FEDERAL UNIVERSITY OF ESPÍRITO SANTO
CENTER OF AGRICULTURAL SCIENCES AND ENGINEERS
POST-GRADUATION IN FOREST SCIENCES

DESENVOLVIMENTO E SELEÇÃO DE MODELO DE RISCO DE INCÊNDIOS FLORESTAIS

DEVELOPMENT AND SELECTION OF THE FOREST FIRE RISK MODEL

Jerônimo Monteiro
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Objective

- **Develop a database-based risk model and evaluate, along with three other forest fire risk methodologies**, which best represents the occurrence of forest fires in forest areas planted along the north-central coast of the state of Espírito Santo and the coast South of Bahia.

Specifics objectives

- Determination of areas with a homogeneous climate and Statistics on forest fires;
- Calculation and spatialization of forest fire risk indexes: Fire Weather Index (FWI); Monte Alegre Alterated Formula (FMA +) and Fire Risk of the National Institute of Space Research (RF);
- To develop a model for calculating the risk of forest fires based on the database (HORUS); and,
- Selection of risk models from the forest inventories cataloged by FIBRIA Celulose S. A.

Structure of work

- EMPIRICAL CLIMATE CLASSIFICATION BY HIERARCHICAL CLUSTER ANALYSIS: APPLICATION IN FOREST FIRE
- FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA
- APPLICATION AND ADJUSTMENT OF FIRE WEATHER INDEX (FWI) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

Structure of work

- APPLICATION AND ADJUSTMENT OF THE MODIFIED MOUNT ALEGRE FORMULA (FMA +) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA
- APPLICATION AND ANALYSIS OF FIRE RISK (RF) IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA
- DEVELOPMENT OF A FOREST FIRE RISK BASED ON A DATABASE IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

Structure of work

- SELECTION OF A FOREST RISK MODEL FOR THE AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND SOUTH OF THE BAHIA COAST

CHAPTER 1

EMPIRICAL CLIMATE CLASSIFICATION BY HIERARCHICAL CLUSTER ANALYSIS: APPLICATION IN FOREST FIRE

Introduction – Chapter 1

EMPIRICAL CLIMATE CLASSIFICATION BY HIERARCHICAL CLUSTER ANALYSIS: APPLICATION IN FOREST FIRE

- To carry out the empirical climatic classification in the light of the forest fires to perform the grouping of the meteorological stations, using the of Ward's method (1963), we are taking as input the following climatic variables:

- Monthly average precipitation,
- Monthly average air temperature,
- Monthly average relative humidity, and,
- Monthly average water deficit.

Methodology – Chapter 1

EMPIRICAL CLIMATE CLASSIFICATION BY HIERARCHICAL CLUSTER ANALYSIS: APPLICATION IN FOREST FIRE

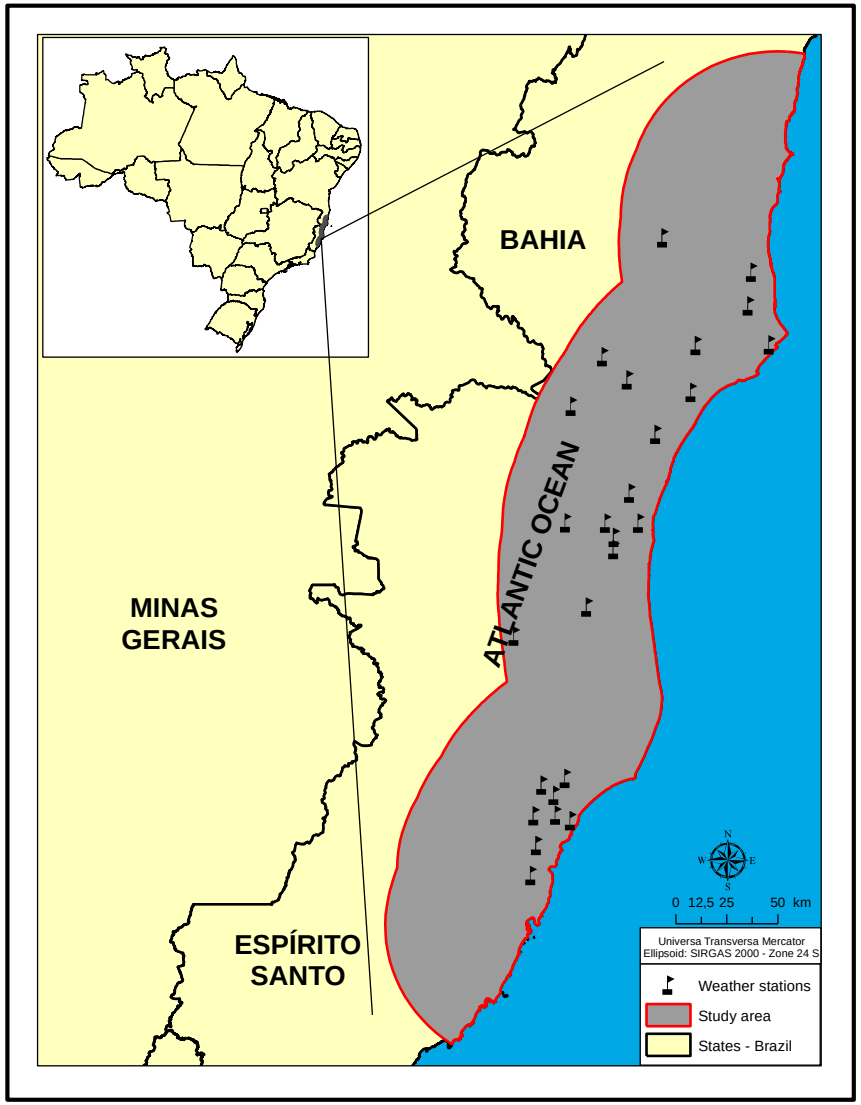


FIGURE 1: Study area.

Methodology – Chapter 1

EMPIRICAL CLIMATE CLASSIFICATION BY HIERARCHICAL CLUSTER ANALYSIS: APPLICATION IN FOREST FIRE

- Steps:

  - Step 1 - Definition of the study area and data preparation
  - Step 2 - Calculation of the water balance
  - Step 3 - Hierarchical grouping analysis
  - Step 4 - Group Validation
  - Step 5 - Spatialization of the climatic classification by the area of coverage of the grouped stations

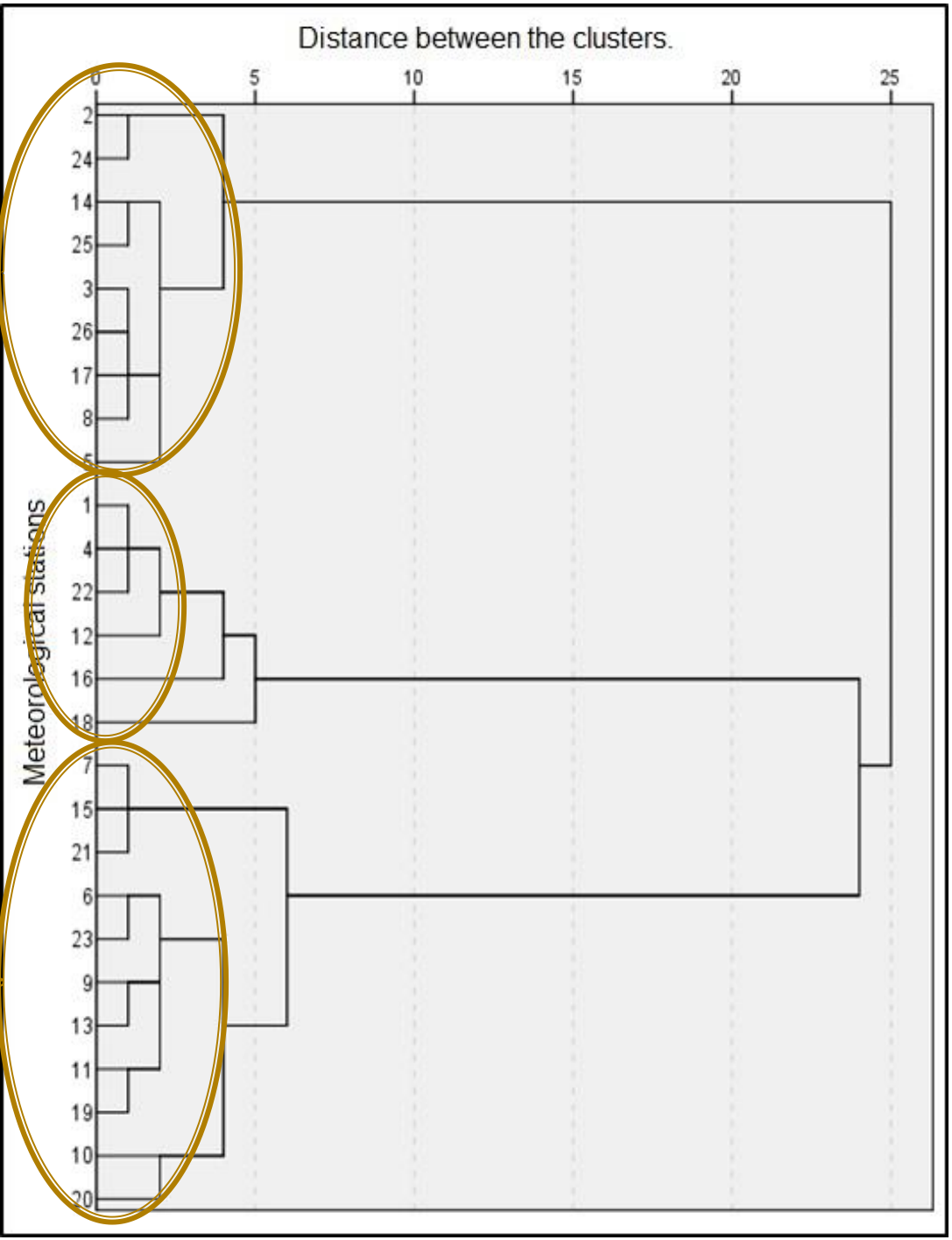


FIGURE 2: Dendrogram using Ward's method for clustering of meteorological stations.

