Understanding global fire regimes using Artificial Intelligence

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Abstract

Improved understanding of fire activity and its influencing factors will impact the way we interact and coexist with not only the fire itself but also with the ecosystem as a whole. We consolidate more than 20 million wildfire records between 2000 and 2018 across the six continents. This data is processed with artificial intelligence methods to discover global fire regimes, areas with characteristic fire behavior over long periods. We discover 15 groups with clear differences in fire-related historical behavior. Despite sharing historical fire behavior, regions belonging to the same group present significant differences in location and influencing factors. Groups are further divided into 62 regimes based on spatial aggregation patterns, providing a comprehensive characterization. This allows an interpretation of how a combination of vegetation, climate, and demographic features results in a specific fire regime. The current work expands on existing classification efforts and is a step forward in addressing the complex challenge of characterizing global fire regimes.

1 Introduction

Fire is a global phenomenon, existing since the emergence of terrestrial plants [26]. The long cohabitation of vegetation and fire has induced their co-evolution [25] and shaped adaptive strategies within different plant species. Our understanding of fire activity and the relationship with its influencing factors is lacking, especially at large spatial scales [21] because of the absence of consistent long term data [20]. Although studies that characterize fire activity at regional level are common [9, 10, 19, 24], the lack of long temporal series has limited the study and assessment of global fire regimes [2, 7].

Several researchers have utilized global forest fire data to investigate various questions including evaluating the impact of fire on vegetation and emissions as well as studying factors influencing spatial and temporal fire activity variation [13, 14, 17, 21, 29]. It has been demonstrated that changing environmental conditions and human activity can and will continue to modify fire activity in several parts of the world. However, these findings have been primarily based on regional-scale studies.

The relationship between vegetation and fires, for a specific ecosystem, is characterized by a fire regime or pyrome [3, 5, 25]. A fire regime is defined as a set of consistent and repeated wildfire

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conditions in a particular region over a long period of time [18, 20]. These regimes depend on a combination of factors that influence fire occurrence and behavior such as ignitions, fuel composition and arrangement, and conductive fire weather [22]. Those fire conditions that define a fire regime [11, 20] have a clear impact not only on the presence of certain vegetation types but also on soil and atmospheric characteristics [7].

Increased understanding of fire regimes will provide an essential knowledge for between regions sharing a regime. As a result, any study on factors altering fire activity evolution or its impact will be significantly improved if implemented per fire regimes [2, 7]. In addition, the knowledge gathered could unveil useful insights and improve various studies, providing relevant information to characterize and assess the impact of current fire regimes on ecological aspects such as vegetation adaptability, soil degradation, carbon stocks, air quality/pollution, and conservation of the biosphere [4, 15, 23, 28], impacting multiple areas of knowledge.

We present a study on understanding of current global fire regimes using AI and a statistical framework that analyzes yearly global wildfire events over 20 years. We process and consolidate this data into grid covering the entire planet to calculate annual statistics on fire behavior. Next, a global classification of fire regimes is derived based on unsupervised machine learning methods. Given the dispersion and complexity of the groups, we further propose a spatial assessment of the core areas of the fire regimes, to evaluate variations in the seasonality of fire activity and to determine key underlying factors such as climate, land use, and socio-economics (see framework details in Appendix).

2 Methods

Data. Two global datasets containing observations of individual wildfires obtained from MODIS MCD64A1 collection 6 with an underlying resolution of 500m were used. The Global Fire Atlas from NASA provided individual wildfires between 2003-2016. Individual wildfire samples between 2000-2018 were obtained from the GlobFire Database. We consolidated yearly observations and statistics in global rasters at multiple resolutions (0.05° - 1°). The temperature and accumulated precipitation at resolution of 0.25° was obtained from the ECMWF ERA 5 reanalysis dataset. We used the TerraClimate dataset to extract the Palmer severity drought index and climate water deficit with a resolution of 2.5 arc-min. Annual land cover with a resolution of 30 m was obtained from the MCD12Q1 dataset. The estimated population density (number of people per square kilometer) for years was extracted from the GPWv4 Revision 11 dataset at a resolution of 30 arc-s grid cell. Accessibility to cities, measured as the land-based travel time (minutes) to the nearest densely-populated areas with 1,500 or more inhabitants per square kilometer was obtained from the Malaria Atlas Project with a resolution of a 30 s-arc. In addition, we used the gridded global datasets of Gross Domestic Product and Human Development Index at a 5 arc-min resolution.

Clustering analysis. A numerical database derived from the global wildfire data between 2000-2018 was generated, with each row associated with a cell in the global grid map. Features correspond to yearly fire-related variables. Clusters were defined using the normalized yearly average values of the whole data of the frequency (number of fires per year), size (area in square kilometers covered by the fire), perimeter (km), duration (days until the fire was suppressed), daily expansion (area evolution per day), and ratio perimeter/area of the observations. Multiple clustering and unsupervised machine learning algorithms including DBSCAN, OPTICS, K-Means, and self-organizing maps along with dimensionality reduction techniques (PCA and t-SNE) were tested and compared. Quantitative and qualitative comparisons were performed using various performance metrics such as intra/inter distance between groups, the silhouette value, and the elbow method comparing the sum of squared distances from each point to its assigned center. The final number of groups was obtained by performing statistical analysis of all possible classifications by comparing multiple subsets of features, number of clusters, algorithms, and expert assessment.

Spatial and temporal analysis. Gaussian kernels using a radius of 5° and bandwidth h that minimizes the difference between the original function $f(x)$ and its kernel density estimator $\hat{f}_h(x)$ are applied for the spatial characterization of regimes. Contour lines are calculated for each local region (regime) accounting for 10, 30, 50, 70, and 90% of the local observations to determine the areas of the world where the fire regime is focused. Regions with at least 30% of the local observations are

then ordered by area (largest to smallest), characterizing the top five or maximum numbers with a significant area in terms of demographic, climatic, and soil features.

3 Results and discussion

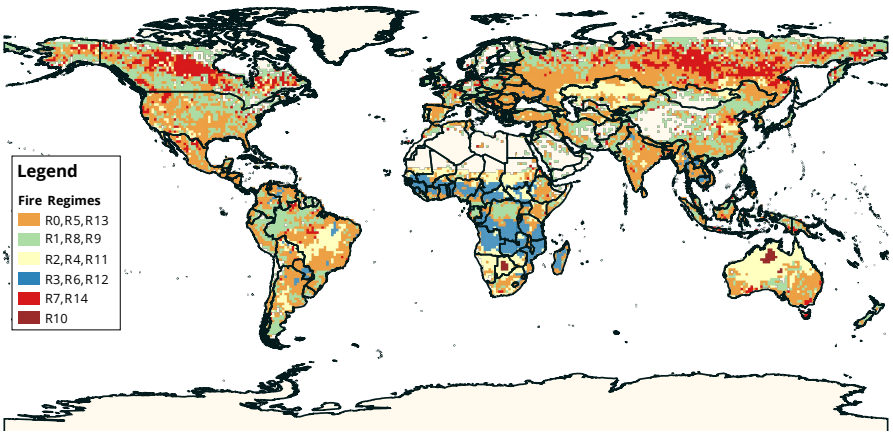

Figure 1: **Fire regimes**. Cells covering the gridded world are classified into the six macro groups (different colors) based on historical averages of fire characteristics including average annual burning frequency, size, perimeter, duration, daily expansion, and perimeter to area ratio values. Regimes cover multiple regions of the globe that do not seem to be related by climatic or demographic conditions.

We determine fifteen clusters defining general fire regimes distributed across the globe (Fig. 1). These regimes differ in the mean characteristics of their fires and their spatial distribution (see Appendix Tables 1-15 for details per regime) and can be further condensed into six relevant macro-groups sharing fire behavior characteristics (Appendix Figs. 3 and 4): very large, fast spreading, and frequent wildfires (R10); large and frequent fires (R11, R2, and R4); medium-sized, slow spreading and infrequent fires (R7, and R14); small, medium-to-high frequency, and long-shaped fires (R13, R0, and R5); small and infrequent fires (R9, R1, and R8); and small/medium and very frequent wildfires (R12, R3, and R6).

A further analysis of the different regimes based on their fire sizes, expansion, and frequencies reveals that R10 regime, mainly distributed across northern Australia and South Africa, is defined by the largest fires, with an average fire size of 511 km^2. Following in fire size but with medium-to-high occurrence frequencies (average of 172 fires per year), are R11, R2, and R4 regimes with mean fire sizes of 107, 34, and 24 km^2, respectively. We observe that R11 regime regions usually surround the most fire-affected R10 areas. In some cases, the surrounding R11 cluster is accompanied by milder R4 and R2 regimes, even though the latter regimes generally occur in the Central African region, Brazil, and Kazakhstan. This spatial pattern of the observed fire activity, matches with the gradient of environmental conditions, a common process of several ecological phenomena [16].

