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Spatiotemporal variation of fire occurrence in the State of Bahia, Brazil, between 2003 and 2019

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Abstract

Wildland fires are responsible for impacts in the fauna and flora in fire sensitive ecosystems and release into the atmosphere greenhouse gases responsible for global warming. This study aims to analyze the spatiotemporal variation of hot spots detected by the AQUA satellite from 2003 to 2019 in the state of Bahia, and to determine the main factors affecting the fire frequency of incidence. A significant downtrend was observed in the number of hot spots recorded over the years and about 65% of them were detected in the months of September and October. The Southcenter and the Northwest state's regions were the ones with highest hot spot incidence, while the Northeast and East Central regions presented lower incidence. *Presidente Jânio Quadros* was the municipality with the highest hot spot incidence per area. Besides this one, there were another 351 municipalities (accounting together with almost 75% of the state area) that were classified in the "Extreme", "Very High" and "High" classes of hot spot incidence. The independent variables that presented a significant correlation with the municipality hot spot density were, in decreasing order of significance: percentage of land covered by savanna; percentage of land covered by agriculture and pastures; percentage of land covered by forests; mean annual temperature; mean annual rainfall; and demographic density. The results obtained in this study should be used by municipal and state environmental agencies seeking to reduce the wildland fire occurrence and thus ensuring biodiversity conservation and reduction in the release of green house gases.
Keywords: fire prevention, hot spots, remote sensing, wildfire.

1. Introduction

Wildland fires are any non-structure fire that occurs in vegetation. They can be classified as controlled burns or wildfires depending on whether the fire is being used in a prescribed manner or if it is out of control (NWCG, 2020). Both, wildfires and controlled burn, are responsible for releasing into the atmosphere large amount of greenhouse gases, thus contributing to global warming. Wildfires in fire-sensitive ecosystems represent a major threat to the preservation of biodiversity, causing impact on the fauna and flora. Moreover, the smoke often causes respiratory complications and represents, in some locations, a public health issue (Arbex et al., 2004; Soares and Batista, 2007; Shlisky et al., 2009).

In several Brazilian states, the use of fire in controlled burns is cultural and difficult to change. Due to the lack of surveillance by the government and knowledge of the law by the population, usually the burns are held in an irregular manner, without the authorization from the responsible environmental agency, thus against the law. The lack of inspection results in a larger number of control burns that turned into wildfires difficult to extinguish that consume large areas of vegetation.

The detection of wildland fires via satellite began in the 1980s (Wang et al., 2012). Until a few years ago, the Advanced Very High-Resolution Radiometer (AVHRR) and Moderate Resolution Imaging Spectroradiometer (MODIS) were the sensors most effective abroad the satellites for this purpose. Currently, the Visible Infrared Imaging Radiometer Suite (VIIRS) sensor, equipped abroad the Suomi NPP and NOAA-20 satellites, has a greater detection capacity (VIIRS sensors detect about 10 times more hot spots than MODIS sensors, for example). Nevertheless, since both satellites equipped with the VIIRS sensor were put into operation only a few years ago, data from other satellites are still important to analyze variations in fire occurrence through time and space (White and White, 2016; INPE, 2020).

The images generated by the thermal and infrared sensors installed in the satellites are sent to a control center (on land), where they are processed through a detection algorithm (Batista, 2004; Wang et al., 2012). It is essential the use of an efficient algorithm, since a hot spot does not necessarily mean that the vegetation is burning, but that certain area presents, at the moment that the satellite passes, high temperature (Batista, 2004). Only after processing the

images received by the satellite, it will be possible to identify which hot spots represent fire in vegetation. Therefore, the data processed by the detection algorithm represents the occurrence of wildland fire. The current algorithm used by the National Aeronautics and Space Administration (NASA) and by the INPE for images generated by MODIS sensors, such as the one abroad the AQUA satellite, is called "Collection 6". The use of the "Collection 6", replacing the "Collection 5", is part of a major reprocessing of the entire MODIS data archive to generate standardized data results with calibration enhancements and algorithm refinements (NASA, 2020a).

Tre Brazilian Weather and Climate Studies Research Center (CPTEC), from the INPE, generates and provides information on the occurrence of fires based on satellite data. Although receiving images from nine satellites that have optical sensors operating in the thermal-average range of 4µm (NOAA-18, NOAA-19, METOP-B, NASA, TERRA, AQUA, NPP-Suomi, NOAA-20, GOES-13 and MSG-3), the images generated by the AQUA satellite processed through the "Collection 6" algorithm has been used as "reference" by the INPE since 2002 to compose comparable time data over the years and thus enable trend analysis for the same periods in regions of interest (White, 2018a; INPE, 2020). Due to the similarities between control burns from wildfires, satellite imagery is unable to discern one from the other. Therefore, a hot spot represents a place where the vegetation is burning, whether controlled or uncontrolled.

This study has the objective to determine the spatiotemporal variation of hot spots detected by the AQUA satellite, processed by the "Collection 6" algorithm, in the state of Bahia, Brazil from 2003 to 2019. Also, to understand why some municipalities burn more than others. The results obtained from this study can be used by municipal and state environmental agencies to assist the development of public policy focused on wildfire prevention and nature conservancy.

2. Materials and methods

Characterization of the study area

Bahia is the fourth largest Brazilian state. With 564,760.43 km^2, it has an area bigger than several countries. The largest municipality is Formosa do Rio Preto (15,901.74 km^2) and the smallest Madre de Deus (32.20 km^2). The total population in the state is 14,016,906, that accounts for a mean demographic density of 24.82 inhab./km^2, varying from 3,859.44 inhab./km^2 at the capital (Salvador) to 0.94 inhab./km^2 in Jaborandi (IBGE, 2010; IBGE, 2020).

The predominant climates in most of the state, according the updated Köppen-Geiger classification (Kottek *et al*., 2006), are: equatorial with dry winter (Aw), hot arid step (BSh) and equatorial fully humid (Af). Other climates classification that occurs in smaller areas in the state of Bahia are: equatorial monsoonal (Am), warm temperature fully humid warm summer (Cfb) and warm temperature fully humid hot summer (Cfa).

According to satellite imagery from the year 2018, most of the land was covered with natural vegetation (including forests, savanna, steppe and mangrove), occupying a total area of 262.786,12 km^2, followed by agriculture/livestock areas, with 251,721.61 km^2. This two land use make up for approximately 90% of the state area (MapBiomas, 2020). Three of six Brazilian biomes are found in Bahia: Atlantic Forest, Cerrado and Caatinga. The protected areas cover about 7% of the state, distributed in 110 Conservation Units (CU) (CBPM, 2020).

According to data from the INPE reference satellite (INPE, 2020), Bahia is the Brazilian state with the fifth highest number of hot spots detected, only behind the states of Pará, Mato Grosso, Rondônia and Tocantins. It is the state from the Northeast Region with the highest wildland fire occurrence. Deforestation data from MapBiomas (2020) accounts for a sum of 87,643 km^2 of deforested areas between 1990 and 2017, which represents a mean of 3,130 km^2 deforested annually.

Datasets

The records of hot spots in the state of Bahia for the period 01/01/2003 to 12/31/2019 were obtained from the INPE Satellite Monitoring Burning Program website, based on data from the AQUA satellite processed through the "Collection 6" algorithm. The values were quantified for the entire state and grouped by month of occurrence and the municipality in which they were detected.

The following variables that may have a significant influence on the number of hot spots were quantified for each municipality: mean annual temperature; mean annual rainfall; population density; municipality area; forest areas (including natural and planted forests, and mangroves); savanna formations (including *Cerrado* restricted sense, *Parque Cerrado*, *Palmeiral* and *Vereda*); non-forest natural formation areas (including wetlands, grasslands, *apicum* and other non-forest formation); non-vegetated areas; and agriculture/pasture areas. These variables were chosen due to availability of historical data and because they have been shown to influence the wildland fire occurrence (e.g. Ajin et al., 2016; Suryabhagavan et al., 2016; White and White, 2016; White et al., 2016; White, 2018b).

The mean annual temperature and the mean annual rainfall were obtained from Climate-Data (2020) based on climate models and data measured between 1982 and 2012. Data from population density were obtained from the last population census (IBGE, 2010). The municipality areas were obtained from IBGE (2020). And the data from the area of forest, savanna, non-forest natural formations, non-vegetated and agriculture/pasture fields were obtained from MapBiomas (2020) from 2003 to 2018 (the last year with available data).

Wildland fire incidence per municipality

The state municipalities were grouped according to the classification originally proposed by White and White (2016) with the inclusion of a new frequency class: Extreme (Table 1). This updated classification seeks to better describe the frequency of wildland fire based on the number of hot spots per area detected by the AQUA satellite during a period of one year.

Table 1 - Frequency of incidence of hot spots detected by the AQUA satellite over one year. The classification follows the originally proposed by White and White (2016) with the inclusion of the "Extreme" frequency class.

Frequency class	Number of hot spots detected per year
Very Low	None or one hot spot for an area > 600 km^2 (Equivalent to < 0.0017 hot spots/km^2).
Low	One hot spot for an area > 300 and ≤ 600 km^2 (Equivalent to > 0.0033 and ≤ 0.0017 hot spots/km^2).
Average	One hot spot for an area > 150 and ≤ 300 km^2 (Equivalent to > 0.0067 and ≤ 0.0033 hot spots/km^2).
High	One hot spot for an area > 75 and ≤ 150 km^2 (Equivalent to > 0.0133 and ≤ 0.0067 hot spots/km^2).
Very High*	One hot spot for an area > 25 and ≤ 75 km^2 (Equivalent to > 0.04 and ≤ 0.0133 hot spots/km^2)
Extreme**	One hot spot for an area ≤ 25 km^2 (Equivalent to ≥ 0.04 hot spots/km^2)

Note: *Size of the class altered from the original proposed by White and White (2016) for the inclusion of the Extreme class. ** New class proposed in this study.

Statistical analysis

The Student's t test was used to test the existence of significant differences among the number of hot spots recorded in different months of the year. Linear regression was used to evaluate the trend in the number of hot spots detected throughout the time series. A correlation matrix was constructed with the Pearson (r) correlation coefficients for the variables analyzed in the study.

3. Results

A total of 229,554 hot spots were detected by the AQUA satellite using the *Collection 6* algorithm in the state of Bahia between 01/01/2003 and 12/31/2019. The year of 2007 had the highest number of detections (29,468), while 2018 had the lowest number (4,956). The mean during the assessed period was 13,503 hot spots per year with a standard deviation of 6,871. The linear regression analysis indicates a significant downtrend during the time series ($r^2 = 0,48$; $p < 0,01$) (Figure 1).

When classifying the hot spots according to the months of the year in which they were registered and using the Student's t test to compare the means, it was possible to define 4 different groups (Figure 2). In the group "A" are the months with the highest number of hot spots detected: September (mean of 4,484 per year, 35.4% of the total) and October (mean of 4,044 per year, 29.9% of the total). In the group "B" are the months of August (mean of 1,254 per year, 9.3% of the total) and November (mean of 1,098 per year, 8.1% of the total). Following, the group "C" with the months of July (mean of 491 per year, 3.6% of the total) and December (mean of 404 per year, 3% of the total). In the group "D" are the months with the lowest detection, that were, in descending order: June, January, March, February, May and April (mean between 290 and 188 hot spots per year, corresponding to 2.2 to 1.4% of the total).

