University of São Paulo

EFFECTS OF ATLANTIC FOREST PATCHES ON WATER-REGULATION ECOSYSTEM SERVICES

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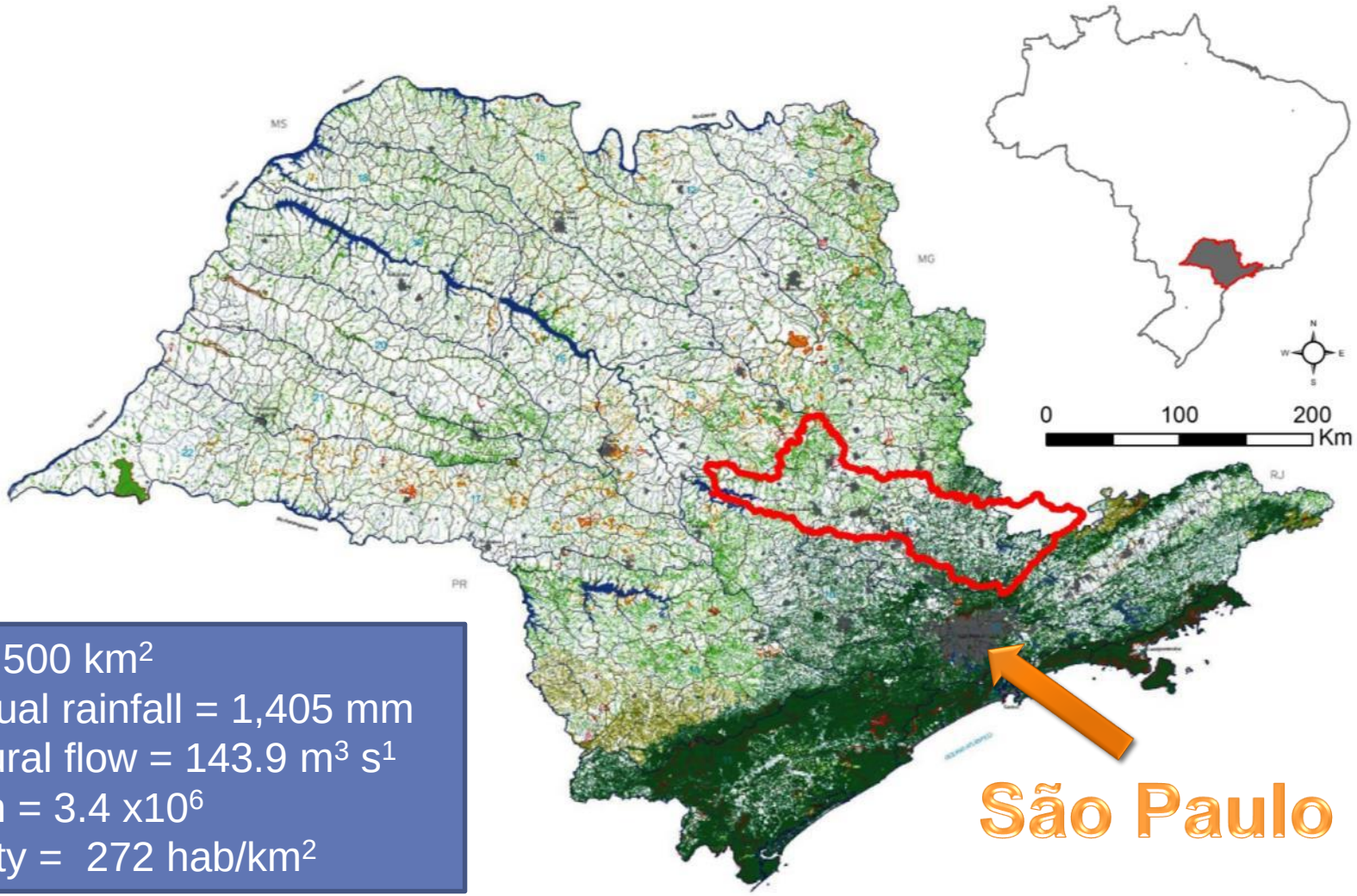
INTRODUCTION

- Forests today are results of diverse modification of the environment:
  - Biotic & Abiotic conditions;
  - Climate;
  - Anthropic patterns.

- Loss of forest cover has effects on ecossystem services:
  - Biodiversity;
  - Water quality & quantity;
  - Carbon stock, etc.

STUDY AREA – Piracicaba River Basin



- Area = 12,500 km^2
- Mean annual rainfall = 1,405 mm
- Mean natural flow = 143.9 $m^3 s^1$
- Population = 3.4 $x10^6$
- Pop density = 272 hab/km^2

OBJETICTIVES

Model:

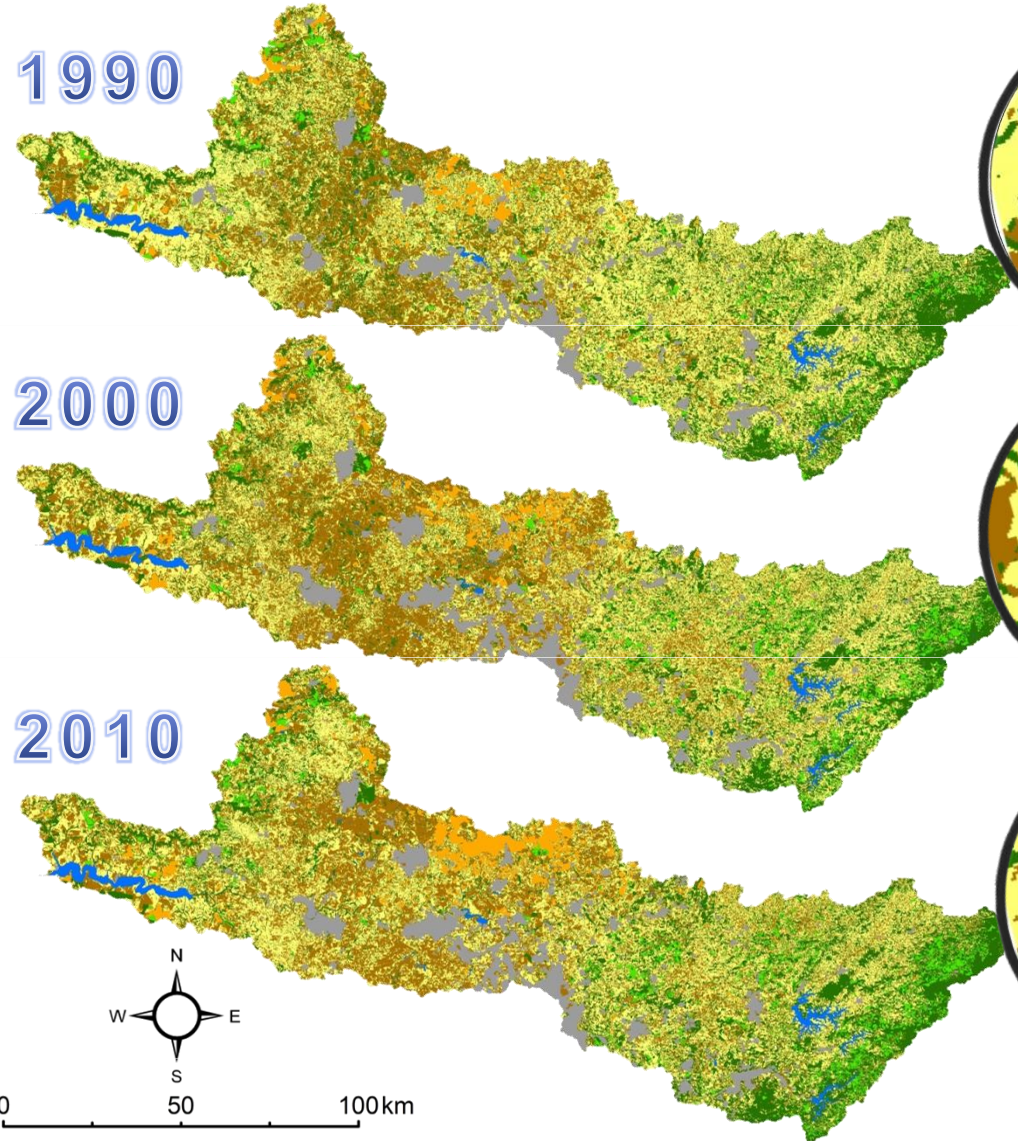
- Native vegetation cover for 2050 using 3 scenarios

