
ENVIRONMENTAL CATASTROPHE
Forest Fires
Impact | Analysis | Results

Team

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Objectives

1. Simulation Tool
2. Monitoring Tool
3. Directives & Policies
4. Prediction Model

Methodology

Data Collection and cleaning:

Data is collected in the form of *JSON* and *CSV* files. Pre processing is done on the data to remove noise and outliers

Data Visualisation:

With the processed data, different visualisation tools such as **Tableau** and **MS Excel** were utilised to better understand the trends and relationships

Wildfire Simulation:

A **python** based fire simulator is created from scratch which shows how wildfires respond to environmental factors such as Temp and Humidity

Data Monitoring:

Data is then monitored through a website created using **JavaScript**. It allows users to view wildfires across the US

Case Study 1: Canada

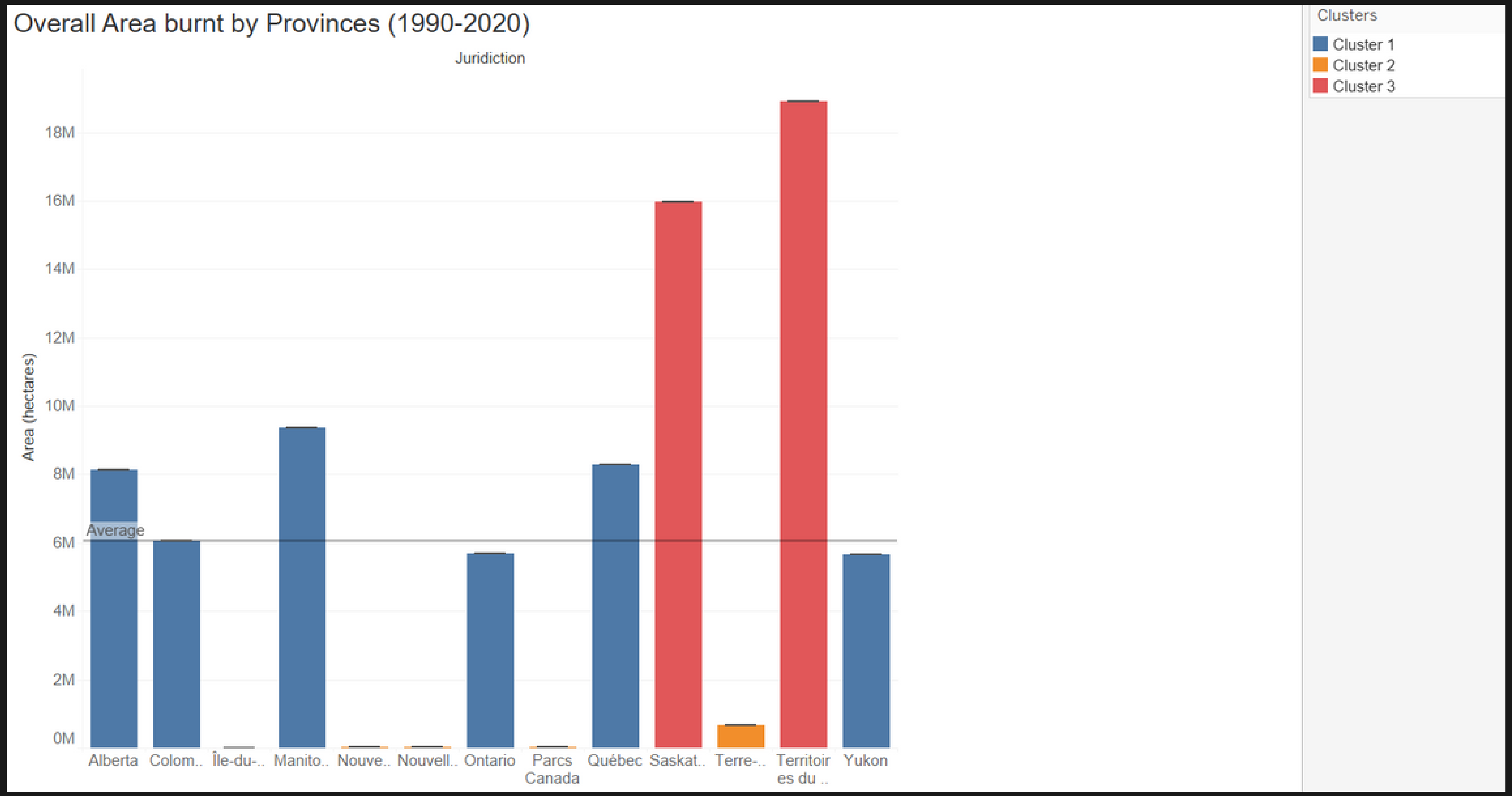
Some Statistics

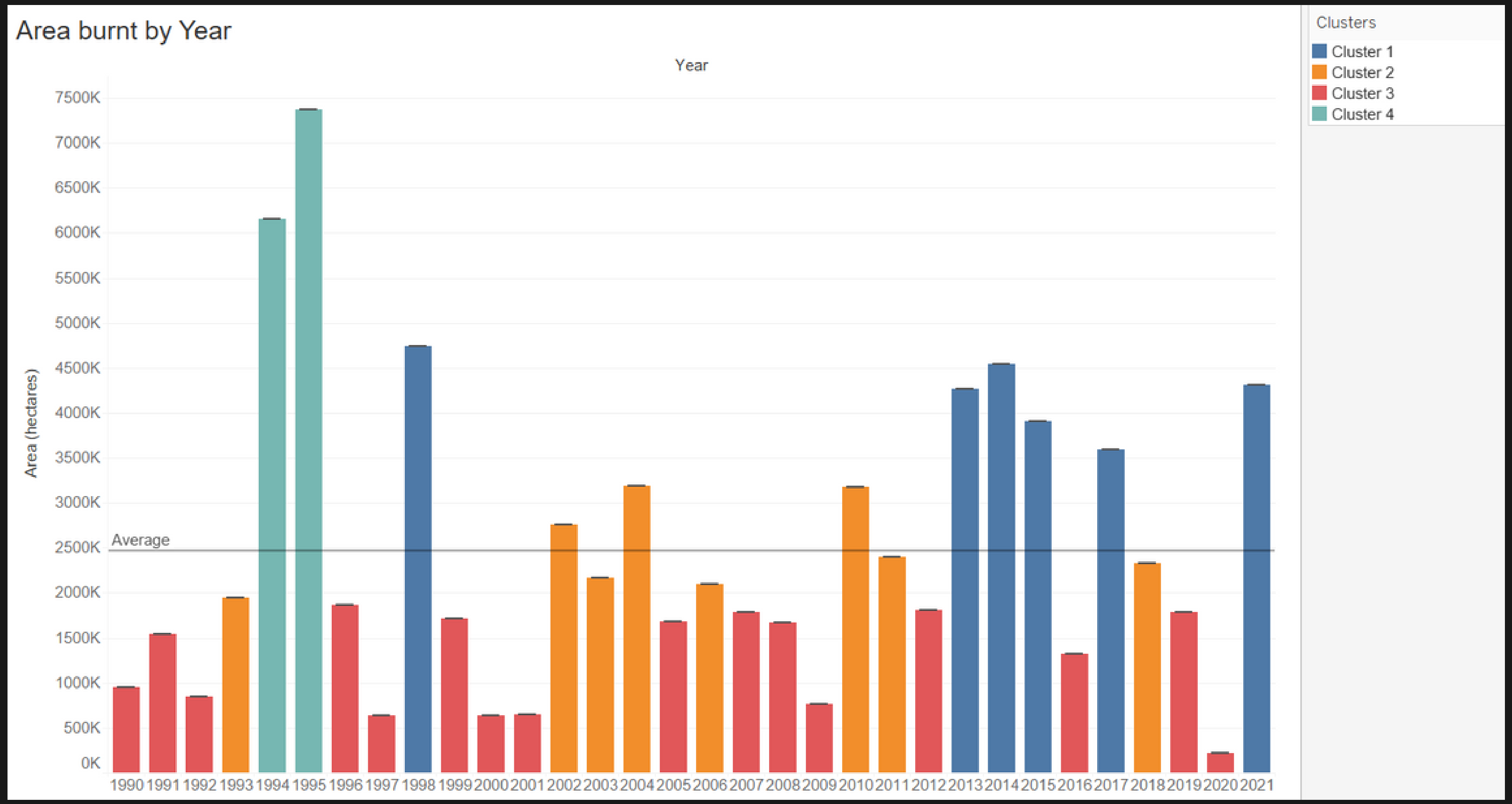
- 2.5 million ha of land burns in Canada on average annually.
- The main causes of fires being Human activities and lightning strikes
- Lightning strikes accounts for around 80% of the land burnt
- Protection and Relief work costs around a billion dollar every year

The Dataset

We have extracted our datasets for analysis from the National Forestry Database of Canada.
http://nfdp.ccfm.org/en/data/fires.php
It has various datasets:
1. Number of Fires by cause, year, and jurisdiction
2. The area burned by cause, year, and jurisdiction.
3. The number of fires and area burned by month in a jurisdiction.
4. dataset on property losses from fire