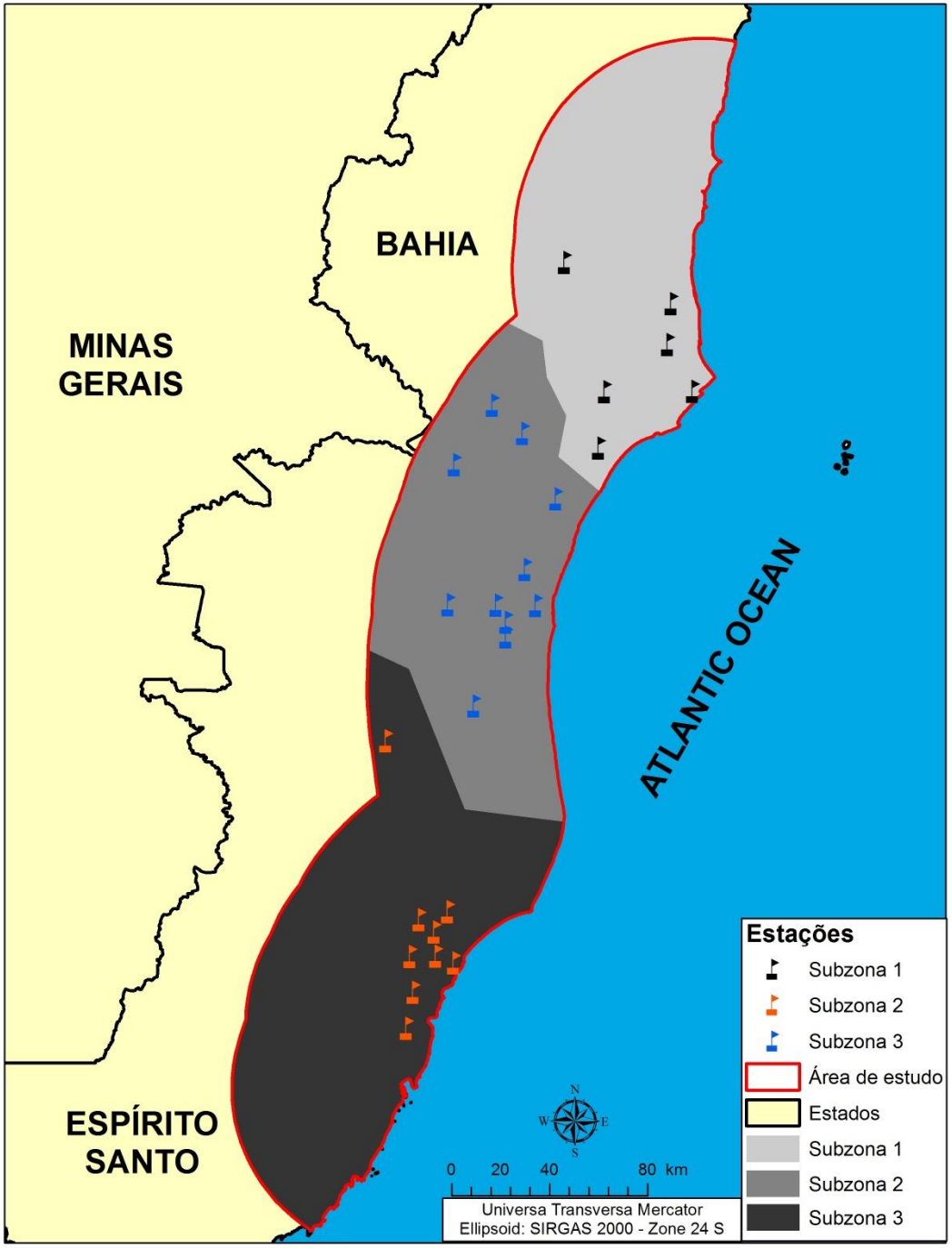
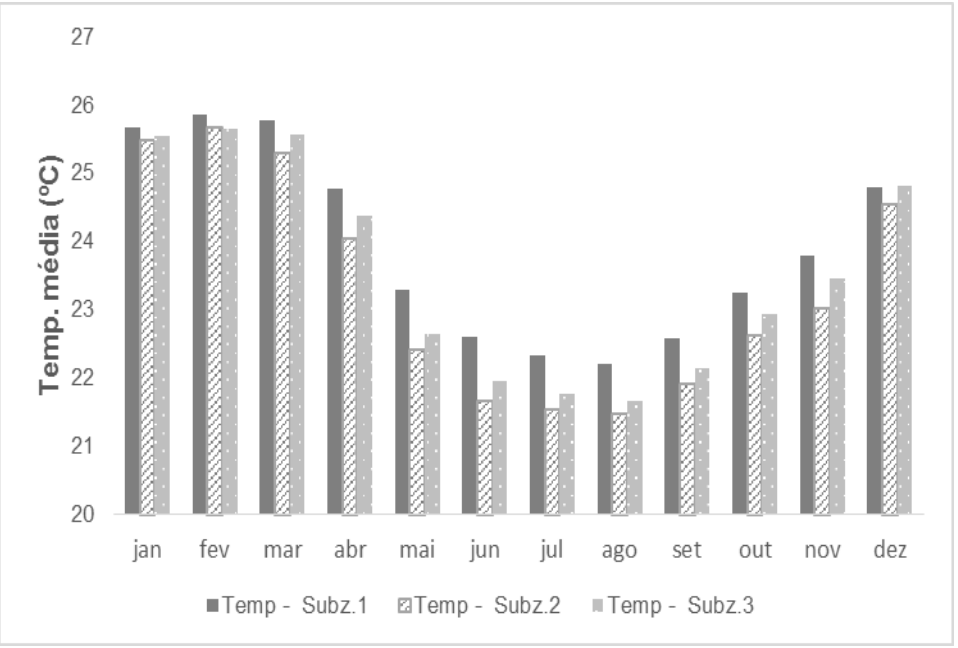
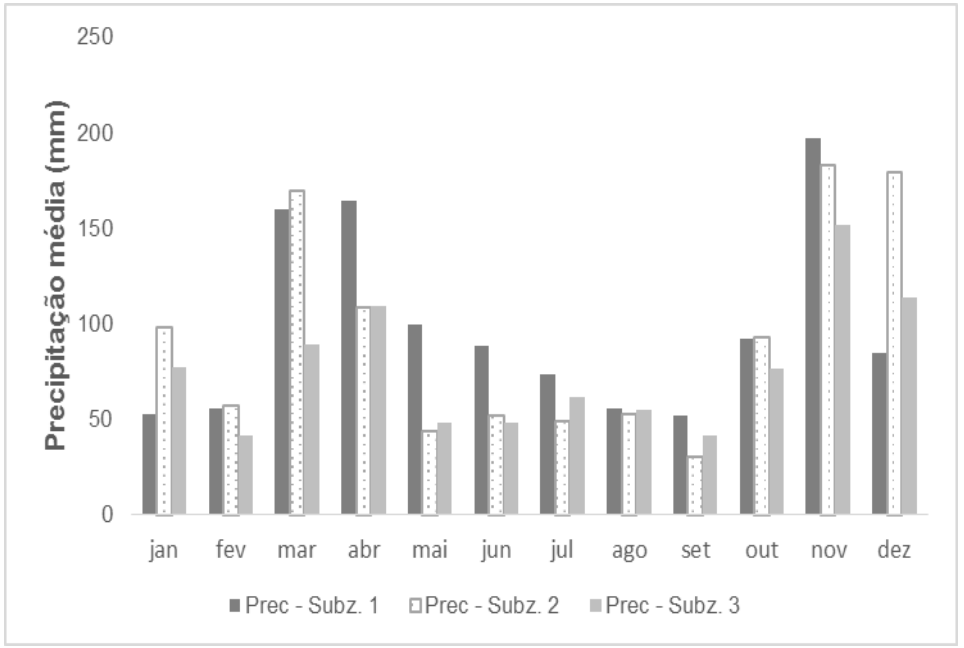
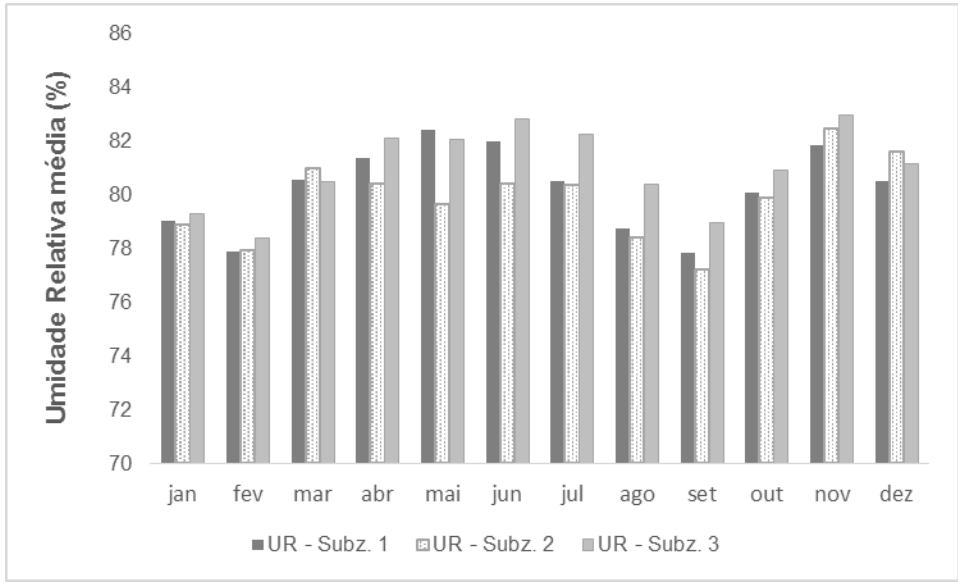


FIGURE 3: Spatial distribution of meteorological stations and climatic subzones after clustering.







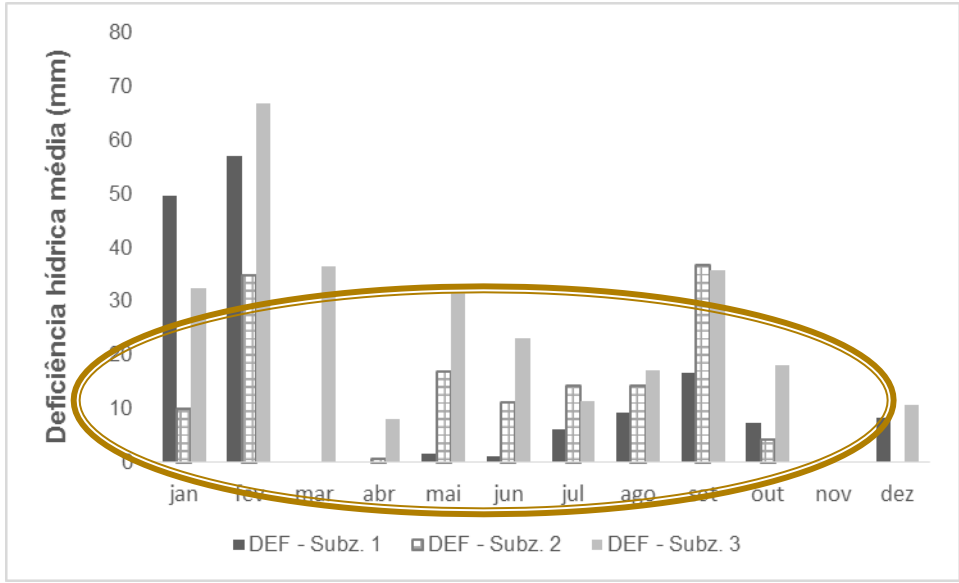


FIGURE 4: Distribution of temperature (°C), precipitation (mm), relative humidity (%) and monthly mean water deficit (mm) in climatic subzones.

Conclusions – Chapter 1

EMPIRICAL CLIMATE CLASSIFICATION BY HIERARCHICAL CLUSTER ANALYSIS: APPLICATION IN FOREST FIRE

- The methodology adopted proved to be efficient for the grouping of meteorological stations in three homogeneous climatic subzones for the study area.
- The cophenetic correlation coefficient proved to be efficient when validating the cluster obtained by the Ward's method.
- The analysis of climatic variables, air temperature, rainfall, relative humidity and water deficit is useful for the consolidation of the study, however, the visual analysis of these variables only is impracticable to perform the climatic classification.

CHAPTER 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

Introduction – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

- It aims to characterize how the meteorological and physical variables of the terrain correlate with the parameters of occurrence of forest fires on the central-north coast of the state of Espírito Santo and the south coast of Bahia.

Methodology – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

- *Acquisition of the database on forest fires*
- *Characterization of the forest fire regime:*
  - *Temporal aspect;*
  - *Space aspect;*
  - *Causal aspect.*

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

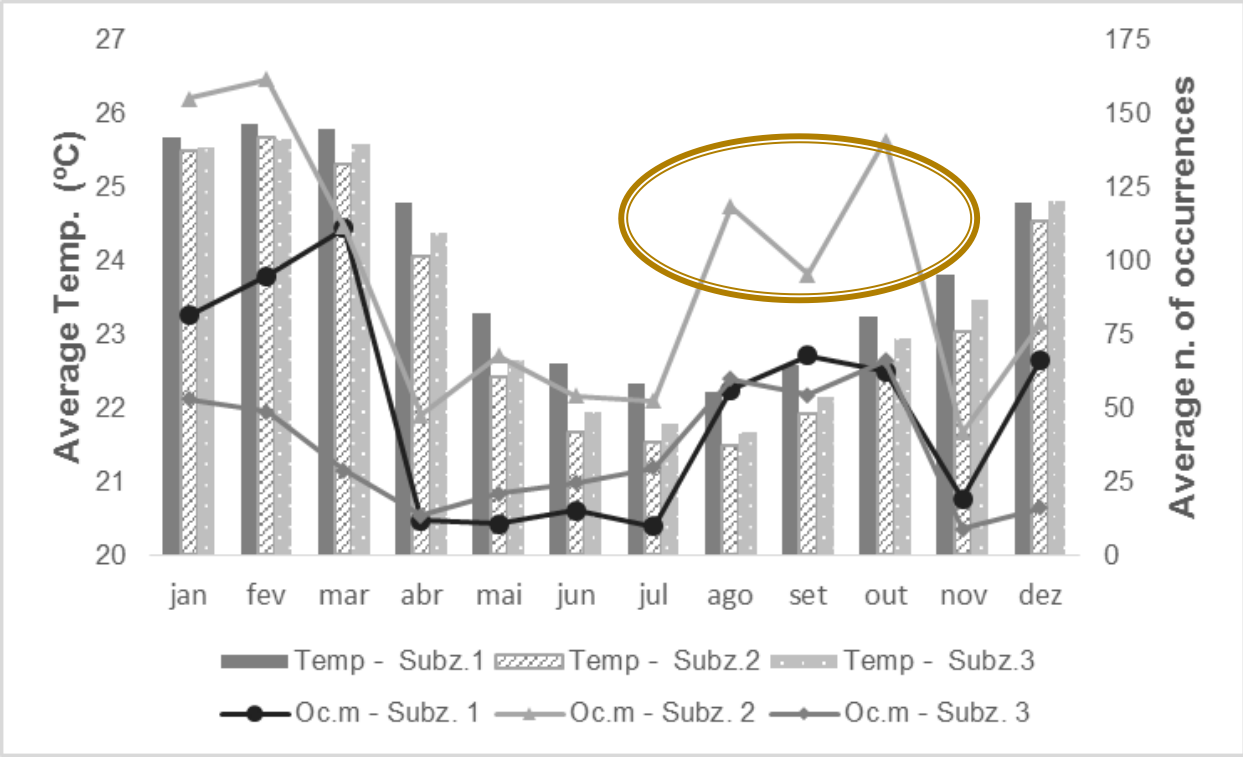


Figure 1 – Graph the average temperature distribution (Temp), and the average number of occurrence of forest fires (Oc.m) for the months of the year, for each subarea in the study area.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-

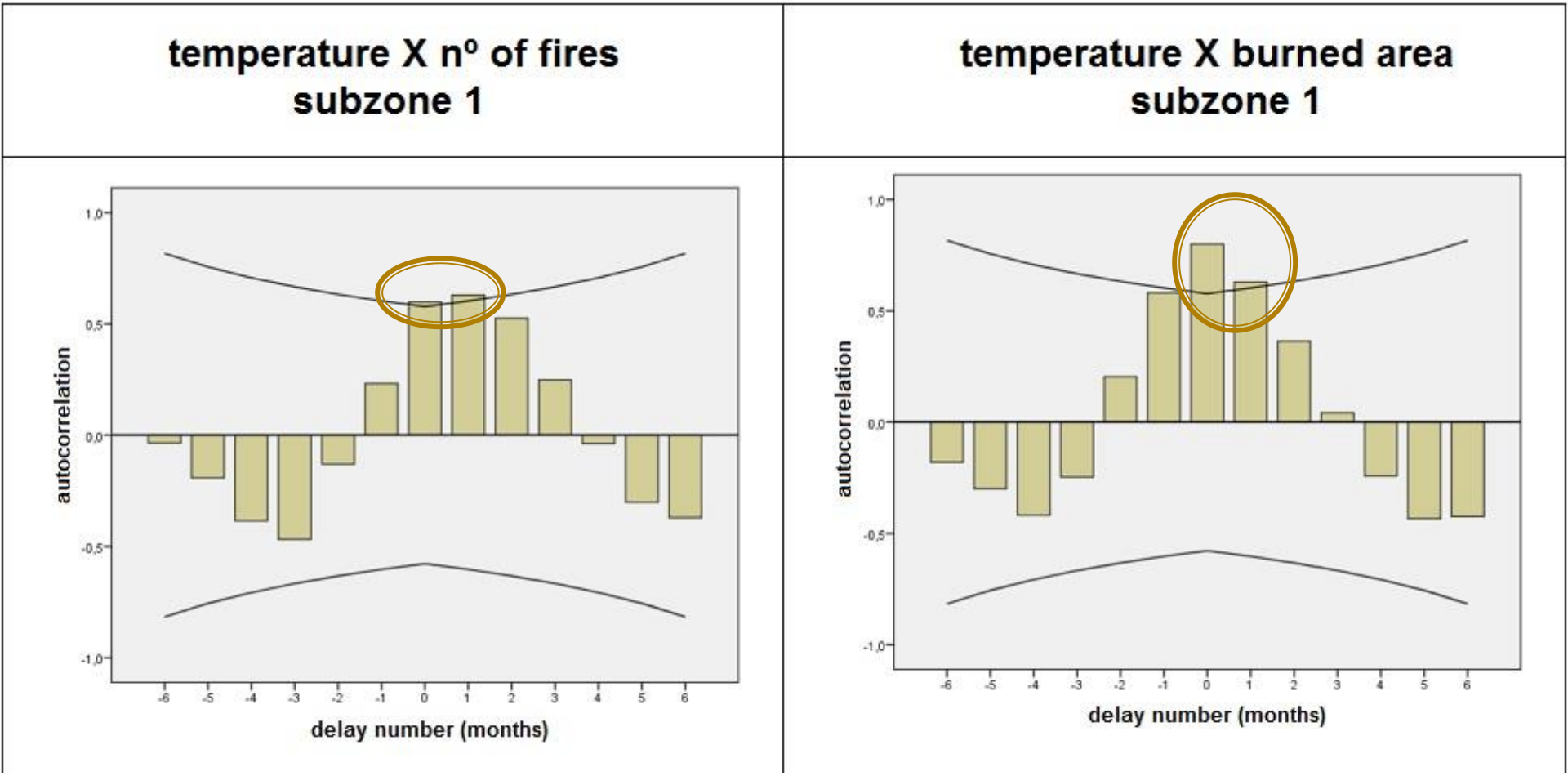


Figure 2 - Autocorrelation graphs between monthly average temperature and forest fires (number of fires and burned area) for subzone 1, for each month within the analyzed period.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