Fire regimes R7 and R14 have average fire sizes of 34 and 9 km^2, respectively, but significantly lower frequency than the previous regimes. The occurrence of R7 and R14 regimes show similar patterns, being mainly distributed across the boreal forests of America and Asia. A heterogeneous macro-group was created from R13, R0, and R5 regimes, consisting of small-to-medium fires, with sizes between 2 to 5 km^2, and medium frequencies. In the case of R0 and R8, there are 31 and 9 fires per year, respectively. In the case of R13, there are 307 fires per year on average. These regimes are distributed across most of Europe, Asia, and America, on warmer zones than those where R7 and R14 are distributed. R12, R6, and R3 groups comprise a more spatially compact category defined by small to medium sizes (2.94 to 4.7 km^2) and very high frequencies (598.62 fires per year on average) of fires occurring almost exclusively in the tropical areas of Africa and in South Asia. Finally, regimes R8, R1, and R9, with average fire sizes of smaller than 2 km^2 and low frequencies (lower than 2 fires per year for R1 and R9, and 9.44 fires per year in the case of R8), are widely distributed across the world, particularly abundant in both cold and dry vegetated regions as well

as in wet evergreen tropical forests. From this analysis, it can be seen that there is a relationship between vegetation, climate, socio-economic factors, and fire activity. However, the distribution of the areas corresponding to a majority of the fire regimes is rather disperse, and no single combination of factors seems to explain the occurrence of individual regimes.

Next, we explore the spatial distribution of the fire regimes. For this, we determine the most relevant (largest and densest) disjoint subregimes belonging to each regime sharing similar fire behavior in different locations. These regions represent the locations where observations belonging to each fire regime are mainly distributed. Interestingly, although each subregimes shares historical fire patterns, significant differences can be observed in terms of location, climate, socio-economic variables, and the proportion of dominant land covers. Similarly, different seasonal patterns and trends of fire-related variables such as frequency and average size, are observed. A representative example of how similar regimes occur commonly in very different regions of the world and are caused by different influencing factors is presented by the subregimes of R1 (Appendix, Fig. 5). That is, the five largest areas covered by the regime present significant variations in seasonal fire activity and influencing factors. In this example, differences are especially clear between the Amazonian hot-spot denoted in blue and the two subregimes located on the northern hemisphere denoted by different shades of green. We found that the largest subregime (R1-a) located in the western part of North America describes the characteristic of low fire activity (1.63 fires per year on average) of R1 regime, driven by cold temperatures and sparse vegetation on the inland parts of the area and an intense suppression on the coastal zones. On the other hand, the Amazonian hot-spot (R1-b) is influenced by very high moisture (PDSI of 75.39, 0.23 m of average yearly precipitation) due to rainfall and closed vegetation coverage.

The hot-spot located in the area of large lakes (R1-c) is characterized by a heterogeneous landscape of mixed forests (16.8%) and croplands (35.9%), which together with suppression policies may justify its limited fire activity. From the two subregimes located in Asia, the one on the eastern part of Siberia (R1-e, orange) is characterized by cold weather (an average of -8.88 C$^\circ$ through the year), low population density (0.056 individuals per km^2), and sparse vegetation, whereas the area in central Asia (R1-d) is clearly defined by the lack of water (average water deficit of 415.79 mm) and absence of large plants (86% of the land covered by a combination of grasslands and non-vegetated areas). Whereas some subgroups show a clear tendency to aggregate the number of fires and area burned in summer in the northern hemisphere, the Amazonian subregime shows a lesser tendency to aggregate over a specific season, with the peak fire activity between December and January, but still occurring in the rest of the year. The eastern Siberian subregime also shows a different temporal pattern, having most of the fires in spring, but those of larger size during summer (see Supplementary Tables 1-15 for a comprehensive description of all regimes and subregimes).

Regime R9 has similar characteristics and even distribution, where fire activity can be controlled by the lack of conductive vegetation, presence of closed evergreen rain forest [8], and suppression efforts. It is also possible to observe for other areas in the limits of the Amazonian forest (R4-c) that continuous coverage of the rain forest is disrupted [9, 12] and can sustain frequent fires of considerable size. Contrary to this process of increased fire activity due to deforestation processes, in western Australia (R4-e), an arid environment is also able to sustain recurrent fires after stabilization of the allochthonous vegetation [6]. Other natural processes can be observed across Asia, where slight differences in climate and subsequently in vegetation, e.g., increased rainfall in Kazakhstan (R4-a) or higher temperatures (R0-a), modify the recurrence and size of fires. Based on the results, it can be stated that there is a clear, but still complex relationship between the distribution of the driving factors and fire activity. Different combinations of climatic, vegetation, and human factors may lead to similar fire patterns in different regions of the world. However, a change in those factors may induce swifts on fire activity to nearby locations [1, 27].

It is also possible to determine clear gradients of fire activity if one of the influencing factors, especially climate or vegetation, changes accordingly. This spatial gradient is clear in the regimes with little fire activity and limited by low temperatures and scarce vegetation in northernmost boreal areas (R9 shifting into R1, and, when fire-related conditions become more conducive, to R7 or R14). Similarly, the regions with larger and intense fires (R10) are surrounded by regimes sustaining smaller but still large fires (R11, and this one, surrounded by R4) if the climate and vegetation becomes gradually less hazardous.

Conclusions

The proposed framework and classification system allow the determination of fire regimes and their most common regions in a systematic way, without assuming geopolitical borders or climatic characteristics of vegetation biomes as constraints when framing their influencing area. This type of assessment, as shown by the study, requires a two-step clustering process. One based on fire characteristics alone and a second one focused on the spatial distribution of those fire characteristics. Without splitting a fire regime into spatially framed subregimes, understanding the underlying factors that cause such specific fire behavior becomes not only difficult but also may produce inconclusive or even misleading results.

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Appendix

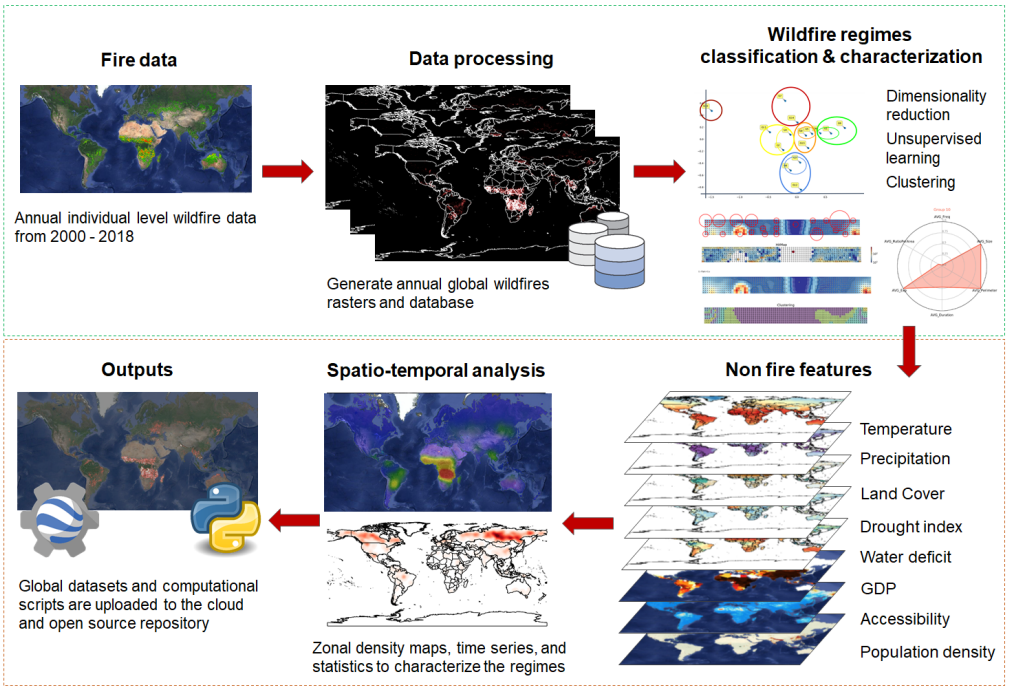

Figure 2: **Overall framework of the study**. (1) Wildfire data describing individual events in terms of fire-related characteristics such as size, perimeter, duration, and average expansion are collected from products derived from MODIS satellite observations. (2) Data are processed and consolidated into a raster dividing the world into a grid with a resolution of $1 \times 1°$. Annual statistics and features are calculated for each cell, generating numerical and spatial datasets. (3) Statistical methods to analyze multidimensional data are combined with unsupervised learning in order to discover similar groups of cells sharing fire-related characteristics. No explicit spatial components are included. (4) Climatic and socio-economic layers are introduced for each fire regime. (5) Spatial density plots are generated for each regime, detecting the regions of the world with more observations. Detected fire regimes are characterized by climatic and demographic data. An evaluation of the influencing factors is performed for the most relevant areas. A temporal analysis to determine trends and seasonality patterns of fire activity is also carried out. (6) All results and generated datasets are deployed on cloud services and a public-access repository, along with the scripts to reproduce all steps of the study.