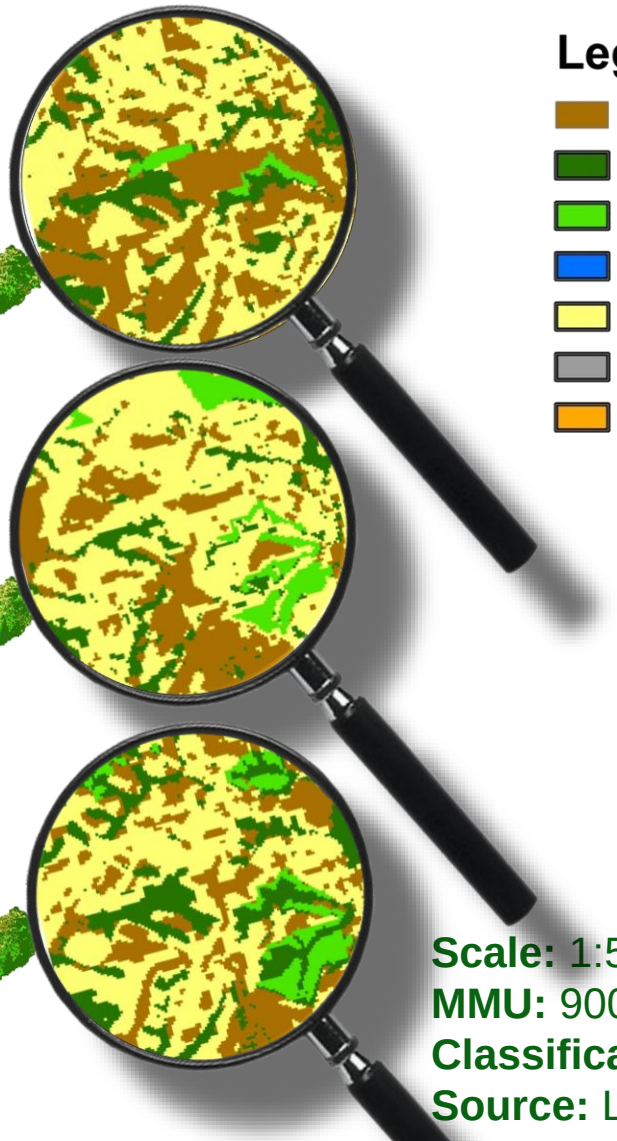
Compare:

- Annual mean flow
- Annual mean water yield
- Dry season water yield
- Wet season water yield

METHODOLOGY

Data Source





Legend

- Crops
- Native Forests
- Forest Plantations
- Water Bodies
- Pasture
- Urban
- Perennial Crops

Scale: 1:50,000
MMU: 900m²
Classification: Supervised
Source: Landsat 5 TM

Landscape Dynamics Analysis

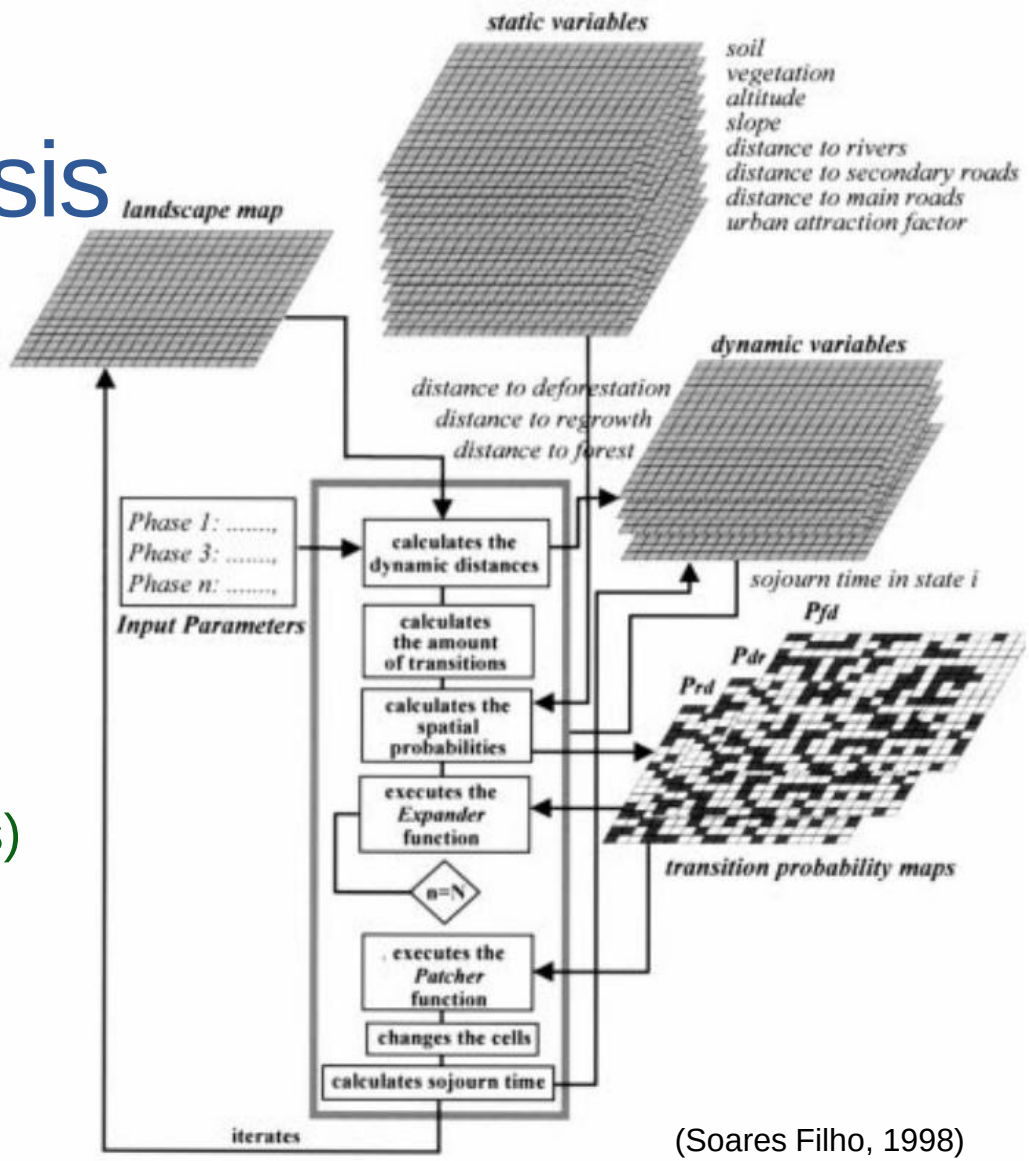
DINAMICA EGO 2.0

LULC for 2 periods

- 1990-2000 e 2000-2010

PRODUCTS:

- (1) Transition Matrices
- (2) Land Cover Change
- (3) Weights of Evidence (Drivers)
- (4) Future LC Scenarios