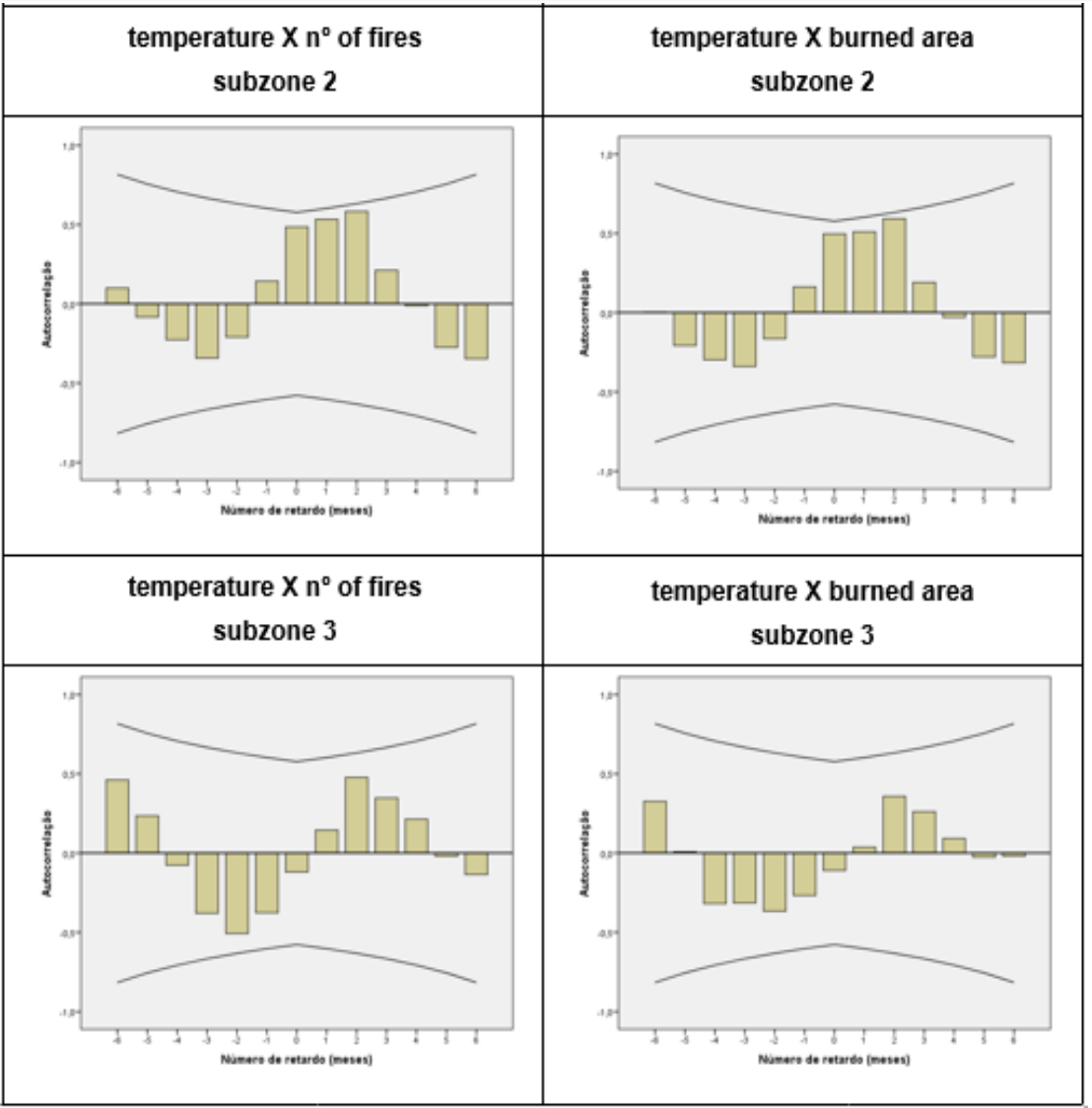


Figure 3 - Autocorrelation graphs between monthly average temperature and forest fires (number of fires and burned area) for subzone 2 and 3, for each month within the analyzed period.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

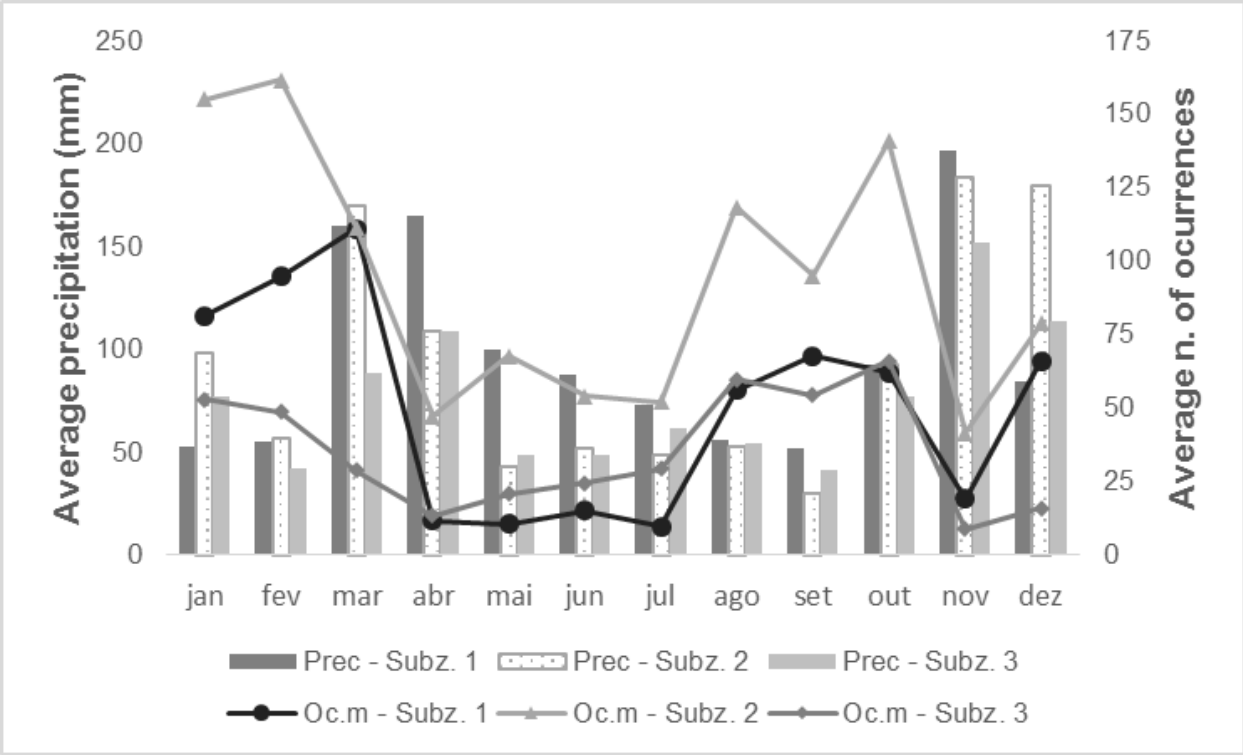


Figure 4 – Graph the average precipitation distribution (Prec), and the average number of occurrence of forest fires (Oc.m) for the months of the year, for each subarea in the study area.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

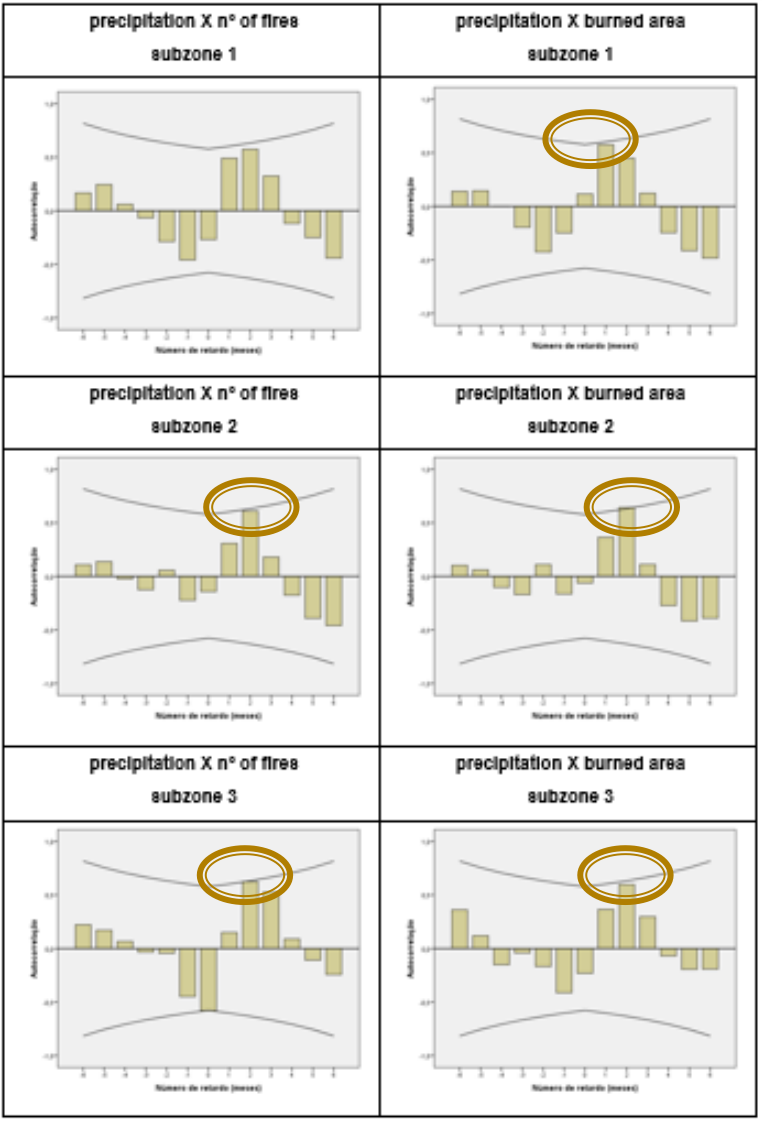


Figure 5 - Autocorrelation graphs between monthly average precipitation and forest fires (number of fires and burned area) for subzones 1, 2 and 3, for each month within the analyzed period.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

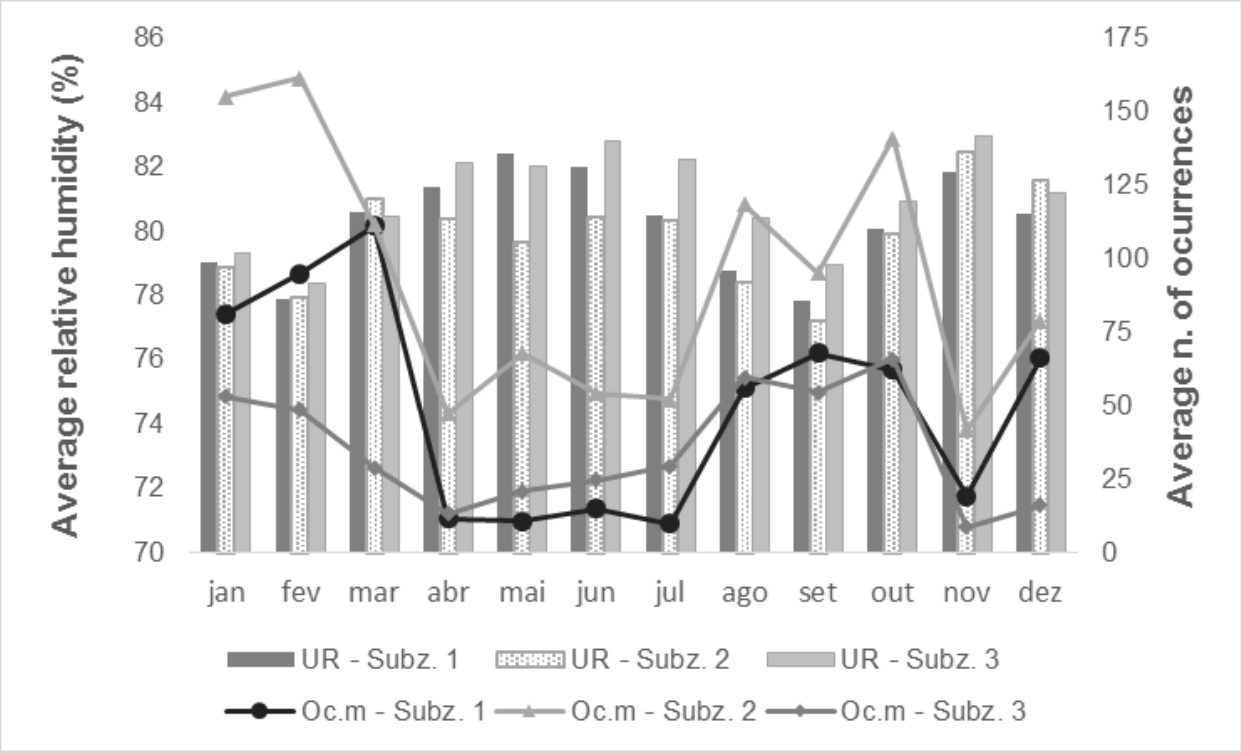


Figure 6 – Graph of the average humidity relative distribution (UR), and the average number of occurrence of forest fires (Oc.m) for the months of the year, for each subarea in the study area.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