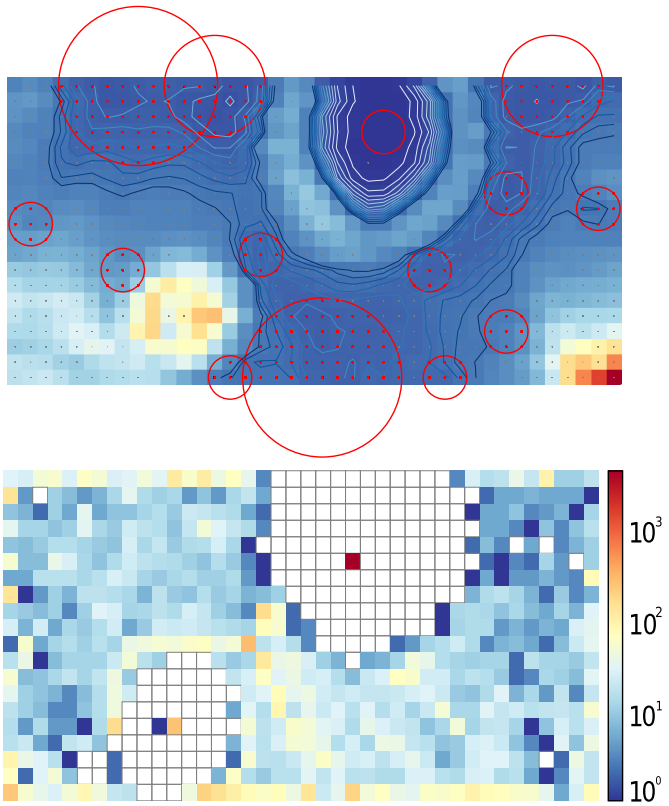

Figure 3: **Discovering regimes** . Self-organizing maps are useful for summarizing multidimensional fire data and for determining potential groups of similar characteristics. These data are reduced to a two-dimensional grid and samples are organized according to their Euclidean distance. Observations sharing similar characteristics are easily visualized in a topographic map (top) where warmer colors represent widely separated samples and cooler colors depict closely related values. Using image processing algorithms, we detect significant potential regimes/clusters (red circles). The number of observations belonging to each section of the map can be presented in a matrix known as hit-map (bottom). As an example, we can easily observe the group of cells without fire activity as a large dark blue region (top) and white valley (bottom), representing a significant percentage of the observations.

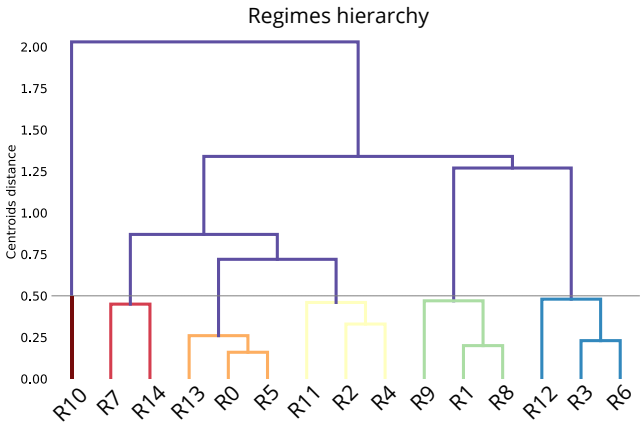

Figure 4: **Regimes' hierarchy**. Dendrogram summarizing the hierarchy of the determined fifteen regimes and similarities between them. As observed, the regimes can be collapsed into six macro groups sharing fire behavior characteristics, consistent with our statistical results (see Supplementary Methods), where, for example, the regime of observations representing extreme and rare events (R10) is clearly independent of other clusters.

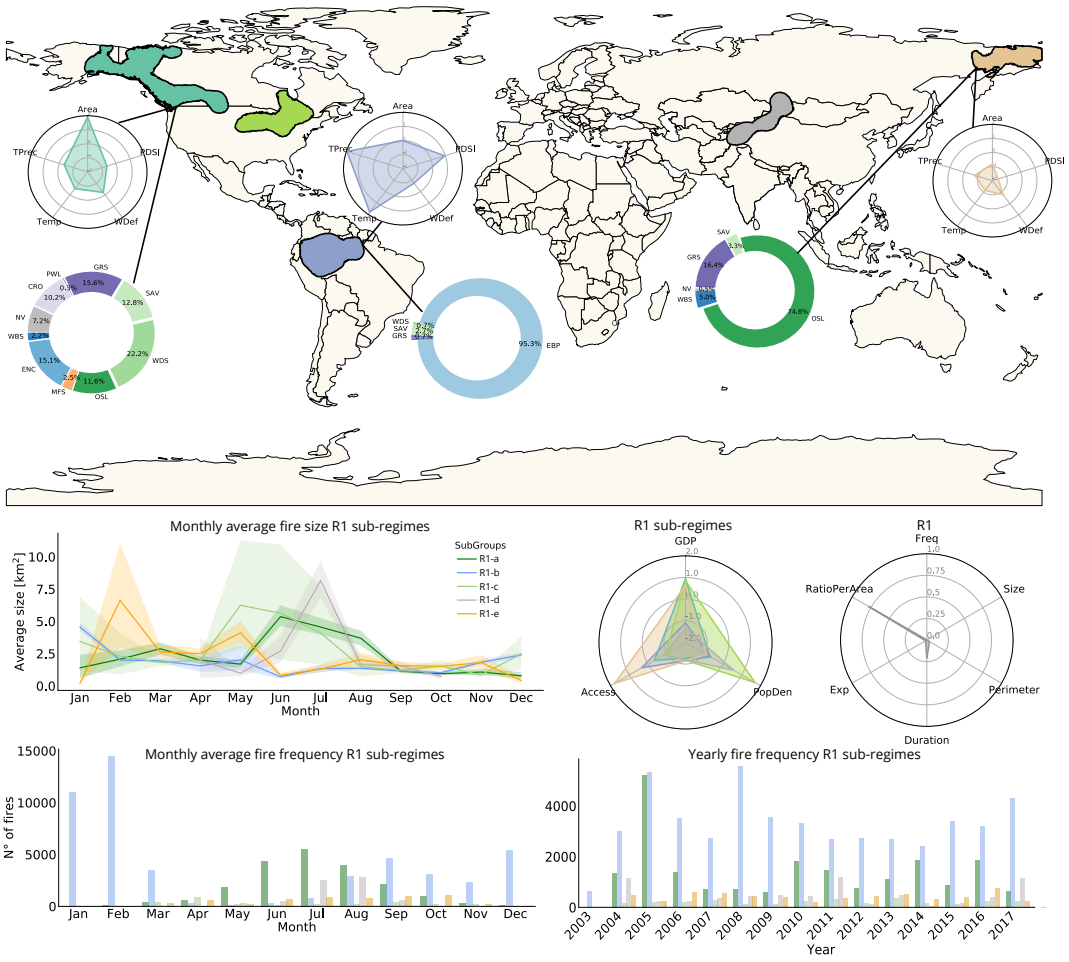

Figure 5: **Characterizing subregimes**. Five largest spatial sub-groups are determined and represented with different colors for R1 regime after a kernel and contour level analysis. Despite belonging to the same regime, dense observation areas are spread in regions with very different climatic and demographic characteristics. In this regime, three of the largest subgroups cover parts of the western coast of Canada and Alaska (dark green), the Amazonian forest of Peru and Brazil (blue), and the eastern extreme of Russia (orange). Significant differences can be observed between these regions from the standardized radial graphs in terms of average temperature (-1.81, 25.47, and 6.49 C), Palmer drought severity index (-44.22, 75.39, and 82.67), precipitation levels (0.07, 0.23, and 0.08 m), accessibility (1,266.64, 2,327.39, and 334.84 min) and gross domestic production (42,948.77, 9,339.71, and 41,295.28 USD). Moreover, the dominant land covers of all regions are completely different; in the first case, more than 65% of the land is covered by savannas (WDS, SAV), grasslands (GRS), and conifers (ENC); in the second case, the Amazonian region is clearly dominated by evergreen broadleaf palmate (EBP); and in the third case, 90% of the area is covered by shrublands (OSL) and grasslands (GRS). Other land cover categories present in these subregimes are mixed forest (MFS), water bodies (WBS), non-vegetated (NV), croplands (CRO), and permanent wetlands (PWL). Similar comparisons can be performed for all subgroups and regimes (Supplementary Tables 1-15).

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R0	AVG Frequency	31.89	R0-a Area 6,160,000 km^2)	AVG PDSI	-56.03 ± 124.58	AVG GDP [US dollars]	17,929.78 ± 18,686.63	GRS 51.5%
				AVG Water deficit [mm]	221.91 ± 245.56			CRO 26.7%
	AVG # of Fires	50,931		AVG Temperature [K]	274.21 ± 13.78	AVG Population density [ppl/km2]	19.34 ± 93.21	NV 10.3%
				AVG Max temperature [K]	288.65 ± 13.33			OSL 4.7%
				AVG Precipitation [m]	0.05 ± 0.02	AVG Accessibility [min]	596.38 ± 637.59	
	AVG Size	5.22	R0-b Area 4,004,000 km^2)	AVG PDSI	-57.33 ± 111.78	AVG GDP [US dollars]	36,757.34 ± 11,899.11	GRS 58.5%
				AVG Water deficit [mm]	760.58 ± 439.65			OSL 13.8%
				AVG Temperature [K]	285.99 ± 7.86	AVG Population density [ppl/km2]	18.20 ± 89.4	SAV 8.2%
				AVG Max temperature [K]	299.52 ± 7.01			CRO 7.1%
	AVG Perimeter	9.66		AVG Precipitation [m]	0.05 ± 0.01	AVG Accessibility [min]	157.03 ± 93.74	WDS 6.3%
	AVG Duration	4.76	R0-c Area 2,297,000 km^2	AVG PDSI	-106.56 ± 116.13	AVG GDP [US dollars]	10,103.61 ± 5149.5	GRS 51.5%
				AVG Water deficit [mm]	673.76 ± 639.56			CRO 26.7%
				AVG Temperature [K]	285.22 ± 9.63	AVG Population density [ppl/km2]	63.66 ± 174.69	NV 10.3%
				AVG Max temperature [K]	297.24 ± 9.97			OSL 4.7%
				AVG Precipitation [m]	0.05 ± 0.02	AVG Accessibility [min]	120.26 ± 98.91	
	AVG Expansion	0.77	R0-d Area 2,125,000 km^2	AVG PDSI	-16.59 ± 150.45	AVG GDP [US dollars]	2,959.19 ± 1,179.19	CRO 77.2%
				AVG Water deficit [mm]	672.26 ± 532.95			GRS 6.6%
	AVG Perimeter/Area	3.06		AVG Temperature [K]	297.77 ± 4.08	AVG Population density [ppl/km2]	373.95 ± 403.7	WDS 4.9%
				AVG Max temperature [K]	306.8 ± 3.95			SAV 4.4%
				AVG Precipitation [m]	0.1 ± 0.12	AVG Accessibility [min]	66.98 ± 144.17	MFS 2.4%
	N° of cells (res 1°)	2,057	R0-e Area 2,006,000 km^2	AVG PDSI	-95.95 ± 134.15	AVG GDP [US dollars]	1,285.5 ± 685.69	GRS 61.4%
				AVG Water deficit [mm]	981.16 ± 204.53			CRO 9.6%
				AVG Temperature [K]	297.6 ± 0.87	AVG Population density [ppl/km2]	65.09 ± 123.2	SAV 8.8%
				AVG Max temperature [K]	305.94 ± 1.2			NV 7.4%
	Total # of fires	814,896		AVG Precipitation [m]	0.07 ± 0.03	AVG Accessibility [min]	228.46 ±156.81	OSL 6.1%