Area burnt and number of Forest fires

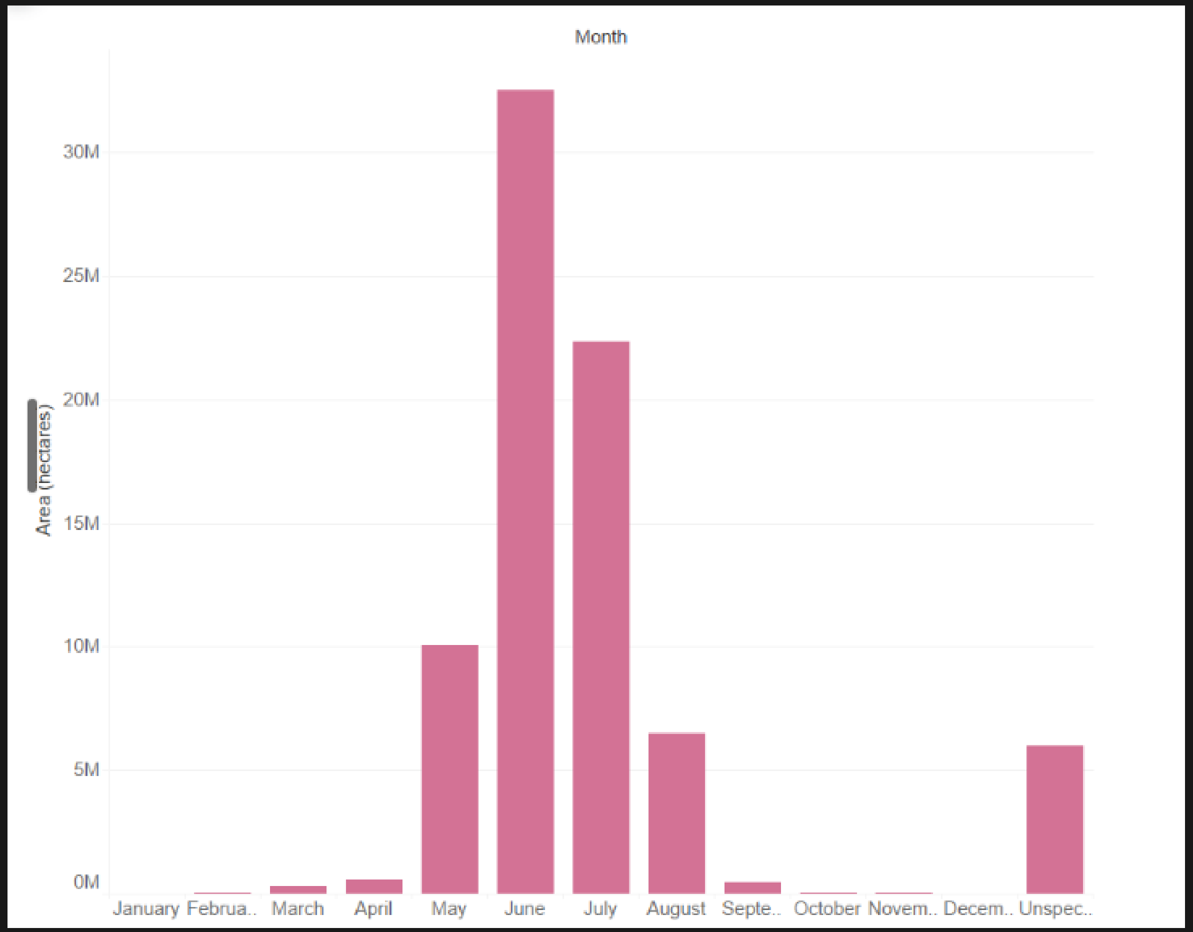




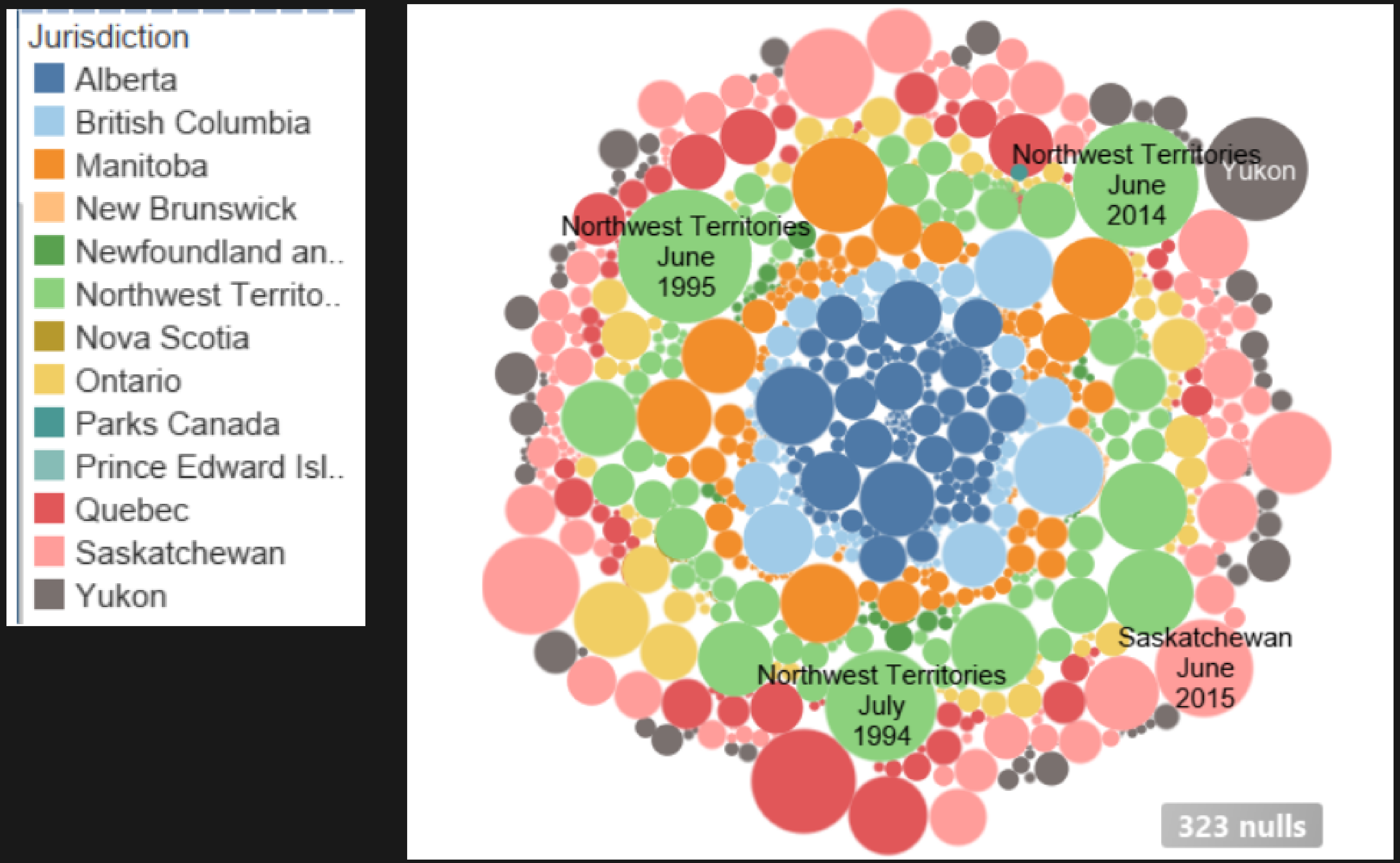
Inferences

- Northwestern Territories record the most forest fire due to extreme temperatures and due to **a fairly dry climate.** The topography being mountaneous also sees more lightning strikes hence observing more forest fires.
- The data for 1995 and 1994 peaks due to more inclusive reporting of forest fires.