Hot spots were detected in 412 of the 417 municipalities in Bahia during the period assessed (Table 2). The municipality with the highest incidence was Formosa do Rio Preto (13,526). Proportionally to its area, Presidente Jânio Quadros registered the highest frequency of incidence of hot spots, followed by Cândido Sales and Belo Campo.

The correlation matrix was done using the proportional values for the following variables that was significantly affected by the municipality area: forest area ($r = 0.29$; $p < 0.001$), savanna formation area ($r = 0.94$; $p < 0.001$); non-forest natural

formations (r = 0.79; p < 0.001), non-vegetated area (r = 0.49; p < 0.001), agriculture/pasture fields area (r = 0.78; p < 0.001); as also in the number of hot spots registered (r = 0.81; p < 0.001). So, it doesn't matter if a municipality has 10 or 1000 km^2 of forest area, for example, but how much that area represents of the total municipality size. The same is true for the number of hot spots. A municipality A, for example, which registered 10 times more hot spots than the municipality B, may present a lower hot spot density if its size is more than 10 times larger than the size of municipality B.

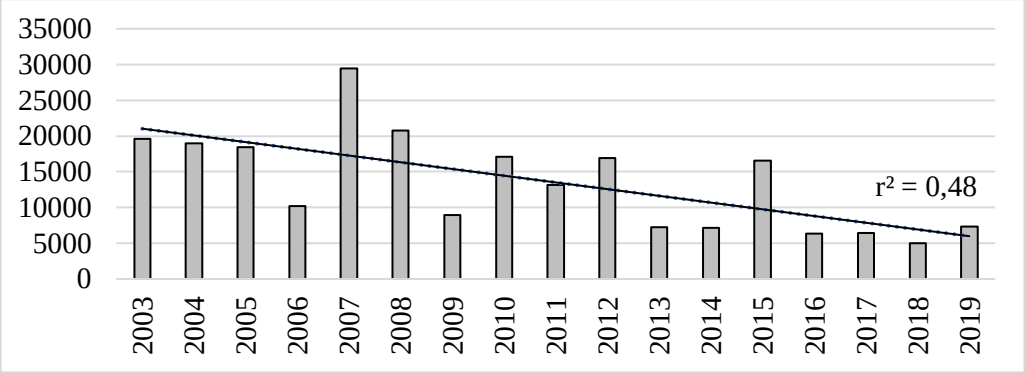

Figure 1 – Number of hot spots detected by the AQUA satellite using the Collection 6 algorithm between 2003 and 2019 in the state of Bahia, Brazil. The regression line indicates a significant downward trend.

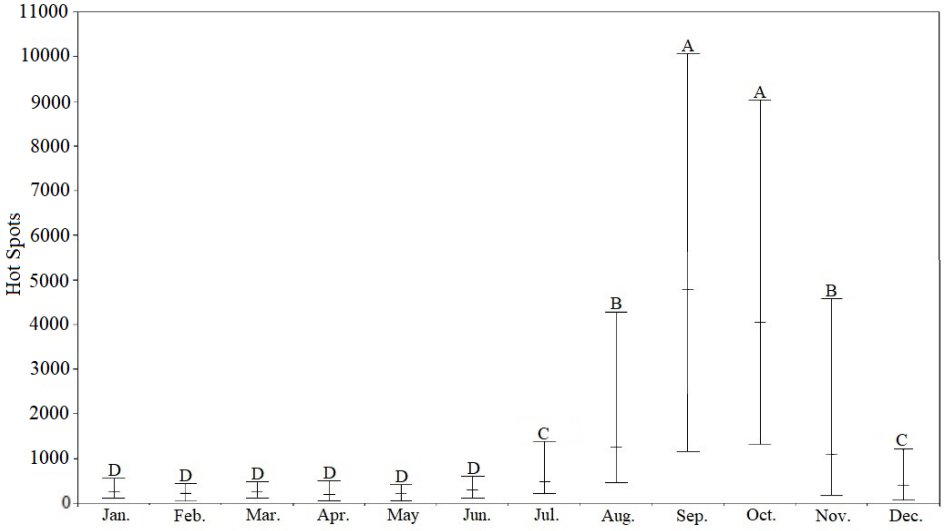

Figure 2 – Maximum, minimum and mean of the number of hot spots detected in each month of the year by the AQUA satellite and processed by the Collection 6 algorithm in the state of Bahia between 2003 and 2019. Letter above the lines indicate significant differences among the means of each month according the Student's t test.

Table 2 - List of municipalities of Bahia state (Brazil) and their number of hot spots (HS) detected; mean annual hot spots; area; area divided by mean annual hot spots; hot spot frequency of incidence; forest area; savanna area; non-forest natural formations area; non-vegetated area; agriculture/pasture area; demographic density; mean annual rainfall and mean annual temperature. Municipalities are grouped in increasing order of the area by the mean annual number of hot spots.

Rank	Municipality	HS*	Mean Annual HS	Area (km^2)**	Area by the mean annual HS (km^2/HS)	HS freq.***	Forest area (km^2)+	Savanna Form. area (km2)+	Non-Forest Natural Form. area (km^2)+	Non-Vegetated Area (km^2)+	Agri. and pasture fields area (km^2)+	Demog. density (hab./km^2) ++	Mean annual rainfall (mm)+++	Mean annual temp. (ºC) +++
1	Presidente Jânio Quadros	2507	147,47	1209,17	8,20	Extreme	513,79	290,65	0,18	0,85	693,96	11,52	604	22,00
2	Cândido Sales	2223	130,76	1169,81	8,95	Extreme	505,54	501,00	0,00	2,54	661,72	17,26	856	22,10
3	Belo Campo	1466	86,24	772,76	8,96	Extreme	233,37	5,53	0,04	2,78	533,30	25,47	780	20,90
4	Tremedal	3271	192,41	2010,32	10,45	Extreme	1040,29	98,68	0,21	1,00	966,56	10,14	736	22,80
5	Cotegipe	6608	388,71	4282,78	11,02	Extreme	3372,40	255,21	77,05	6,13	815,42	3,25	1039	24,60

6	Caraíbas	1190	70,00	805,63	11,51	Extreme	257,71	0,01	0,05	0,37	541,51	12,69	674	23,30
7	Guajeru	1259	74,06	872,87	11,79	Extreme	324,34	4,58	0,09	0,50	547,67	11,12	650	22,60
8	Maetinga	843	49,59	614,83	12,40	Extreme	249,57	2,09	0,03	0,32	364,54	10,32	625	22,40
9	Santa Rita de Cássia	7890	464,12	6030,09	12,99	Extreme	5194,81	0,00	169,24	12,45	649,16	4,39	957	24,60
10	Aracatu	1932	113,65	1489,80	13,11	Extreme	501,47	0,31	0,29	1,21	986,56	9,22	584	21,70
11	Encruzilhada	2417	142,18	1890,13	13,29	Extreme	907,74	0,03	0,01	1,10	980,85	11,99	777	22,20
12	Mansidão	3832	225,41	3130,13	13,89	Extreme	2665,39	118,96	125,49	17,97	315,49	3,96	929	24,00
13	Cristópolis	1251	73,59	1052,84	14,31	Extreme	857,54	575,04	6,38	2,68	186,23	12,73	1024	23,40
14	Anagé	1437	84,53	1336,36	15,81	Extreme	576,88	351,96	0,10	2,45	751,29	13,10	664	23,50
15	Vitória da Conquista	3693	217,24	3705,84	17,06	Extreme	1142,65	660,09	0,05	44,12	2517,92	91,41	712	20,00
16	Piripá	504	29,65	511,76	17,26	Extreme	335,63	978,31	0,20	1,36	174,41	29,08	719	22,20
17	Caculé	597	35,12	610,98	17,40	Extreme	234,14	0,13	0,17	1,54	372,45	33,27	736	22,90
18	Riachão das Neves	5724	336,71	5979,00	17,76	Extreme	3749,26	56,33	449,11	13,36	1760,81	3,87	1047	24,40
19	Tabocas do Brejo Velho	1305	76,76	1437,19	18,72	Extreme	1157,52	2,28	5,30	2,01	272,31	8,31	824	24,50
20	Condeúba	1196	70,35	1348,44	19,17	Extreme	766,75	122,80	2,04	1,91	576,41	13,14	744	22,10
21	Sítio do Mato	1438	84,59	1627,79	19,24	Extreme	771,90	21,52	0,26	3,12	827,74	6,88	856	25,50
22	Baianópolis	2930	172,35	3320,72	19,27	Extreme	2664,49	0,01	90,32	9,73	555,57	4,14	1028	23,60
23	Carinhanha	2189	128,76	2529,45	19,64	Extreme	1374,33	2,80	25,85	5,56	1100,23	10,37	778	24,90
24	Formosa do Rio Preto	13526	795,65	15901,75	19,99	Extreme	9211,45	501,06	2264,77	26,18	4399,32	1,38	902	24,30
25	Ribeirão do Largo	1107	65,12	1363,70	20,94	Extreme	480,00	368,06	0,08	0,33	883,29	6,77	881	20,90
26	Catolândia	561	33,00	703,37	21,31	Extreme	620,87	17,36	8,15	1,06	90,30	4,06	1168	23,90
27	Rio do Antônio	617	36,29	777,90	21,43	Extreme	224,74	0,00	0,12	0,65	551,99	18,19	668	23,40
28	Tanque Novo	566	33,29	729,52	21,91	Extreme	317,59	0,00	6,55	1,60	403,66	22,31	792	22,10
29	Ibiassucê	374	22,00	483,27	21,97	Extreme	199,22	0,00	0,12	0,74	282,01	23,58	758	23,10
30	Cocos	7789	458,18	10140,57	22,13	Extreme	4648,36	2086,12	4732,00	53,02	705,97	1,77	909	23,70
31	Bom Jesus da Serra	355	20,88	467,81	22,40	Extreme	139,91	90,78	0,15	0,85	326,83	23,99	567	20,80
32	Malhada de Pedras	413	24,29	549,54	22,62	Extreme	109,69	186,90	0,04	0,55	439,19	16,01	624	23,60
33	Urandi	666	39,18	902,40	23,03	Extreme	365,85	8713,72	24,65	1,58	499,60	16,98	800	23,00
34	Mirante	862	50,71	1172,86	23,13	Extreme	332,90	621,61	0,73	5,19	833,78	9,70	593	23,00
35	Jacaraci	979	57,59	1332,42	23,14	Extreme	774,21	5,81	18,41	1,43	538,11	11,05	890	21,60
36	Bom Jesus da Lapa	3015	177,35	4115,51	23,21	Extreme	2317,31	1102,40	4,03	11,99	1739,48	15,11	833	25,40
37	Serra do Ramalho	1691	99,47	2342,15	23,55	Extreme	956,53	0,00	2,04	41,05	1316,85	12,20	868	25,00
38	Angical	1091	64,18	1530,05	23,84	Extreme	1024,08	3401,42	9,47	1,66	492,52	9,21	996	24,60
39	Botuporã	430	25,29	627,61	24,81	Extreme	251,65	75,22	0,14	1,00	374,71	17,28	773	23,30
40	Gandu	153	9,00	229,63	25,51	V. High	159,50	0,00	0,14	1,27	68,64	124,76	1449	22,80
41	Caetité	1741	102,41	2651,54	25,89	V. High	1766,62	25,45	33,59	7,76	843,09	19,45	862	21,80
42	Muquém de São Francisco	2518	148,12	3853,18	26,01	V. High	2591,07	19,31	0,74	5,51	1219,98	2,82	861	25,40
43	Wanderley	1905	112,06	2920,68	26,06	V. High	2011,44	191,17	3,41	2,20	900,31	4,22	930	24,40
44	Cordeiros	339	19,94	523,64	26,26	V. High	274,31	135,03	1,60	1,20	246,24	15,25	754	21,80
45	São Félix do Coribe	1100	64,71	1754,36	27,11	V. High	1176,32	122,36	0,46	75,77	500,07	13,74	809	24,90
46	Iramaia	1057	62,18	1708,12	27,47	V. High	777,61	985,19	22,36	1,27	905,95	6,16	747	22,00
47	Mortugaba	326	19,18	528,21	27,54	V. High	287,48	2292,22	0,32	0,92	239,37	20,38	824	21,70
48	Barreiras	4811	283,00	7859,72	27,77	V. High	3700,79	137,61	1286,47	55,66	2494,59	17,49	1045	24,90
49	Lagoa Real	549	32,29	912,22	28,25	V. High	461,74	534,77	2,65	0,66	446,71	15,88	652	23,50
50	Canavieiras	798	46,94	1334,30	28,42	V. High	661,10	167,55	74,48	8,91	568,12	24,37	1743	24,10
51	Barra	6769	398,18	11422,54	28,69	V. High	8767,43	662,87	1322,63	31,07	1221,71	4,32	649	25,70
52	Candiba	256	15,06	433,64	28,80	V. High	91,06	245,64	2,51	1,96	337,78	31,60	818	23,20
53	São Desidério	8917	524,53	15116,40	28,82	V. High	7575,79	24,89	1787,94	95,06	5654,59	1,82	1289	24,70
54	Buritirama	2377	139,82	4046,74	28,94	V. High	3695,05	1094,88	121,99	18,90	209,57	4,97	965	24,70
55	Riacho de Santana	1852	108,94	3183,91	29,23	V. High	1872,29	1771,27	82,18	3,12	1224,85	11,87	852	23,30
56	Poções	539	31,71	937,27	29,56	V. High	256,61	755,44	0,09	9,15	670,69	54,08	572	19,80
57	Caatiba	294	17,29	512,44	29,63	V. High	222,11	0,00	0,10	0,31	356,61	22,14	1008	23,10
58	Manoel Vitorino	1261	74,18	2201,76	29,68	V. High	846,51	3244,77	1,38	5,21	1335,70	6,45	703	22,70
59	Malhada	1127	66,29	1971,72	29,74	V. High	809,88	0,05	3,94	44,72	1071,43	7,97	784	25,00
60	Santa Maria da Vitória	1123	66,06	1984,91	30,05	V. High	1333,79	0,22	22,16	17,00	609,94	20,49	771	24,90
61	Correntina	6484	381,41	11492,17	30,13	V. High	5872,79	0,09	2277,86	123,71	3217,65	2,62	939	23,90
62	Jaborandi	5456	320,94	9988,72	31,12	V. High	4474,11	232,30	3501,63	75,77	1939,96	0,94	870	24,20
63	Brumado	1198	70,47	2207,61	31,33	V. High	770,82	127,17	1,63	14,05	1418,55	29,01	590	23,80
64	Coribe	1439	84,65	2662,89	31,46	V. High	1523,65	262,05	449,34	70,77	613,16	5,77	809	23,30
65	Licínio de Almeida	459	27,00	856,63	31,73	V. High	549,95	1730,42	18,56	1,93	284,85	14,60	857	21,60
66	Cícero Dantas	461	27,12	863,93	31,86	V. High	315,02	169,16	0,45	1,45	546,89	36,50	844	22,60