Table 1: **Fire regimes and subregimes details**. Tables 1-15 provide a comprehensive description of all regimes and subregimes. Regimes are characterized using the inter-annual averages of fire behavior features including frequency (AVG number of fires experienced by a 1×1 regime cell), the number of fires (AVG number of fires during the study period), size (AVG size of the wildfires in km^2, perimeter (AVG perimeter of the experienced wildfires in km), duration (AVG duration in days), expansion (AVG daily expansion of the wildfires in km^2/day), perimeter per area ratio (AVG ratio to characterize the shape of the wildfires); and the total number of cells and fires classified as part of the regime. Areas of the subregimes within the 30% hot-spots thresholds are characterized by their (1) spatial location (five largest hot-spots); (2) climatic conditions considering AVG Palmer drought severity index (PDSI), AVG water deficit [mm], AVG temperature [K°], AVG max temperature [K°], and AVG total precipitation [m]; and (3) socio-economic descriptors including the AVG gross domestic product (GDP) in US dollars, AVG population density (total population per km^2, AVG accessibility (land-based travel time in minutes to the nearest densely-populated areas with 1,500 or more inhabitants per square kilometer), and land-use configuration. Land use includes the following categories: Closed shrublands (CSL), Croplands (CRO), Deciduous broadleaf forests (DBF), Evergreen broadleaf palmate (EBP), Evergreen needleaf conifer (ENC), Grasslands (GRS), Mixed Forest (MFS), Non-vegetated (NV), Open shrublands (OSL), Permanent wetlands (PWL), Savannas (SAV), Water bodies (WBS), and Woody Savannas (WDS).

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R0	AVG Frequency	31.89	**R0-a Area 6,160,000** km^2)	AVG PDSI	-56.03 ± 124.58	AVG GDP [US dollars]	17,929.78 ± 18,686.63	GRS 51.5%
				AVG Water deficit [mm]	221.91 ± 245.56			CRO 26.7%
	AVG # of Fires	50,931		AVG Temperature [K]	274.21 ± 13.78	AVG Population density [ppl/km2]	19.34 ± 93.21	NV 10.3%
				AVG Max temperature [K]	288.65 ± 13.33			OSL 4.7%
				AVG Precipitation [m]	0.05 ± 0.02	AVG Accessibility [min]	596.38 ± 637.59	
	AVG Size	5.22	**R0-b Area 4,004,000** km^2)	AVG PDSI	-57.33 ± 111.78	AVG GDP [US dollars]	36,757.34 ± 11,899.11	GRS 58.5%
				AVG Water deficit [mm]	760.58 ± 439.65			OSL 13.8%
				AVG Temperature [K]	285.99 ± 7.86	AVG Population density [ppl/km2]	18.20 ± 89.4	SAV 8.2%
	AVG Perimeter	9.66		AVG Max temperature [K]	299.52 ± 7.01			CRO 7.1%
				AVG Precipitation [m]	0.05 ± 0.01	AVG Accessibility [min]	157.03 ± 93.74	WDS 6.3%
	AVG Duration	4.76	**R0-c Area 2,297,000** km^2	AVG PDSI	-106.56 ± 116.13	AVG GDP [US dollars]	10,103.61 ± 5149.5	GRS 51.5%
				AVG Water deficit [mm]	673.76 ± 639.56			CRO 26.7%
				AVG Temperature [K]	285.22 ± 9.63	AVG Population density [ppl/km2]	63.66 ± 174.69	NV 10.3%
				AVG Max temperature [K]	297.24 ± 9.97			OSL 4.7%
				AVG Precipitation [m]	0.05 ± 0.02	AVG Accessibility [min]	120.26 ± 98.91	
	AVG Expansion	0.77	**R0-d Area 2,125,000** km^2	AVG PDSI	-16.59 ± 150.45	AVG GDP [US dollars]	2,959.19 ± 1,179.19	CRO 77.2%
				AVG Water deficit [mm]	672.26 ± 532.95			GRS 6.6%
	AVG Perimeter/Area	3.06		AVG Temperature [K]	297.77 ± 4.08	AVG Population density [ppl/km2]	373.95 ± 403.7	WDS 4.9%
				AVG Max temperature [K]	306.8 ± 3.95			SAV 4.4%
				AVG Precipitation [m]	0.1 ± 0.12	AVG Accessibility [min]	66.98 ± 144.17	MFS 2.4%
	N° of cells (res 1°)	2,057	**R0-e Area 2,006,000** km^2	AVG PDSI	-95.95 ± 134.15	AVG GDP [US dollars]	1,285.5 ± 685.69	GRS 61.4%
				AVG Water deficit [mm]	981.16 ± 204.53			CRO 9.6%
				AVG Temperature [K]	297.6 ± 0.87	AVG Population density [ppl/km2]	65.09 ± 123.2	SAV 8.8%
				AVG Max temperature [K]	305.94 ± 1.2			NV 7.4%
	Total # of fires	814,896		AVG Precipitation [m]	0.07 ± 0.03	AVG Accessibility [min]	228.46 ±156.81	OSL 6.1%

Table 2: **Regime 1**. R1 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R1	AVG Frequency	1.63	**R1-a Area 2,851,000** km^2	AVG PDSI	-44.22 ± 112.27	AVG GDP [US dollars]	42,948.77 ± 9,999.68	WDS 22.2%
				AVG Water deficit [mm]	123.02 ± 169.04			GRS 15.6%
	AVG # of Fires	5,324.68		AVG Temperature [K]	271.34 ± 11.07	AVG Population density [ppl/km2]	2.90 ± 33.48	ENC 15.1%
				AVG Max temperature [K]	284.45 ± 10.41			SAV 12.8%
				AVG Precipitation [m]	0.07 ± 0.02	AVG Accessibility [min]	1,266.64 ± 1,118.64	OSL 11.6%
	AVG Size	0.79	**R1-b Area 2,640,000** km^2	AVG PDSI	75.39 ± 159.71	AVG GDP [US dollars]	9,339.71 ± 2,859.48	EBP 95.3%
				AVG Water deficit [mm]	51.76 ± 56.7			
				AVG Temperature [K]	298.62 ± 0.61	AVG Population density [ppl/km2]	3.31 ± 22.08	SAV 2.7%
	AVG Perimeter	3.66		AVG Max temperature [K]	306.29 ± 0.92			
				AVG Precipitation [m]	0.23 ± 0.06	AVG Accessibility [min]	2,327.39 ± 1,471.56	
	AVG Duration	2.70	**R1-c Area 1,784,000** km^2	AVG PDSI	82.67 ± 172.89	AVG GDP [US dollars]	41,295.28 ± 4,414.2	CRO 35.9%
				AVG Water deficit [mm]	116.08 ± 164.43			MFS 16.8%
				AVG Temperature [K]	279.64 ± 10.86	AVG Population density [ppl/km2]	37.72 ± 147.89	WDS 13.9%
				AVG Max temperature [K]	293.64 ± 9.69			WBS 11.1%
				AVG Precipitation [m]	0.08 ± 0.02	AVG Accessibility [min]	334.84 ± 616.89	
	AVG Expansion	0.30	**R1-d Area 1,351,000** km^2	AVG PDSI	-116.55 ± 236.67	AVG GDP [US dollars]	37,944.20 ± 9,218.88	OSL 74.8%
				AVG Water deficit [mm]	47.38 ± 116.56			GRS 16.4%
	AVG Perimeter/Area	6.59		AVG Temperature [K]	264.27 ± 15.14	AVG Population density [ppl/km2]	0.06 ± 0.02	WBD 5%
				AVG Max temperature [K]	278.32 ± 13.26			SAV 3.3%
				AVG Precipitation [m]	0.04 ± 0.02	AVG Accessibility [min]	4,555.78 ± 1594.01	
	N° of cells (res 1°)	1,335	**R1-e Area 1,205,000** km^2	AVG PDSI	19.34 ± 177.1	AVG GDP [US dollars]	5,244.49 ± 4,634.23	GRS 53%
				AVG Water deficit [mm]	415.79 ± 388.96			NV 33.5%
				AVG Temperature [K]	274.29 ± 11.54	AVG Population density [ppl/km2]	21.17 ± 97.56	MFS 4.6%
				AVG Max temperature [K]	286.77 ± 11.25			CRO 3.8%
	Total # of fires	85,195		AVG Precipitation [m]	0.05 ± 0.02	AVG Accessibility [min]	505.12 ± 380.83	WDS 2.5%

