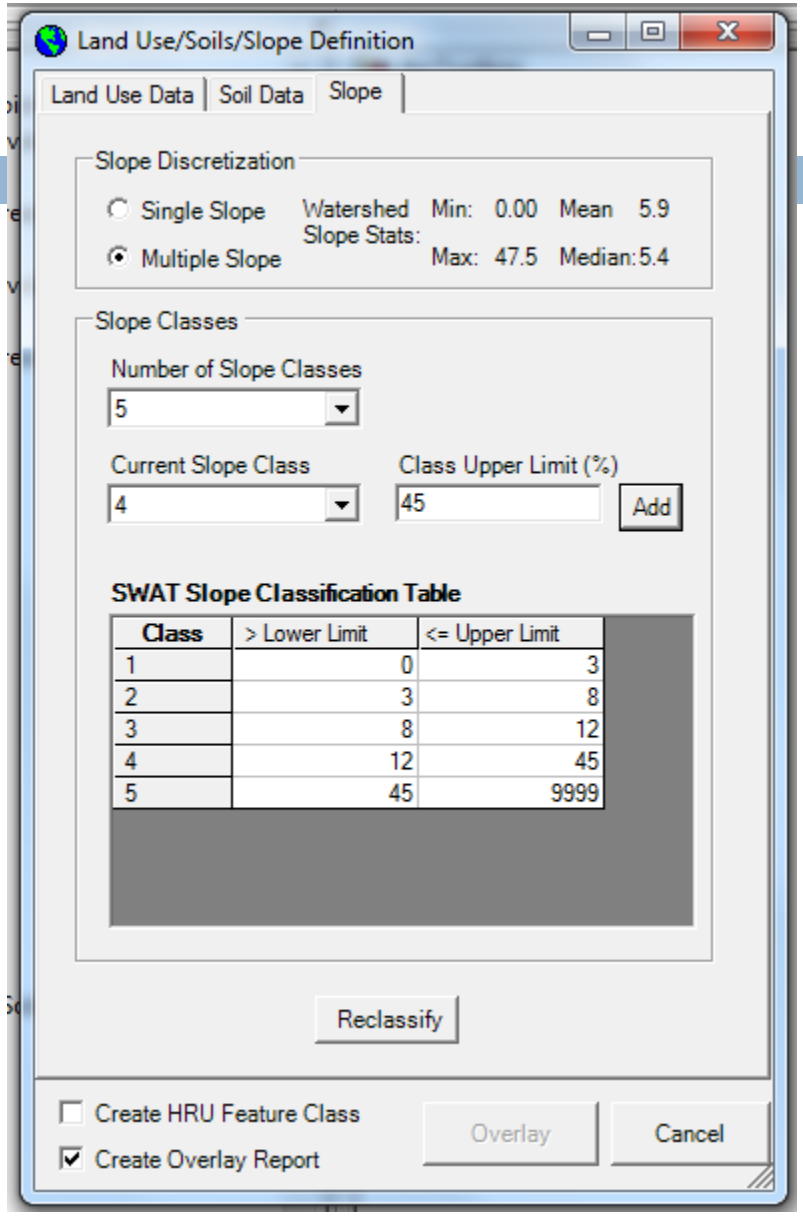
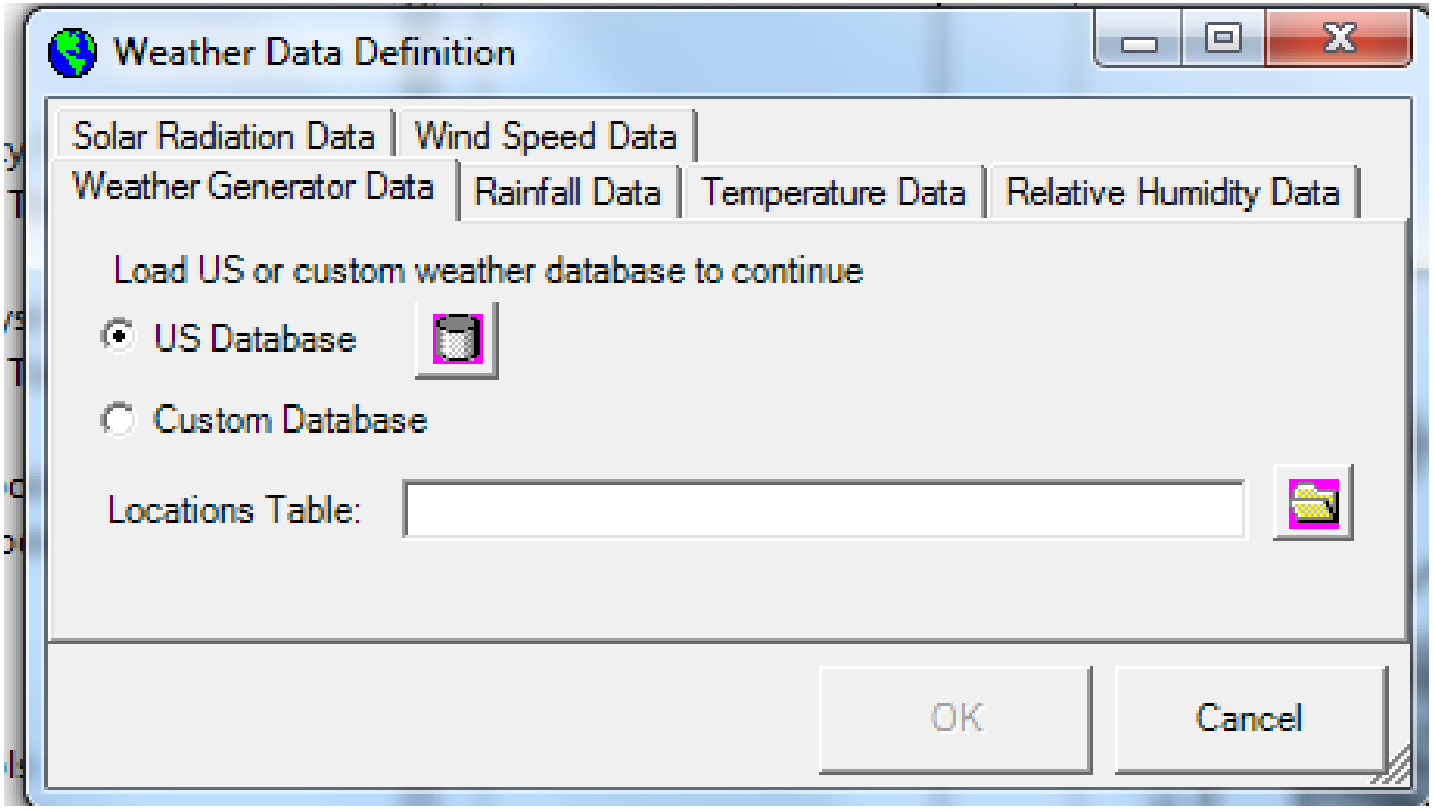
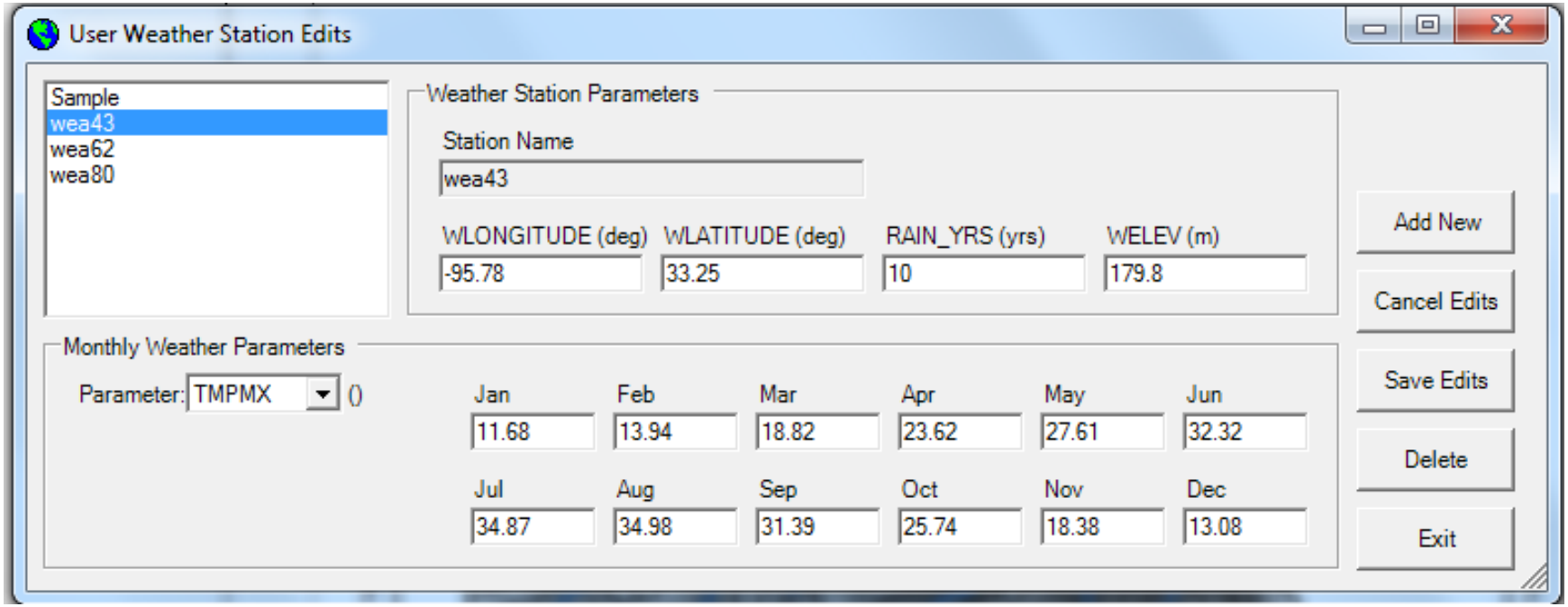
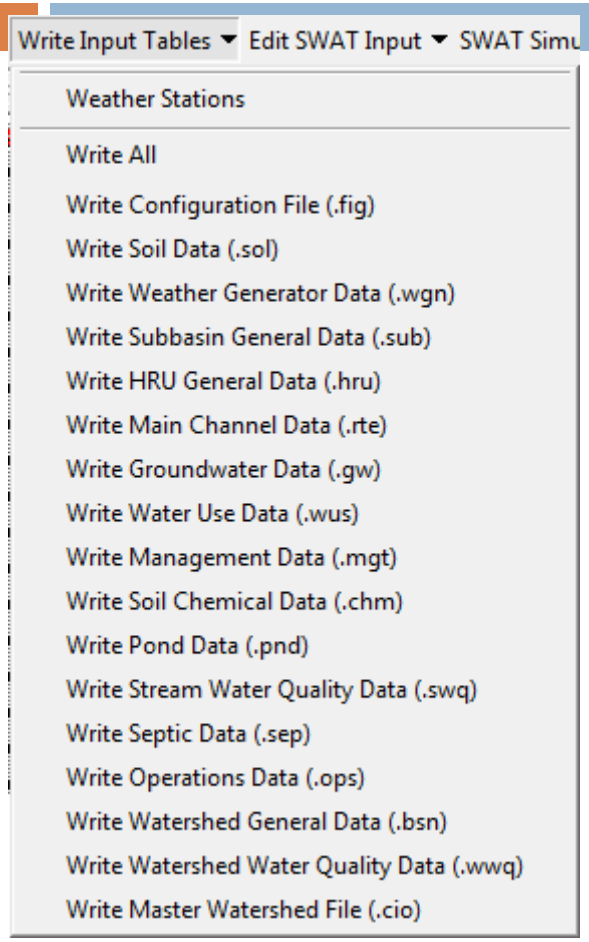
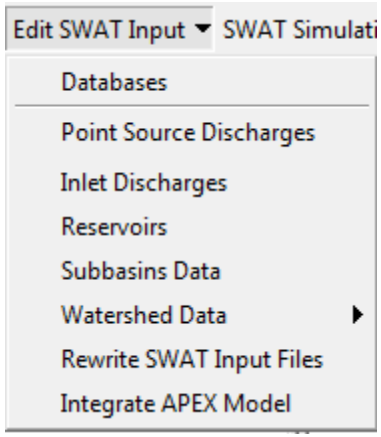
15
16
17
18
19
20
21
22
23
24
25
Declividade
(%)
0-3
20-45
3-8
> 45
8-20
0 1.5 3 6 9 12
Kilometers