67	Santana	1002	58,94	1909,35	32,39	V. High	1173,73	0,00	2,81	16,28	712,69	13,60	929	24,50
68	Itaeté	697	41,00	1331,82	32,48	V. High	652,15	126,61	54,71	1,21	615,37	12,34	724	24,00
69	Souto Soares	537	31,59	1026,63	32,50	V. High	615,18	0,00	21,34	0,83	389,24	16,00	695	21,50
70	Wagner	270	15,88	522,37	32,89	V. High	286,78	0,01	0,38	1,16	234,04	21,34	763	22,90
71	Macarani	620	36,47	1210,11	33,18	V. High	134,18	0,00	1,70	2,24	1071,84	13,28	786	23,70
72	Macaúbas	1252	73,65	2459,10	33,39	V. High	1432,07	2153,24	35,13	7,94	982,77	15,71	785	23,60
73	Planalto	391	23,00	769,00	33,43	V. High	214,55	3007,05	0,05	2,62	551,41	27,70	641	19,20
74	Feira da Mata	595	35,00	1176,11	33,60	V. High	692,34	246,17	3,07	64,76	415,47	3,78	875	24,30
75	Belmonte	976	57,41	1939,45	33,78	V. High	971,74	68,38	107,00	17,93	797,48	11,06	1595	24,20
76	Campo Alegre de Lourdes	1394	82,00	2781,17	33,92	V. High	2157,09	0,01	13,03	3,89	606,08	10,10	704	25,90
77	Brejolândia	1111	65,35	2247,21	34,39	V. High	1357,69	14,89	1,80	1,48	886,24	4,04	813	24,60
78	Novo Horizonte	305	17,94	627,50	34,98	V. High	487,07	0,00	2,50	2,47	135,44	17,52	767	22,40
79	Barra do Mendes	763	44,88	1586,63	35,35	V. High	1142,29	86,07	79,09	4,65	360,19	9,08	603	22,60
80	Jucuruçu	701	41,24	1457,86	35,35	V. High	298,37	372,70	8,50	0,33	1150,07	7,06	1042	24,60
81	Firmino Alves	81	4,76	172,35	36,17	V. High	24,56	444,89	0,06	0,45	147,30	33,15	949	22,90
82	Iraquara	462	27,18	991,82	36,50	V. High	506,46	2154,54	15,96	1,01	468,28	21,96	761	22,10
83	Seabra	1118	65,76	2402,17	36,53	V. High	1488,35	13,62	51,84	5,22	856,62	16,60	753	21,80
84	Boa Nova	393	23,12	849,54	36,75	V. High	358,14	50,35	0,25	1,58	489,48	17,74	701	20,10
85	Ibitiara	829	48,76	1834,00	37,61	V. High	946,75	256,23	13,39	2,84	870,61	8,39	710	21,80
86	Sebastião Laranjeiras	897	52,76	1984,51	37,61	V. High	923,95	5,50	31,15	1,19	1027,20	5,32	813	23,70
87	Boninal	399	23,47	896,86	38,21	V. High	548,99	0,09	17,50	0,98	329,45	14,66	562	21,00
88	Esplanada	576	33,88	1299,36	38,35	V. High	602,55	1357,04	13,62	6,87	674,11	25,27	1226	23,60
89	Palmas de Monte Alto	1135	66,76	2562,82	38,39	V. High	819,55	5145,95	7,90	6,00	1729,25	8,23	758	23,60
90	Tanhaçu	565	33,24	1277,51	38,44	V. High	257,46	2,05	0,47	9,01	1009,13	16,21	614	23,80
91	Caetanos	383	22,53	877,65	38,96	V. High	262,24	561,27	0,07	3,50	611,82	17,61	583	23,00
92	Serra Dourada	690	40,59	1592,25	39,23	V. High	623,25	0,01	0,60	1,82	966,52	13,45	814	24,70
93	Luís Eduardo Magalhães	1693	99,59	3940,54	39,57	V. High	1233,14	252,80	795,05	40,90	2175,61	15,25	1511	24,20
94	Boquira	612	36,00	1426,23	39,62	V. High	674,51	179,16	9,74	1,96	739,93	14,86	747	24,00
95	Marcionílio Souza	469	27,59	1099,38	39,85	V. High	328,67	1488,22	0,93	1,43	766,45	8,22	791	23,20
96	Maracás	1024	60,24	2413,27	40,06	V. High	995,59	313,32	2,53	5,80	1395,50	10,92	796	18,50
97	Itambé	650	38,24	1536,30	40,18	V. High	322,22	42,70	0,41	2,11	1144,66	16,41	750	23,40
98	São Félix	43	2,53	103,23	40,81	V. High	20,42	0,00	0,01	0,49	80,45	142,11	1277	24,50
99	Ibicuí	473	27,82	1139,38	40,95	V. High	140,41	4415,58	1,15	1,31	996,43	13,41	965	22,60
100	Alcobaça	613	36,06	1482,29	41,11	V. High	780,00	0,04	30,77	5,60	666,92	14,36	1110	24,50
101	Igaporã	341	20,06	836,59	41,71	V. High	464,10	0,04	20,31	4,09	347,80	18,26	751	22,20
102	Pilão Arcado	4706	276,82	11626,64	42,00	V. High	8849,99	193,89	1027,02	30,98	1587,59	2,80	644	26,40
103	Paratinga	1058	62,24	2624,12	42,16	V. High	1754,78	0,05	29,75	5,15	817,83	11,28	768	25,90
104	Bonito	318	18,71	791,28	42,30	V. High	514,43	0,72	4,46	1,78	270,28	20,42	772	19,70
105	Ibotirama	670	39,41	1740,09	44,15	V. High	1294,64	709,57	65,66	9,85	322,81	14,76	863	25,50
106	Utinga	242	14,24	633,76	44,52	V. High	309,80	477,82	2,91	1,90	319,09	28,47	627	22,50
107	Lençóis	483	28,41	1283,33	45,17	V. High	974,59	7,37	106,95	0,80	200,74	8,12	1206	23,90
108	Canápolis	173	10,18	460,39	45,24	V. High	258,47	212,18	1,34	0,62	199,97	21,52	856	23,80
109	Matina	287	16,88	773,28	45,80	V. High	266,55	1302,04	2,59	3,26	500,60	14,37	762	23,70
110	Novo Triunfo	93	5,47	251,32	45,94	V. High	110,11	187,10	0,12	0,18	140,96	59,89	789	23,00
111	Palmeiras	269	15,82	737,45	46,60	V. High	484,71	4894,39	85,50	1,03	166,19	12,79	888	22,00
112	Andaraí	578	34,00	1590,32	46,77	V. High	810,15	3352,99	164,33	2,10	611,33	7,50	1065	23,90
113	Saúde	184	10,82	509,10	47,04	V. High	294,23	0,13	1,99	0,28	211,85	23,49	927	23,10
114	Mucugê	885	52,06	2462,15	47,30	V. High	1220,66	43,55	637,29	2,21	591,48	4,30	932	20,30
115	Wenceslau Guimarães	233	13,71	655,24	47,81	V. High	433,90	710,80	0,71	0,36	220,31	32,92	1381	23,60
116	Itanagra	188	11,06	534,06	48,29	V. High	241,10	0,05	13,31	0,22	235,74	15,49	1792	24,30
117	Mulungu do Morro	226	13,29	646,62	48,64	V. High	310,75	2216,26	5,41	0,85	329,58	21,64	664	21,40
118	Iguaí	300	17,65	860,22	48,75	V. High	317,68	0,06	0,53	1,27	540,71	31,05	1004	22,60
119	Conde	324	19,06	931,11	48,85	V. High	452,07	0,00	28,54	4,78	477,31	24,49	1489	25,00
120	Barra da Estiva	572	33,65	1657,41	49,26	V. High	821,83	237,10	110,50	8,77	716,02	15,73	928	20,10
121	Almadina	84	4,94	245,24	49,63	V. High	123,55	0,02	0,14	0,40	121,12	25,32	1198	22,60
122	Santa Cruz da Vitória	97	5,71	284,08	49,79	V. High	40,99	0,04	0,19	0,41	242,44	22,38	1012	23,30
123	Paramirim	368	21,65	1087,06	50,22	V. High	543,38	302,50	15,44	3,23	520,61	17,95	745	23,20
124	Itapitanga	141	8,29	420,66	50,72	V. High	91,78	0,43	0,36	0,40	328,10	24,99	1226	23,50
125	Pindaí	210	12,35	628,47	50,88	V. High	192,19	464,94	4,99	2,01	428,95	25,45	688	23,10
126	Mucuri	587	34,53	1787,63	51,77	V. High	905,69	11,33	9,24	9,62	850,79	20,23	1583	24,30
127	Itagibá	266	15,65	810,99	51,83	V. High	252,48	934,64	0,77	2,69	554,11	19,26	1257	23,40
128	Santa Luzia	265	15,59	824,46	52,89	V. High	475,34	0,20	13,86	1,60	188,76	17,22	1237	23,80
129	Brotas de Macaúbas	757	44,53	2370,49	53,23	V. High	1836,28	10,42	72,98	3,88	456,70	4,78	743	22,70
130	Contendas do	311	18,29	977,46	53,43	V. High	585,49	677,89	6,75	3,08	381,84	4,46	581	24,30