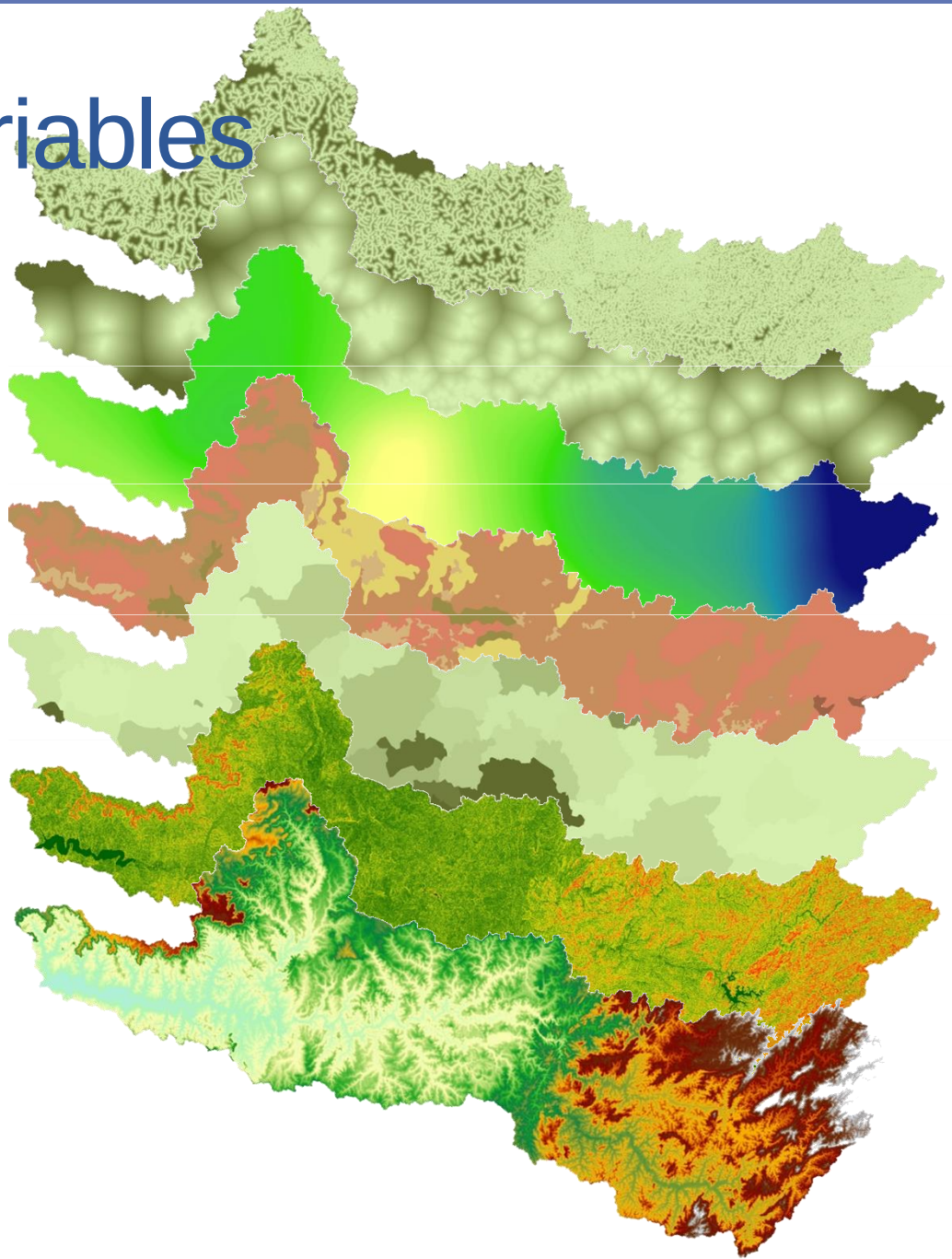
(Soares Filho, 1998)

For more information: http://www.csr.ufmg.br/dinamica, dinamica@csr.ufmg.br

Independent Variables

- **Physical**
  - Soil types
  - Distance to water (m)
  - Distance to forest (m)
  - Annual mean rainfall (mm)
  - Slope (%)
  - Altitude (m)

- **Anthropogenic**
  - Total Population Density
  - Rural Population Density
  - Gross Domestic Product
  - Distance to transportation
  - Distance to urban zones
  - Predominant land use



Native Vegetation Scenarios

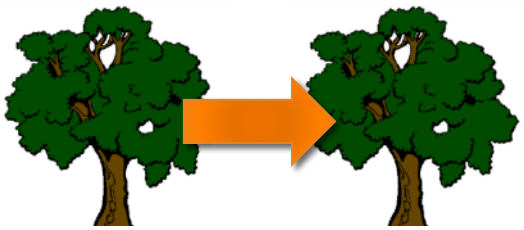
Status Quo (A),

Law Enforcement (B),

Riparian Law Enforcement (C)

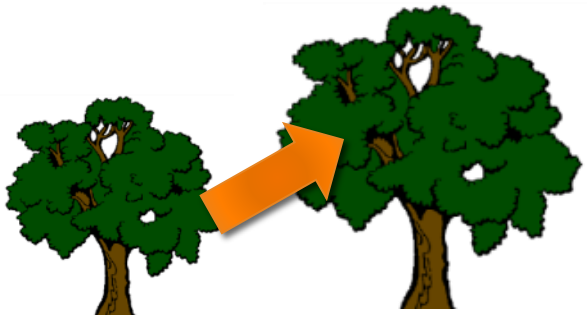
(A)

Last decade tendency



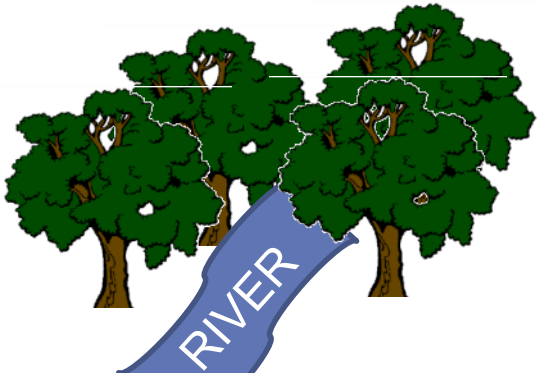
(B)

Last decade tendency
without deforestation



(C)