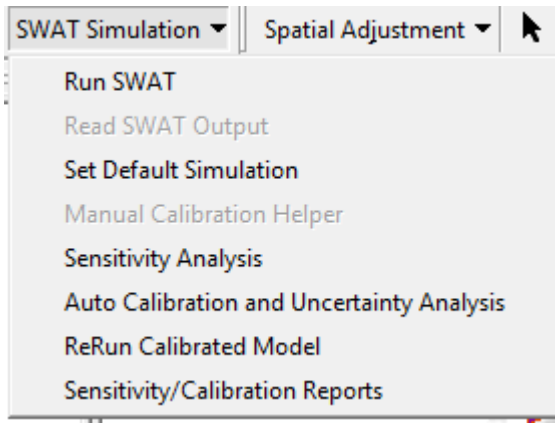

Land Use/Soils/Slope Definition
Land Use Data
Soil Data
Slope
Slope Discretization
Single Slope
Multiple Slope
Watershed Slope Stats:
Min: 0.00
Mean 5.9
Max: 47.5
Median: 5.4
Slope Classes
Number of Slope Classes
5
Current Slope Class
4
Class Upper Limit (%)
45
Add
SWAT Slope Classification Table
Class
> Lower Limit
<= Upper Limit
1 0 3
2 3 8
3 8 12
4 12 45
5 45 9999
Reclassify
Create HRU Feature Class
Create Overlay Report
Overlay
Cancel

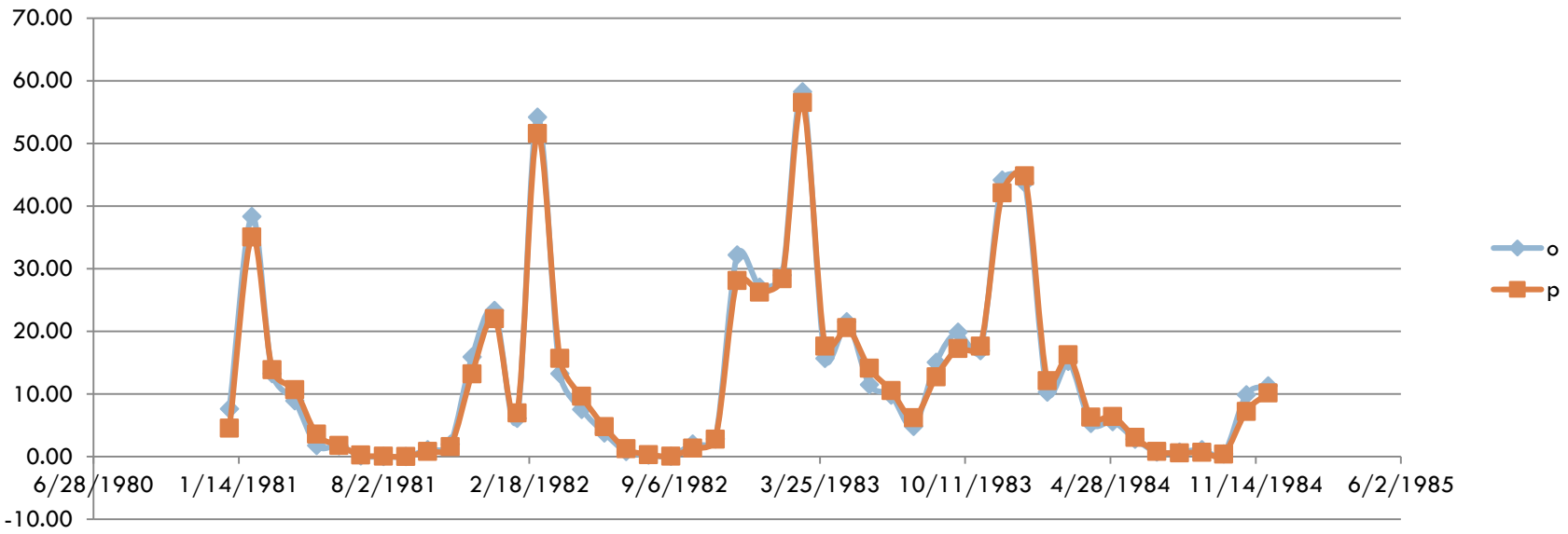

Weather Data Definition
Solar Radiation Data
Wind Speed Data
Weather Generator Data
Rainfall Data
Temperature Data
Relative Humidity Data
Load US or custom weather database to continue
US Database
Custom Database
Locations Table:
OK
Cancel


User Weather Station Edits
Sample
wea43
wea62
wea80
Weather Station Parameters
Station Name
wea43
WLONGITUDE (deg)
WLATITUDE (deg)
RAIN_YRS (yrs)
WELEV (m)
-95.78
33.25
10
179.8
Add New
Cancel Edits
Save Edits
Delete
Exit
Monthly Weather Parameters
Parameter: TMPMX
()
Jan
Feb
Mar
Apr
May
Jun
11.68
13.94
18.82
23.62
27.61
32.32
Jul
Aug
Sep
Oct
Nov
Dec
34.87
34.98
31.39
25.74
18.38
13.08


Write Input Tables
Edit SWAT Input
SWAT Simu
Weather Stations
Write All
Write Configuration File (.fig)
Write Soil Data (.sol)
Write Weather Generator Data (.wgn)
Write Subbasin General Data (.sub)
Write HRU General Data (.hru)
Write Main Channel Data (.rte)
Write Groundwater Data (.gw)
Write Water Use Data (.wus)
Write Management Data (.mgt)
Write Soil Chemical Data (.chm)
Write Pond Data (.pnd)
Write Stream Water Quality Data (.swq)
Write Septic Data (.sep)
Write Operations Data (.ops)
Write Watershed General Data (.bsn)
Write Watershed Water Quality Data (.wwq)
Write Master Watershed File (.cio)