	Sincorá													
131	Miguel Calmon	508	29,88	1599,67	53,53	V. High	748,38	19,68	14,94	1,96	833,03	16,88	590	23,00
132	Umburanas	560	32,94	1775,63	53,90	V. High	1045,30	108,72	310,68	0,87	418,73	10,18	553	22,50
133	Mascote	233	13,71	742,69	54,19	V. High	404,89	0,00	11,45	1,03	370,18	18,95	1393	23,90
134	Cardeal da Silva	92	5,41	293,46	54,23	V. High	131,70	0,01	0,10	0,61	124,50	34,64	1438	24,20
135	Morpará	653	38,41	2093,87	54,51	V. High	1651,09	7883,86	0,83	2,10	436,54	4,88	777	25,50
136	Mundo Novo	465	27,35	1491,99	54,55	V. High	671,65	0,01	0,33	0,17	819,55	16,34	875	22,10
137	Milagres	131	7,71	420,36	54,55	V. High	128,10	5,14	1,02	2,37	288,81	36,24	517	22,10
138	Nova Redenção	173	10,18	565,36	55,56	V. High	155,83	2999,43	1,09	0,41	407,82	18,64	805	23,50
139	Taperoá	138	8,12	452,00	55,68	V. High	378,36	669,34	0,62	0,33	68,85	45,64	2082	24,60
140	Caturama	218	12,82	716,26	55,86	V. High	265,99	0,00	3,44	0,57	446,03	13,31	765	23,50
141	Piatã	554	32,59	1825,86	56,03	V. High	1221,72	0,13	279,42	3,97	320,45	10,49	1018	19,10
142	Boa Vista do Tupim	900	52,94	2972,11	56,14	V. High	1427,82	324,13	2,86	1,60	1526,26	6,40	664	23,40
143	Pindobaçu	150	8,82	495,85	56,20	V. High	284,10	215,61	0,68	0,37	209,49	40,54	808	23,70
144	Teolândia	87	5,12	289,60	56,59	V. High	190,97	3,29	0,20	0,12	98,33	46,68	1461	23,20
145	Itapé	136	8,00	453,14	56,64	V. High	101,76	22,86	1,09	0,51	349,78	23,94	1227	24,10
146	Ituberá	124	7,29	415,43	56,95	V. High	314,71	581,36	34,63	1,86	44,31	63,73	2095	24,60
147	Mirangaba	517	30,41	1751,78	57,60	V. High	674,00	198,92	414,35	0,26	662,99	9,59	789	21,40
148	Ibipitanga	280	16,47	954,37	57,94	V. High	275,46	0,00	0,14	1,03	677,50	14,85	690	24,50
149	Livramento de N. Senhora	573	33,71	1953,38	57,95	V. High	655,62	222,11	26,46	3,42	1266,18	19,99	623	23,90
150	Iuiú	446	26,24	1522,35	58,03	V. High	321,80	0,01	0,77	70,31	1129,21	7,34	776	24,40
151	Ituaçu	350	20,59	1199,37	58,26	V. High	614,93	829,13	46,25	4,14	533,48	14,90	644	23,60
152	Prado	492	28,94	1687,83	58,32	V. High	681,04	257,39	9,47	16,18	976,94	15,87	979	24,60
153	Santa Cruz Cabrália	422	24,82	1462,94	58,93	V. High	856,15	155,01	9,20	5,38	587,23	16,92	1614	24,10
154	Ourolândia	443	26,06	1544,99	59,29	V. High	312,48	0,00	346,32	1,38	884,30	11,03	445	23,10
155	Rio do Pires	186	10,94	656,22	59,98	V. High	437,64	0,10	22,98	1,27	194,11	14,54	757	24,00
156	Xique-Xique	1420	83,53	5079,66	60,81	V. High	3086,59	0,02	603,47	35,05	1243,99	8,28	642	25,80
157	Érico Cardoso	204	12,00	735,25	61,27	V. High	516,73	917,35	128,22	2,12	121,28	15,48	799	22,70
158	Ibipeba	383	22,53	1382,01	61,34	V. High	839,34	54,93	48,87	1,80	489,83	12,29	628	22,90
159	Lajedo do Tabocal	105	6,18	382,94	62,00	V. High	78,39	1269,06	0,01	0,40	303,93	19,23	765	19,50
160	Piritiba	265	15,59	980,33	62,89	V. High	269,95	3,98	0,28	1,31	706,94	22,96	749	22,50
161	Jacobina	587	34,53	2192,90	63,51	V. High	948,45	448,35	172,97	7,10	1063,30	33,60	831	24,00
162	Itororó	84	4,94	314,06	63,56	V. High	100,09	0,01	0,11	1,39	212,40	63,50	865	23,50
163	Santo Amaro	130	7,65	489,32	63,99	V. High	179,89	0,22	3,75	3,22	258,34	117,26	1713	24,70
164	Várzea Nova	321	18,88	1225,89	64,92	V. High	421,66	0,00	127,44	2,55	674,04	10,96	537	21,90
165	Jandaíra	168	9,88	643,75	65,14	V. High	280,61	66,41	9,30	10,86	320,72	16,11	1231	24,10
166	Camaçari	203	11,94	785,34	65,77	V. High	213,19	6,88	63,83	95,91	397,07	309,65	1710	24,90
167	Pojuca	81	4,76	314,93	66,10	V. High	76,34	0,00	1,58	4,73	209,90	113,97	1570	24,20
168	Nova Itarana	122	7,18	475,38	66,24	V. High	84,55	144,98	0,53	2,43	387,73	15,80	599	21,10
169	Maraú	214	12,59	848,89	67,43	V. High	615,57	793,99	59,94	3,62	123,54	23,20	2327	24,70
170	Aporá	120	7,06	479,26	67,90	V. High	55,04	3,28	0,09	0,56	506,09	31,56	928	23,40
171	Caém	135	7,94	540,91	68,11	V. High	207,08	583,88	2,94	0,15	329,13	18,91	911	23,90
172	Planaltino	238	14,00	955,36	68,24	V. High	268,81	385,10	1,28	1,77	683,17	9,52	726	20,40
173	Acajutiba	45	2,65	181,48	68,56	V. High	18,63	5,47	0,03	0,87	160,55	81,34	976	23,50
174	Guaratinga	539	31,71	2189,40	69,05	V. High	512,05	27,18	43,28	1,57	1632,27	9,53	1092	24,50
175	Ruy Barbosa	489	28,76	1991,77	69,24	V. High	695,10	0,04	0,95	2,99	1291,43	13,76	754	23,20
176	Macajuba	172	10,12	701,17	69,30	V. High	199,41	354,06	0,50	0,80	500,26	17,27	757	23,00
177	Jeremoabo	1134	66,71	4627,28	69,37	V. High	3149,48	0,01	137,42	2,76	1337,10	8,09	629	24,30
178	Lajedinho	206	12,12	846,73	69,88	V. High	227,71	0,01	0,21	0,50	618,09	5,07	678	21,70
179	Potiraguá	270	15,88	1111,57	69,99	V. High	154,06	434,03	1,95	0,83	953,62	9,95	881	24,00
180	Nova Canaã	195	11,47	804,62	70,15	V. High	169,41	0,07	0,20	0,73	634,24	19,58	1019	22,20
181	Amélia Rodrigues	42	2,47	173,48	70,22	V. High	41,97	0,01	0,04	2,56	128,91	145,20	1277	23,40
182	Gentio do Ouro	917	53,94	3817,95	70,78	V. High	3072,32	0,02	298,76	45,50	397,04	2,87	772	21,20
183	Maiquinique	141	8,29	588,30	70,93	V. High	62,85	2146,94	1,58	1,21	522,53	17,85	781	23,70
184	Itagi	74	4,35	310,62	71,36	V. High	221,96	0,02	0,00	0,29	88,37	50,35	1071	23,20
185	Nova Viçosa	310	18,24	1316,38	72,19	V. High	792,06	0,00	12,05	10,60	491,15	29,15	1560	24,30
186	Caravelas	554	32,59	2377,87	72,97	V. High	1153,42	0,04	66,45	7,95	1117,22	8,95	1519	24,30
187	Valença	261	15,35	1124,32	73,23	V. High	752,29	0,00	27,05	5,78	310,26	74,35	2109	24,60
188	Coaraci	63	3,71	274,50	74,07	V. High	161,33	5,10	0,13	1,32	111,73	74,17	1203	23,40
189	Cafarnaum	147	8,65	643,66	74,44	V. High	169,90	0,00	20,60	2,06	450,80	25,49	559	21,90
190	Itaberaba	544	32,00	2386,39	74,57	V. High	670,96	0,04	2,02	7,86	1701,98	26,30	747	24,40
191	Araças	108	6,35	474,66	74,72	V. High	237,83	0,00	2,47	0,77	245,99	23,73	1623	23,90
192	Porto Seguro	519	30,53	2285,76	74,87	V. High	1037,66	0,01	16,28	25,61	1202,88	52,70	1624	24,40
193	Oliveira dos Brejinhos	748	44,00	3313,42	75,30	High	1856,50	0,01	67,72	3,65	1383,52	6,21	738	24,60
194	Ipupiara	234	13,76	1055,76	76,70	High	804,81	0,01	14,31	2,58	234,03	8,75	696	23,20