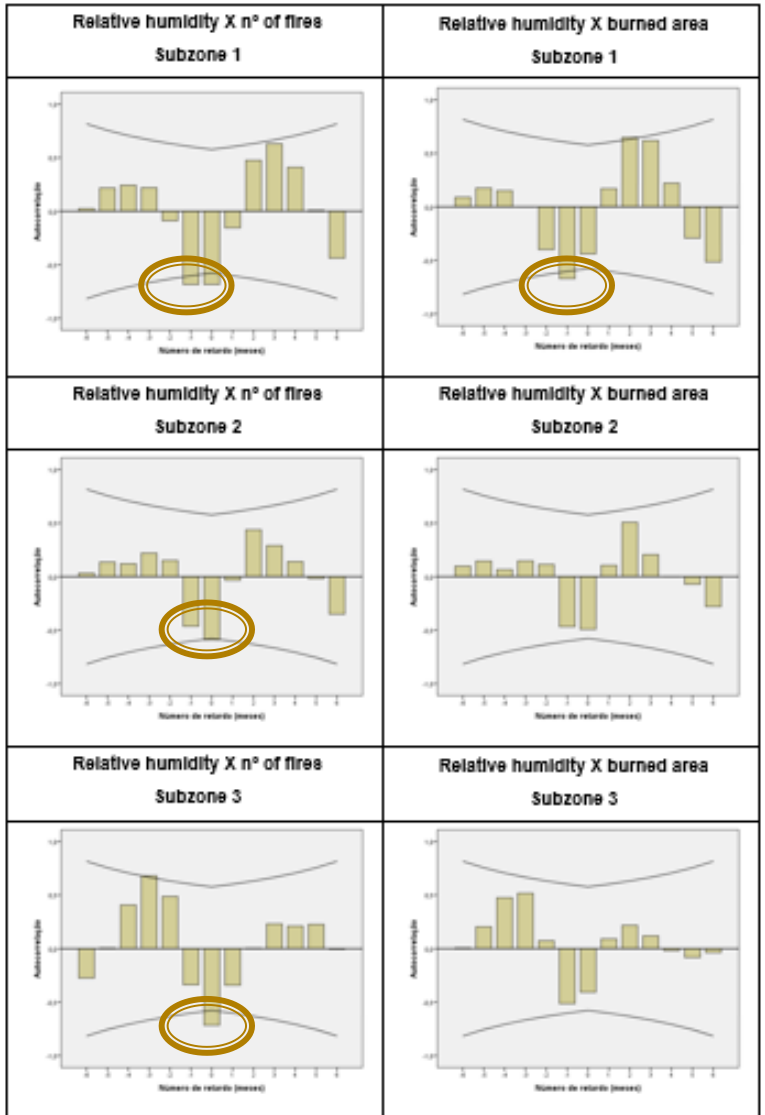


Figure 7 - Autocorrelation graphs between monthly average humidity relative and forest fires (number of fires and burned area) for subzones 1, 2 and 3, for each month within the analyzed period.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

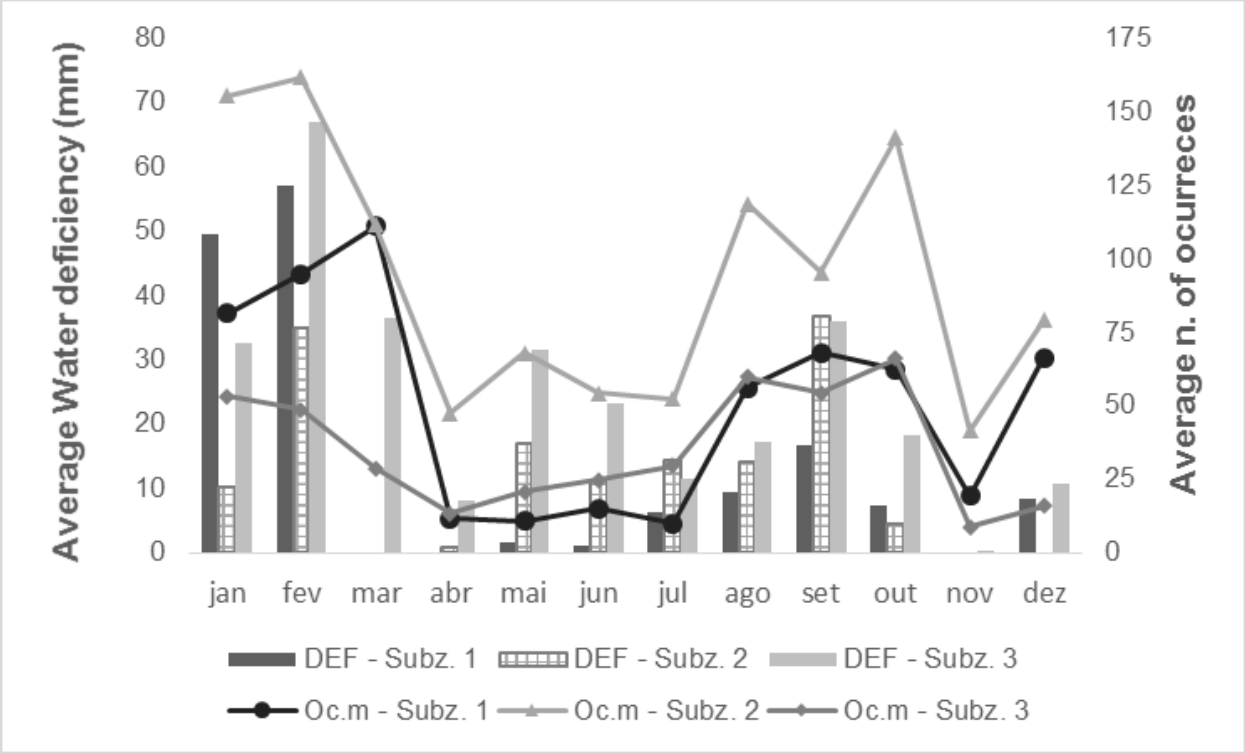


Figure 8 – Graph the average water deficit distribution (DEF), and the average number of occurrence of forest fires (Oc.m) for the months of the year, for each subarea in the study area.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

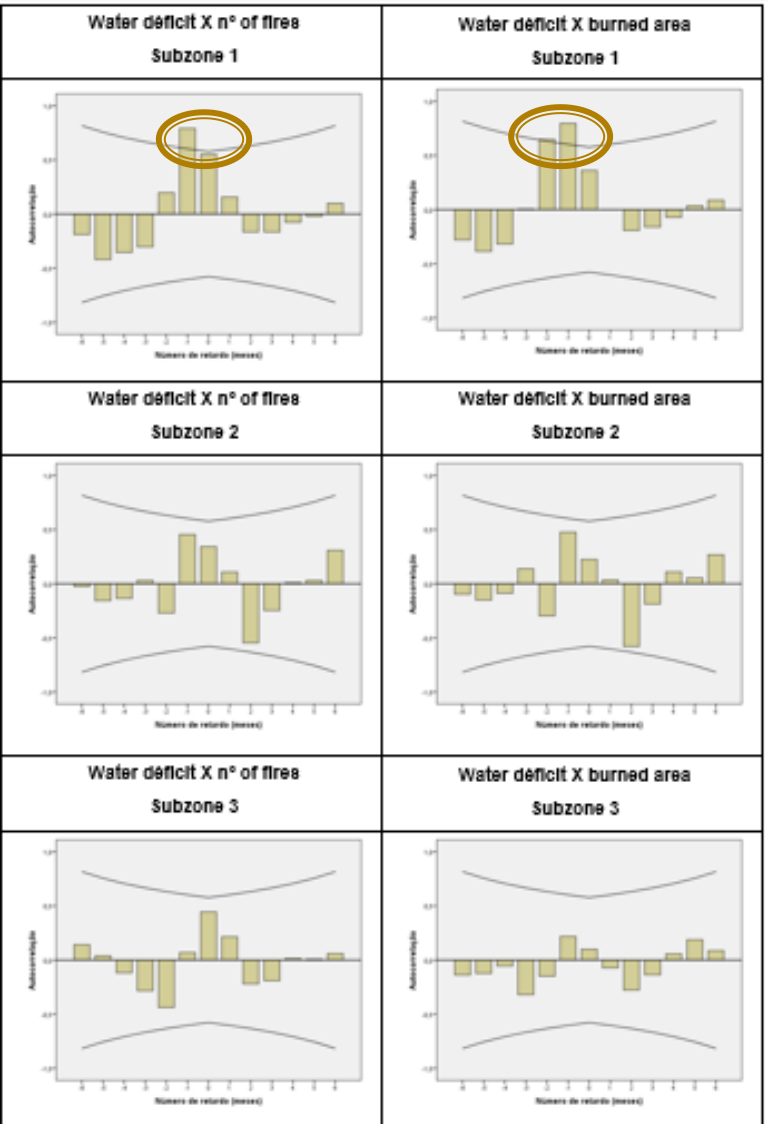


Figure 9 - Autocorrelation graphs between monthly average water deficit and forest fires (number of fires and burned area) for subzones 1, 2 and 3, for each month within the analyzed period.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

Mês	Average number of ocurrences			Is the month at the time of occurrence?		
	Subzone 1	Subzone 2	Subzone 3	Subzone 1	Subzone 2	Subzone 3
January	81,4	155,2	53,0	YES	YES	YES
February	94,8	161,6	48,6	YES	YES	YES
March	111,0	111,6	28,8	YES	YES	NO
April	11,6	47,4	13,4	NO	NO	NO
May	10,6	67,8	20,8	NO	NO	NO
June	15,0	54,2	24,6	NO	NO	NO
July	9,75	52,25	29,5	NO	NO	NO
August	56,0	118,5	59,75	YES	YES	YES
September	67,8	101,2	54,4	YES	YES	YES
October	62,2	141,0	66,0	YES	YES	YES
November	19,2	41,6	8,8	NO	NO	NO
December	66,2	79,0	16,0	YES	NO	NO

Table 1 - Average number of occurrence and definition of the time of occurrence of forest fires for the study subzones.

Results – Chapter 2

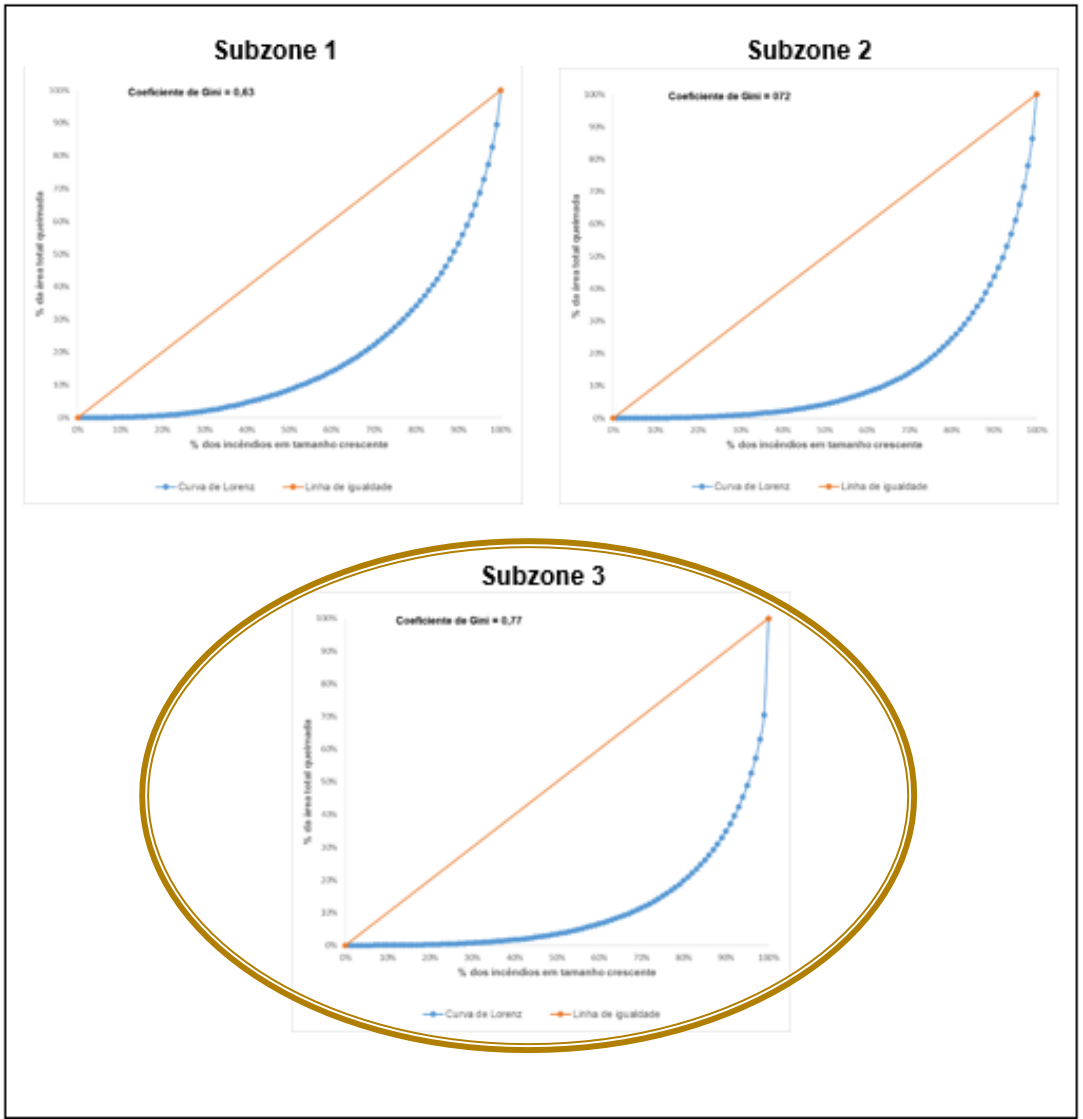
FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

Class	Size (ha)	% of occurrences		
		Subzone 1	Subzone 2	Subzone 3
I	< 0.1	13.50	22.07	24.20
II	0.1 – 4.0	64.92	61.66	61.80
III	4.1 – 40.0	21.37	16.17	13.60
IV	40.1 – 200.0	0.20	0.11	0.30
V	> 200.0	0.00	0.00	0.10

Table 2 - Distribution of size classes and percentage of occurrences of forest fires within each class, for each subarea in the study area.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA



Note: Subzone 3 shows a greater distance from the equality line, that is, there is a greater difference between the sizes of area burned by the fires within subarea 3 compared to subzones 1 and 2.