Riparian restoration
30, 50 & 100m

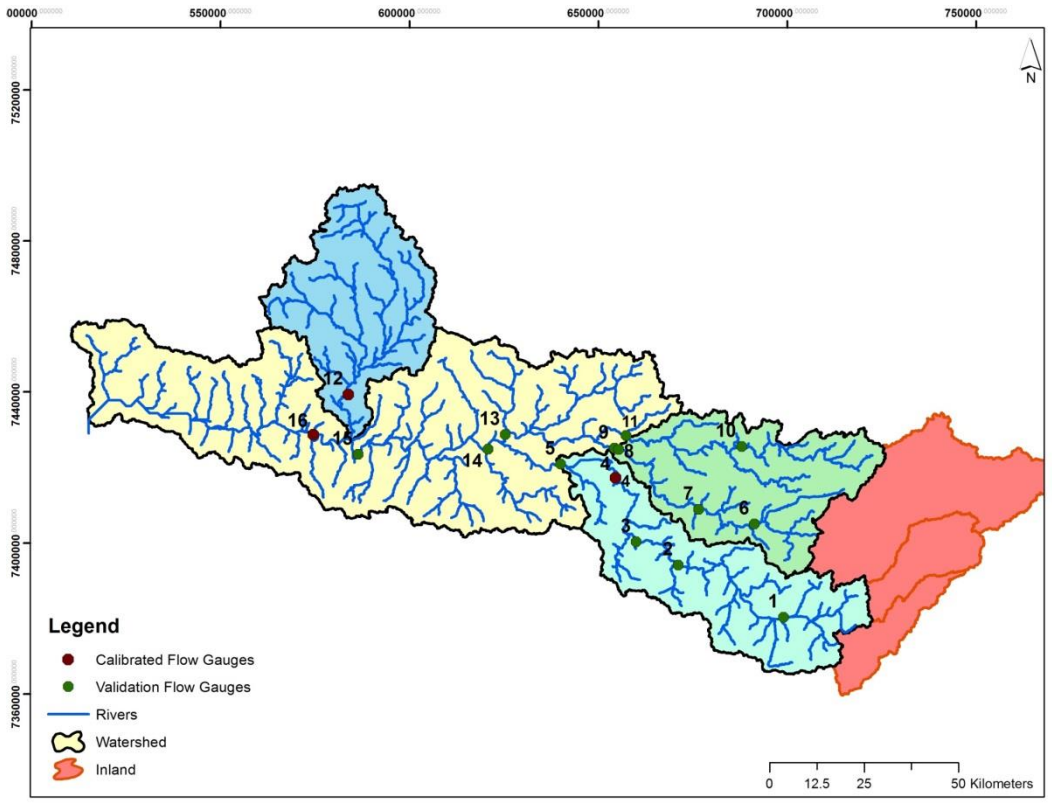


Hydrological Modeling

Soil & Water Assessment Tool | SWAT

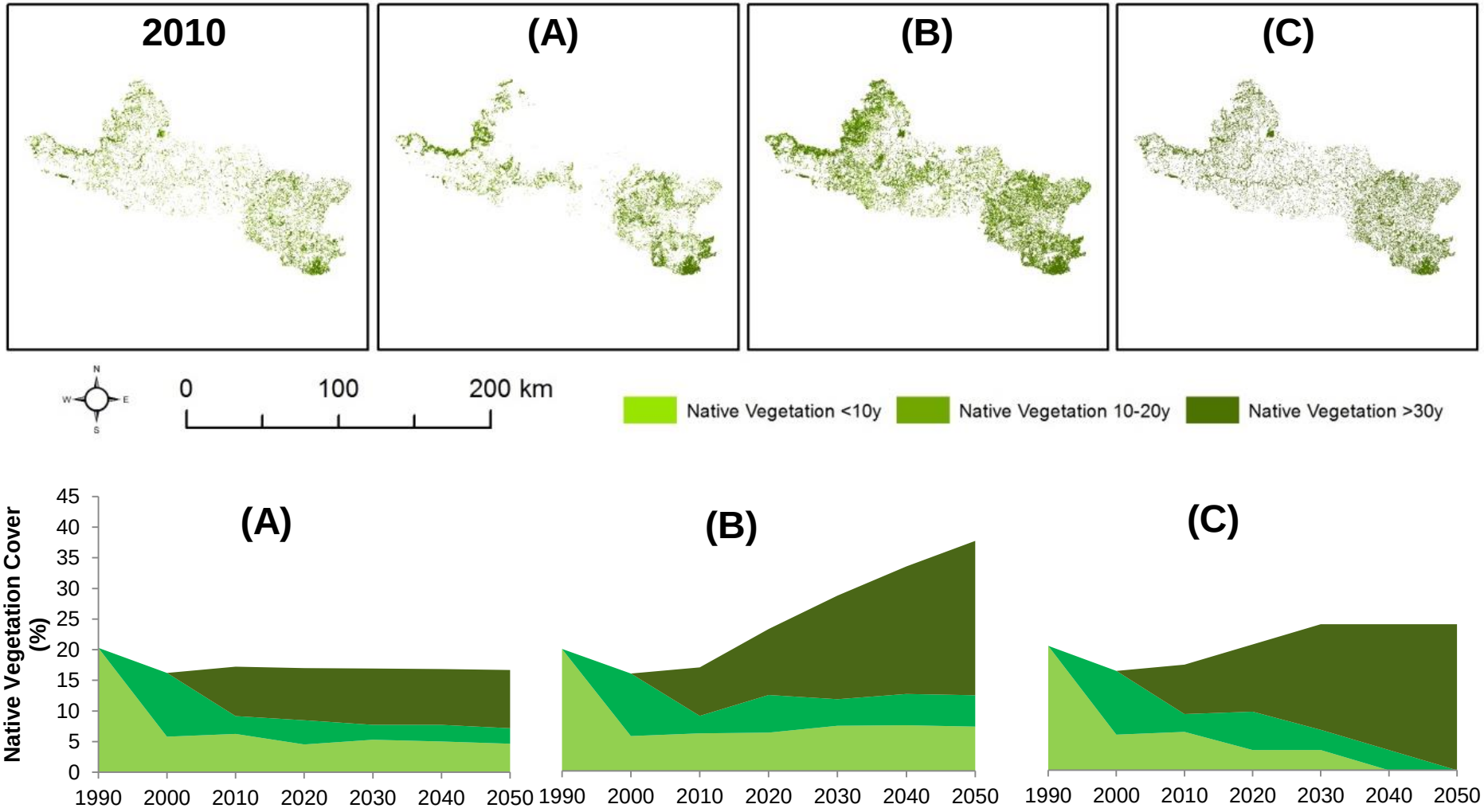
Bressiani, et al. 2014. Presented on the first day

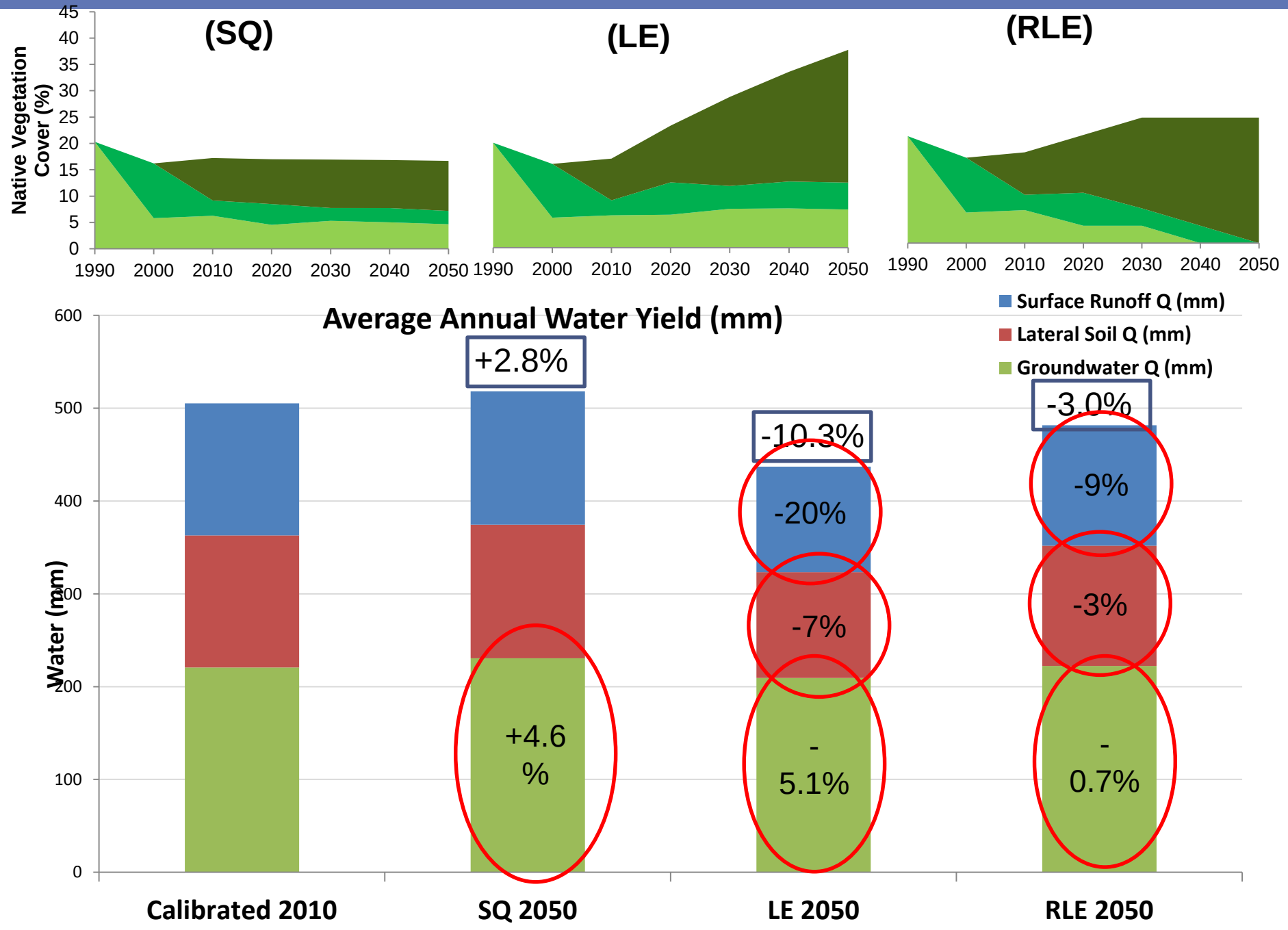
	NSE	BR2	PBIAS
1	0.65	0.79	15.81
2	0.73	0.75	13.58
3	0.75	0.86	9.58
4	0.76	0.86	3.95
5	0.80	0.83	13.40
6	0.76	0.82	-0.88
7	0.78	0.86	4.82
8	0.71	0.88	-7.94
9	0.86	0.69	-2.34
10	0.67	0.79	3.56
11	0.77	0.81	-1.58
12	0.66	0.72	-4.36
13	0.79	0.83	1.36
14	0.83	0.88	8.61
15	0.83	0.86	14.61
16	0.83	0.89	8.29