195	Jequié	657	38,65	2969,03	76,82	High	1730,19	388,40	2,30	23,44	1176,94	47,07	703	23,30
196	Aiquara	37	2,18	167,88	77,13	High	79,19	0,01	0,13	0,10	88,44	28,82	1198	23,60
197	Itapetinga	362	21,29	1651,16	77,54	High	202,49	1,51	2,92	9,05	1435,64	41,95	857	23,60
198	Dário Meira	90	5,29	413,64	78,13	High	218,89	0,01	0,20	0,30	194,14	28,82	1158	23,50
199	São Gabriel	249	14,65	1146,05	78,24	High	318,24	74,55	71,90	2,77	752,89	15,36	582	23,50
200	Itabuna	87	5,12	401,03	78,36	High	266,43	0,43	0,71	16,48	117,13	473,50	1419	24,40
201	Guanambi	276	16,24	1272,37	78,37	High	229,16	343,84	8,13	21,24	1008,23	60,80	720	23,60
202	Campo Formoso	1539	90,53	7161,83	79,11	High	3119,00	0,00	1845,27	11,11	2186,20	9,18	946	23,20
203	Nordestina	100	5,88	465,41	79,12	High	119,30	496,49	6,25	1,44	338,10	26,38	461	24,10
204	João Dourado	190	11,18	913,26	81,71	High	91,24	0,00	15,43	2,24	804,29	24,65	573	22,30
205	Andorinha	283	16,65	1362,39	81,84	High	673,61	317,74	63,55	1,76	622,32	11,55	623	23,70
206	Camamu	174	10,24	839,70	82,04	High	641,83	4018,93	5,88	0,88	107,90	38,22	2340	24,60
207	Aurelino Leal	92	5,41	445,39	82,30	High	210,61	733,62	0,51	0,43	233,49	29,70	1478	24,40
208	Ibicoara	166	9,76	817,36	83,71	High	437,18	711,35	117,46	1,64	260,29	20,34	977	20,00
209	Itapicuru	316	18,59	1556,75	83,75	High	400,97	6,22	0,81	1,45	1182,28	20,35	830	24,20
210	Morro do Chapéu	1166	68,59	5744,97	83,76	High	3401,38	981,96	339,07	28,82	1974,84	6,12	691	20,20
211	Gongogi	41	2,41	202,19	83,84	High	83,12	0,00	0,38	0,24	118,36	42,28	1250	24,00
212	Iaçu	474	27,88	2342,50	84,01	High	724,01	0,24	2,54	5,14	1606,85	10,50	586	23,50
213	Mata de São João	122	7,18	605,21	84,33	High	288,76	601,20	7,13	14,01	311,51	63,46	1632	24,70
214	Itapebi	203	11,94	1013,07	84,84	High	302,41	3120,73	0,87	2,19	672,23	10,44	1107	23,40
215	Barra do Choça	153	9,00	765,15	85,02	High	242,86	0,02	0,00	1,17	519,74	44,42	741	19,90
216	Sítio do Quinto	140	8,24	700,17	85,02	High	159,73	0,02	4,22	0,61	535,29	17,98	727	23,00
217	Entre Rios	236	13,88	1187,51	85,54	High	579,08	88,08	29,05	12,78	593,39	32,81	1339	23,40
218	Ponto Novo	104	6,12	530,14	86,66	High	112,90	1896,82	7,20	1,69	405,89	31,65	696	24,10
219	Barro Alto	81	4,76	414,51	87,00	High	76,54	1,61	5,64	0,59	331,52	32,68	602	22,70
220	Itarantim	322	18,94	1674,03	88,38	High	150,26	328,62	3,61	1,61	1508,29	10,27	785	23,80
221	Pau Brasil	120	7,06	626,31	88,73	High	250,92	0,00	0,53	0,52	374,08	17,89	1015	23,70
222	Abaíra	103	6,06	538,68	88,91	High	312,06	290,38	88,16	0,62	137,83	15,68	849	22,80
223	Itaju do Colônia	234	13,76	1225,29	89,02	High	184,15	13,19	2,02	0,44	1038,42	5,98	973	23,80
224	Una	215	12,65	1126,73	89,09	High	980,38	453,29	16,73	2,25	215,73	20,48	1577	24,10
225	Irecê	60	3,53	319,17	90,43	High	27,35	0,01	4,63	8,10	279,08	207,45	583	23,30
226	Ilhéus	294	17,29	1588,56	91,86	High	1276,54	0,17	5,16	16,73	272,30	104,67	1946	24,50
227	Cachoeira	74	4,35	399,93	91,88	High	198,79	134,69	0,60	1,19	162,68	81,03	1268	24,30
228	Rio de Contas	200	11,76	1115,25	94,80	High	517,51	2,95	214,19	3,14	342,66	12,23	821	20,70
229	Eunápolis	255	15,00	1425,97	95,06	High	414,66	4,49	0,69	16,76	992,40	84,97	1165	23,80
230	Ibicaraí	41	2,41	230,95	95,76	High	136,42	60,35	0,15	1,62	92,69	104,65	1172	23,60
231	Itacaré	128	7,53	726,27	96,46	High	628,80	0,00	4,29	1,26	86,28	32,96	2301	24,70
232	Floresta Azul	56	3,29	321,01	97,45	High	95,41	204,21	0,39	0,53	224,42	36,32	1134	23,60
233	Itiruçu	55	3,24	322,02	99,53	High	68,36	516,45	0,00	0,99	252,62	40,46	777	19,70
234	Canarana	99	5,82	579,73	99,55	High	70,54	616,50	8,40	2,07	498,39	41,76	592	22,60
235	Piraí do Norte	33	1,94	193,43	99,64	High	146,39	1082,78	0,15	0,02	46,73	52,32	1610	23,70
236	Senhor do Bonfim	134	7,88	789,36	100,14	High	254,22	116,16	6,57	6,52	520,47	89,93	768	23,40
237	Rio Real	125	7,35	738,61	100,45	High	113,62	0,03	0,72	1,94	599,76	51,84	919	23,80
238	Jaguarari	412	24,24	2466,01	101,75	High	1015,69	1401,89	816,19	15,85	617,73	12,35	663	22,30
239	Filadélfia	95	5,59	579,69	103,73	High	120,37	864,48	4,15	0,99	451,97	29,36	727	23,90
240	Jaguaquara	150	8,82	924,74	104,80	High	309,75	0,00	0,16	6,52	607,97	54,95	790	20,50
241	Antônio Gonçalves	56	3,29	345,28	104,82	High	224,44	249,44	0,44	0,19	120,03	35,09	849	23,60
242	Cansanção	219	12,88	1351,89	104,94	High	445,78	0,01	15,49	5,16	878,52	24,62	508	23,80
243	América Dourada	133	7,82	822,37	105,12	High	120,36	68,25	15,54	1,74	684,46	19,05	534	22,60
244	Uibaí	87	5,12	545,30	106,55	High	293,26	785,01	17,00	0,94	234,08	24,73	683	24,30
245	Itanhém	222	13,06	1394,17	106,76	High	117,38	109,65	0,80	1,55	1274,34	13,81	1152	24,50
246	Itagimirim	139	8,18	876,80	107,23	High	148,39	752,22	0,43	0,84	712,13	8,47	1045	23,30
247	Monte Santo	476	28,00	3034,20	108,36	High	1099,26	2615,40	127,12	2,34	1804,94	16,43	601	23,10
248	Ibiquera	109	6,41	698,25	108,90	High	233,85	830,24	0,27	0,40	463,35	5,15	688	22,00
249	Lafaiete Coutinho	77	4,53	498,10	109,97	High	132,82	0,04	0,04	0,28	364,86	9,62	765	21,30
250	Pedro Alexandre	138	8,12	896,07	110,39	High	148,83	0,00	6,64	1,21	738,86	18,97	614	23,50
251	Presidente Tancredo Neves	68	4,00	441,89	110,47	High	255,46	314,90	0,83	0,59	184,99	57,16	1594	23,00
252	Cravolândia	28	1,65	182,59	110,86	High	87,88	0,00	0,01	0,86	93,73	31,08	753	21,20
253	Caldeirão Grande	70	4,12	458,31	111,30	High	278,45	0,01	1,07	0,38	187,14	27,46	871	23,70
254	Dias d'Ávila	28	1,65	184,23	111,85	High	40,44	262,33	6,73	21,02	102,03	360,64	1668	24,80
255	Jussari	50	2,94	329,19	111,92	High	138,30	0,05	0,17	0,36	190,33	18,14	1196	23,40
256	Cairu	68	4,00	448,82	112,20	High	299,23	408,99	53,31	6,70	27,97	33,35	2151	24,60
257	Ubaitaba	27	1,59	181,10	114,03	High	127,18	75,58	0,31	1,07	51,49	115,72	1472	24,30