Figure 10 - Graphs of the distribution of the size of forest fires by means of the Lorenz Curve for subzones 1, 2 and 3.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

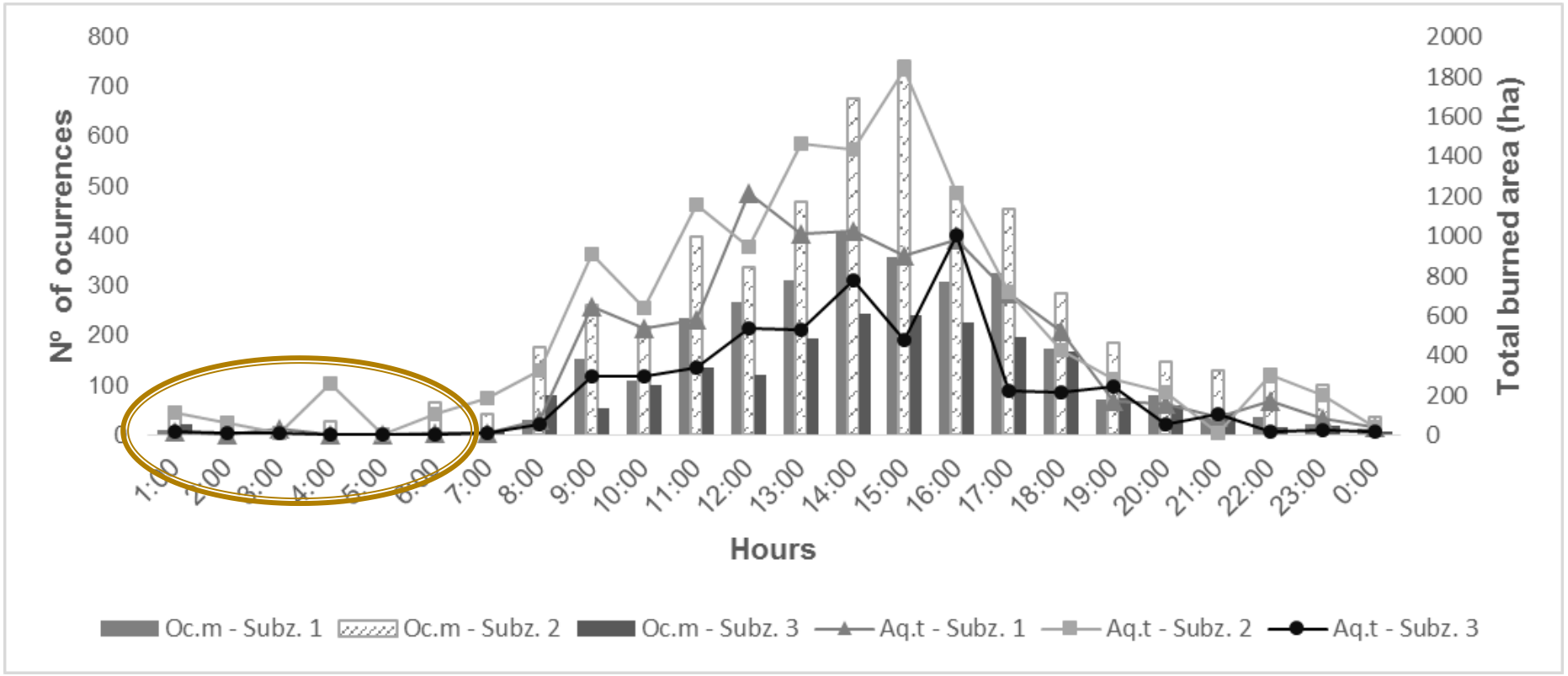


Figure 11 - Graph of the hourly distribution of the number of total occurrences (Oc.t) of forest fires and total burned area (Aq.t) for each subazone in the study area, being: 01:00 hrs = 01:00 hrs to 01 hrs : 59h

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

Days of the week	% of occurrences		
	Subzone 1 (%)	Subzone 2 (%)	Subzone 3 (%)
Monday	18.64	15.76	17.40
Tuesday	11.75	15.19	14.74
Wednesday	11.68	12.43	13.75
Thursday	14.35	15.52	12.47
Friday	14.79	11.66	14.88
Saturday	12.76	13.53	12.96
Sunday	16.04	15.91	13.80

Tabela 3 - Distribuição dos dias da semana e a porcentagem de ocorrências de incêndios florestais dentro de cada dia, para cada subzona na área de estudo.

Results – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

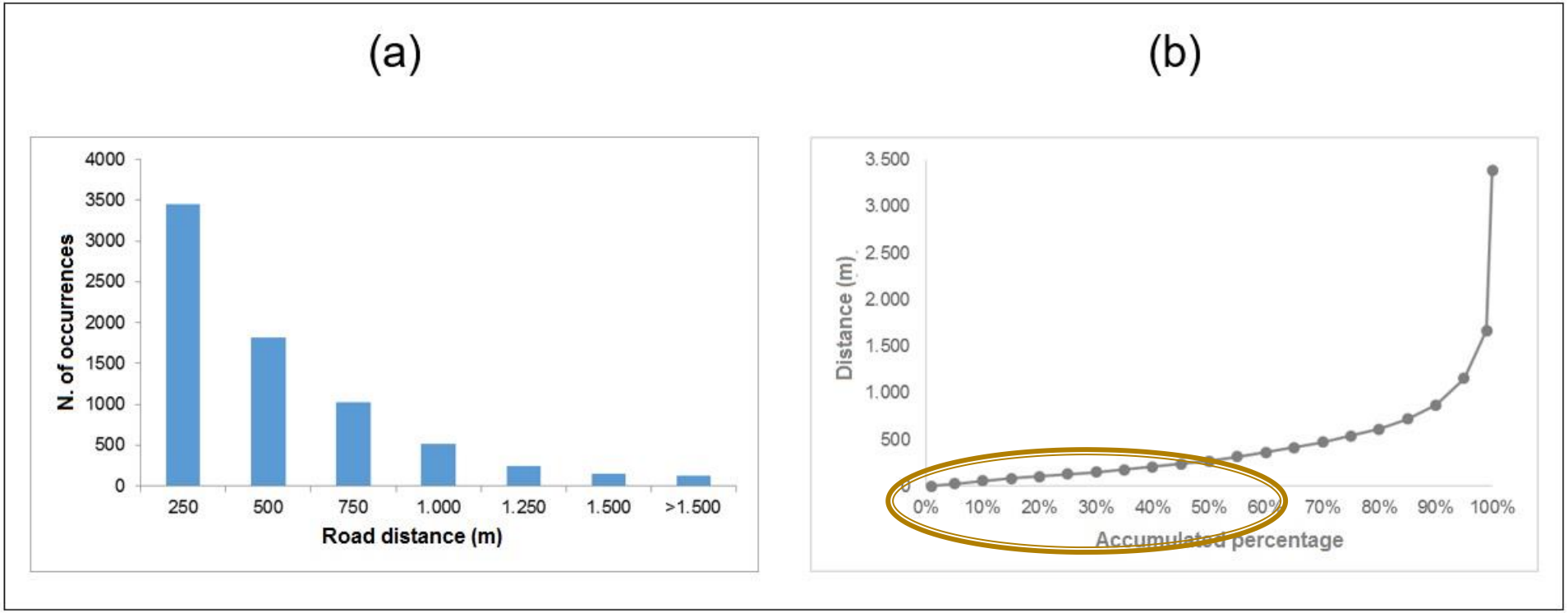


Figure 13 - Graphs of frequency distribution (a) and accumulated percentage (b) in relation to the distance between forest fires and roads in the study area.

Conclusions – Chapter 2

FOREST FIRE STATISTICS IN THE AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

- Considering both subzones, approximately 80% of the fires analyzed correspond to areas smaller than 4ha;
- The highest concentration of the number of occurrences originated from 13:00.
- During the hours of 00:00 and 06:00, on average, 1.8% of forest fires occur;
- There was no statistical difference in forest fires between the days of the week;
- The analysis of the occurrences allowed a greater understanding of the forest fires present in the central-north coast of Espírito Santo and south of Bahia.

CHAPTER 3

APPLICATION AND ADJUSTMENT OF FIRE WEATHER INDEX (FWI) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

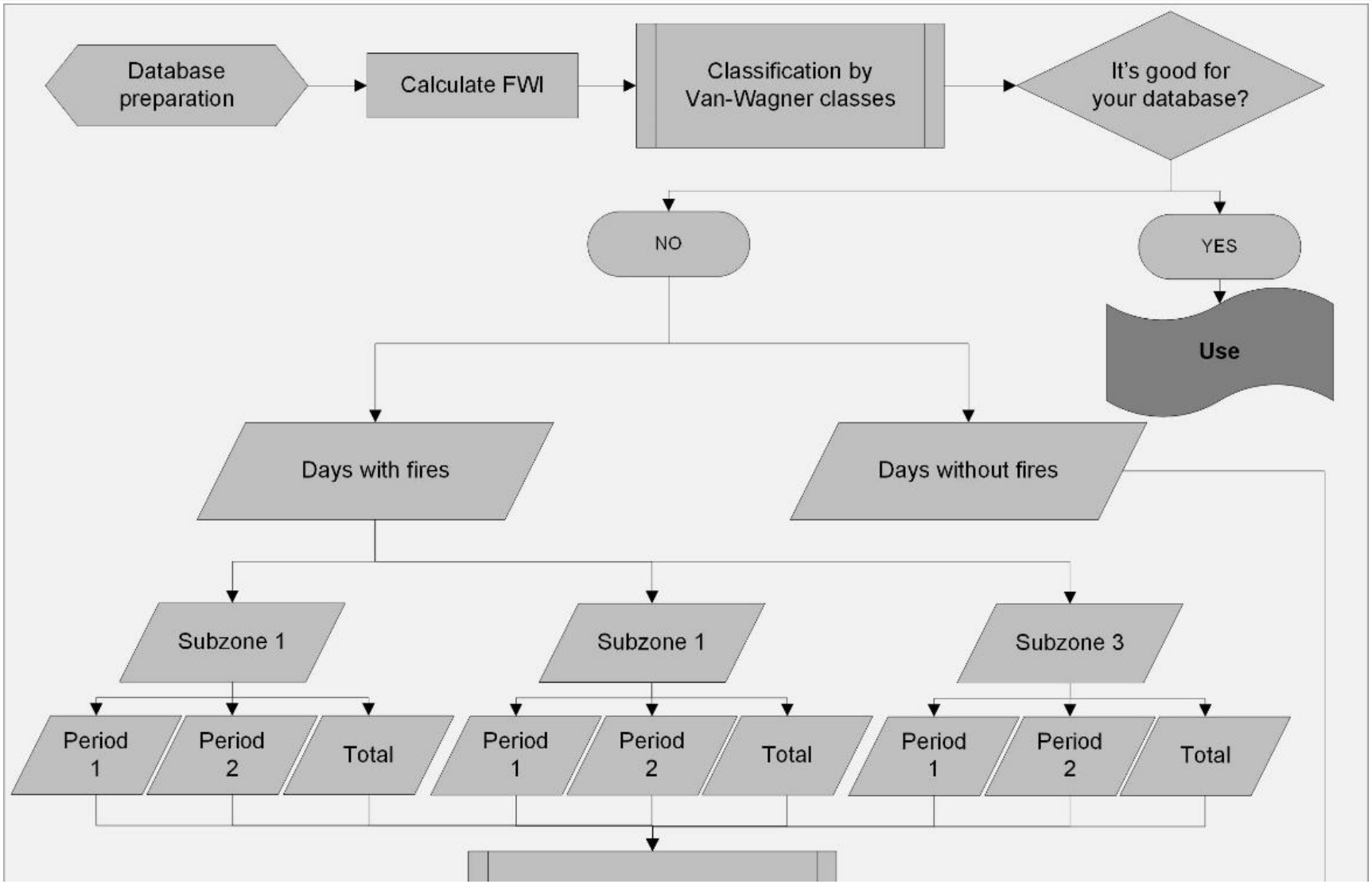
Objective – Chapter 3

APPLICATION AND ADJUSTMENT OF FIRE WEATHER INDEX (FWI) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

- It aims to make the application of the FWI system in the areas of planted forests in the central-north coast of the state of Espírito Santo and the south coast of Bahia, and to carry out a methodological test to adjust the risk classes in a previous use of the FWI system.

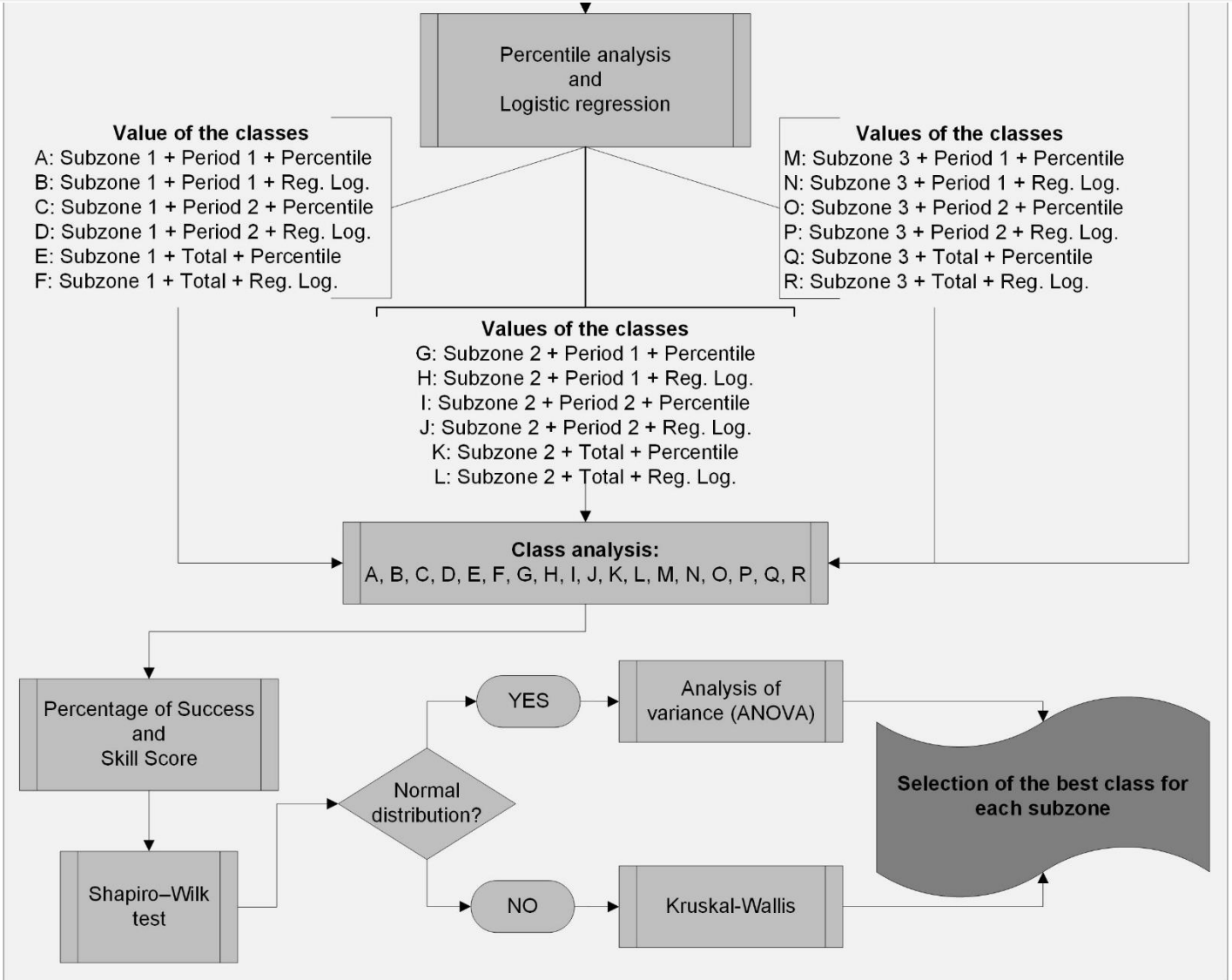
Methodology – Chapter 3

APPLICATION AND ADJUSTMENT OF FIRE WEATHER INDEX (FWI) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA



Methodology – Chapter 3

APPLICATION AND ADJUSTMENT OF FIRE WEATHER INDEX (FWI) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA



Results – Chapter 3

APPLICATION AND ADJUSTMENT OF FIRE WEATHER INDEX (FWI) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

	Sucess percentage (%)			Skill score
	With fire	Without fire	General	
A	59.44	70.49	68.72	0.2047
B	10.30	97.22	83.29	0.1080
C	59.82	75.85	73.38	0.2591
D	14.50	95.42	82.94	0.1318
E	59.50	81.69	81.13	0.0976
F	0.00	99.93	97.39	0.0000
G	58.60	69.95	68.16	0.1926
H	2.25	98.01	64.44	0.0033
I	63.08	61.18	61.43	0.1260
J	0.16	99.58	86.46	0.0000
K	62.46	67.71	67.13	0.1532
L	2.25	99.19	88.45	0.0240
M	58.38	75.83	74.51	0.1575
N	0.54	99.38	91.94	0.0000
O	59.29	69.14	68.26	0.1271
P	2.06	99.77	91.05	0.0322
Q	60.93	72.75	72.03	0.1221
R	1.90	99.64	93.63	0.0272

Table 2 - Results obtained by the success percentage and skill score tests for the class values.