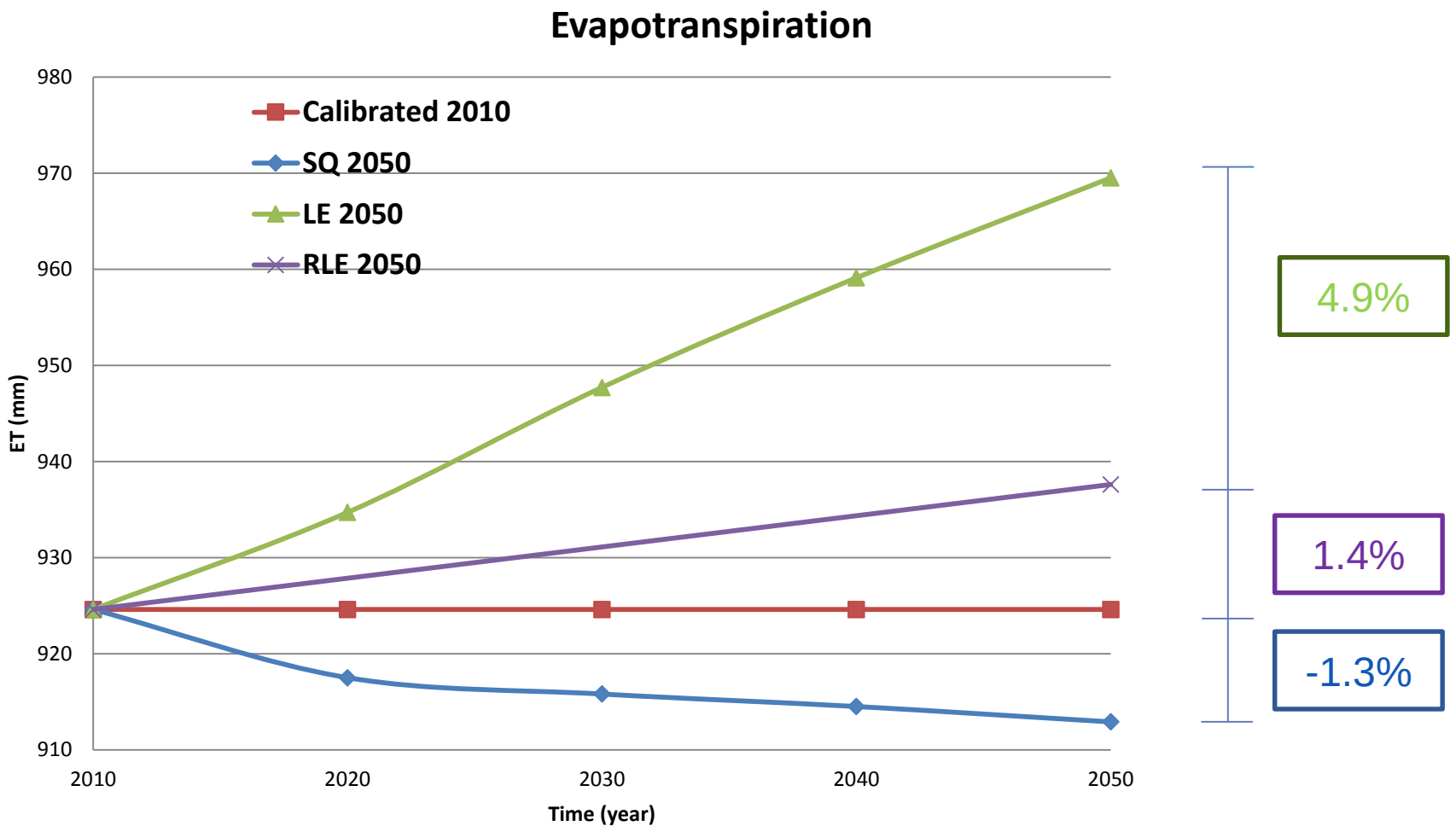
Forest Age & Cover

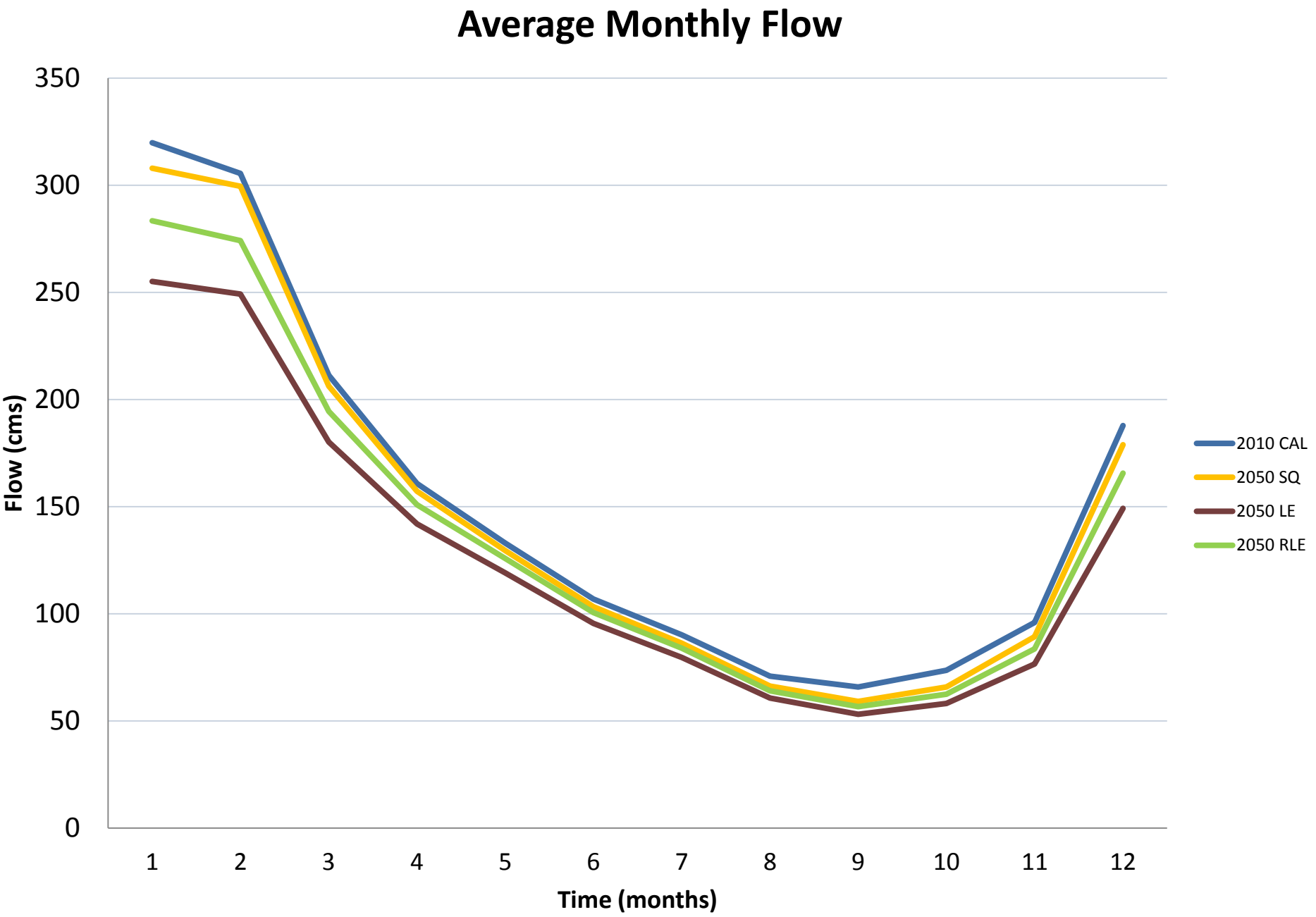
Status Quo (A),
Law Enforcement (B),
Riparian Law Enforcement (C)