258	Irajuba	67	3,94	459,05	116,47	High	119,40	610,78	0,06	0,83	338,21	16,93	700	21,30
259	Santa Brígida	130	7,65	900,06	117,70	High	288,90	329,73	0,30	0,65	610,24	17,06	545	24,90
260	Euclides da Cunha	285	16,76	1992,64	118,86	High	939,97	1093,42	6,48	2,76	1043,26	27,75	622	23,10
261	Itamaraju	336	19,76	2360,29	119,42	High	605,30	1632,30	9,34	5,41	1739,50	28,47	1136	24,60
262	Itabela	130	7,65	924,93	120,95	High	293,52	2484,95	0,85	2,93	627,29	33,37	1261	24,20
263	Inhambupe	149	8,76	1082,26	123,48	High	219,84	238,64	0,77	1,52	912,65	29,70	905	23,50
264	Tapiramutá	98	5,76	714,69	123,98	High	330,77	1025,30	0,45	0,43	382,40	24,88	916	20,40
265	São Sebastião do Passé	73	4,29	536,58	124,96	High	100,94	0,69	1,07	3,01	431,30	78,30	1640	24,60
266	Vereda	105	6,18	782,14	126,63	High	121,44	212,82	1,34	0,37	658,66	7,78	1159	24,70
267	Presidente Dutra	31	1,82	232,06	127,26	High	30,05	149,64	2,52	1,21	198,30	84,07	616	23,70
268	Buerarema	29	1,71	219,49	128,66	High	173,79	0,01	0,13	0,95	44,59	80,73	1292	24,10
269	Jaguaripe	113	6,65	863,11	129,85	High	482,43	2526,05	100,09	4,59	234,40	18,32	1825	24,80
270	Itatim	71	4,18	547,51	131,09	High	116,90	0,05	0,82	3,97	424,92	24,89	554	23,00
271	Mairi	117	6,88	906,68	131,74	High	136,62	0,01	0,36	0,54	769,15	20,29	760	22,80
272	Nilo Peçanha	50	2,94	390,96	132,93	High	328,89	0,02	14,65	0,69	42,92	31,38	2057	24,60
273	Barra do Rocha	27	1,59	214,41	135,00	High	157,38	0,00	0,18	0,28	56,43	30,30	1242	23,80
274	Queimadas	251	14,76	2011,06	136,21	High	230,53	119,03	20,48	5,85	1753,35	12,13	553	24,10
275	Terra Nova	23	1,35	184,30	136,22	High	14,30	0,06	0,13	0,97	168,87	64,36	1488	24,30
276	Antas	40	2,35	321,61	136,68	High	56,84	3,82	0,35	0,46	263,96	53,08	847	22,70
277	Nova Soure	114	6,71	921,71	137,45	High	300,85	0,00	1,97	1,54	632,07	25,40	760	24,10
278	Aratuípe	21	1,24	174,01	140,87	High	88,06	42,42	0,41	0,08	84,69	47,47	1676	24,50
279	Itaguaçu da Bahia	517	30,41	4310,24	141,73	High	2150,87	95,91	758,95	2,23	1389,20	2,97	658	25,20
280	Várzea do Poço	24	1,41	206,48	146,26	High	16,13	300,19	0,09	0,46	189,75	42,27	752	23,10
281	Muritiba	10	0,59	86,31	146,73	High	5,58	0,89	0,00	2,05	78,64	323,58	1222	23,10
282	Ibititá	65	3,82	573,03	149,87	High	56,12	463,30	6,57	1,25	508,71	28,63	635	22,60
283	Jussiape	66	3,88	589,76	151,91	Average	304,12	110,04	53,50	1,02	230,85	13,72	598	23,70
284	Coronel João Sá	98	5,76	883,52	153,26	Average	187,38	39,59	40,13	7,01	648,25	19,32	531	24,00
285	Vera Cruz	33	1,94	299,37	154,22	Average	113,53	1808,29	6,64	8,92	47,75	125,33	1874	25,10
286	Quijingue	150	8,82	1380,80	156,49	Average	476,02	13,68	7,04	3,32	894,33	20,28	397	24,00
287	Teixeira de Freitas	125	7,35	1165,62	158,52	Average	225,58	310,95	2,06	21,91	915,12	118,87	1099	24,30
288	Itiúba	177	10,41	1650,59	158,53	Average	360,44	803,67	18,37	1,77	1263,65	20,96	659	23,90
289	Alagoinhas	75	4,41	707,56	160,38	Average	233,33	353,80	0,39	21,23	452,59	188,67	1478	23,50
290	São José do Jacuípe	38	2,24	362,37	162,11	Average	13,85	522,17	0,10	0,78	345,30	25,30	631	23,20
291	Itamari	15	0,88	143,48	162,61	Average	86,62	1698,69	0,10	0,13	56,61	71,14	1334	23,00
292	Capim Grosso	48	2,82	464,78	164,61	Average	51,23	36,23	4,06	4,68	402,48	79,47	667	23,30
293	Lapão	66	3,88	642,88	165,59	Average	61,61	0,01	5,02	2,04	574,11	42,38	590	22,90
294	Itaquara	35	2,06	344,09	167,13	Average	86,44	545,53	0,01	1,06	256,47	23,77	694	21,10
295	São José da Vitória	13	0,76	127,93	167,29	Average	99,85	11,00	0,06	0,28	27,72	78,84	1288	23,70
296	Ubatã	18	1,06	177,64	167,77	Average	120,12	0,06	0,29	1,24	55,88	93,22	1290	23,90
297	Cruz das Almas	14	0,82	139,12	168,93	Average	8,75	147,48	0,00	5,01	125,29	402,12	1136	23,00
298	Simões Filho	20	1,18	201,22	171,04	Average	62,38	1115,23	2,27	18,44	106,57	586,65	1674	24,90
299	Maragogipe	43	2,53	438,18	173,23	Average	210,72	8653,83	3,25	2,39	188,81	97,27	1418	24,60
300	Ibirataia	31	1,82	318,13	174,46	Average	231,24	179,00	0,77	1,18	84,57	64,24	1269	23,60
301	Dom Basílio	66	3,88	688,65	177,38	Average	244,16	209,43	2,84	1,15	439,80	16,78	593	24,00
302	Laje	43	2,53	449,83	177,84	Average	116,42	9,29	1,76	0,67	330,66	48,50	1308	23,30
303	Central	54	3,18	566,97	178,49	Average	179,48	0,01	18,70	6,37	362,39	28,24	593	23,60
304	Nazaré	26	1,53	278,63	182,18	Average	143,50	276,62	1,63	0,92	131,03	107,47	1615	24,70
305	Sento Sé	1132	66,59	12181,24	182,93	Average	7734,17	103,81	2084,97	19,32	1383,09	2,95	600	26,70
306	Banzaê	38	2,24	409,51	183,20	Average	190,22	152,32	0,10	0,49	218,61	51,92	693	23,90
307	São Francisco do Conde	25	1,47	269,61	183,33	Average	67,14	67,33	5,67	6,56	115,71	126,24	1796	24,80
308	Brejões	48	2,82	518,57	183,66	Average	117,94	140,34	0,20	2,18	397,93	29,70	810	20,80
309	Medeiros Neto	118	6,94	1311,74	188,98	Average	63,64	0,00	2,43	2,72	1242,81	17,40	1065	24,50
310	Barro Preto	18	1,06	201,59	190,39	Average	175,59	110,72	0,05	0,23	25,69	50,26	1243	23,50
311	Ipiaú	25	1,47	280,45	190,71	Average	170,44	1,97	0,28	3,48	106,03	166,05	1202	23,60
312	Ibirapuã	68	4,00	771,10	192,77	Average	169,95	0,00	1,07	1,08	598,75	10,10	1009	24,10
313	Lajedão	55	3,24	624,35	192,98	Average	42,41	0,90	0,86	0,66	580,14	6,07	1042	23,80
314	Santaluz	141	8,29	1623,45	195,73	Average	273,64	30,00	11,56	7,94	1329,37	21,65	594	23,20
315	Conceição do Jacuípe	10	0,59	117,53	199,80	Average	13,13	512,39	0,03	5,49	98,88	256,30	1188	23,30
316	Crisópolis	54	3,18	636,61	200,41	Average	49,30	0,01	0,08	1,01	557,20	32,99	800	23,50
317	São Gonçalo dos Campos	25	1,47	294,77	200,44	Average	24,63	229,50	0,39	5,70	252,68	110,67	1079	23,20
318	Catu	36	2,12	426,96	201,62	Average	97,34	471,23	0,23	3,95	314,68	122,72	1525	24,00
319	Jussara	109	6,41	1355,17	211,36	Average	328,98	37,23	136,47	2,84	886,76	15,87	576	24,00