Results – Chapter 3

APPLICATION AND ADJUSTMENT OF FIRE WEATHER INDEX (FWI) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

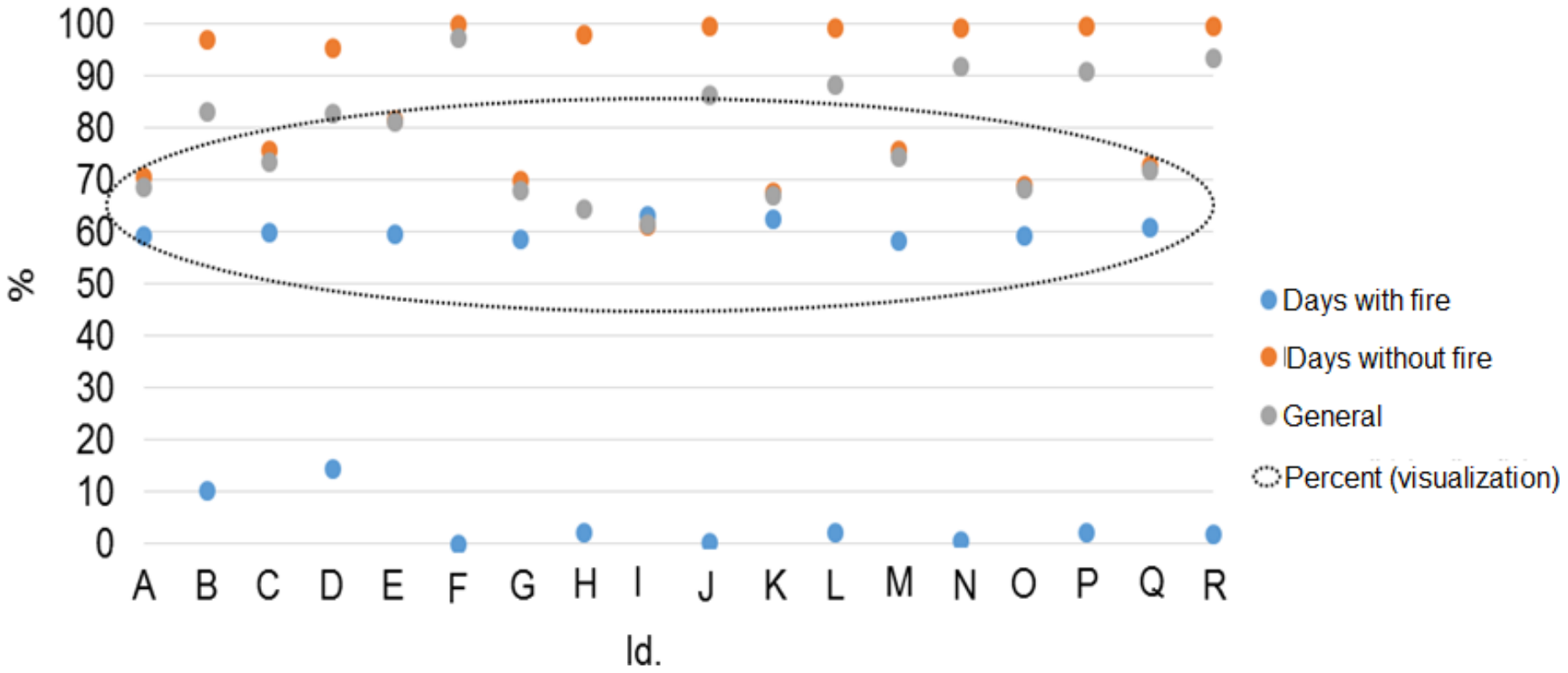


Figure 2 - Graph of the dispersion of the percentages, days with fire, without fire and general, by the different id's.

Conclusions – Chapter 3

APPLICATION AND ADJUSTMENT OF FIRE WEATHER INDEX (FWI) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

- The classes found by the percentile method were those selected, since they are closer to the correct ideal.

- Identify with this research a possible application for the FWI in the study area, since, compared to the previous works carried out in the area, it allowed a greater accuracy.

CHAPTER 4

APPLICATION AND ADJUSTMENT OF THE MODIFIED MOUNT ALEGRE FORMULA (FMA+) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

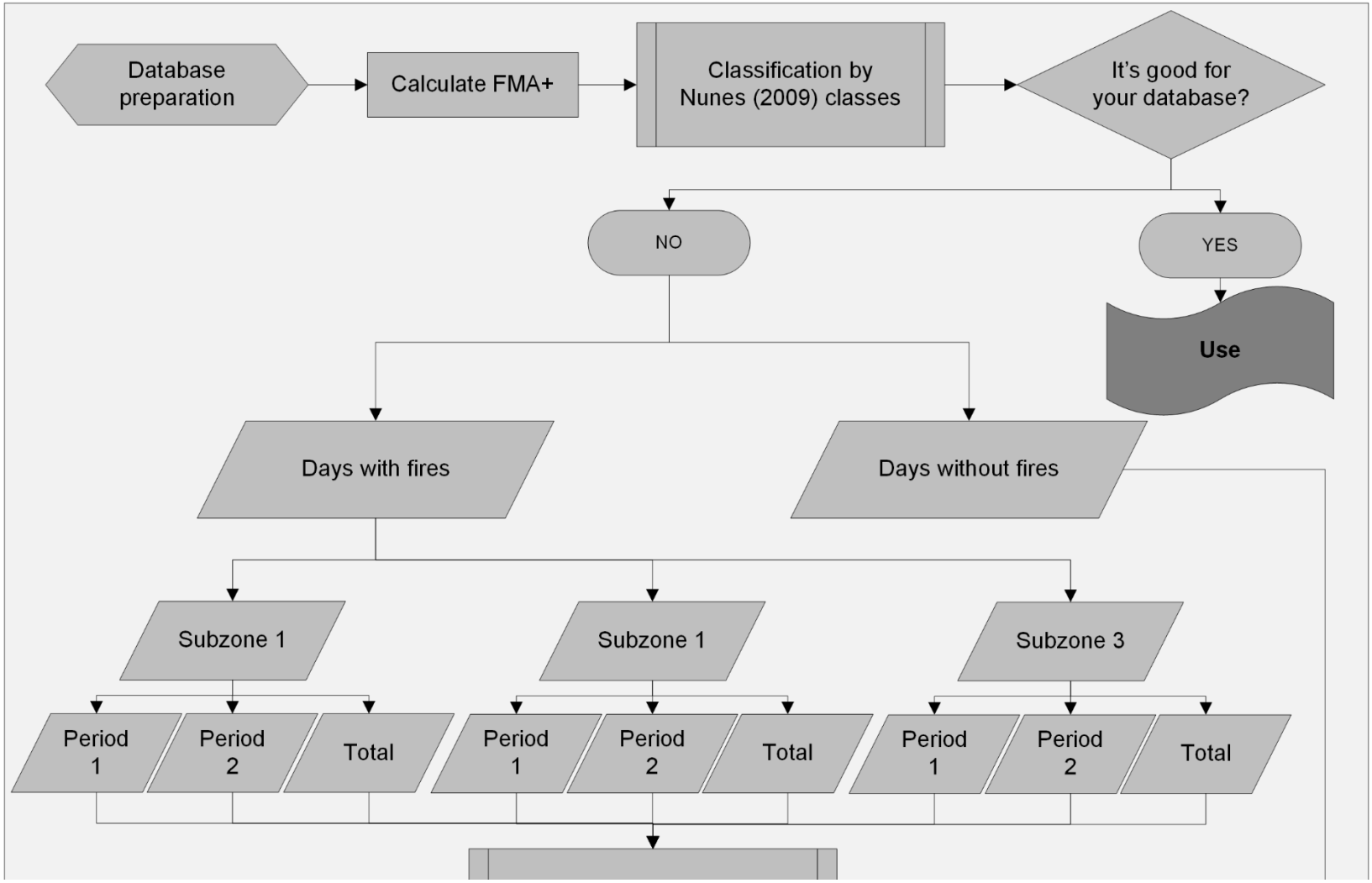
Objective – Chapter 4

APPLICATION AND ADJUSTMENT OF THE MODIFIED MOUNT ALEGRE FORMULA (FMA +) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

- It aims to make the application of the FMA^{+} system in the areas of planted forests on the north-central coast of the state of Espírito Santo and the south coast of Bahia, and conduct a methodological test to adjust the risk classes.

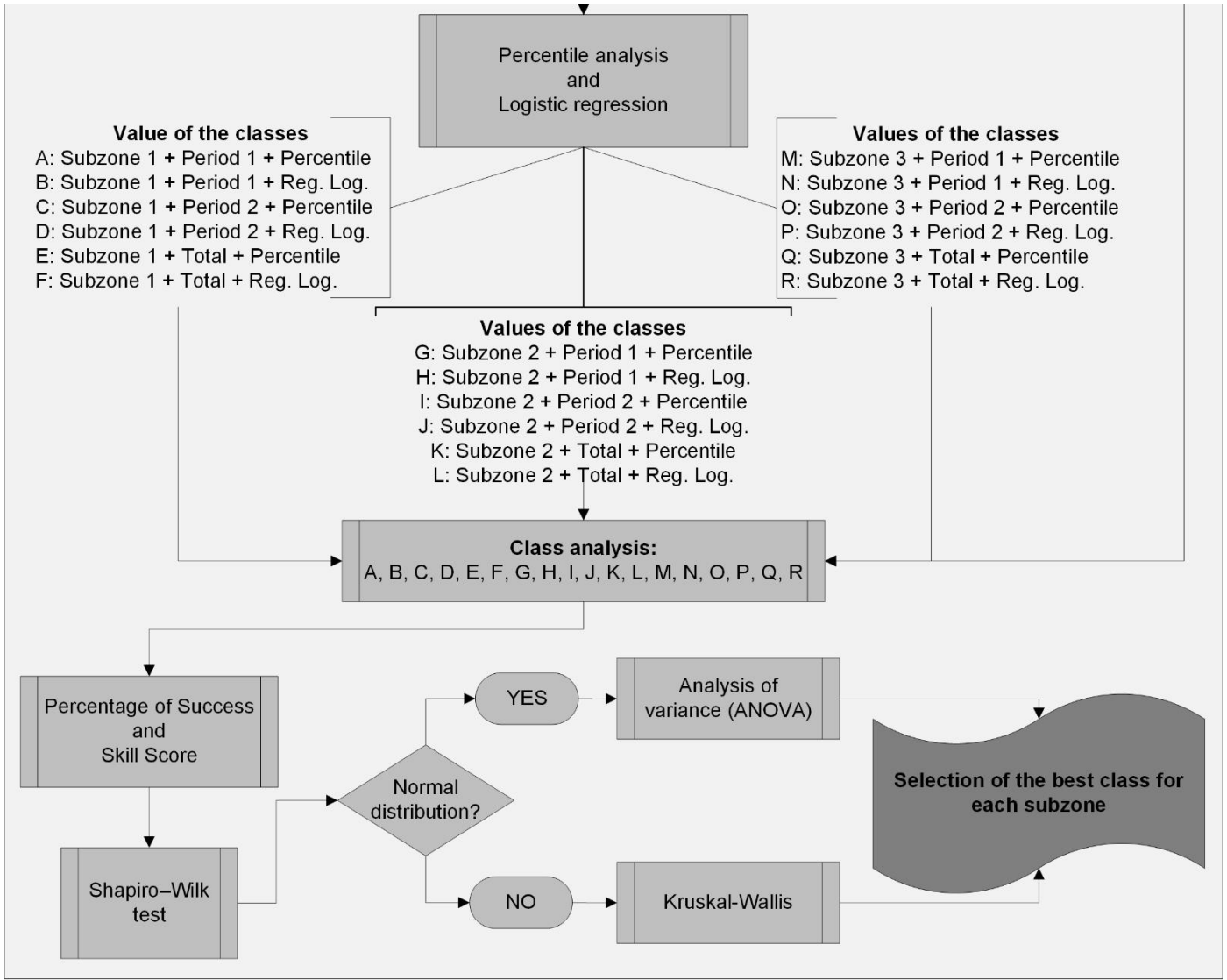
Methodology – Chapter 4

APPLICATION AND ADJUSTMENT OF THE MODIFIED MOUNT ALEGRE FORMULA (FMA +) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA



Methodology – Chapter 4

APPLICATION AND ADJUSTMENT OF THE MODIFIED MOUNT ALEGRE FORMULA (FMA +) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA



Results – Chapter 4

APPLICATION AND ADJUSTMENT OF THE MODIFIED MOUNT ALEGRE FORMULA (FMA +) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

Subzone	Sucess percentage (%)			Skill score
	With fire	Without fire	General	
1	87.36	47.08	51.88	0.1306
2	90.24	34.98	41.11	0.0779
3	92.41	37.26	40.64	0.0545

Table 1 - Results obtained by the percentage success and skill score tests for the class values proposed by Nunes (2009).