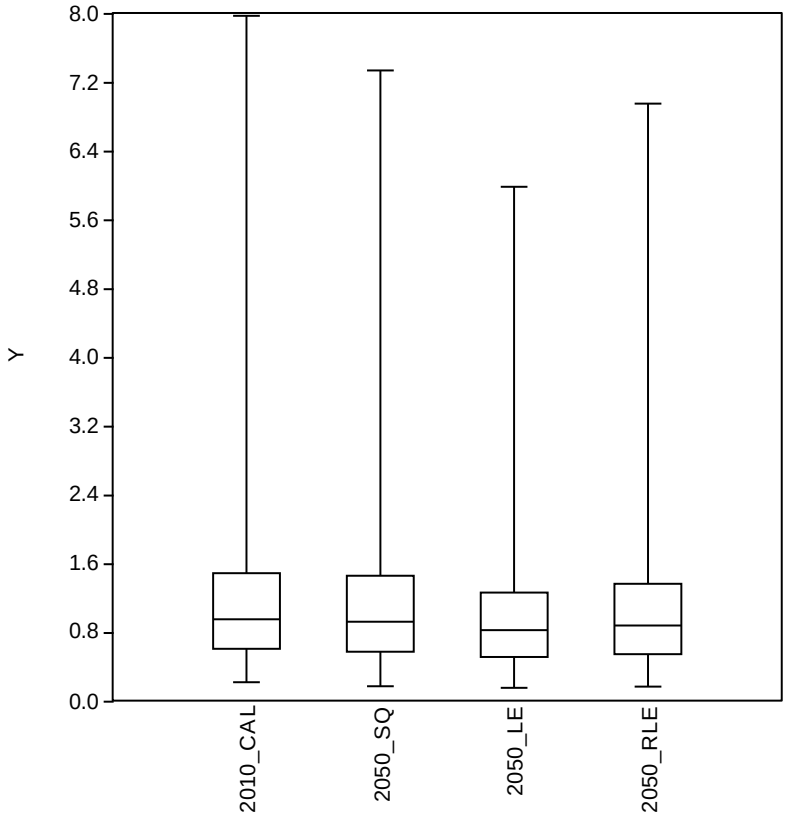



(SQ)
(LE)
(RLE)
Native Vegetation Cover (%)
45
40
35
30
25
20
15
10
5
0
1990
2000
2010
2020
2030
2040
2050
Average Annual Water Yield (mm)
Surface Runoff Q (mm)
Lateral Soil Q (mm)
Groundwater Q (mm)
Water (mm)
600
500
400
300
200
100
0
+2.8%
-10.3%
-3.0%
-20%
-7%
+4.6 %
- 5.1%
-9%
-3%
- 0.7%
Calibrated 2010
SQ 2050
LE 2050
RLE 2050

ET

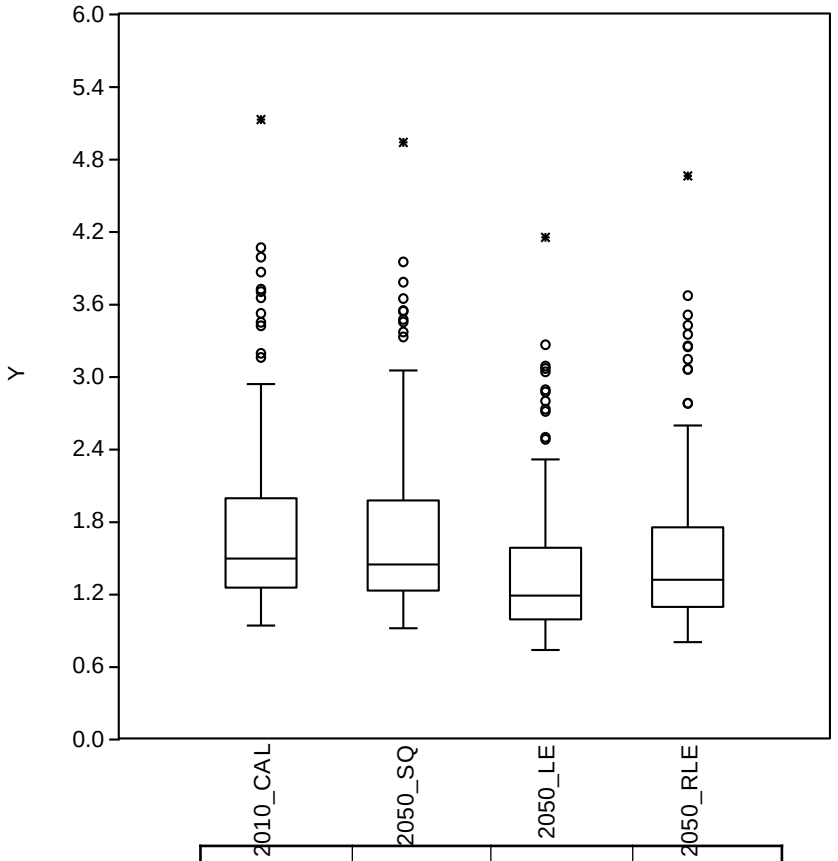

Evapotranspiration
980
970
960
950
940
930
920
910
ET (mm)
Calibrated 2010
SQ 2050
LE 2050
RLE 2050
2010
2020
2030
2040
2050
Time (year)
4.9%
1.4%
-1.3%


Average Monthly Flow
350
300
250
200
150
100
50
0
Flow (cms)
1
2
3
4
5
6
7
8
9
10
11
12
Time (months)
2010 CAL
2050 SQ
2050 LE
2050 RLE



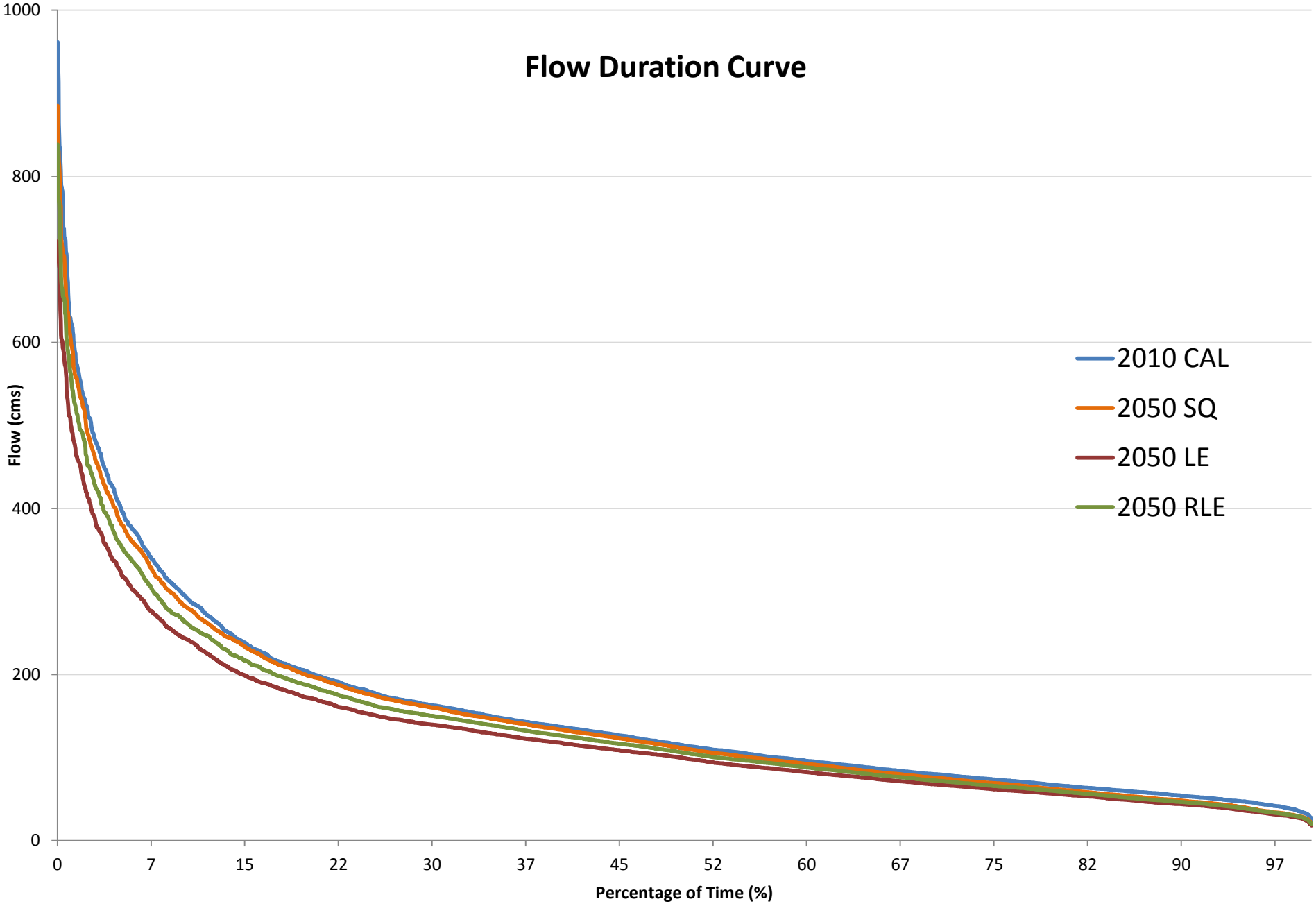
	2010_CAL	2050_SQ	2050_LE	2050_RLE
Min	0.22	0.17	0.15	0.16
Max	7.97	7.33	5.98	6.95
Variance	1.01	0.94	0.65	0.80
STD	1.01	0.97	0.81	0.90
Median	0.95	0.92	0.82	0.87