320	Jitaúna	21	1,24	262,05	212,14	Average	188,07	72,01	0,11	0,43	73,37	64,47	1150	23,50
321	Paulo Afonso	123	7,24	1545,19	213,56	Average	547,47	2256,58	1,79	16,57	947,62	68,62	540	25,80
322	Candeias	20	1,18	251,63	213,88	Average	53,42	12,92	3,12	11,00	165,14	321,87	1797	24,60
323	Santa Teresinha	56	3,29	719,26	218,35	Average	103,37	3420,17	0,33	0,42	614,37	13,64	651	23,00
324	Cipó	12	0,71	155,72	220,60	Average	43,06	16,09	0,11	2,02	110,60	122,78	891	24,90
325	Coração de Maria	29	1,71	378,42	221,83	Average	28,82	1822,82	0,10	1,51	347,96	64,34	1145	23,10
326	Casa Nova	730	42,94	9647,07	224,66	Average	5154,80	183,48	1563,73	32,32	1934,50	6,73	480	25,40
327	Camacan	44	2,59	584,85	225,96	Average	474,79	371,23	0,29	1,34	108,14	50,22	1217	23,60
328	Baixa Grande	72	4,24	967,51	228,44	Average	172,06	40,33	0,39	0,51	794,26	21,19	754	22,90
329	Ubaíra	49	2,88	659,14	228,68	Average	383,41	478,49	0,07	0,67	274,98	27,19	881	22,20
330	Teodoro Sampaio	18	1,06	244,61	231,02	Average	33,78	224,36	0,02	0,25	209,58	34,10	1341	24,10
331	Remanso	343	20,18	4683,40	232,12	Average	2266,63	389,60	254,63	7,72	1575,61	8,32	590	26,80
332	Salinas da Margarida	11	0,65	151,50	234,14	Average	32,22	27,15	6,37	1,94	18,72	89,81	1756	25,00
333	Ibirapitanga	34	2,00	472,69	236,35	Average	381,62	1182,05	0,78	0,82	89,04	50,53	1563	24,10
334	Pedrão	11	0,65	158,49	244,94	Average	15,48	282,15	0,00	0,20	142,13	43,03	1193	23,00
335	Lauro de Freitas	4	0,24	57,66	245,07	Average	15,56	0,00	0,22	24,72	16,42	2833,38	1232	25,00
336	Igrapiúna	40	2,35	591,31	251,31	Average	447,75	0,00	11,78	0,45	80,24	25,31	2183	24,50
337	Ipecaetá	25	1,47	372,57	253,34	Average	20,85	4,77	0,13	0,33	351,22	41,45	721	23,40
338	Conceição da Feira	11	0,65	164,80	254,69	Average	14,72	287,91	0,01	1,79	124,83	125,19	1110	23,10
339	Itajuípe	18	1,06	270,75	255,71	Average	237,98	3,08	0,09	1,04	31,51	74,10	1495	24,10
340	Conceição do Coité	67	3,94	1015,25	257,60	Average	200,31	0,01	9,64	11,45	793,42	61,06	585	22,30
341	Capela do Alto Alegre	41	2,41	629,59	261,05	Average	14,53	1,75	0,09	0,87	614,02	17,75	695	22,80
342	Sátiro Dias	65	3,82	1008,18	263,68	Average	228,77	0,01	0,60	0,62	780,06	18,78	654	23,60
343	Santa Inês	24	1,41	379,27	268,65	Average	144,22	1171,71	0,00	1,65	233,29	32,83	648	21,60
344	Castro Alves	45	2,65	713,79	269,65	Average	46,35	4658,22	0,05	1,57	665,57	35,70	761	22,70
345	Jiquiriçá	15	0,88	238,60	270,42	Average	137,74	28,95	0,09	0,20	100,55	58,97	1041	22,40
346	Uruçuca	32	1,88	510,10	270,99	Average	457,45	269,26	1,35	1,31	49,53	50,61	1585	24,20
347	Amargosa	27	1,59	431,67	271,79	Average	110,56	1150,62	0,03	2,37	318,66	74,16	960	21,80
348	Ribeira do Pombal	73	4,29	1177,45	274,20	Average	372,95	8,12	0,82	3,89	799,68	62,34	711	24,20
349	Quixabeira	22	1,29	366,39	283,12	Average	38,17	0,04	1,66	0,51	322,95	24,64	712	23,30
350	Araci	89	5,24	1495,55	285,67	Average	370,89	0,01	23,20	24,88	1068,20	33,19	659	23,70
351	Biritinga	32	1,88	553,76	294,19	Average	137,00	7,86	0,54	0,45	415,62	26,97	701	23,60
352	Serrolândia	18	1,06	322,02	304,13	Low	33,09	7092,13	0,63	1,14	286,71	41,72	751	23,40
353	Tucano	118	6,94	2185,01	314,79	Low	672,04	11,93	13,78	8,05	1490,77	18,73	648	24,40
354	Apuarema	8	0,47	150,83	320,51	Low	70,59	0,02	0,40	0,23	79,59	48,17	1394	22,80
355	Arataca	23	1,35	435,96	322,23	Low	409,21	0,02	0,19	0,28	26,30	27,70	1268	23,60
356	Ribeira do Amparo	35	2,06	667,34	324,13	Low	183,75	1039,49	0,52	0,52	457,64	22,22	788	24,70
357	Aramari	19	1,12	368,95	330,11	Low	105,37	0,00	0,78	0,49	257,30	30,44	1316	23,30
358	Canudos	161	9,47	3189,54	336,78	Low	2159,46	315,45	351,92	11,80	650,91	4,89	465	23,80
359	Adustina	31	1,82	632,14	346,66	Low	98,87	4,17	5,08	1,65	525,38	24,84	617	23,50
360	Ipirá	150	8,82	3105,28	351,93	Low	171,69	0,01	0,58	6,35	2925,96	19,39	675	22,60
361	Governador Mangabeira	5	0,29	106,85	363,28	Low	7,14	11,80	0,00	0,53	90,83	186,40	1158	23,00
362	Rafael Jambeiro	49	2,88	1090,55	378,35	Low	93,16	0,02	0,69	2,14	992,59	18,95	647	23,10
363	Nova Ibiá	9	0,53	203,20	383,82	Low	146,52	0,00	0,16	0,20	56,32	37,19	1344	23,00
364	Mutuípe	12	0,71	275,83	390,76	Low	116,91	0,21	0,22	0,69	158,01	75,74	1179	23,00
365	Água Fria	32	1,88	743,01	394,73	Low	264,50	219,40	1,00	0,85	476,68	23,77	899	22,70
366	Várzea da Roça	20	1,18	468,41	398,15	Low	14,86	0,00	0,21	0,68	444,94	26,83	752	22,80
367	Feira de Santana	54	3,18	1304,43	410,65	Low	65,36	190,99	2,47	101,82	1124,24	416,03	888	23,00
368	Juazeiro	278	16,35	6721,24	411,01	Low	1911,37	1367,95	2391,97	59,87	2318,37	30,45	422	24,80
369	Serra Preta	22	1,29	595,30	460,00	Low	28,78	864,19	0,08	1,04	565,13	28,71	710	22,80
370	Gavião	14	0,82	384,59	467,00	Low	5,33	200,29	0,02	0,38	378,86	12,33	561	23,60
371	Valente	14	0,82	394,88	479,49	Low	47,28	7592,10	0,40	1,70	345,06	63,90	559	23,00
372	Barrocas	7	0,41	207,30	503,44	Low	27,52	918,25	0,53	2,83	176,23	70,61	627	22,90
373	Nova Fátima	11	0,65	346,79	535,94	Low	3,99	616,14	0,13	1,52	341,23	21,73	504	23,30
374	Lamarão	6	0,35	189,26	536,23	Low	5,78	9,51	0,03	0,24	183,18	45,74	824	23,30
375	Santo Antônio de Jesus	8	0,47	261,74	556,20	Low	55,39	38,38	0,27	6,21	199,54	348,14	1178	23,00
376	Saubara	5	0,29	166,43	565,86	Low	63,48	30,72	3,18	2,80	16,87	68,51	1699	24,80
377	Irará	8	0,47	267,88	569,25	Low	13,60	0,00	0,03	1,92	252,31	98,87	1022	22,60
378	Santo Estêvão	10	0,59	360,33	612,57	V. Low	12,19	770,77	0,04	4,94	325,81	131,91	789	23,00
379	Anguera	5	0,29	187,84	638,66	V. Low	5,81	159,24	0,00	0,37	181,63	57,85	735	23,20
380	Heliópolis	9	0,53	338,80	639,95	V. Low	22,90	491,11	0,10	0,71	315,13	38,94	733	23,30
381	São Miguel das Matas	6	0,35	230,89	654,18	V. Low	54,62	595,73	0,33	0,09	174,93	48,57	1015	22,30

382	Itaparica	3	0,18	118,04	668,89	V. Low	8,49	1003,17	0,48	3,23	13,42	175,58	1921	25,00
383	Paripiranga	11	0,65	435,71	673,37	V. Low	36,76	247,56	2,39	1,28	395,31	63,76	897	22,60
384	Retirolândia	6	0,35	242,33	686,60	V. Low	13,76	316,35	0,16	1,16	227,21	66,43	525	23,10
385	Candeal	10	0,59	447,58	760,88	V. Low	26,47	2,46	0,15	0,30	420,62	19,98	716	23,50
386	Fátima	8	0,47	359,39	763,71	V. Low	10,48	0,01	0,69	0,97	347,21	49,12	690	23,40
387	Olindina	14	0,82	637,32	773,88	V. Low	40,05	45,46	0,17	1,89	500,08	46,00	680	24,10
388	Abaré	35	2,06	1604,92	779,53	V. Low	502,61	0,09	258,97	1,47	839,53	11,49	531	24,90
389	Tanquinho	5	0,29	243,84	829,05	V. Low	14,02	0,02	0,18	0,17	229,47	36,43	812	23,30
390	Antônio Cardoso	6	0,35	293,53	831,67	V. Low	8,46	18,61	0,00	0,23	270,75	39,24	926	23,60
391	Muniz Ferreira	2	0,12	104,54	888,59	V. Low	33,77	0,00	0,07	0,09	70,62	66,45	1455	23,90
392	Sobradinho	21	1,24	1154,91	934,92	V. Low	493,55	0,01	276,22	5,07	308,18	17,76	444	25,20
393	São Felipe	4	0,24	222,41	945,23	V. Low	41,93	919,14	0,01	0,25	180,17	98,57	1284	23,30
394	Santa Bárbara	6	0,35	347,02	983,23	V. Low	5,27	670,82	0,04	1,86	339,77	55,15	857	23,20
395	Uauá	49	2,88	3074,79	1066,76	V. Low	1274,80	1274,68	1019,21	4,95	775,42	8,00	481	23,60
396	Conceição do Almeida	4	0,24	284,84	1210,55	V. Low	17,74	0,07	0,02	0,16	266,93	61,70	1122	23,20
397	Pintadas	9	0,53	647,14	1222,38	V. Low	10,63	0,01	0,07	0,65	635,64	18,96	540	23,30
398	Macururé	30	1,76	2545,86	1442,65	V. Low	864,77	0,02	448,92	1,69	1230,38	3,52	429	24,10
399	Glória	18	1,06	1566,61	1479,58	V. Low	671,58	291,93	6,01	3,16	736,57	12,01	508	25,60
400	Pé de Serra	6	0,35	596,77	1690,85	V. Low	12,14	1040,57	0,28	2,41	581,96	22,32	444	23,20
401	Varzedo	2	0,12	221,40	1881,89	V. Low	58,47	0,00	0,16	0,23	161,99	40,16	960	22,90
402	Salvador	6	0,35	693,83	1965,85	V. Low	70,75	317,14	3,95	177,62	49,58	3859,44	1781	25,20
403	Serrinha	5	0,29	583,31	1983,27	V. Low	46,46	0,00	0,22	4,82	531,58	122,97	801	23,20
404	Ichu	1	0,06	138,02	2346,27	V. Low	5,43	76,91	0,07	0,29	132,26	41,16	648	23,30
405	Chorrochó	20	1,18	3005,32	2554,52	V. Low	1490,91	0,02	604,87	3,58	903,95	3,57	416	24,40
406	Ouriçangas	1	0,06	156,98	2668,69	V. Low	29,76	45,22	0,23	0,37	132,74	53,51	1120	22,80
407	Teofilândia	2	0,12	351,89	2991,08	V. Low	19,60	11,67	0,87	1,19	330,10	64,02	673	23,10
408	Santanópolis	1	0,06	222,69	3785,66	V. Low	8,71	13,35	0,03	0,35	213,57	38,02	940	22,90
409	Riachão do Jacuípe	5	0,29	1155,42	3928,42	V. Low	17,44	417,61	0,20	3,51	1133,94	27,87	539	23,40
410	Curaçá	25	1,47	5935,94	4036,44	V. Low	2218,93	0,02	2404,63	14,48	1285,75	5,29	461	24,60
411	São Domingos	1	0,06	289,96	4929,37	V. Low	12,74	0,00	0,12	0,92	276,00	28,22	521	23,40
412	Rodelas	7	0,41	2207,16	5360,24	V. Low	1184,67	0,01	60,94	9,35	816,60	2,85	447	24,60
413	Madre de Deus	0	0,00	32,20	-	V. Low	1,73	720,98	0,49	2,20	0,58	539,61	1852	25,00
414	Dom Macedo Costa	0	0,00	94,78	-	V. Low	12,62	106,90	0,01	0,03	82,15	45,70	1190	23,20
415	Sapeaçu	0	0,00	131,22	-	V. Low	2,96	1935,30	0,00	0,73	127,48	141,50	1066	23,00
416	Elísio Medrado	0	0,00	179,33	-	V. Low	34,12	0,03	0,01	0,00	145,21	41,06	895	22,10
417	Cabaceiras do Paraguaçu	0	0,00	222,03	-	V. Low	2,09	3047,84	0,00	0,92	193,31	76,66	932	23,20

*Accumulated between 2003 and 2019 (Source: INPE, 2020). ** Source: IBGE, 2020. *** According to classification originally proposed by White and White (2016) with the inclusion of the class "Extreme". +Annual mean from data from 2003 to 2018 (Source: MapBiomas, 2020).

++Based on the last population census (Source: IBGE, 2010). ++++ Average value based on data from 1982 to 2012 (Source: Climate-Data, 2020).

Based on the analysis of the correlation matrix (Table 3) the most significant correlations obtained and related to the wildland fire occurrence were: the hot spot density increased as the percent of the municipality covered by savanna formations increased and as the percent of the municipality covered by agricultural and pasture fields decrease. Other less significant correlations were the hot spot density increases as the percent of a municipality covered by forest decreases; as the mean annual temperature decreases; as the mean annual rainfall decreases; and as the demographic density decreases. Non-significant correlations were found between the hot spot density and the percentage of non-forest natural formations, as also with the percentage of non-vegetated area.