Edit SWAT Input
SWAT Simulati
Databases
Point Source Discharges
Inlet Discharges
Reservoirs
Subbasins Data
Watershed Data
Rewrite SWAT Input Files
Integrate APEX Model


SWAT Simulation
Spatial Adjustment
Run SWAT
Read SWAT Output
Set Default Simulation
Manual Calibration Helper
Sensitivity Analysis
Auto Calibration and Uncertainty Analysis
ReRun Calibrated Model
Sensitivity/Calibration Reports


70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
-10.00
6/28/1980
1/14/1981
8/2/1981
2/18/1982
9/6/1982
3/25/1983
10/11/1983
4/28/1984
11/14/1984
6/2/1985
o
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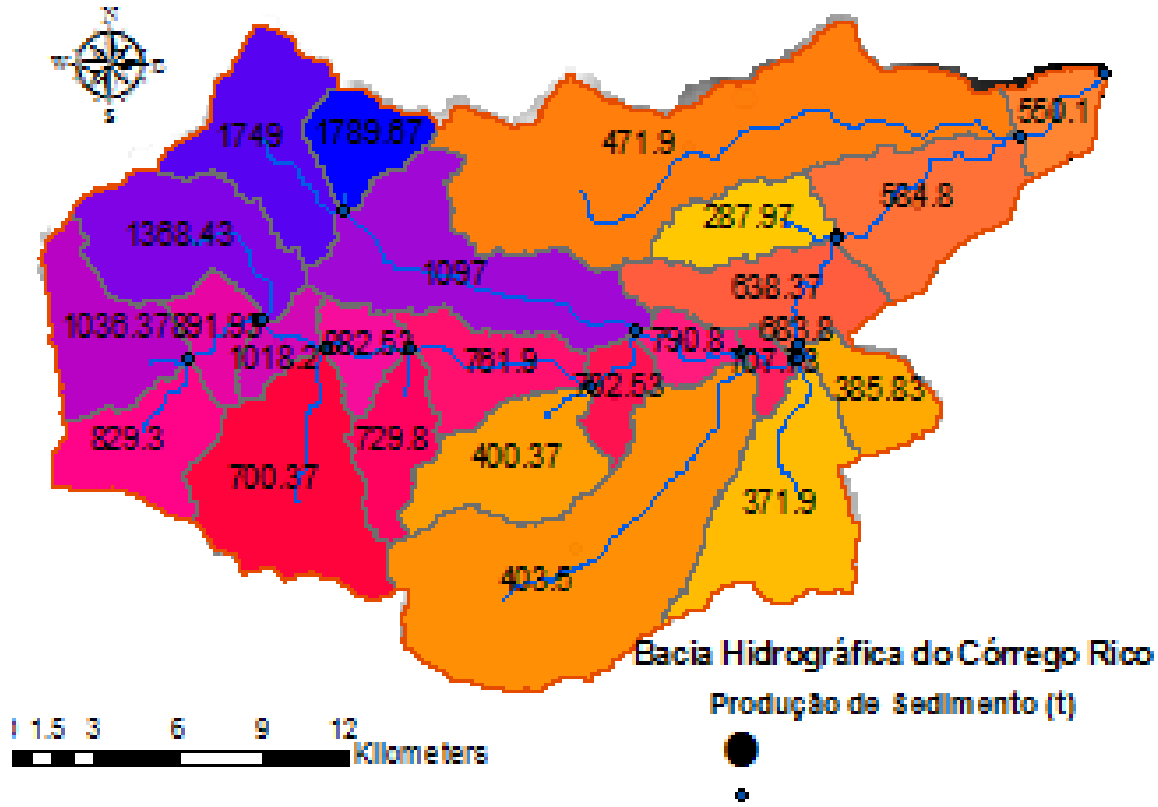
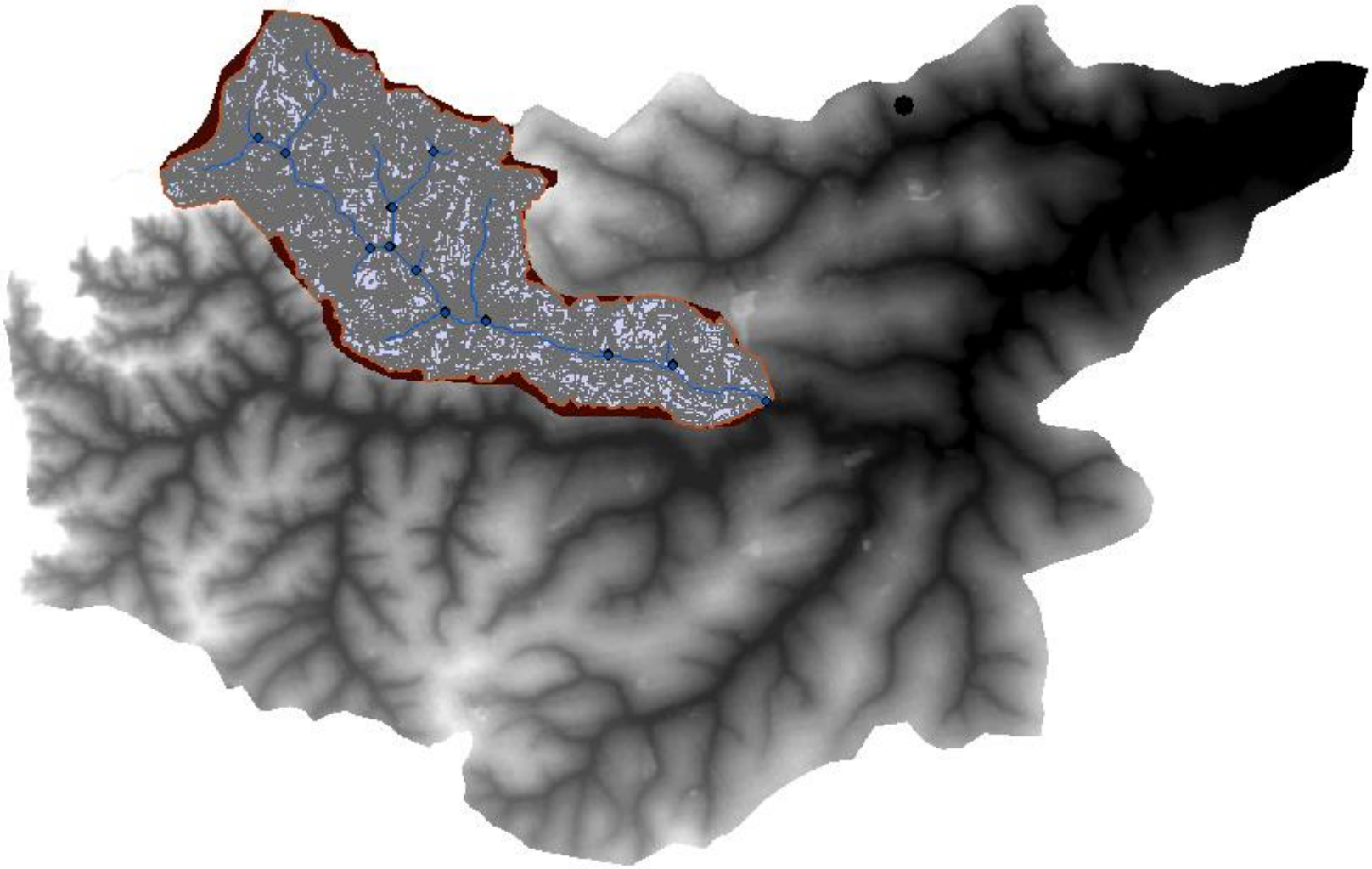
RESULTS AND DISCUSSION