Table 3: **Regime 1**. R1 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R2	AVG Frequency	398.99	R2-a Area 1,375,000 km^2	AVG PDSI	-213.83 ± 220.22	AVG GDP [US dollars]	1,928.77 ± 872.34	SAV 43.4%
	AVG # of Fires	64,393.3		AVG Water deficit [mm]	777.56 ± 603.69			GRS 41.8%
	AVG Size	34.03		AVG Temperature [K]	300.37 ± 1.86	AVG Population density [ppl/km2]	12.75 ± 18.45	EBP 5.2%
	AVG Perimeter	24.22		AVG Max temperature [K]	309.19 ± 2.8			MFS 3.2%
	AVG Duration	6.24		AVG Precipitation [m]	0.08 ± 0.07	AVG Accessibility [min]	500.11 ± 377.59	WDS 3.1%
	AVG Expansion	2.28	R2-b Area 404,000 ${km}^{2}	AVG PDSI	244.03 ± 261.56	AVG GDP [US dollars]	6,029.77 ± 2,413.07	GRS 74.7%
	AVG Perimeter/Area	0.94		AVG Water deficit [mm]	915.52 ± 621.05			SAV 9%
	N° of cells (res 1°)	93		AVG Temperature [K]	295.61 ± 3.04	AVG Population density [ppl/km2]	2.75 ± 5.16	CSL 6.8%
	Total # of fires	965,900		AVG Max temperature [K]	305.98 ± 2.95			OSL 4.2%
				AVG Precipitation [m]	0.07 ± 0.09	AVG Accessibility [min]	587.89 ± 273.43	WDS 3.1%

Table 4: **Regime 2**. R2 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R3	AVG Frequency	616.62	R3-a Area 4,202,000 km^2	AVG PDSI	-196.97 ± 152.14	AVG GDP [US dollars]	2,035.66 ± 1,089.43	GRS 36.3%
				AVG Water deficit [mm]	676.12 ± 518.87			SAV 35%
	AVG # of Fires	398,406		AVG Temperature [K]	300.1 ± 1.72	AVG Population density [ppl/km2]	57.9 ± 153.67	CRO 12.6%
				AVG Max temperature [K]	308.7 ± 2.48			EBP 7.7%
	AVG Size	3.37		AVG Precipitation [m]	0.09 ± 0.07	AVG Accessibility [min]	256.18 ± 292.03	WDS 3.4%
			R3-b Area 3,176,000 km^2	AVG PDSI	-17.18 ± 105.5	AVG GDP [US dollars]	2,307.22 ± 1,579.92	SAV 45.5%
	AVG Perimeter	7.79		AVG Water deficit [mm]	536.48 ± 450.1			GRS 25.7%
				AVG Temperature [K]	295.68 ± 1.58	AVG Population density [ppl/km2]	25.94 ± 118.55	WDS 15.8%
	AVG Duration	4.30		AVG Max temperature [K]	304.49 ± 1.72			DBF 3.1%
				AVG Precipitation [m]	0.09 ± 0.09	AVG Accessibility [min]	283.22 ± 210.73	MFS 2.8%
	AVG Expansion	0.58	R3-c Area 960,000 km^2	AVG PDSI	-95.69 ± 248.4	AVG GDP [US dollars]	3,480.65 ± 3,402.52	CRO 34%
				AVG Water deficit [mm]	329.22 ± 326.19			EBP 27.2%
	AVG Perimeter/Area	2.72		AVG Temperature [K]	298.61 ± 2.07	AVG Population density [ppl/km2]	86.35 ± 125.48	WDS 15.2%
				AVG Max temperature [K]	307.02 ± 2.09			SAV 10.7%
	N° of cells (res 1°)	333		AVG Precipitation [m]	0.15 ± 0.12	AVG Accessibility [min]	180.41 ± 154.04	MFS 4.9%
			R3-d Area 531,000 km^2	AVG PDSI	19.18 ± 221.84	AVG GDP [US dollars]	7,532.68 ± 2,720.27	SAV 63.6%
	Total # of fires	6,374,490		AVG Water deficit [mm]	368.59 ± 282.76			WDS 12.9%
				AVG Temperature [K]	295.93 ± 3.85	AVG Population density [ppl/km2]	17.3 ± 79.8	GRS 11.9%
				AVG Max temperature [K]	308.33 ± 2.95			CRO 10.5%
				AVG Precipitation [m]	0.11 ± 0.06	AVG Accessibility [min]	170.68 ± 129.09	
			R3-e Area 463,000 km^2	AVG PDSI	-135.18 ± 114.28	AVG GDP [US dollars]	1,420.92 ± 0.0	GRS 76.4%
				AVG Water deficit [mm]	585.16 ± 421.72			WDS 8.2%
				AVG Temperature [K]	295.98 ± 2.03	AVG Population density [ppl/km2]	31.96 ± 88.41	SAV 6.4%
				AVG Max temperature [K]	304.34 ± 1.95			EBP 5.2%
				AVG Precipitation [m]	0.12 ± 0.13	AVG Accessibility [min]	486.82 ± 265.72	

Table 5: **Regime 3**. R3 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R4	AVG Frequency	39.56	**R4-a** **Area 3,400,000** km^2	AVG PDSI	-58.95 ± 165.48	AVG GDP [US dollars]	15,839.66 ± 9,630.03	GRS 84.5% CRO 11.8%
				AVG Water deficit [mm]	584.34 ± 641.65			
	AVG # of Fires	73,720		AVG Temperature [K]	279.82 ± 12.85	AVG Population density [ppl/km2]	10.05 ± 60.17	
				AVG Max temperature [K]	293.71 ± 13.12			
				AVG Precipitation [m]	0.03 ± 0.01	AVG Accessibility [min]	370.1 ± 274.41	
	AVG Size	23.63	**R4-b** **Area 3,139,000** km^2	AVG PDSI	42.32 ± 146.38	AVG GDP [US dollars]	1,921.12 ± 820.93	GRS 53.4% NV 38.1% CRO 6.9%
				AVG Water deficit [mm]	1,659.69 ± 500.25			
				AVG Temperature [K]	301.79 ± 3.61	AVG Population density [ppl/km2]	25.75 ± 52.72	
	AVG Perimeter	21.39		AVG Max temperature [K]	312.36 ± 2.75			
				AVG Precipitation [m]	0.02 ± 0.03	AVG Accessibility [min]	643.57 ± 769.82	
	AVG Duration	5.30	**R4-c** **Area 2,954,000** km^2	AVG PDSI	-70.67 ± 156.95	AVG GDP [US dollars]	9,158.96 ± 4,351.73	SAV 43.9% GRS 23.1% EBP 21% WDS 4.6% MFS 3.7%
				AVG Water deficit [mm]	368.94 ± 348.53			
				AVG Temperature [K]	298.81 ± 1.05	AVG Population density [ppl/km2]	7.27 ± 43.16	
				AVG Max temperature [K]	307.52 ± 1.62			
				AVG Precipitation [m]	0.12 ± 0.1	AVG Accessibility [min]	316.61 ± 326.88	
	AVG Expansion	2.60	**R4-d** **Area 2,459,000** km^2	AVG PDSI	40.01 ± 156.95	AVG GDP [US dollars]	7,982.99 ± 3,642.01	GRS 53.1% OSL 34.3% NV 4.4% CSL 2.8% SAV 2.8%
				AVG Water deficit [mm]	1,063.12 ± 355.01			
				AVG Temperature [K]	293.67 ± 3.89	AVG Population density [ppl/km2]	18.9 ± 89.74	
	AVG Perimeter/Area	1.70		AVG Max temperature [K]	305.88 ± 3.4			
				AVG Precipitation [m]	0.04 ± 0.04	AVG Accessibility [min]	232.51 ± 187.33	
	N° of cells (res 1°)	1,236	**R4-e** **Area 2,191,000** km^2	AVG PDSI	47.11 ± 152.9	AVG GDP [US dollars]	45,082.77 ± 5,033.36	OSL 94.9% CSL 2.2%
				AVG Water deficit [mm]	1,644.23 ± 627.61			
				AVG Temperature [K]	296.37 ± 5.88	AVG Population density [ppl/km2]	0.07 ± 1.22	
				AVG Max temperature [K]	309.2 ± 5.8			
	Total # of fires	1,179,505		AVG Precipitation [m]	0.02 ± 0.02	AVG Accessibility [min]	1,361.62 ± 552.15	