Analysis by Month

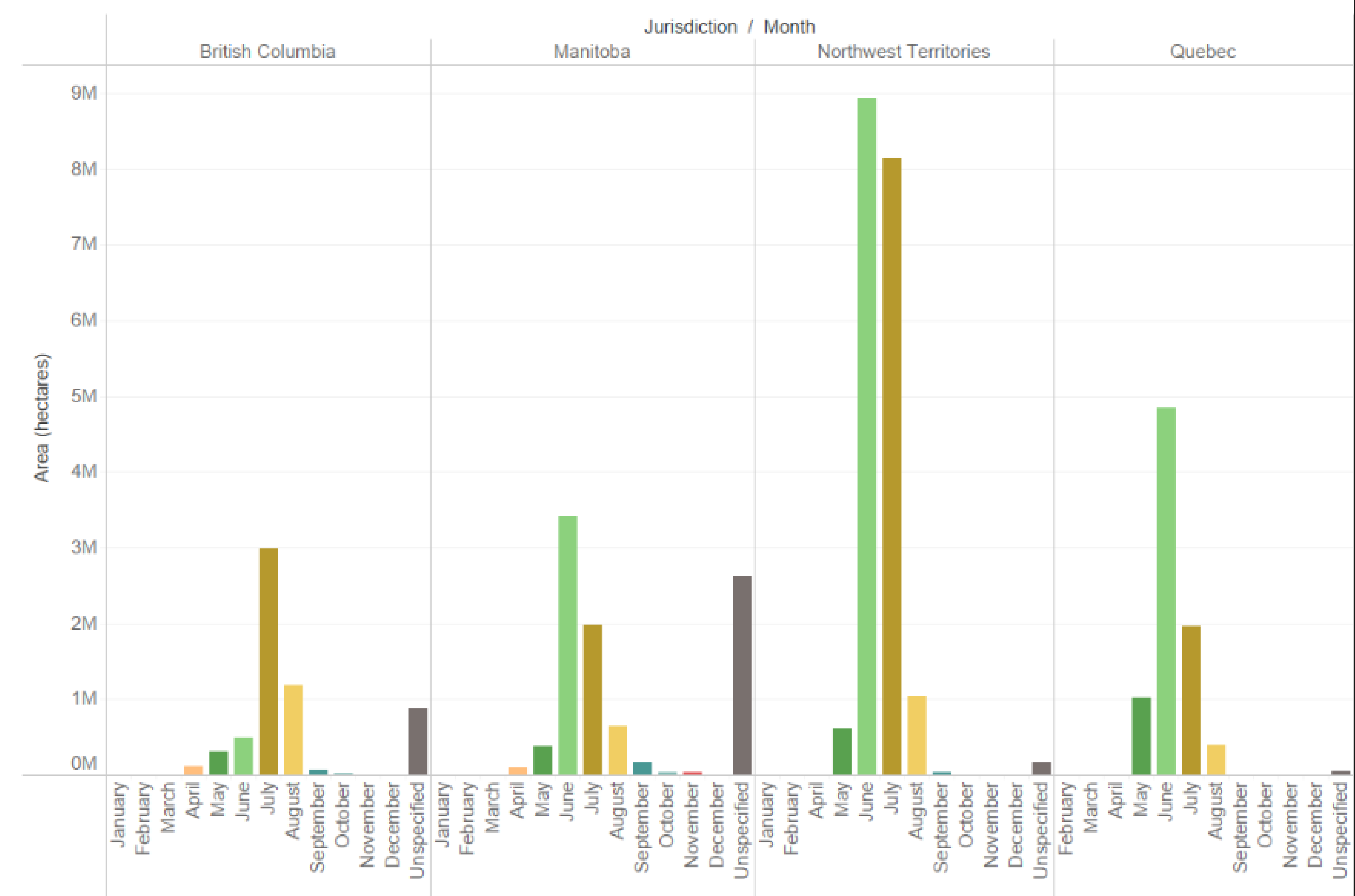


The monthly analysis gives us the average estimate of seasonal causes behind forest fires



June and July notice the most forest fires in terms of area due to warmer climate

Region-Wise Analysis



Analysis of the Major regions in Western, Central, North-Western and Eastern Canada

Here we can notice the behaviour by month/season is uniform across various different parts in Canada.