- Arraes, C. L. *Estimativa da perda de solo e expectativa de erosão na microbacia do Córrego do Tijuco – SP*. Dissertação apresentada a Faculdade de Ciências Agrárias e Veterinárias – Unesp – Câmpus de Jaboticabal – 2009. p. 84.



RESULTS AND DISCUSSION

Subbasin	Rmin	Rmax	Kmin	Kmax	LS	Cmin	Cmax	P=1
1	7889	7953	0.04	0.07	1.82	0.00004	0.3222	1

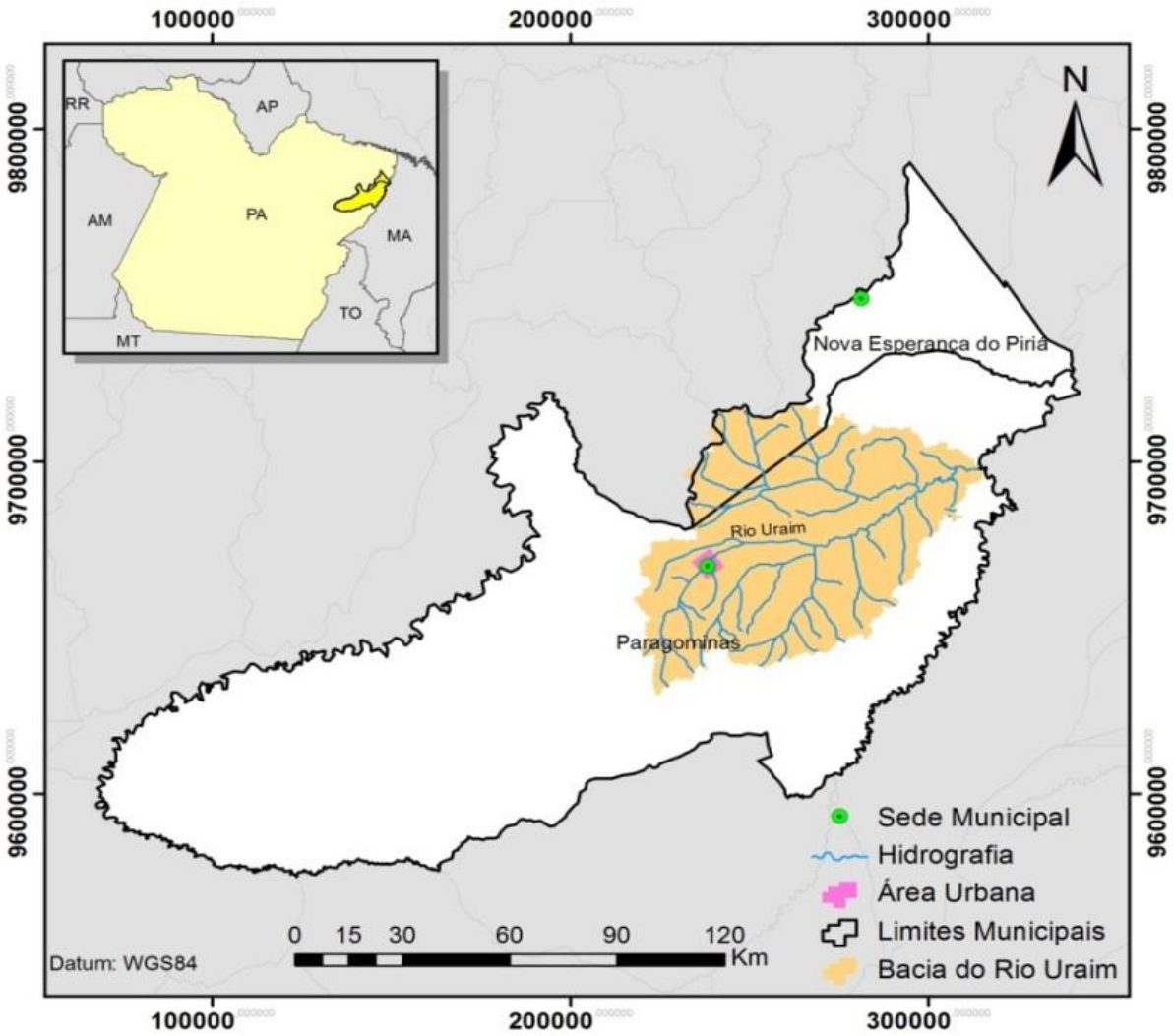
$$A=RxKxLSxCxP$$

RESULTS AND DISCUSSION

Perda de Solo Minima	Perda de Solo Max
$Mg.ha^{-1}.ano^{-1}$	$Mg.ha^{-1}.ano^{-1}$
0.0229728	326.45697