Table 6: **Regime 4**. R4 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R5	AVG Frequency	21.36	**R5-a** **Area 4,940,000** km^2	AVG PDSI	-69.13 ± 89.58	AVG GDP [US dollars]	29,667.85 ± 33,568.92	MFS 30.3%
				AVG Water deficit [mm]	130.74 ± 170.44			CRO 28.5%
				AVG Temperature [K]	277.5 ± 10.69	AVG Population density [ppl/km2]	43.7 ± 196.36	SAV 12.5%
	AVG # of Fires	33,982.25		AVG Max temperature [K]	289.83 ± 11.0			WDS 9.5%
				AVG Precipitation [m]	0.06 ± 0.02	AVG Accessibility [min]	324.7 ± 603.62	PWL 4.4%
	AVG Size	2.58	**R5-b** **Area 3,804,000** km^2	AVG PDSI	64.43 ± 144.38	AVG GDP [US dollars]	38,280.27 ± 9,084.44	CRO 33.7%
				AVG Water deficit [mm]	361.25 ± 224.51			GRS 24.6%
				AVG Temperature [K]	286.85 ± 8.67	AVG Population density [ppl/km2]	37.34 ± 181.84	WDS 20.7%
	AVG Perimeter	6.92		AVG Max temperature [K]	300.43 ± 6.74			DBF 7.9%
				AVG Precipitation [m]	0.07 ± 0.02	AVG Accessibility [min]	98.03 ± 78.04	SAV 7.6%
	AVG Duration	4.64	**R5-c** **Area 1,750,000** km^2	AVG PDSI	-159.3 ± 155.6	AVG GDP [US dollars]	4,139.49 ± 1,723.21	WDS 38.4%
				AVG Water deficit [mm]	140.68 ± 96.48			SAV 31.7%
				AVG Temperature [K]	289.24 ± 6.43	AVG Population density [ppl/km2]	194.05 ± 322.13	EBP 8.2%
				AVG Max temperature [K]	299.53 ± 5.29			GRS 5.8%
				AVG Precipitation [m]	0.14 ± 0.08	AVG Accessibility [min]	207.65 ± 248.61	CRO 5.4%
	AVG Expansion	0.45	**R5-d** **Area 1,220,000** km^2	AVG PDSI	-71.78 ± 122.66	AVG GDP [US dollars]	41,856.29 ± 5800	GRS 56.8%
				AVG Water deficit [mm]	651.34 ± 558.56			OSL 11.8%
				AVG Temperature [K]	281.98 ± 8.85	AVG Population density [ppl/km2]	8.71 ± 58	WDS 10.2%
	AVG Perimeter/Area	4.15		AVG Max temperature [K]	295.39 ± 9.38			ENC 9.6%
				AVG Precipitation [m]	0.04 ± 0.02	AVG Accessibility [min]	185.27 ± 97.05	NV 5%
	N° of cells (res 1°)	2,735	**R5-e** **Area 1,194,000** km^2	AVG PDSI	-65.74 ± 216.61	AVG GDP [US dollars]	35,297.79 ± 1661.34	GRS 38.7%
				AVG Water deficit [mm]	985.2 ± 595.58			OSL 36.3%
				AVG Temperature [K]	291.46 ± 5.78	AVG Population density [ppl/km2]	2.62 ± 18.13	CRO 10.4%
				AVG Max temperature [K]	305.02 ± 7.02			SAV 7.5%
	Total # of fires	543,716		AVG Precipitation [m]	0.04 ± 0.02	AVG Accessibility [min]	323.16 ± 193.05	WDS 2.5%

Table 7: **Regime 5**. R5 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R6	AVG Frequency	790.48	**R6-a** **Area 3,645,000** km^2	AVG PDSI	-70.53 ± 122.12	AVG GDP [US dollars]	2,013.19 ± 1,628.09	SAV 51.6%
				AVG Water deficit [mm]	475.75 ± 412.76			WDS 18.9%
				AVG Temperature [K]	296.09 ± 1.14	AVG Population density [ppl/km2]	27.13 ± 75.47	CRO 13.8%
	AVG # of Fires	325,829.5		AVG Max temperature [K]	304.62 ± 1.35			EBP 4.4%
				AVG Precipitation [m]	0.1 ± 0.09	AVG Accessibility [min]	270.93 ± 189.36	DBF 4.3%
	AVG Size	7.79	**R6-b** **Area 1,155,000** km^2	AVG PDSI	-121.99 ± 242.76	AVG GDP [US dollars]	2,180.17 ± 773.76	GRS 48.7%
				AVG Water deficit [mm]	828.77 ± 585.09			SAV 40.9%
				AVG Temperature [K]	300.43 ± 1.82	AVG Population density [ppl/km2]	23.73 ± 32.46	CRO 3.2%
	AVG Perimeter	12.38		AVG Max temperature [K]	309.32 ± 2.66			EBP 2.6%
				AVG Precipitation [m]	0.08 ± 0.06	AVG Accessibility [min]	283.09 ± 196.99	WDS 2.1%
	AVG Duration	5.39	**R6-c** **Area 885,000** km^2	AVG PDSI	-278.46 ± 172.61	AVG GDP [US dollars]	1,391.22 ± 597.51	GRS 39.5%
				AVG Water deficit [mm]	929.5 ± 651.82			SAV 32.2%
				AVG Temperature [K]	300.48 ± 2.14	AVG Population density [ppl/km2]	17.27 ± 32.07	CRO 16.4%
				AVG Max temperature [K]	309.92 ± 2.89			DBF 5.2%
				AVG Precipitation [m]	0.08 ± 0.08	AVG Accessibility [min]	372.31 ± 266.18	MFS 4.9%
	AVG Expansion	0.95	**R6-d** **Area 582,000** km^2	AVG PDSI	-110.08 ± 160.06	AVG GDP [US dollars]	1,880.84 ± 762.73	GRS 62.7%
				AVG Water deficit [mm]	721.82 ± 545.48			SAV 22%
				AVG Temperature [K]	301.27 ± 1.89	AVG Population density [ppl/km2]	51.8 ± 86.96	CRO 12.2%
	AVG Perimeter/Area	1.70		AVG Max temperature [K]	309.51 ± 2.45			WDS 2%
				AVG Precipitation [m]	0.07 ± 0.07	AVG Accessibility [min]	118.02 ± 66.93	
	N° of cells (res 1°)	188	**R6-e** **Area 359,000** km^2	AVG PDSI	111.43 ± 353.81	AVG GDP [US dollars]	1,878.83 ± 618.68	GRS 77.2%
				AVG Water deficit [mm]	1,073.64 ± 682.41			SAV 14.6%
				AVG Temperature [K]	302.52 ± 2.62	AVG Population density [ppl/km2]	21.87 ± 29.55	CRO 6.1%
				AVG Max temperature [K]	312.19 ± 2.88			
	Total # of fires	5,213,272		AVG Precipitation [m]	0.05 ± 0.07	AVG Accessibility [min]	262.77 ± 177.33	

Table 8: **Regime 6**. R6 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R7	AVG Frequency	3.50	**R7-a** **Area 1,280,000** km^2	AVG PDSI	-14.11 ± 123.77	AVG GDP [US dollars]	39,666.61 ± 10,112.52	SAV 41.4%
	AVG # of Fires	964.2		AVG Water deficit [mm]	96.65 ± 164.08			WDS 41.3%
	AVG Size	33.94		AVG Temperature [K]	270.6 ± 14.06	AVG Population density [ppl/km2]	0.17 ± 2.19	OSL 6.9%
	AVG Perimeter	33.61		AVG Max temperature [K]	285.63 ± 12.61			WBS 5.1%
	AVG Duration	12.81		AVG Precipitation [m]	0.04 ± 0.02	AVG Accessibility [min]	1630.55 ± 1,065.22	ENC 3.9%
	AVG Expansion	1.54	**R7-b** **Area 313,000** km^2	AVG PDSI	-74.79 ± 257.57	AVG GDP [US dollars]	22,476.51 ± 3,260.94	WDS 47.7%
	AVG Perimeter/Area	2.10		AVG Water deficit [mm]	68.22 ± 142.32			SAV 38.7%
	N° of cells (res 1°)	358		AVG Temperature [K]	267.59 ± 16.61	AVG Population density [ppl/km2]	0.07 ± 0.17	MFS 9.4%
	Total # of fires	13,500		AVG Max temperature [K]	282.9 ± 14.95			DNF 3.6%
				AVG Precipitation [m]	0.04 ± 0.02	AVG Accessibility [min]	3,260.62 ± 1761.49	