Overall Inferences

Temperature → Positively impacts → Forest Fires

Drier Climate → Positively impacts → Forest Fires

Canada's Fire Management Strategies

Fire has ecological benefits so suppression should be done on various ranges

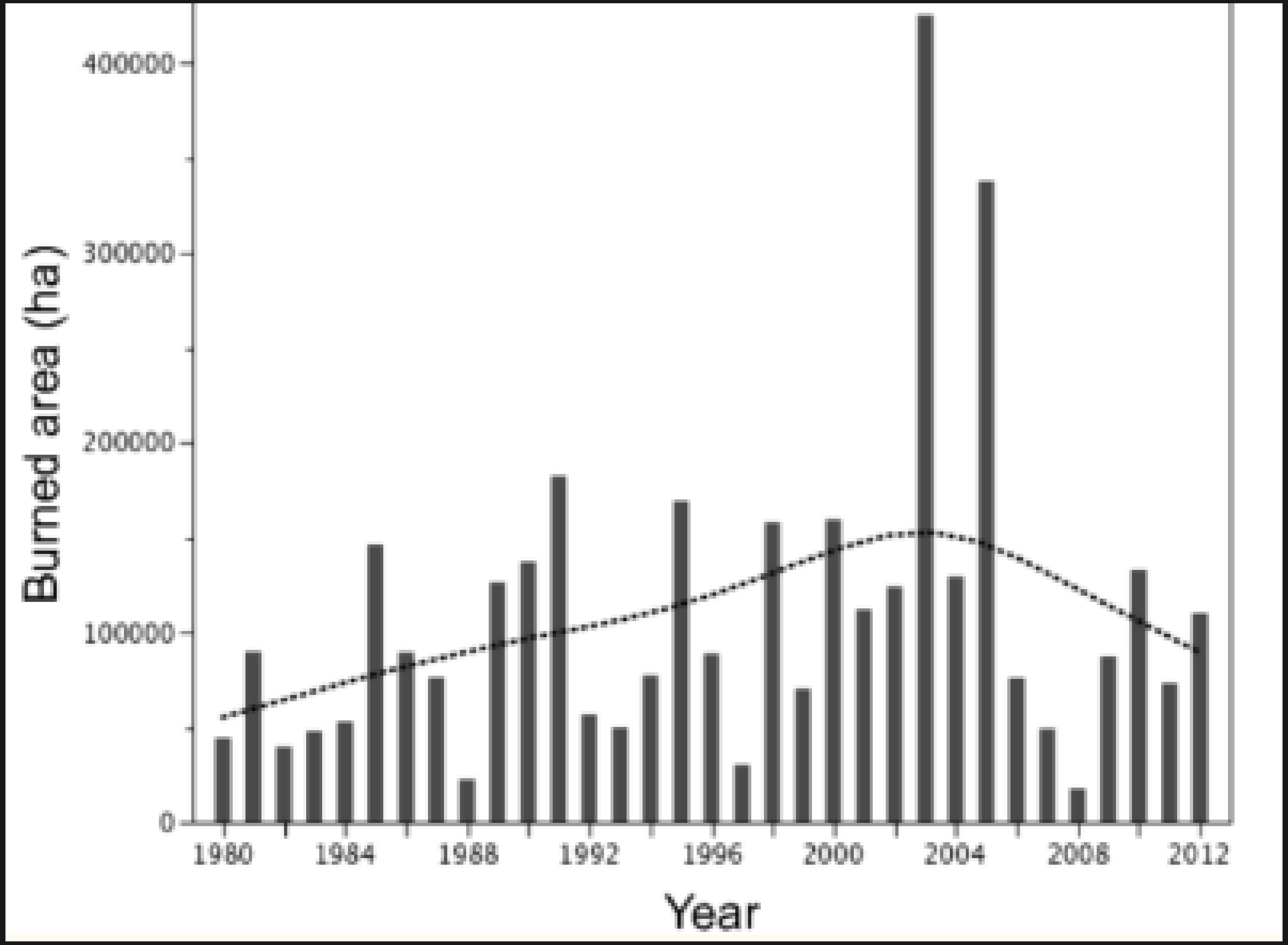
Monitoring and Prediction tools are important

Prescribed burning for lower risks

Case Study 2: Portugal

Some Statistics

- Forest area decreased 4.6% between 1995 and 2010 corresponding to a net decrease of 0.3% year or 104 ha/year.
- The decrease in pine forest area is the major driver of the observed decrease in forest surface.
- The area occupied by pine forest diminished by 263 x 103 ha between 1995 and 2010.