Perda de Solo	EUPS		
	$Mg.ha^{-1}.ano^{-1}$	Area (ha)	%
Muito baixo	< 10	1251.7	15.63
Baixo	10 a 20	28.5	0.36
Moderado	20 a 50	274.8	3.43
Alto	50 a 100	1041.4	13.00
Muito alto	> 100	5412.2	67.58
	Total	8008.6	100.01

A microbacia hidrográfica do rio Uraim está localizada na mesorregiões paraenses



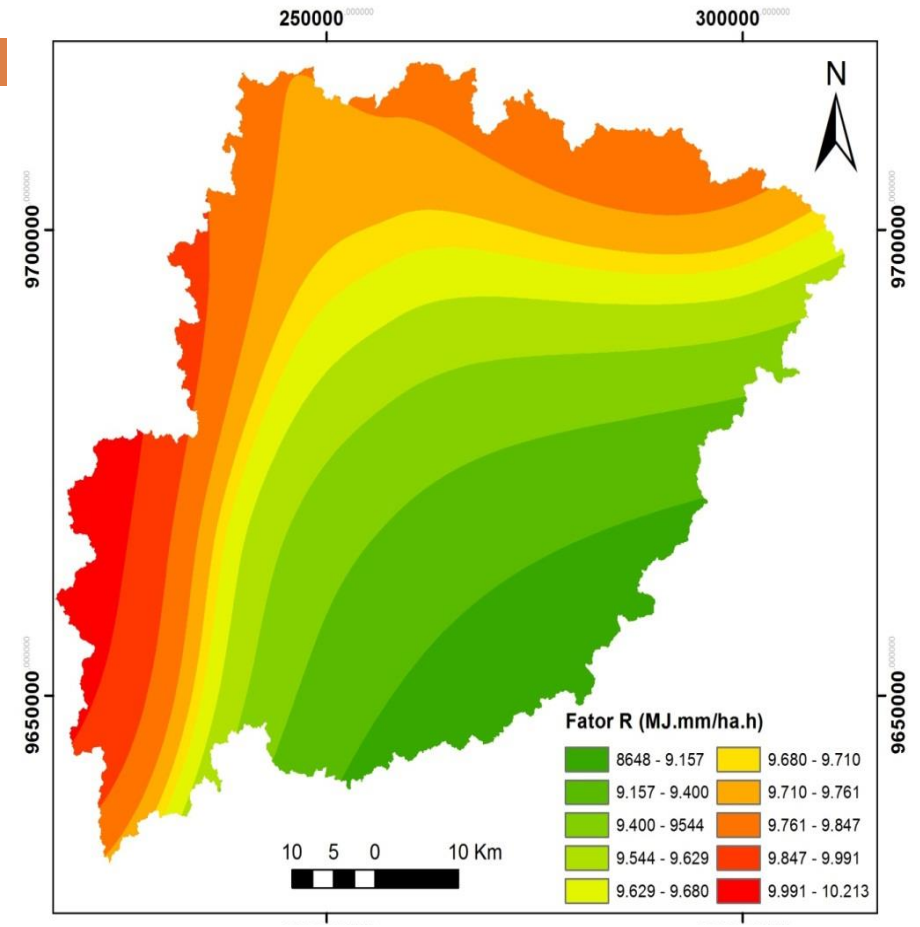


Figura 3 - Distribuição espacial do fator R.

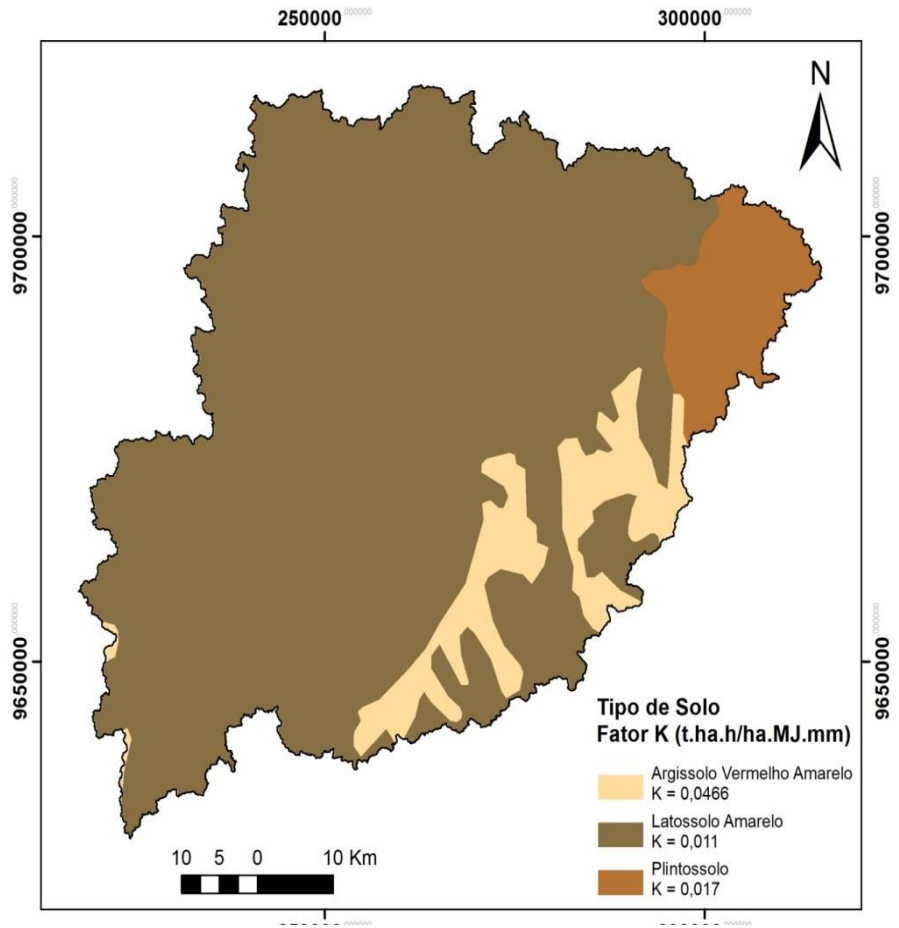


Figura 4 - Distribuição das unidades de mapeamento de solos da microbacia do Uraim