Table 9: **Regime 7**. R7 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R8	AVG Frequency	9.44	**R8-a** **Area 5,558,000** km^2	AVG PDSI	41.15 ± 120.84	AVG GDP [US dollars]	41,532.5 ± 5,512.08	CRO 30.6%
				AVG Water deficit [mm]	296.31 ± 266.14			GRS 24.7%
	AVG # of Fires	15,612		AVG Temperature [K]	281.53 ± 9.67	AVG Population density [ppl/km2]	22.48 ± 89.22	WDS 18.4%
				AVG Max temperature [K]	295.74 ± 8.45			ENC 7.4%
	AVG Size	1.68		AVG Precipitation [m]	0.06 ± 0.02	AVG Accessibility [min]	213.42 ± 313.19	DBF 6.6%
			R8-b **Area 2,984,000** km^2	AVG PDSI	-115.7 ± 111.05	AVG GDP [US dollars]	4,227.29 ± 2,063.82	WDS 28.7%
				AVG Water deficit [mm]	134.54 ± 81.68			SAV 23.7%
	AVG Perimeter	5.36		AVG Temperature [K]	288.20 ± 6.3	AVG Population density [ppl/km2]	218.65 ± 419.32	GRS 13.1%
				AVG Max temperature [K]	298.21 ± 5.11			EBP 12.6%
				AVG Precipitation [m]	0.15 ± 0.09	AVG Accessibility [min]	247.83 ± 294.98	CRO 7.1%
	AVG Duration	3.91	**R8-c** **Area 1,681,000** km^2	AVG PDSI	-27.41 ± 169.16	AVG GDP [US dollars]	17,577.18 ± 6,671.45	MFS 53.7%
				AVG Water deficit [mm]	68.16 ± 118.52			WDS 15.4%
				AVG Temperature [K]	276.99 ± 9.98	AVG Population density [ppl/km2]	21.49 ± 157.34	ENC 10.5%
				AVG Max temperature [K]	288.22 ± 10.63			CRO 6.6%
				AVG Precipitation [m]	0.06 ± 0.02	AVG Accessibility [min]	221.36 ± 161.5	SAV 5.1%
	AVG Expansion	0.36	**R8-d** **Area 1,348,000** km^2	AVG PDSI	-155.53 ± 188.71	AVG GDP [US dollars]	5,275.18 ± 1,795.85	GRS 64.2%
				AVG Water deficit [mm]	442.91 ± 426.27			CRO 19.9%
	AVG Perimeter/Area	5.28		AVG Temperature [K]	278.53 ± 13.21	AVG Population density [ppl/km2]	129.87 ± 463.14	DBF 9.2%
				AVG Max temperature [K]	292.92 ± 12.21			NV 2.5%
				AVG Precipitation [m]	0.04 ± 0.04	AVG Accessibility [min]	222.1 ± 229.9	
	N° of cells (res 1°)	1952	**R8-e** **Area 1,255,000** km^2	AVG PDSI	-141.85 ± 153.42	AVG GDP [US dollars]	30,478.88 ± 10,477.64	CRO 45.8%
				AVG Water deficit [mm]	138.76 ± 194.18			MFS 17.6%
				AVG Temperature [K]	282.38 ± 6.83	AVG Population density [ppl/km2]	174.59 ± 270	SAV 13.3%
				AVG Max temperature [K]	293.85 ± 8.09			GRS 6.5%
	Total # of fires	249,797		AVG Precipitation [m]	0.08 ± 0.03	AVG Accessibility [min]	33.94 ± 22.04	ENC 6.2%

Table 10: **Regime 8**. R8 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R9	AVG Frequency	0.30	**R9-a** **Area 2,650,000** km^2	AVG PDSI	63.87 ± 97.66	AVG GDP [US dollars]	37,566.63 ± 6,259.65	SAV 19.5% MFS 18.1% WDS 12.7% WBS 11.8% DBF 9.3%
				AVG Water deficit [mm]	50.78 ± 86.34			
				AVG Temperature [K]	274.72 ± 11.41	AVG Population density [ppl/km2]	20.82 ± 108.71	
	AVG # of Fires	2,058.87		AVG Max temperature [K]	288.27 ± 10.21			
				AVG Precipitation [m]	0.08 ± 0.02	AVG Accessibility [min]	1536.29 ± 1,724.4	
	AVG Size	0.28	**R9-b** **Area 2,593,000** km^2	AVG PDSI	-59.09 ± 129.16	AVG GDP [US dollars]	4,616.73 ± 2071.9	GRS 46.6% NV 44.6% WDS 2.3% CRO 2.1%
				AVG Water deficit [mm]	452.79 ± 404.37			
				AVG Temperature [K]	275.5 ± 11.04	AVG Population density [ppl/km2]	28.35 ± 158.99	
	AVG Perimeter	2.25		AVG Max temperature [K]	288.89 ± 10.22			
				AVG Precipitation [m]	0.03 ± 0.03	AVG Accessibility [min]	760.26 ± 789.5	
	AVG Duration	1.34	**R9-c** **Area 2,293,000** km^2	AVG PDSI	71.96 ± 143.75	AVG GDP [US dollars]	9,299.38 ± 3,967.94	EBP 95% SAV 3.2%
				AVG Water deficit [mm]	49.13 ± 48.23			
				AVG Temperature [K]	297.78 ± 0.59	AVG Population density [ppl/km2]	6.18 ± 41.8	
				AVG Max temperature [K]	305.55 ± 0.86			
				AVG Precipitation [m]	0.24 ± 0.05	AVG Accessibility [min]	2,416.05 ± 1,541.81	
	AVG Expansion	0.23	**R9-d** **Area 790,000** km^2	AVG PDSI	-89.95 ± 248.22	AVG GDP [US dollars]	43,428.7 ± 1,990.3	OSL 55.4% GRS 39.5% WBS 5.1%
				AVG Water deficit [mm]	63.44 ± 153.06			
				AVG Temperature [K]	262.81 ± 15.48	AVG Population density [ppl/km2]	0.01 ± 0.84	
	AVG Perimeter/Area	8.45		AVG Max temperature [K]	277.26 ± 13.87			
				AVG Precipitation [m]	0.03 ± 0.02	AVG Accessibility [min]	5,468.78 ± 1,330.9	
	N° of cells (res 1°)	730	**R9-e** **Area 666,000** km^2	AVG PDSI	-43.72 ± 198.5	AVG GDP [US dollars]	43,526.02 ± 0	OSL 36.9% SAV 32% GRS 22.7% WBS 7.3%
				AVG Water deficit [mm]	94.4 ± 181.04			
				AVG Temperature [K]	265.16 ± 14.5	AVG Population density [ppl/km2]	0.01 ± 0.21	
	Total # of fires	32,942		AVG Max temperature [K]	278.92 ± 13.26			
				AVG Precipitation [m]	0.03 ± 0.02	AVG Accessibility [min]	3,413.65 ± 975.07	

Table 11: **Regime 9**. R9 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R10	AVG Frequency	30.50	**R10-a** **Area 723,000** km^2	AVG PDSI	94.2 ± 185.97	AVG GDP [US dollars]	43,430.03 ± 1,721.87	OSL 57.3% GRS 42.6%
	AVG # of Fires	780,738		AVG Water deficit [mm]	1,347.91 ± 494.79			
	AVG Size	511.61		AVG Temperature [K]	299.31 ± 4.44	AVG Population density [ppl/km2]	0.03 ± 0.27	
	AVG Perimeter	102.79		AVG Max temperature [K]	310.12 ± 3.83			
	AVG Duration	43,896		AVG Precipitation [m]	0.05 ± 0.07	AVG Accessibility [min]	1,043.62 ± 500.85	
	AVG Expansion	18.23	**R10-b** **Area 336,000 ${km}^{2}$**	AVG PDSI	10.12 ± 171.38	AVG GDP [US dollars]	11,115.88 ± 620.48	OSL 52% GRS 46.7%
	AVG Perimeter/Area	0.78		AVG Water deficit [mm]	1,336.27 ± 432.84			
	N° of cells (res 1°)	37		AVG Temperature [K]	295.31 ± 4.43	AVG Population density [ppl/km2]	1.93 ± 3.71	
	Total # of fires	60,567		AVG Max temperature [K]	307.06 ± 3.75			
				AVG Precipitation [m]	0.04 ± 0.05	AVG Accessibility [min]	409.38 ± 188.37	

Table 12: **Regime 10**. R10 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R11	AVG Frequency	77.37	R11-a Area 2,798,000 km^2	AVG PDSI	70.02 ± 178.9	AVG GDP [US dollars]	43,651.49 ± 4,498.78	OSL 64.8%
	AVG # of Fires	24,574.9		AVG Water deficit [mm]	1,389.33 ± 433.11			GRS 29.6%
	AVG Size	106.54		AVG Temperature [K]	298.76 ± 4.6	AVG Population density [ppl/km2]	0.09 ± 12.63	SAV 3.1%
	AVG Perimeter	45.93		AVG Max temperature [K]	309.74 ± 4.1			
	AVG Duration	5.56		AVG Precipitation [m]	0.05 ± 0.06	AVG Accessibility [min]	1,252.88 ± 635.63	
	AVG Expansion	7.11	R11-b Area 898,000 km^2	AVG PDSI	116.07 ± 200.22	AVG GDP [US dollars]	8,835.03 ± 2,773.3	GRS 55.2%
	AVG Perimeter/Area	0.98		AVG Water deficit [mm]	1,187.18 ± 476.4			OSL 36.8%
	N° of cells (res 1°)	294		AVG Temperature [K]	295.44 ± 3.94	AVG Population density [ppl/km2]	2.19 ± 6	CSL 6.6%
	Total # of fires	368,624		AVG Max temperature [K]	306.74 ± 3.42			
				AVG Precipitation [m]	0.05 ± 0.06	AVG Accessibility [min]	424.13 ± 235.29	
			R11-c Area 223,000 km^2	AVG PDSI	-64.84 ± 265.02	AVG GDP [US dollars]	13,733.36 ± 3,175.58	SAV 79.2%
				AVG Water deficit [mm]	353.09 ± 443.5			EBP 11.6%
				AVG Temperature [K]	300.01 ± 1.22	AVG Population density [ppl/km2]	3.41 ± 11.7	GRS 9.2%
				AVG Max temperature [K]	308.4 ± 1.89			
				AVG Precipitation [m]	0.14 ± 0.13	AVG Accessibility [min]	271.37 ± 166.42	