Results – Chapter 4

APPLICATION AND ADJUSTMENT OF THE MODIFIED MOUNT ALEGRE FORMULA (FMA +) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

	Sucess percentage (%)			Skill score
	With fire	Without fire	General	
A	60.29	65.30	64.35	0.1802
B	0.91	97.92	79.61	0.0000
C	58.31	71.17	69.18	0.1998
D	1.81	97.52	82.75	0.0000
E	61.39	72.50	71.18	0.1979
F	1.54	98.66	87.09	0.0032
G	59.83	63.17	62.64	0.1408
H	3.16	98.66	83.56	0.0286
I	61.32	58.25	58.66	0.0979
J	0.00	100.00	86.80	0.0000
K	61.17	64.18	63.85	0.1214
L	0.14	99.73	88.69	0.0000
M	58.29	73.05	71.94	0.1346
N	0.00	99.74	92.23	0.0000
O	59.59	64.29	63.87	0.0970
P	0.59	99.80	90.95	0.0069
Q	58.90	70.74	70.01	0.1023
R	0.42	99.73	93.63	0.0028

Table 2 - Results obtained by the success percentage and skill score tests for the class values.

Conclusions – Chapter 4

APPLICATION AND ADJUSTMENT OF THE MODIFIED MOUNT ALEGRE FORMULA (FMA +) IN AREAS OF PLANTED FORESTS IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

- The application of the FMA^{+} system obtained excellent results.
- The methodology proposed for the test of classes was efficient, and allowed an analysis of the values found for the classes and of the times with greater occurrence and the total set of data.
- It was observed that the application of the percentiles to the development of limits for new classes implied a better adjustment of the index for the subzones of study.

CHAPTER 5

APPLICATION AND ANALYSIS OF FIRE RISK (RF) IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

Objective – Chapter 5

APPLICATION AND ANALYSIS OF FIRE RISK (RF) IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

- Aims to evaluate the RF in the areas of forests planted in the center-north coast of the state of Espírito Santo and the south coast of Bahia.

Results– Chapter 5

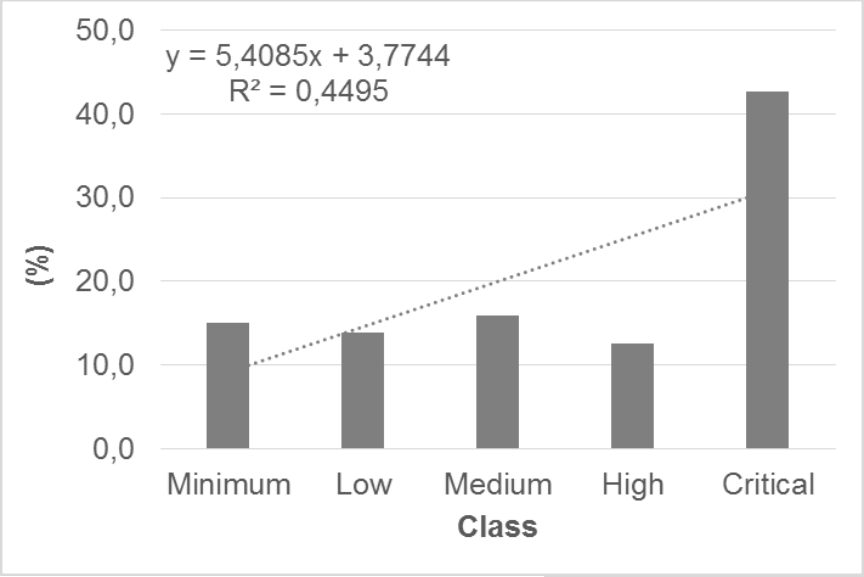
APPLICATION AND ANALYSIS OF FIRE RISK (RF) IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

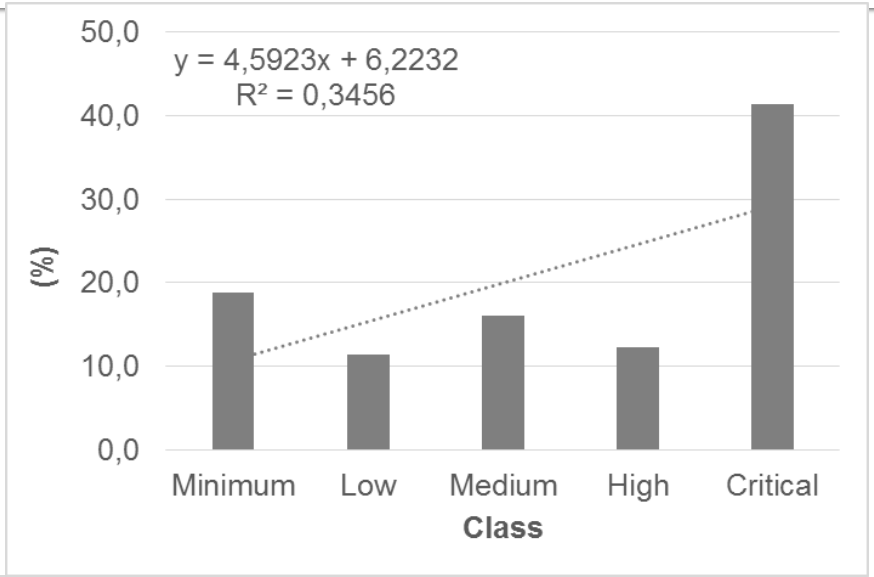
Class of RF	Percentage within the class (%)		
	Subzone 1	Subzone 2	Subzone 3
Minimun	15,05	18,88	31,63
Low	13,79	11,43	6,49
Medium	15,88	16,01	14,91
High	12,57	12,25	13,64
Critical	42,71	41,43	33,33

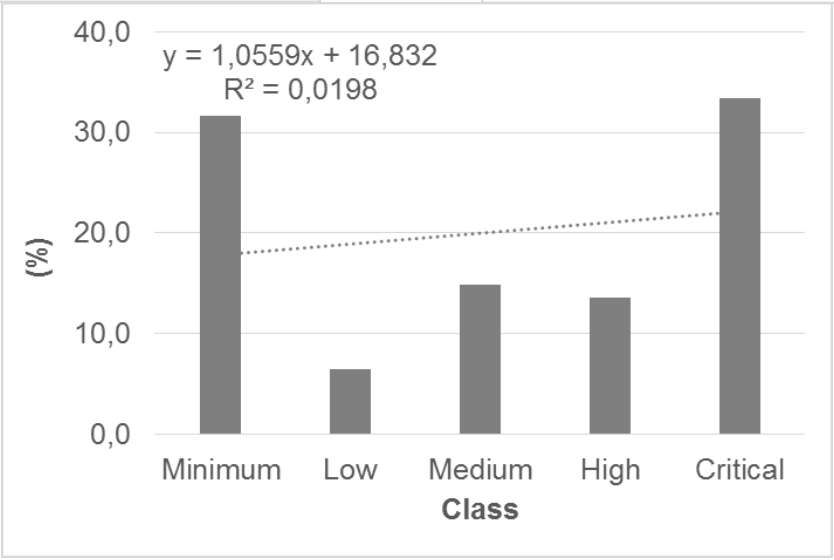
Table 1 - Percentage values of the total number of days with occurrence of forest fires for each class of fire risk, for each subzone.

Results– Chapter 5

APPLICATION AND ANALYSIS OF FIRE RISK (RF) IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA







Conclusions– Chapter 5

APPLICATION AND ANALYSIS OF FIRE RISK (RF) IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF ESPÍRITO SANTO STATE AND SOUTHERN COAST OF BAHIA

- The fire risk (RF) presented satisfactory data for the prediction of forest fires in both subareas of the study area.
- It is essential to carry out more detailed studies in the days that did not occur forest fires, in order to detect the days in which the occurrence is expected and it does not occur.
- The importance of the RF for the Country, being used by several organs, updated daily, and is available to all who want to access it.

CHAPTER 6

DEVELOPMENT OF A FOREST FIRE RISK BASED ON A DATABASE IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

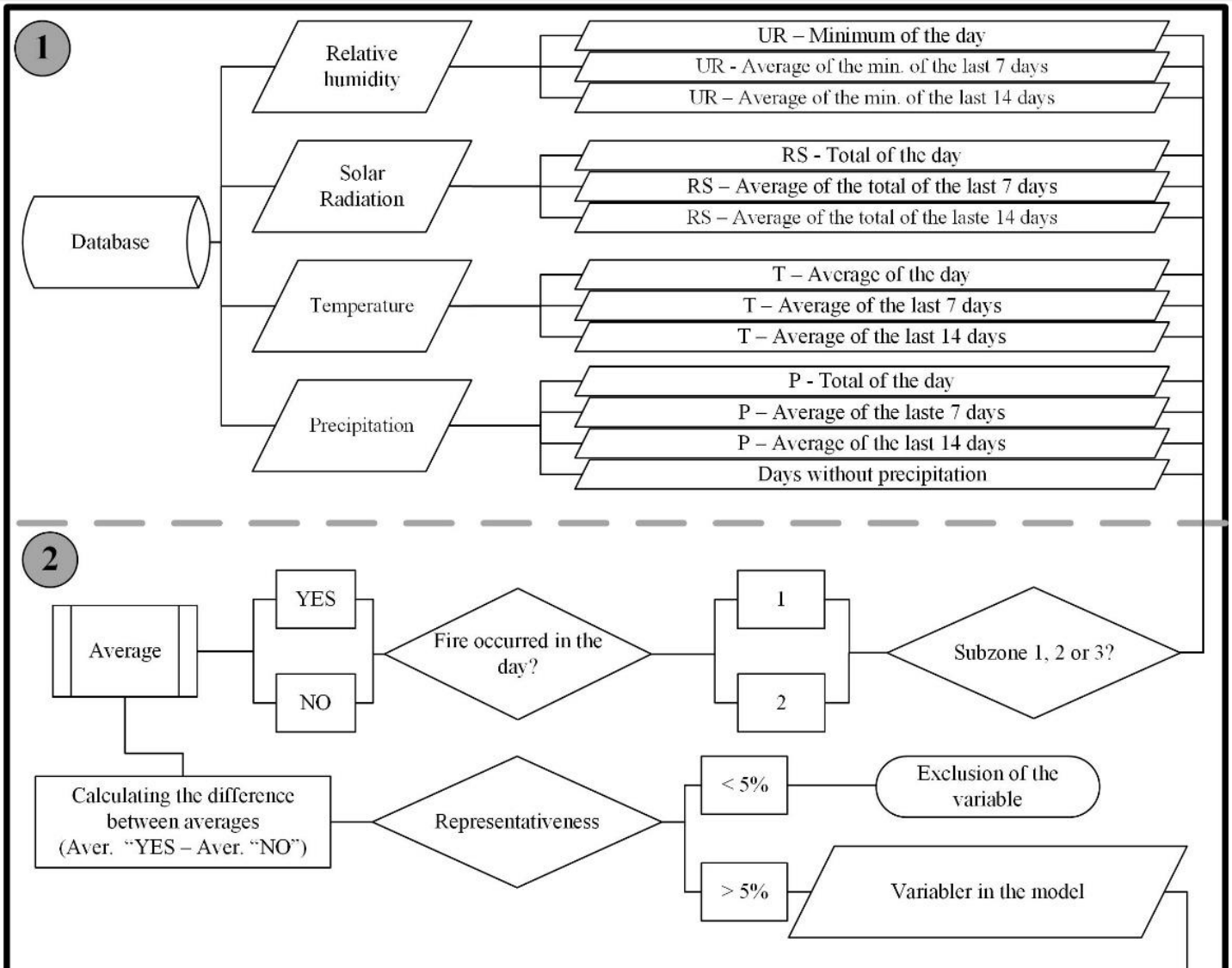
Objective – Chapter 6

DEVELOPMENT OF A FOREST FIRE RISK BASED ON A DATABASE IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA

- The objective of this work is the creation of a new index for the north-central coast area of the state of Espírito Santo and the south coast of Bahia, to present an assessment of its behavior against the indexes already used and 'consecrated' throughout National and international territory.

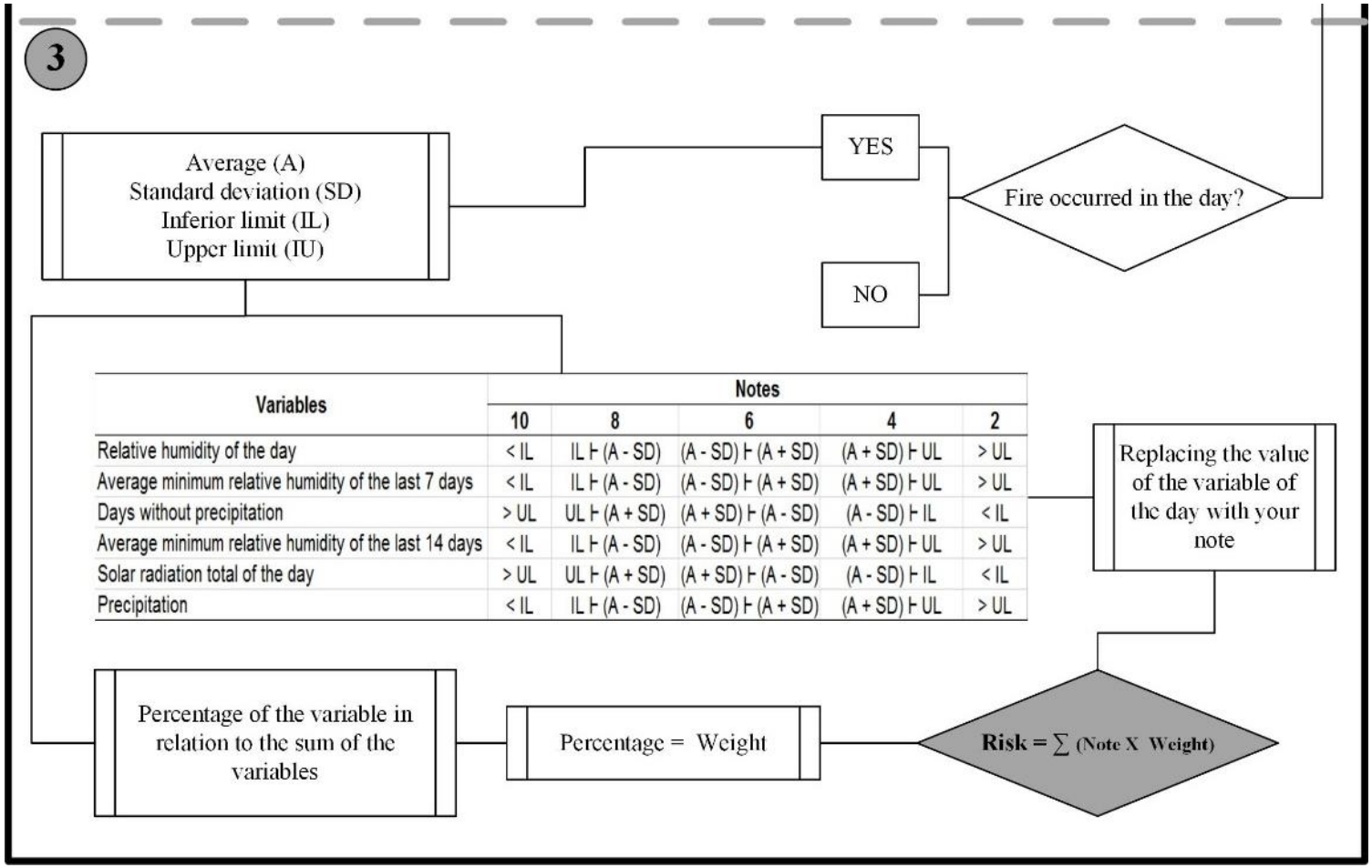
Methodology – Chapter 6

DEVELOPMENT OF A FOREST FIRE RISK BASED ON A DATABASE IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA



Methodology – Chapter 6

DEVELOPMENT OF A FOREST FIRE RISK BASED ON A DATABASE IN AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND THE SOUTH COAST OF BAHIA