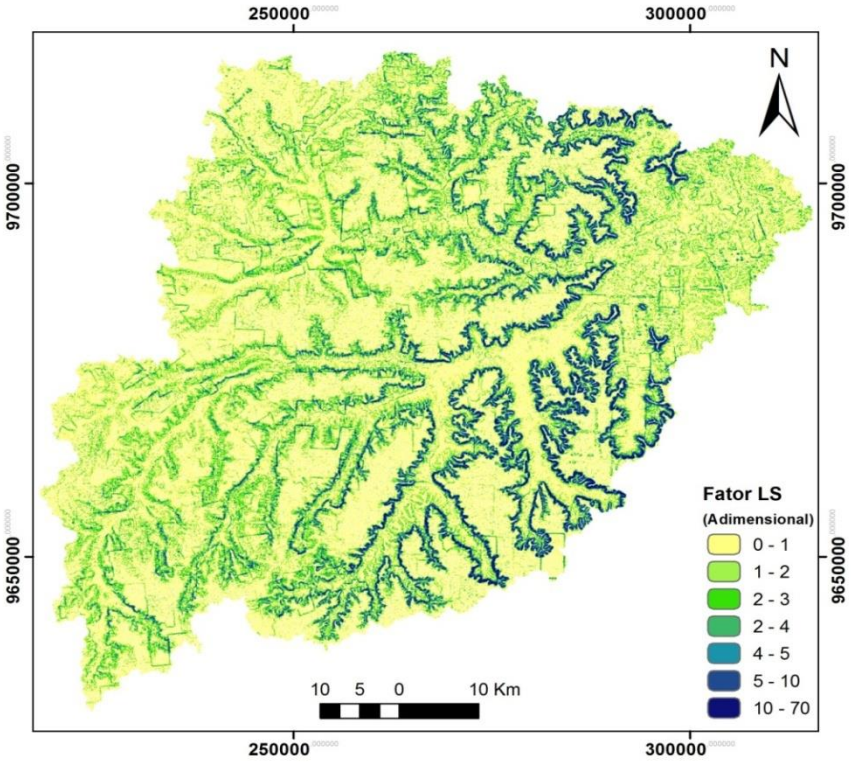


Figura 5 - Distribuição espacial do fator LS modificado.

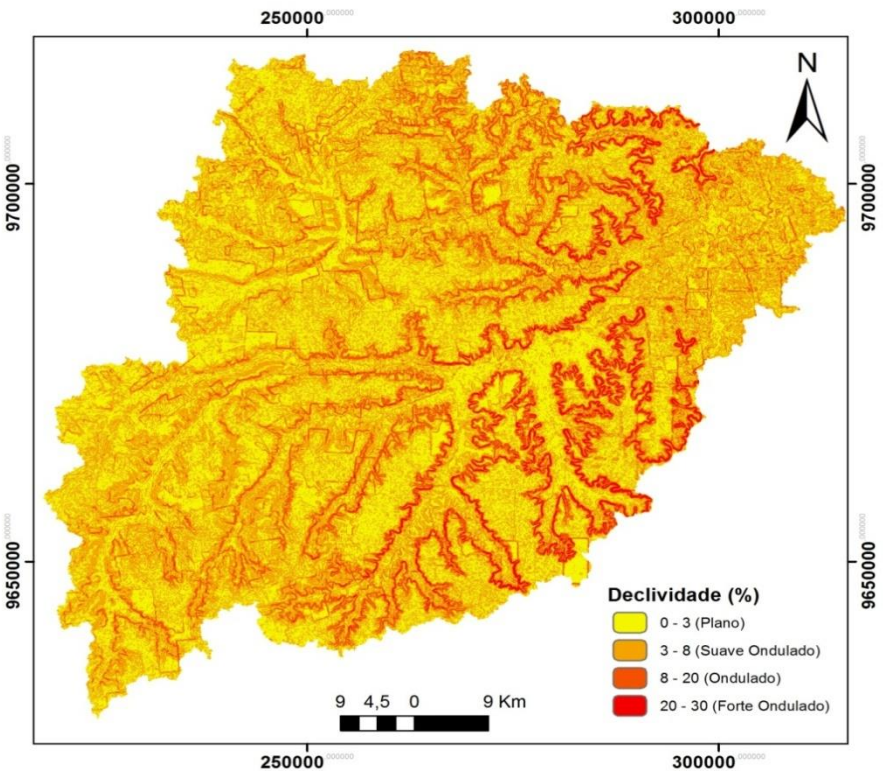


Figura 6 – Classes de Relevo e Declividade da microbacia do rio Uraim.

Tabela – Erosão Laminar no ano de 1984

Erosão Anual*	**A (t.ha^{-1}.ano^{-1})***	**Área (ha)**	**Cobertura Relativa (%)**
Nula a pequena	< 10	312.314,61	61,34
Moderada	10 a 15	48.748,93	9,57
Média	15 a 50	99.585,56	19,56
Média forte	50 a 120	30.581,34	6,01
Forte	120 a 200	8420,16	1,65
Muito Forte	> 200	9489,75	1,86
Total	-	509.140,36	100,00

Tabela - Erosão Laminar no ano de 2010

Erosão Anual*	**A (t.ha^{-1}.ano^{-1})***	**Área (ha)**	**Cobertura Relativa (%)**
Nula a pequena	< 10	256.399,88	50,36
Moderada	10 a 15	44.076,73	8,66
Média	15 a 50	120.218,22	23,61
Média forte	50 a 120	54.762,07	10,76
Forte	120 a 200	16.652,22	3,27
Muito Forte	> 200	17.031,22	3,35
Total	-	509.140,36	100,00

Tabela - Erosão Laminar anual Média em 1984 e 2010.