Table 13: **Regime 11**. R11 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R12	AVG Frequency	1175.74	R12-a Area 3,224,000 km^2	AVG PDSI	-3.94 ± 123.62	AVG GDP [US dollars]	2,770.2 ± 2,727.32	SAV 42.9%
	AVG # of Fires	250394.75		AVG Water deficit [mm]	397.09 ± 356.39			WDS 20.3%
	AVG Size	2.94		AVG Temperature [K]	296.28 ± 0.96	AVG Population density [ppl/km2]	25.27 ± 127.8	GRS 16.1%
	AVG Perimeter	7.61		AVG Max temperature [K]	304.89 ± 1.17			EBP 13.2%
	AVG Duration	4.34		AVG Precipitation [m]	0.11 ± 0.08	AVG Accessibility [min]	297.41 ± 231.97	DBF 3.2%
	AVG Expansion	0.55	R12-b Area 721,000 km^2	AVG PDSI	-20.19 ± 184.98	AVG GDP [US dollars]	1,425.04 ± 543.39	GRS 44.4%
	AVG Perimeter/Area	2.82		AVG Water deficit [mm]	639.13 ± 505.56			SAV 42.1%
	N° of cells (res 1°)	179		AVG Temperature [K]	300.45 ± 1.9	AVG Population density [ppl/km2]	35.17 ± 165.24	WDS 7.2%
	Total # of fires	4,006,316		AVG Max temperature [K]	309.05 ± 2.46			EBP 2.8%
				AVG Precipitation [m]	0.11 ± 0.11	AVG Accessibility [min]	160.91 ± 96.86	
			R12-c Area 80,000 km^2	AVG PDSI	-421.3 ± 214.02	AVG GDP [US dollars]	786.45 ± 102.88	SAV 70.6%
				AVG Water deficit [mm]	381.25 ± 437.14			EBP 12.7%
				AVG Temperature [K]	299.22 ± 1.36	AVG Population density [ppl/km2]	22.14 ± 75.8	MFS 6.9%
				AVG Max temperature [K]	307.64 ± 2.18			DBF 5.9%
				AVG Precipitation [m]	0.1 ± 0.07	AVG Accessibility [min]	343.77 ± 145.15	WDS 3.9%

Table 14: **Regime 12**. R12 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R13	AVG Frequency	307.14	**R13-a** **Area 1,734,000** km^2	AVG PDSI	9.25 ± 147.84	AVG GDP [US dollars]	9,319.79 ± 4,606.4	SAV 41.5%
				AVG Water deficit [mm]	470.94 ± 258.03			GRS 27.1%
				AVG Temperature [K]	295.7 ± 3.37	AVG Population density [ppl/km2]	19.27 ± 65.94	CRO 10.7%
	AVG # of Fires	132,845		AVG Max temperature [K]	307.75 ± 2.79			WDS 9.4%
				AVG Precipitation [m]	0.11 ± 0.06	AVG Accessibility [min]	205.14 ± 216.19	MFS 7.5%
	AVG Size	1.83	**R13-b** **Area 1,727,000** km^2	AVG PDSI	-92.44 ± 202.42	AVG GDP [US dollars]	3,313.1 ± 3,820.58	EBP 34.8%
				AVG Water deficit [mm]	296.33 ± 287.1			CRO 24.4%
				AVG Temperature [K]	297.33 ± 2.54	AVG Population density [ppl/km2]	101.9 ± 254.31	WDS 16.3%
				AVG Max temperature [K]	305.89 ± 2.23			SAV 11.9%
	AVG Perimeter	5.81		AVG Precipitation [m]	0.16 ± 0.13	AVG Accessibility [min]	206.65 ± 186.37	MFS 5%
	AVG Duration	4.15	**R13-c** **Area 1,044,000** km^2	AVG PDSI	-84.67 ± 188.12	AVG GDP [US dollars]	8,842 ± 3,102.56	CRO 78.4%
				AVG Water deficit [mm]	295.76 ± 373.63			GRS 9.5%
				AVG Temperature [K]	282.36 ± 9.88	AVG Population density [ppl/km2]	59.86 ± 133.37	SAV 2.6%
				AVG Max temperature [K]	294.29 ± 10.51			WBS 2.6%
				AVG Precipitation [m]	0.05 ± 0.02	AVG Accessibility [min]	83.9 ± 49.82	MFS 2.5%
	AVG Expansion	0.38	**R13-d** **Area 700,000** km^2	AVG PDSI	-269.19 ± 174.99	AVG GDP [US dollars]	2,783.33 ± 837.05	SAV 34.6%
				AVG Water deficit [mm]	432.78 ± 407.55			GRS 21.5%
				AVG Temperature [K]	298.92 ± 1.64	AVG Population density [ppl/km2]	75.06 ± 116.44	CRO 20.7%
	AVG Perimeter/Area	3.66		AVG Max temperature [K]	307.15 ± 2.53			EBP 17.9%
				AVG Precipitation [m]	0.11 ± 0.09	AVG Accessibility [min]	131.01 ± 120.99	WDS 2.6%
	N° of cells (res 1°)	503	**R13-e** **Area 436,000** km^2	AVG PDSI	-224.77 ± 298.02	AVG GDP [US dollars]	906.25 ± 303.03	EBP 38.8%
				AVG Water deficit [mm]	260.06 ± 212.24			SAV 22.3%
				AVG Temperature [K]	295.07 ± 0.65	AVG Population density [ppl/km2]	120.46 ± 179.98	NV 13.1%
				AVG Max temperature [K]	302.64 ± 1.12			WBS 9.4%
	Total # of fires	2,125,520		AVG Precipitation [m]	0.16 ± 0.06	AVG Accessibility [min]	316.26 ± 410.3	GRS 8%

Table 15: **Regime 13**. R13 regime and subregimes description.

Group	Fire characterization		Sub-groups	Climate features		Demographic features		Land Cover %
R14	AVG Frequency	6.25	**R14-a** **Area 4,603,000** km^2	AVG PDSI	3.82 ± 150.84	AVG GDP [US dollars]	28,143.75 ± 2,0148.3	WDS 36.7%
				AVG Water deficit [mm]	61.32 ± 113.06			SAV 27%
				AVG Temperature [K]	267.57 ± 16.27	AVG Population density [ppl/km2]	1.03 ± 11.34	MFS 13.7%
	AVG # of Fires	6,090.4		AVG Max temperature [K]	282.27 ± 15.07			ENC 4%
				AVG Precipitation [m]	0.05 ± 0.03	AVG Accessibility [min]	2,135.49 ± 1,716.49	GRS 3.7%
	AVG Size	8.98	**R14-b** **Area 1,551,000** km^2	AVG PDSI	11.07 ± 114.86	AVG GDP [US dollars]	40,326.96 ± 10,420.81	SAV 36.8%
				AVG Water deficit [mm]	86.8 ± 146.9			WDS 34.5%
				AVG Temperature [K]	270.02 ± 14.04	AVG Population density [ppl/km2]	0.09 ± 0.9	OSL 10.9%
				AVG Max temperature [K]	284.98 ± 12.57			ENC 9.3%
	AVG Perimeter	14.98		AVG Precipitation [m]	0.04 ± 0.02	AVG Accessibility [min]	1,973.91 ± 1,230.63	WBS 3.7%
	AVG Duration	8.32	**R14-c** **Area 344,000** km^2	AVG PDSI	114.4 ± 267.16	AVG GDP [US dollars]	28,543.96 ± 2,858	
				AVG Water deficit [mm]	77.08 ± 175.35			SAV 50%
				AVG Temperature [K]	262.82 ± 18.09	AVG Population density [ppl/km2]	0.1 ± 0.09	OSL 45.2%
				AVG Max temperature [K]	277.25 ± 18.24			GRS 4.3%
				AVG Precipitation [m]	0.04 ± 0.03	AVG Accessibility [min]	1,999.31 ± 824	
	AVG Expansion	0.66	**R14-d** **Area 192,000** km^2	AVG PDSI	-98.05 ± 245.25	AVG GDP [US dollars]	87,872.49 ± 26,410.96	WDS 43.7%
				AVG Water deficit [mm]	61.83 ± 142.58			ENC 24.1%
				AVG Temperature [K]	272.09 ± 13.09	AVG Population density [ppl/km2]	2.64 ± 0.8	MFS 12.1%
	AVG Perimeter/Area	3.03		AVG Max temperature [K]	285.89 ± 12.54			SAV 10.2%
				AVG Precipitation [m]	0.05 ± 0.03	AVG Accessibility [min]	698.02 ± 452.16	WBS 7.5%
	N° of cells (res 1°)	967	**R14-e** **Area 186,000** km^2	AVG PDSI	-120.31 ± 209.21	AVG GDP [US dollars]	31,883.99 ± 1,565.96	SAV 69.6%
				AVG Water deficit [mm]	17.06 ± 80.44			WDS 21.6%
				AVG Temperature [K]	270.41 ± 12.6	AVG Population density [ppl/km2]	0.07 ± 0.7	PWL 5%
				AVG Max temperature [K]	284.37 ± 11.01			WBS 3.3%
	Total # of fires	91,356		AVG Precipitation [m]	0.08 ± 0.04	AVG Accessibility [min]	1,610.7 ± 697.28	

Table 16: **Regime 14**. R14 regime and subregimes description.