Using the updated classification originally proposed by White and White (2016), 39 municipalities from the state of Bahia (together occupying 16.1% of the state area) were classified with "Extreme" frequency of hot spot incidence; 153 municipalities (occupying 46.3% of the state area) with "Very High" frequency of hot spot incidence; 90 (16.3% of the state area) with "High"; 69 (11.3% of the state area) with "Medium"; 26 (4.4% of the state area) with "Low"; and 40 (5.6% of the state area) with "Very Low". Most of the municipalities with the lowest wildland fire incidence were located in the Northeast and in the East Central regions while the ones with the highest fire frequency were located in the Southcenter and in the Northwest regions (Figure 3).

Table 3 – Matrix of Pearson correlation coefficients (r) between all variables (dependents and independent) used in this study.

	Forest cover area (%)	Savanna formations area (%)	Non-forest natural formation area (%)	Non-vegetated area (%)	Agri. and pasture fields area (%)	Demog. density	Mean annual rainfall	Mean annual temp.	Hot spot density (HS/km^2)
Forest cover area (%)	1.00	**-0.51****	**-0.15***	0.02	**-0.42****	0.04	**0.73****	0.08	**-0.15***
Savanna formations area (%)		1.00	**0.32****	-0.11	**-0.47****	**-0.16***	**-0.46****	0.06	**0.48****
Non-forest natural formation area (%)	.		1,00	-0,01	**-0,40****	-0.06	**-0,10***	0,07	-0,01
Non-vegetated area (%)	.		.	1,00	**-0,10***	**0.88****	**0,20****	0,16*	-0,08
Agri. and pastures fields area (%)	.		.	.	1,00	-0.07	**-0.34****	**-0,23****	**-0,25****
Demog. density	.		.	.	.	1,00	**0,20****	**0,11***	**-0,12***
Mean annual rainfall	.		.	.	.	.	1,00	**0,30****	**-0,12***
Mean annual temp.	.		.	.	.	.	.	1,00	**-0,13***
Hot spot density (HS/km^2)	.		.	.	.	.	.	.	1,00

Note: ** significant at $p < 0.001$; * significant at $p < 0.05$

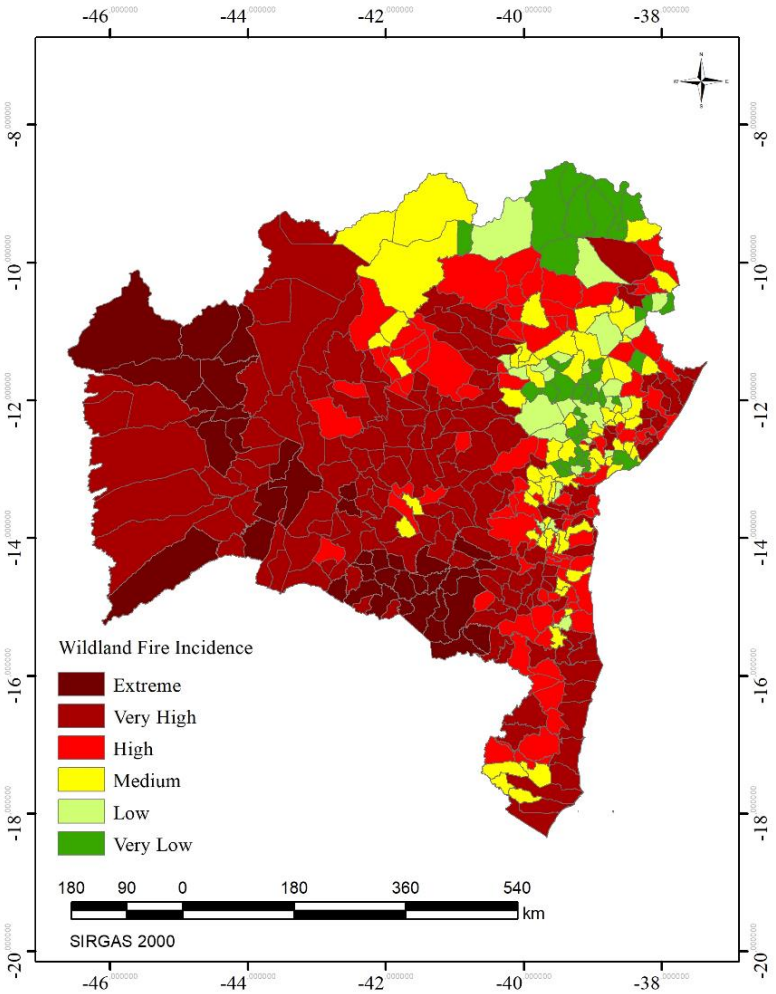

Figure 3 – Hot spot frequency of incidence in the municipalities of the state of Bahia (Brazil), based on the mean annual number of hot spots from 2003 to 2019 detected by the AQUA satellite. The categorization is based on the originally proposed White and White (2016) classification, updated with the inclusion of the class "Extreme".

4. Discussion

Even though 229,554 hot spots were detected in the state of Bahia during the period analyzed, it is important to state that this number only represents a small part of the real number of wildland fires that actually occurred. The MODIS sensor used by the AQUA satellite is relatively outdated. It is capable of detecting only fires with a front line width greater than 30 meters, inferior to recent launched satellites equipped with VIIRS sensor that can detect wildland fires with smaller front line (NASA, 2020b). Additionally, satellite based fire detection may also be restricted by the presence of clouds, by the canopy of the forest when the fire is consuming only the understory, when fires started and ended during the interval between the satellite passage, or when the fire occurs in a mountainside opposite to the satellite observation path (INPE, 2020). Nevertheless, since the AQUA satellite has been in operation for several years, its data is important to compose comparable time series.

The downtrend recorded in the number of hot spots in the state of Bahia is also verified when analyzing the data from the whole country. According INPE (2020), 2007 was the year with the highest number of hot spots detected by the AQUA satellite in Brazil, with a relative decrease in the following years. The same was registered in this study. The possible explanation to the reduction in the numbers from the country, as a whole, can be the decrease in the deforestation (White, 2018b, 2019; INPE, 2020). Unfortunately, data of deforestation from Bahia are unavailable for the years 2018 and 2019. However, data from 2003 to 2017 indicates a significant decline in such period (MapBiomas, 2020). Other factors such as the El Niño and La Nina can also have influence the data in this study, since recent studies proved the relation between El Niño–Southern Oscillation and interannual fire activity (Jiménez-Muñoz et al., 2016, White, 2018b, 2019). Despite the downtrend contradicts recent studies that indicate global warming is increasing wildfire occurrence in the last years (Moritz, 2012), it is important to mention that the 17 year period analyzed in this study is too short to identify patterns related to climate change.

The predominant climate in Bahia is tropical with dry winter and rainy summer, in most of the municipalities the dry season lasts for at least 5 months (Mendonça and Danni-oliveira, 2007). At the end of this period and the beginning of the rainy season (September and October for most of the state) the wildland fires are more frequent. In a smaller region denominated *zona da mata*, a 300 km extension across all the Bahia coastal zone, the summer is dry and the winter rainy (White and Ribeiro, 2011). Therefore, in this region, the wildland fires are more frequent between December and March. The highest number of hot spots in the months of September and October found in this study is related to the predominant climate in the state that follows the pattern observed in most of South America countries. All South American countries below the equator, with the exception of Chile, present higher fire activity from August to November (White, 2019). In Brazil, the fire season lasts from July to December, with the peak in the months of August and September (Soares and Batista, 2007).

Through the analysis of the correlation matrix it was possible to conclude that the municipality with lower mean annual temperature and lower mean annual rainfall presented higher hot spot density. The correlation with the rainfall was expected, since vegetation moisture content increases with rainfall, making it more difficult to burn (Soares and Batista 2007; White and Ribeiro 2011; White, 2018a). The temperature also influences the moisture of the vegetation and, consequently, the facility which it burns. Despite higher temperatures favor the drying of the vegetation (Soares and Batista 2007; White, 2018b), in tropical regions, higher temperature is associated with higher rainfall amount. This occurs in the Bahia municipalities, since the correlation between both variables was positive and significant. Therefore, even though higher temperatures can contribute with a higher wildland fire occurrence, its effect was possibly suppressed by the rainfall.

Although meteorological parameters play a key role in the wildland fire occurrence, it is essential to analyze human activities in order to understand better fire occurrence since, in Brazil, 99% of the ignitions sources are associated with human activities and only 1% are originated from a natural source, that is lightning (Soares and Batista, 2007). A good way to understand the main factors associated with the wildland fire occurrence is analyzing the land use variable (White et al., 2016; White, 2018b). In this study, the municipalities with a greater percentage of its total area covered by savanna formations presented a greater hot spot density. Also, the municipalities with higher percentage of its total area covered by forests presented lower hot spot density. Those results are in accordance with the literature, since tropical forests, including the Atlantic Forest biome, has a low wildfire risk of occurrence (Ajin et al., 2016; Suryabhagavan et al., 2016; White, 2018a), while savanna formations have a high wildfire risk of occurrence (Nolasco and Sanhueza, 2011; White, 2019). Also, the percentage of land covered by pastures and agricultural fields presented a negative significant correlation with the hot spot density. Such correlation was unexpected, since fire is a commonly

used tool for clearing areas in farming activities and has already been shown by several authors as presenting a positive significative correlation with wildland fire occurrence (Ajin *et al*., 2016; Suryabhagavan *et al*., 2016; White *et al.*, 2016; White, 2018b). A possible explanation for such finding could be that, as presented in Table 3, the municipalities with a greater percentage of land use covered by savanna formations presented less percentage of land used to farming activities. Therefore, if the savanna formations burn more frequent than pastures and agricultural fields, could end up mistakenly reflecting in the statistical analysis that farming activities diminish wildland fire activity.

The demographic density also presented a negative significant correlation with the hot spot density. Some authors affirm that more densely populated regions would be more prone to burn, since most of the wildland fires are initiated by humans (Soares and Batista, 2007). Nevertheless, larger populations are usually concentrated in urbanized areas, with lower vegetated formations and consequently with lower wildland fire occurrence.

The map indicating the wildland fire incidence in the municipalities of the state of Bahia is an important visual tool to assess the future risk of wildland fire occurrence, since data from past fires is an important variable used to predict areas with higher risk of future fires (White *et al*., 2016).

4. Conclusions

During the period analyzed, the number of hot spots in Bahia presented a significative downtrend over the years. The months of September and October were the ones with higher fire occurrence. The percentage of land covered by savanna formations was the variable that had the greatest influence on the municipal hot spot density. The others variables that also had significative influence in the hot spot density were, in decreasing order of significance: percentage of land covered by agriculture and pasture fields; percentage of land covered by forests; mean annual temperature; mean annual rainfall; and demographic density.

Almost 75% of the state area was classified with “High”, “Very High” or “Extreme” frequency of incidence of hot spots. The municipalities with the highest hot spot incidence were located in the Southcenter and in the Northwest regions, while the ones with the lowest hot spot incidence were in the Northeast and East Central regions.

The data obtained thought this study can and should be used in the development of public policies focused in the reduction of environmental harmful wildland fire events, as well as, to subsidize programs of biodiversity management and conservation.

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