Ano	**Média A (t.ha^{-1}.ano^{-1})**
1984	23,034
2010	36,694
Incremento	13,660

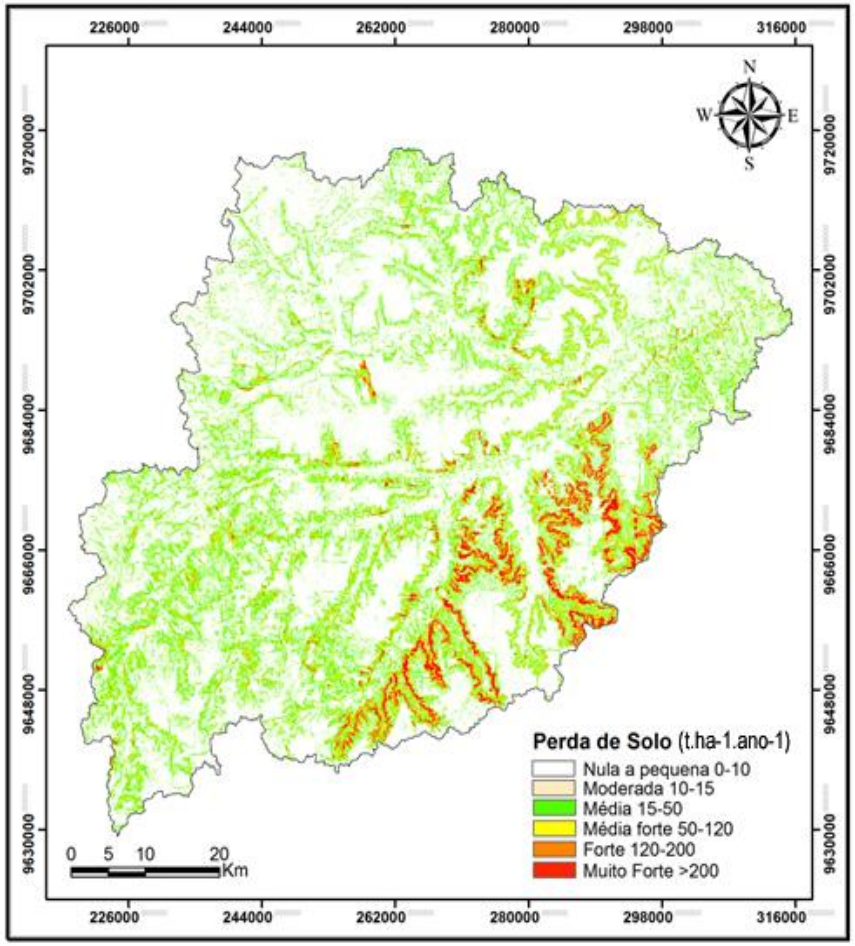


Figura 8 – Perda anual de solo na microbacia do rio Uraim no ano de 1984.

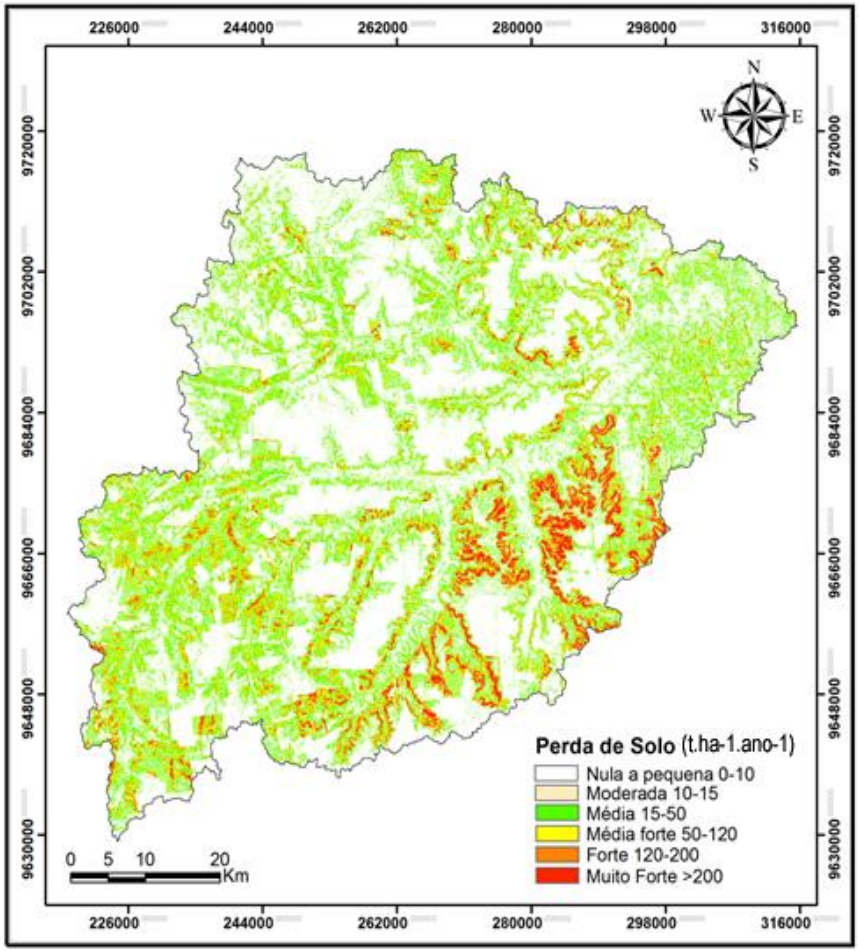


Figura 9- Perda anual de solo na microbacia do rio Uraim no ano de 2010.

Thank you!

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