Flow/Watershed Area



	2010_CAL	2050_SQ	2050_LE	2050_RLE
Min	0.94	0.91	0.73	0.80
Max	5.12	4.93	4.15	4.66
Mean	1.80	1.74	1.43	1.59
Variance	0.69	0.63	0.44	0.56
STD	0.83	0.79	0.66	0.75
Median	1.50	1.44	1.19	1.31

100 Dry Days


Flow Duration Curve
1000
800
600
400
200
0
Flow (cms)
0
7
15
22
30
37
45
52
60
67
75
82
90
97
Percentage of Time (%)
2010 CAL
2050 SQ
2050 LE
2050 RLE

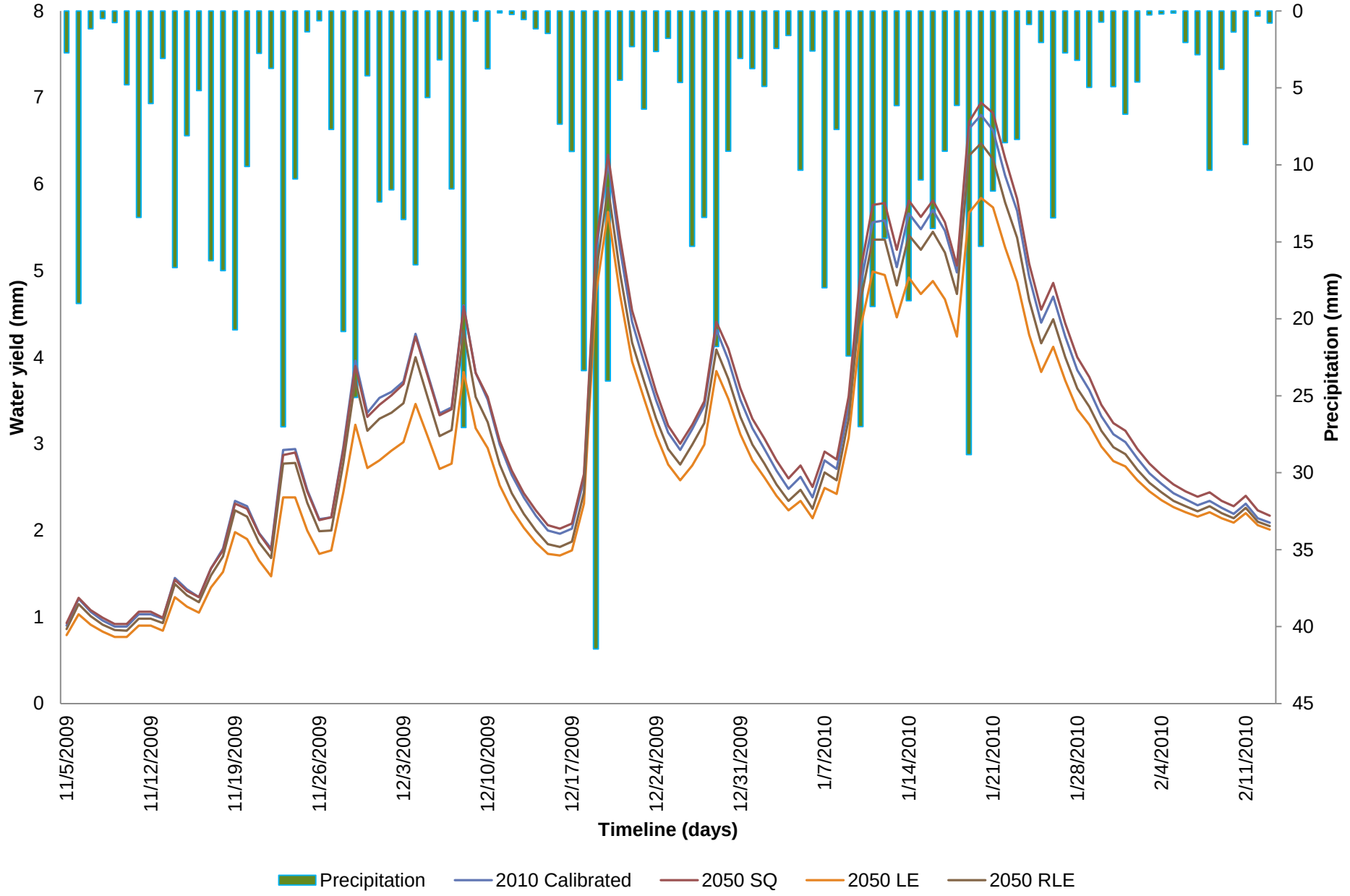


Figure 32. Water yield (mm) and precipitation (mm) outputs of individual scenarios of the Piracicaba River basin for a selected 100 days of rain season.