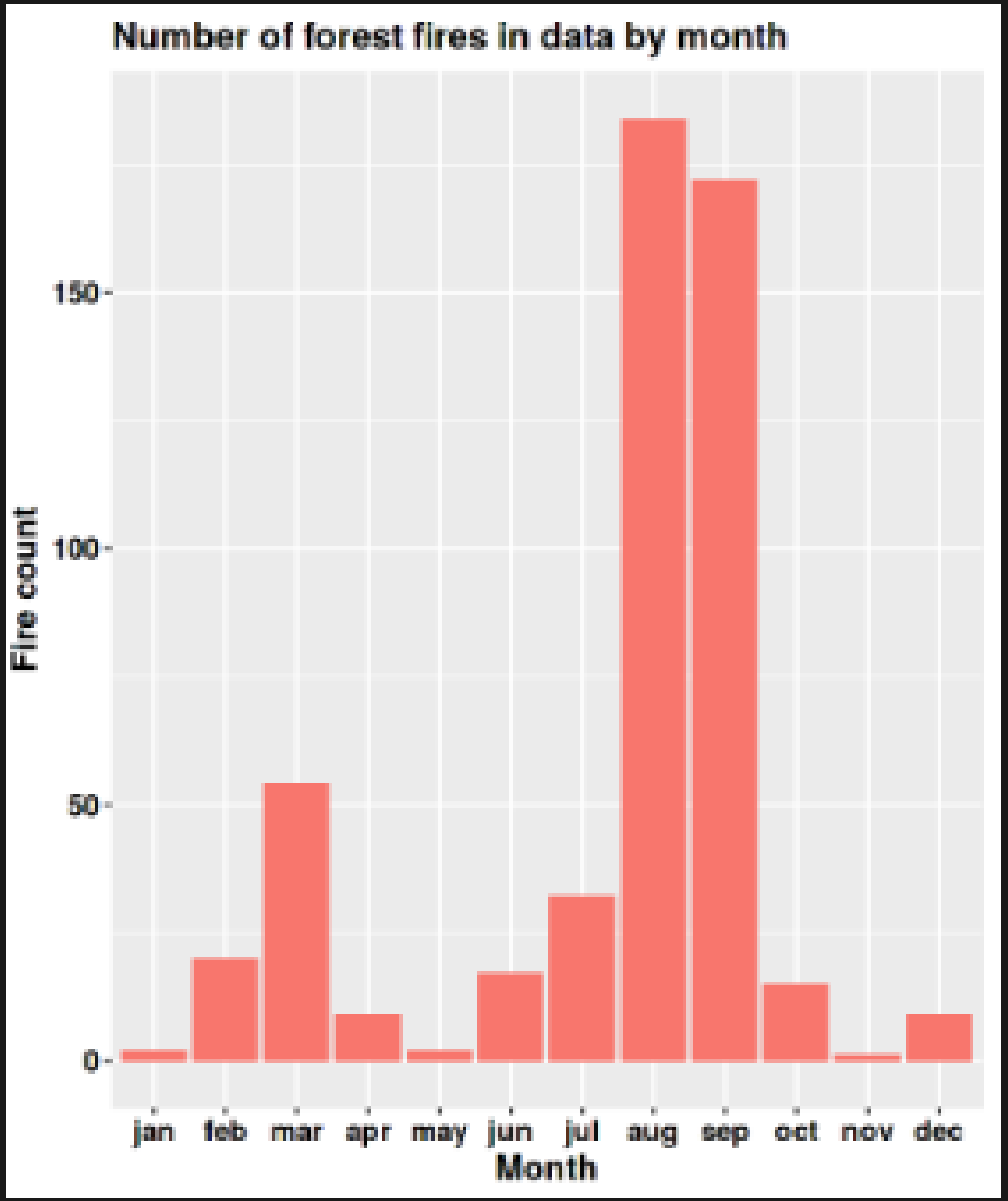
The Dataset

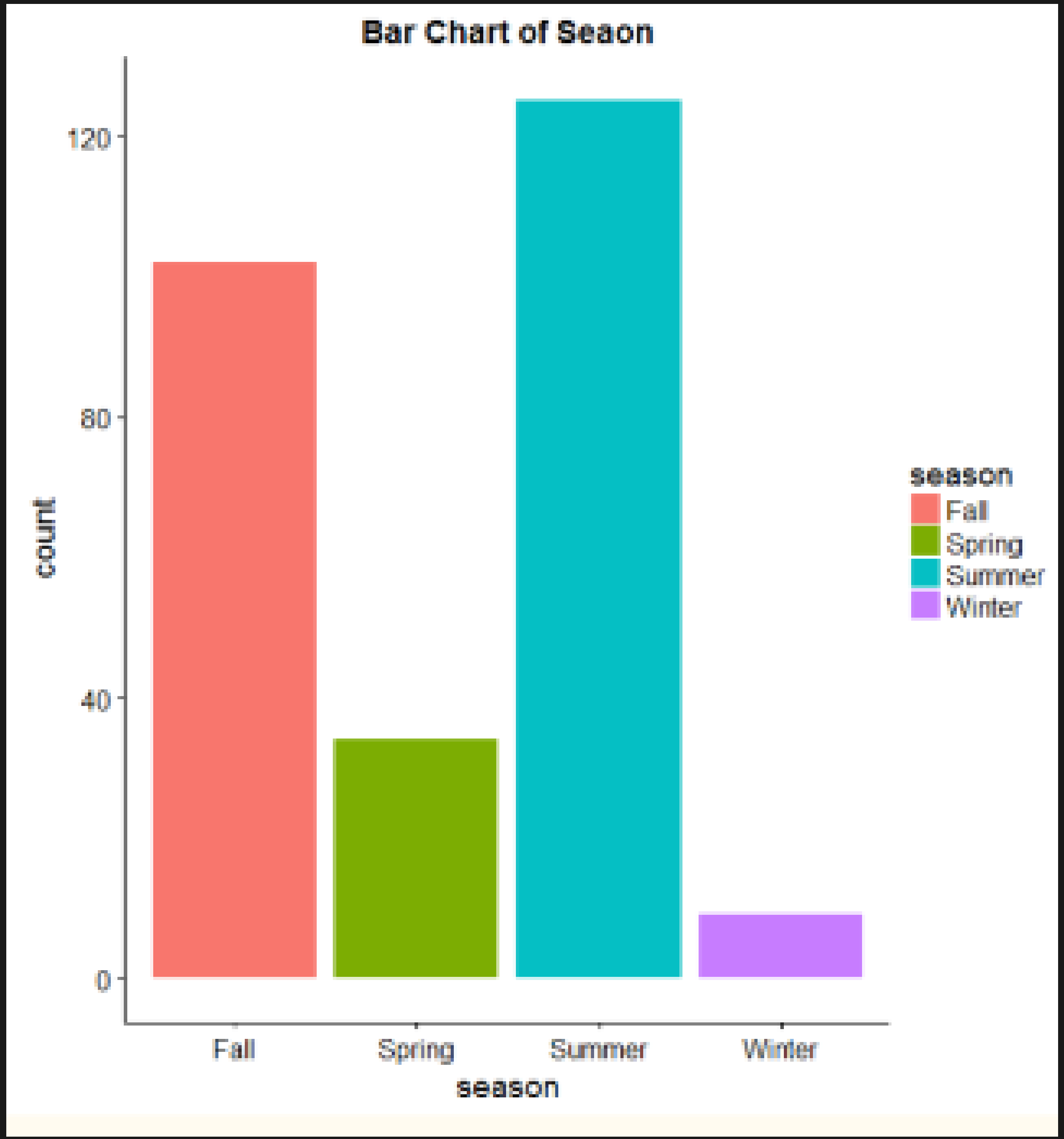
The dataset contains forest fire data from the Montesinho National Park, which is located in the northeast region of Portugal.
The data used in the analysis was collected from January 2000 to December 2003.
The dataset contains the following attributes:

- X: X-axis spatial coordinate within the Montesinho park map
- Y: Y-axis spatial coordinate within the Montesinho park map
- month: Month of the year
- day: Day of the week
- FFMC: Fine Fuel Moisture Code index from the FWI system
- DMC: Duff Moisture Code index from the FWI system
- DC: Drought Code index from the FWI system
- ISI: Initial Spread Index from the FWI system
- temp: Temperature in Celsius degrees
- RH: Relative humidity in percentage
- wind: Wind speed in km/h
- rain: Outside rain in mm/m2
- area: The burned area of the forest (in ha)

When do forest fires happen the most ?

After analysing the data, the following graphs can be visualised:

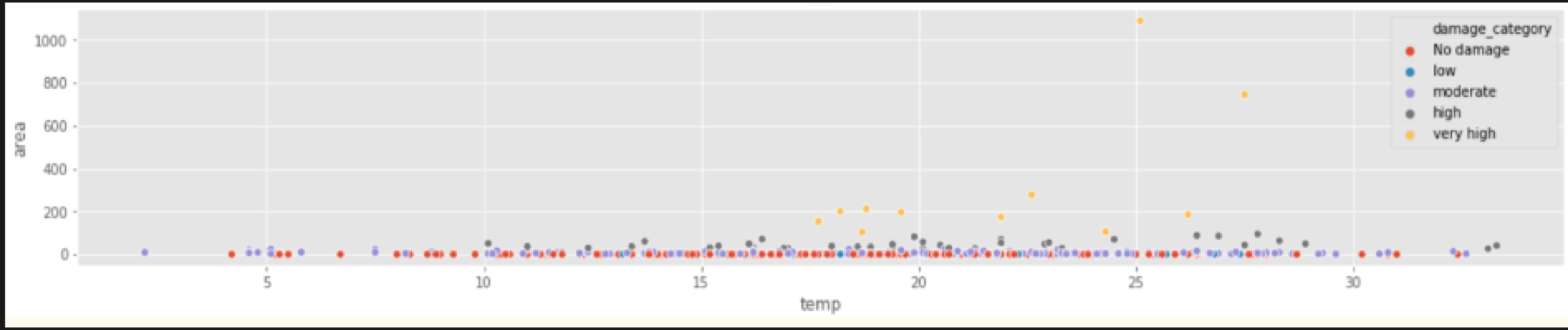


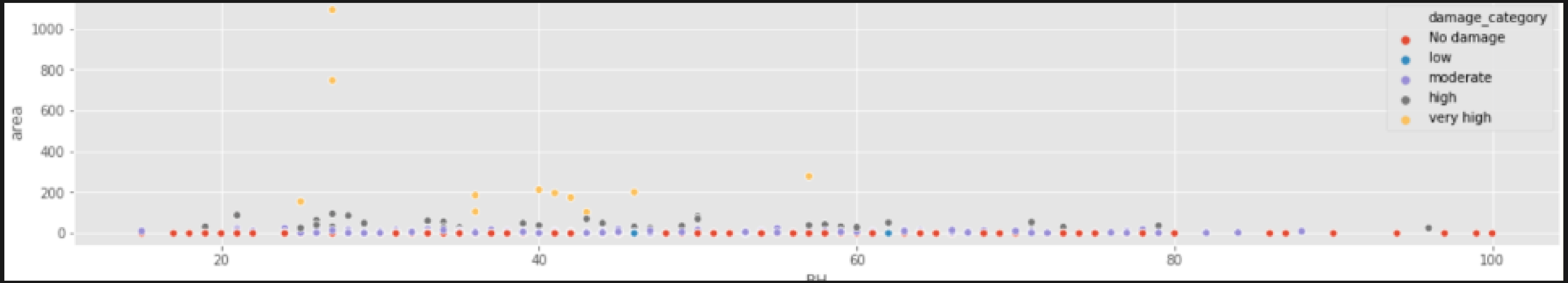


- Fall: mid September to early December
- Spring: March to May
- Summer: June to mid-September
- Winter: December to February

Reasoning: Natural Factors

The summer and fall seasons witness the most forest fires because of **higher temperature** and **lower relative humidity**.