Variables	Notes				
	10	8	6	4	2
Relative humidity of the day	< IL	IL ⊢ (A - SD)	(A - SD) ⊢ (A + SD)	(A + SD) ⊢ UL	> UL
Average minimum relative humidity of the last 7 days	< IL	IL ⊢ (A - SD)	(A - SD) ⊢ (A + SD)	(A + SD) ⊢ UL	> UL
Days without precipitation	> UL	UL ⊢ (A + SD)	(A + SD) ⊢ (A - SD)	(A - SD) ⊢ IL	< IL
Average minimum relative humidity of the last 14 days	< IL	IL ⊢ (A - SD)	(A - SD) ⊢ (A + SD)	(A + SD) ⊢ UL	> UL
Solar radiation total of the day	> UL	UL ⊢ (A + SD)	(A + SD) ⊢ (A - SD)	(A - SD) ⊢ IL	< IL
Precipitation	< IL	IL ⊢ (A - SD)	(A - SD) ⊢ (A + SD)	(A + SD) ⊢ UL	> UL

Results – Chapter 6

	Sucess percentage (%)			Skill score
	With fire	Without fire	General	
A	59.95	71.41	66.96	0.3109
B	66.09	67.47	66.93	0.3254
C	59.84	73.54	69.33	0.3167
D	48.74	81.06	71.12	0.3053
E	60.25	80.66	75.55	0.3857
F	44.83	87.72	76.99	0.3467
G	59.17	68.47	67.35	0.1516
H	0.00	100.00	88.00	0.0000
I	59.59	63.98	63.18	0.1603
J	5.40	97.25	80.50	0.0388
K	58.41	72.34	70.88	0.1654
L	2.06	99.41	89.21	0.0251
M	59.66	58.97	59.20	0.1682
N	29.43	77.57	61.63	0.0747
O	59.82	56.57	57.45	0.1323
P	7.98	94.50	70.99	0.0327
Q	60.19	65.87	64.66	0.1989
R	13.50	93.69	76.51	0.0935

Table 1 - Results obtained by success percentage and skill score tests for class values.

Conclusions – Chapter 6

- The application of the HORUS database system obtained excellent results.

- The methodology proposed for the test of classes was efficient, and allowed an analysis of the values found for the classes allowing the analysis of the times with greater occurrence and the total set of data.

CHAPTER 7

SELECTION OF A FOREST RISK MODEL FOR THE AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND SOUTH OF THE BAHIA COAST

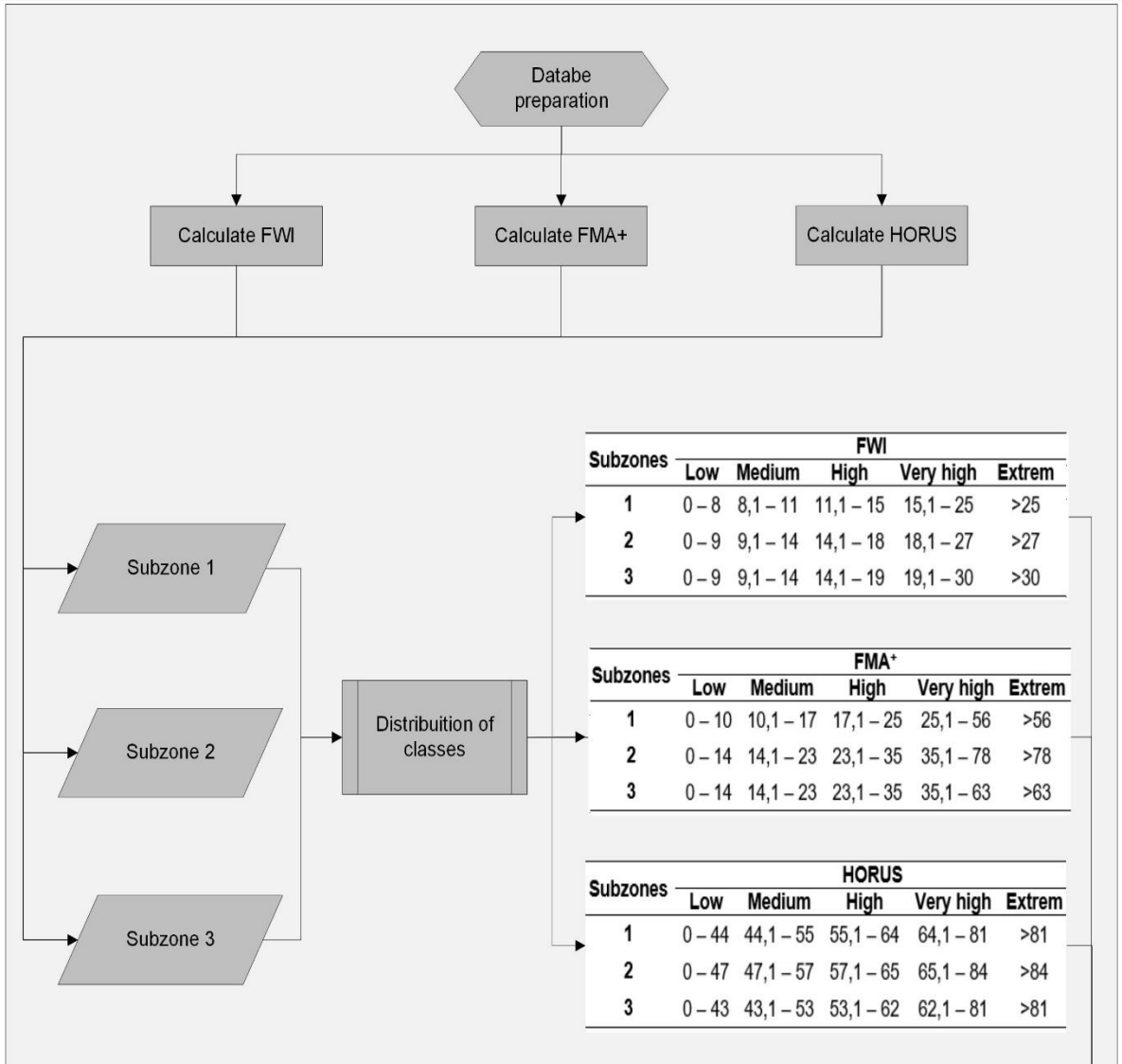
Objective – Chapter 7

SELECTION OF A FOREST RISK MODEL FOR THE AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND SOUTH OF THE BAHIA COAST

- This chapter aims to select a forest fire risk model for the forest areas planted on the central north coast of the state of Espírito Santo and the south coast of Bahia. This choice was based on a new meteorological database, independent of that tested in previous chapters.

Methodology – Chapter 7

SELECTION OF A FOREST RISK MODEL FOR THE AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND SOUTH OF THE BAHIA COAST



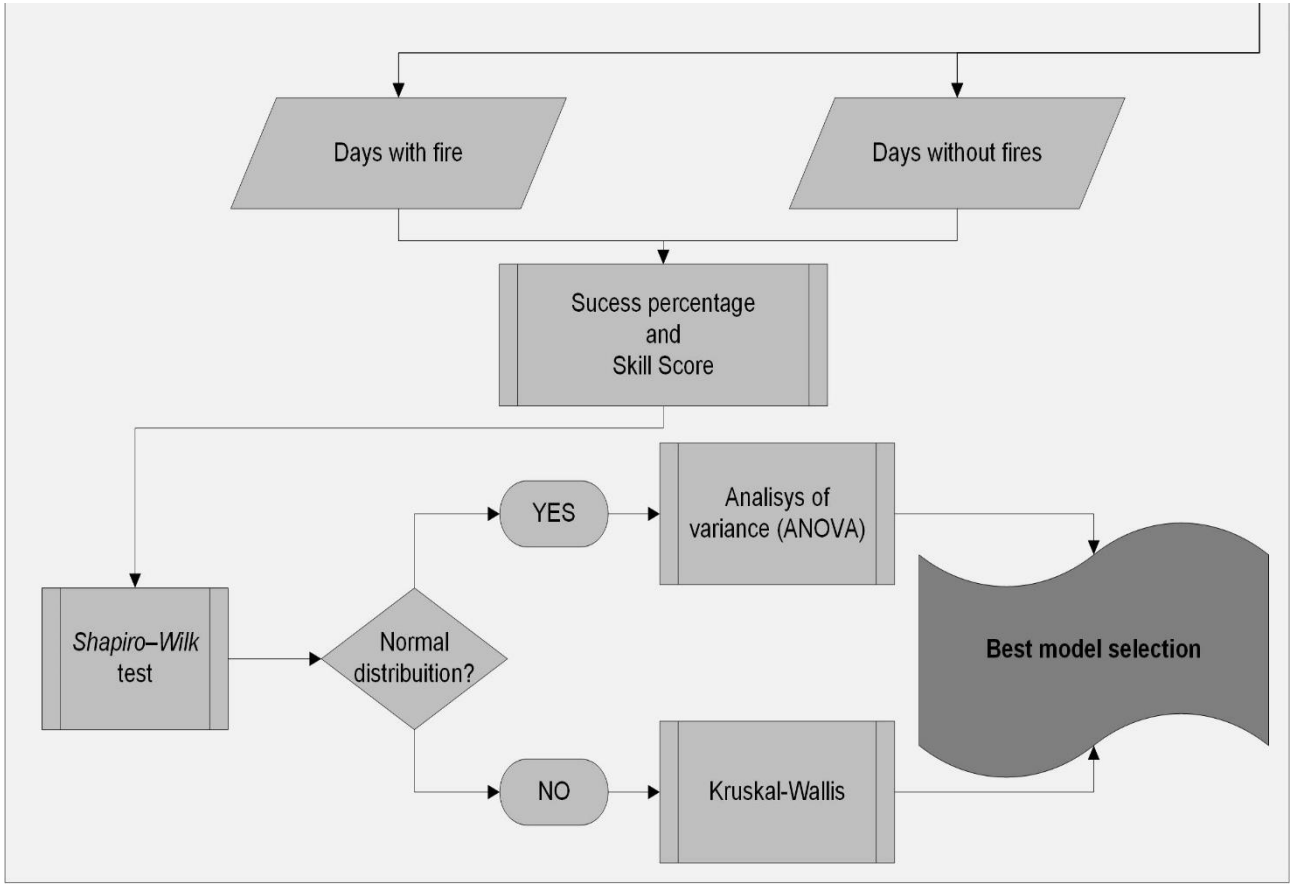
Subzones	FWI				
	Low	Medium	High	Very high	Extrem
1	0 – 8	8,1 – 11	11,1 – 15	15,1 – 25	>25
2	0 – 9	9,1 – 14	14,1 – 18	18,1 – 27	>27
3	0 – 9	9,1 – 14	14,1 – 19	19,1 – 30	>30

Subzones	FMA+				
	Low	Medium	High	Very high	Extrem
1	0 – 10	10,1 – 17	17,1 – 25	25,1 – 56	>56
2	0 – 14	14,1 – 23	23,1 – 35	35,1 – 78	>78
3	0 – 14	14,1 – 23	23,1 – 35	35,1 – 63	>63

Subzones	HORUS				
	Low	Medium	High	Very high	Extrem
1	0 – 44	44,1 – 55	55,1 – 64	64,1 – 81	>81
2	0 – 47	47,1 – 57	57,1 – 65	65,1 – 84	>84
3	0 – 43	43,1 – 53	53,1 – 62	62,1 – 81	>81

Methodology – Chapter 7

SELECTION OF A FOREST RISK MODEL FOR THE AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND SOUTH OF THE BAHIA COAST



Results – Chapter 7

SELECTION OF A FOREST RISK MODEL FOR THE AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND SOUTH OF THE BAHIA COAST

Model	Subzone	Sucess percentage (%)			Skill score
		With fire	Without fire	General	
FWI	1	59.15	67.03	66.13	0.1363
	2	50.35	77.06	73.97	0.1773
	3	35.16	73.8	69.88	0.0515
FMA+	1	69.86	46.96	46.68	0.0653
	2	71.33	54.35	56.29	0.1062
	3	63.30	52.07	53.33	0.0615
HORUS	1	34.42	87.91	81.82	0.1985
	2	45.61	88.35	83.46	0.2938
	3	40.66	84.62	79.55	0.2014

Table 1 - Results obtained by the percentage success and skill score tests for the class values of the FWI, FMA + and HORUS models.

Conclusions – Chapter 7

SELECTION OF A FOREST RISK MODEL FOR THE AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND SOUTH OF THE BAHIA COAST

- The use of different data to choose the model was of fundamental importance.
- The methodology used in previous chapters for the test of classes was efficient, because the models obtained a good match with the previously defined classes.
- The HORUS model presented excellent results, being the model to be used for subzones 2 and 3.

Conclusions – Chapter 7

SELECTION OF A FOREST RISK MODEL FOR THE AREAS OF FORESTS PLANTED IN THE CENTRAL-NORTH COAST OF THE SPIRITO SANTO STATE AND SOUTH OF THE BAHIA COAST

- The FWI model presented the best results for subarea 1.

- The FWI model is seen as the most successful model for the study area, since it found higher values, for a sub-area, for the model developed through the study area database. However, a study will be needed for the Calibration of its parameters.

Thank you!

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