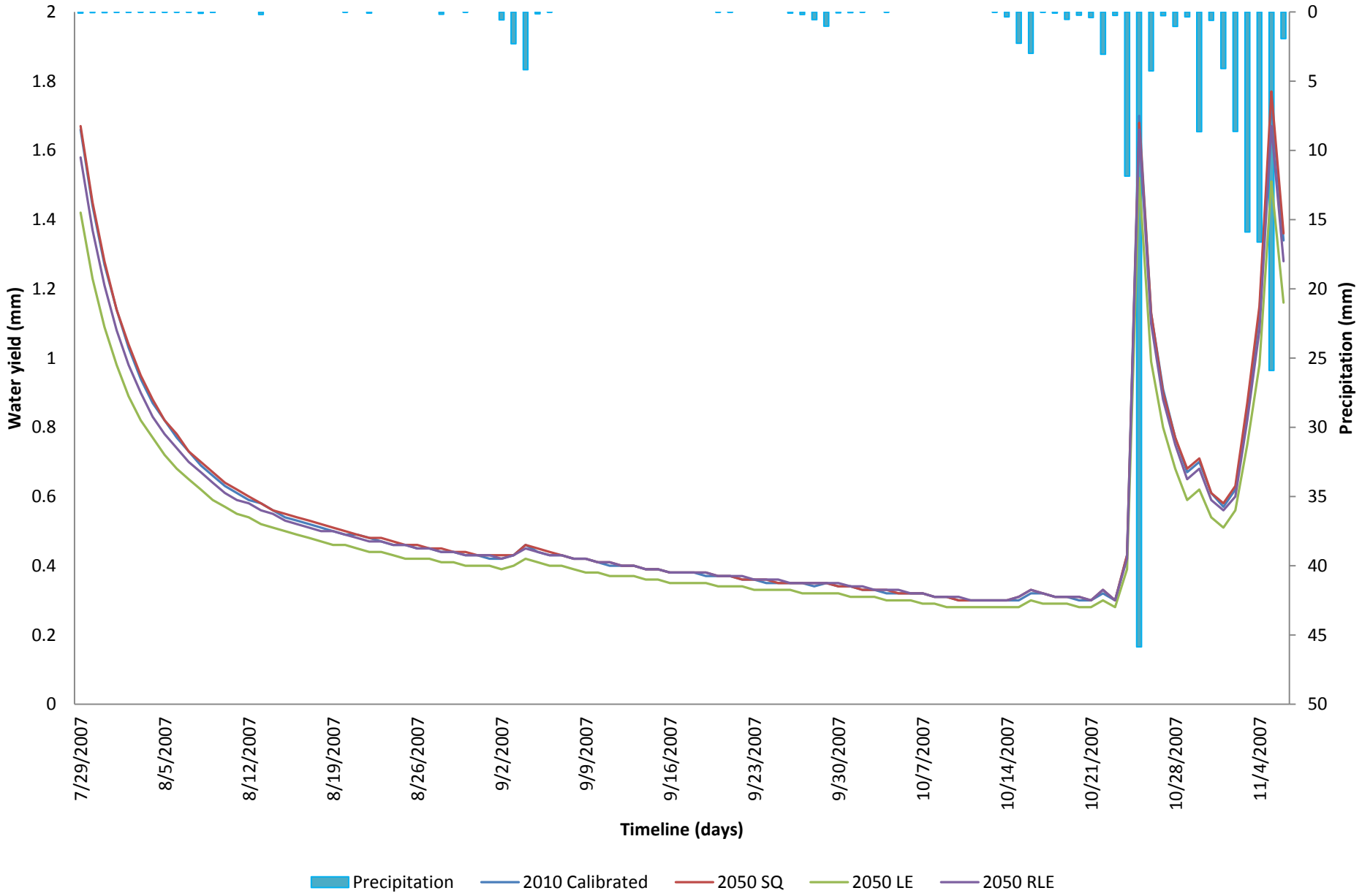
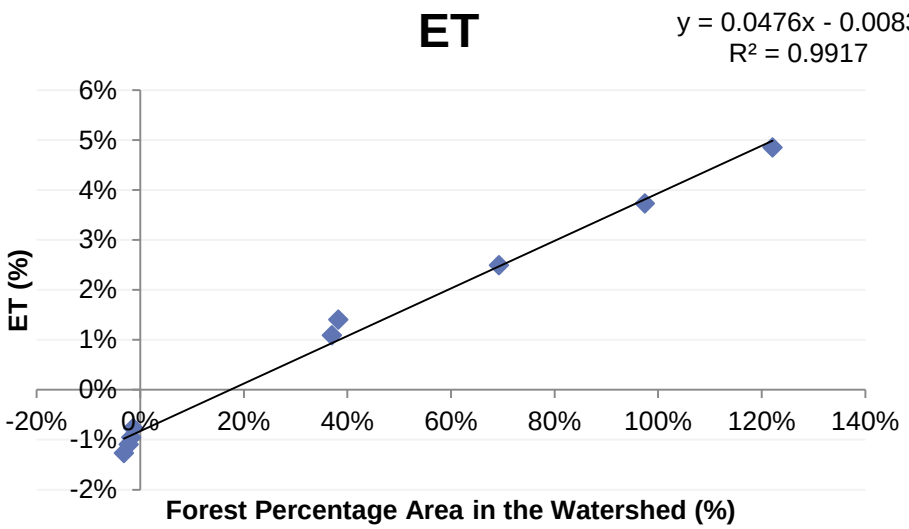
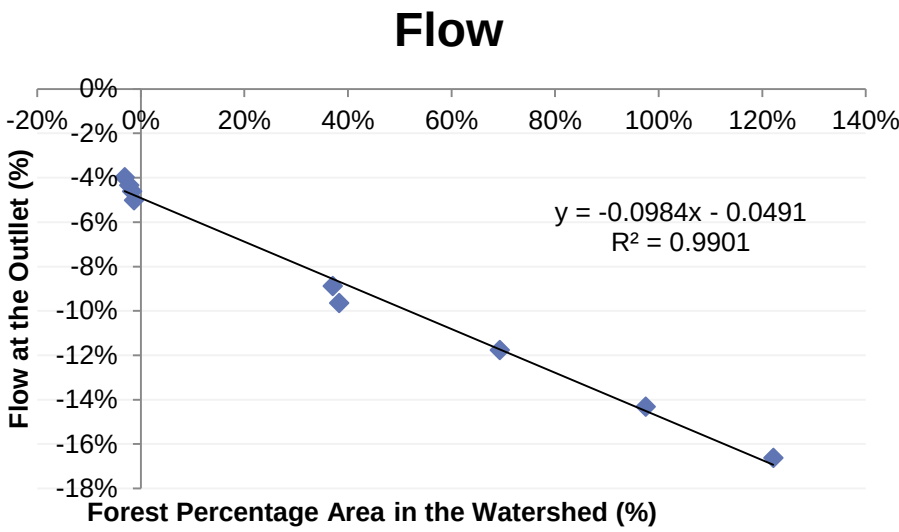
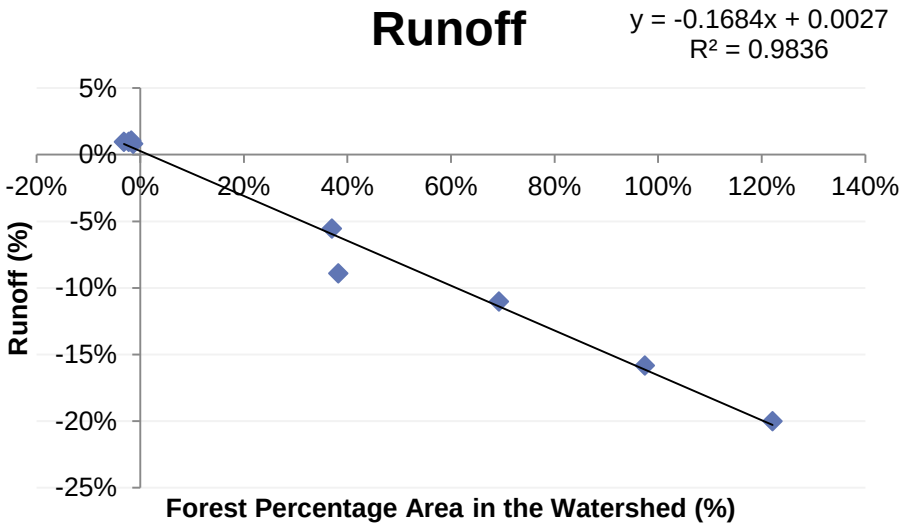
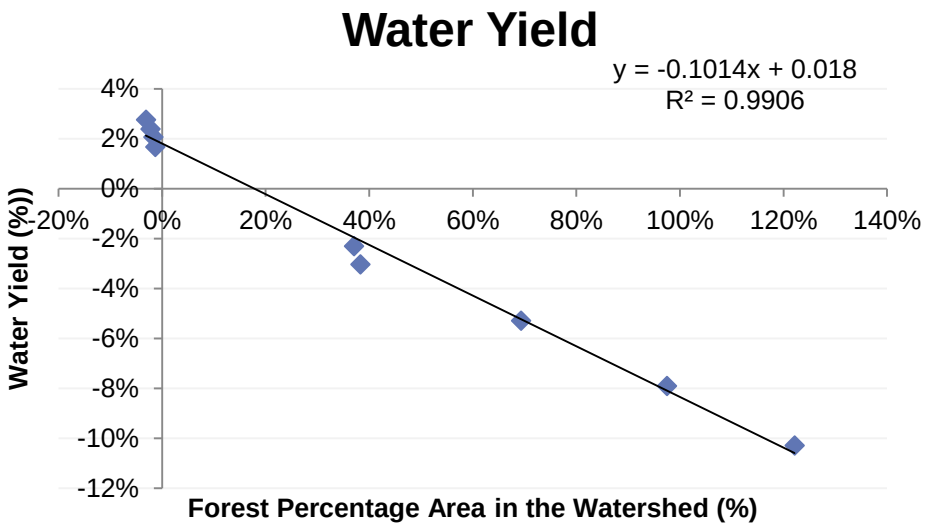


Figure 33. Water yield (mm) and precipitation (mm) outputs of individual scenarios of the Piracicaba River basin for a selected 100 days of drought season.


ET
y = 0.0476x - 0.0083
R² = 0.9917
ET (%)
Forest Percentage Area in the Watershed (%)


Flow
y = -0.0984x - 0.0491
R² = 0.9901
Flow at the Outllet (%)
Forest Percentage Area in the Watershed (%)


Runoff
y = -0.1684x + 0.0027
R² = 0.9836
Runoff (%)
Forest Percentage Area in the Watershed (%)


Water Yield
y = -0.1014x + 0.018
R² = 0.9906
Water Yield (%))
Forest Percentage Area in the Watershed (%)

Conclusions

- Decrease in forest:
  - ET increase
  - Flow decrease
  - Runoff decrease
  - Water yield decrease
- More analysis on spatial distribution differences
- Ecosystem payments services

ACKNOWLEGMENTS

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