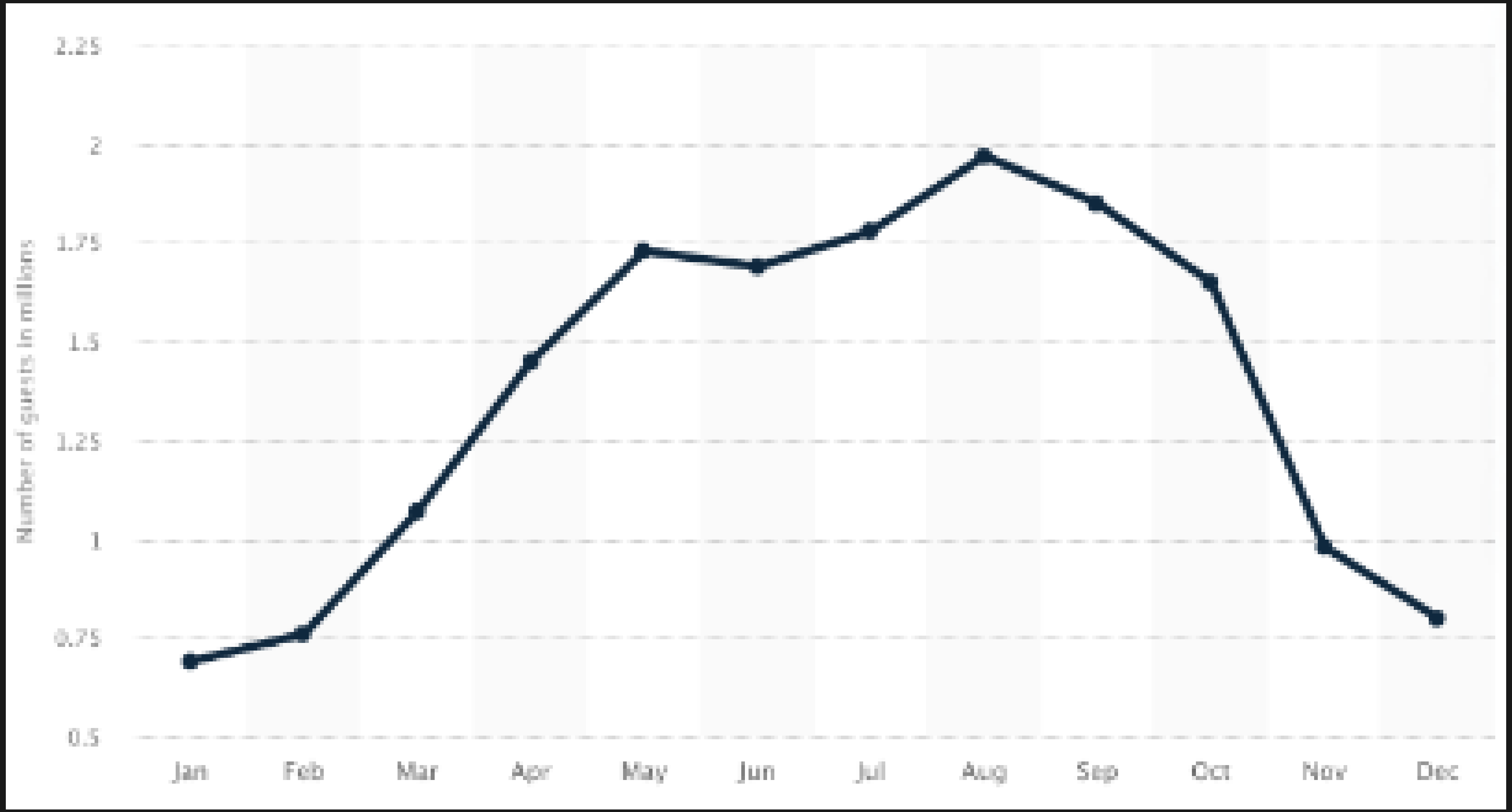


These environmental factors makes it extremely difficult to contain fires and increases ISI by a huge margin.

Reasoning: Anthropogenic Factors

Portugal's peak tourist season tends to be from late June to early September.

People prefer to go hiking and trekking in these 2 seasons. This means there will be bon-fires, camp fires etc in the forests and more risk of forest fires.



Political and Institutional Factors

- Prior to the wildfire crises of 2003 and 2005 fire management policies have been markedly reactive, inconsistent and short-sighted.
- Before the 1974 revolution, Forest Rangers had authority over the forests. However, post-revolution, the enforcement capacity diminished and power was transferred to Portuguese forest service (PFS).
- In 1980, Fire suppression was transferred from the PFS to the national fire fighting service.
- After the catastrophic fires of 2003 and 2005, the current national fire system, the DFCI, and fire plan were established in 2006.

Year	Plan
1996	Forest Policy Bases Law
1999	Portuguese Forest Sustainable Development Plan
2003	Action Plan for the Forest Sector
2003	Forest Sector Structural Reform
2005	Operational Plan of Forest Fires Prevention and Suppression
2006	National Plan of Forest Defence Against Fires (2006-2018)
2006	National Forest Strategy

changes in national-level Portuguese forest strategies and plans

Existing Fire Management Strategy

Promoting forest and environmental education

Drafting legislations in favour of forest conservation

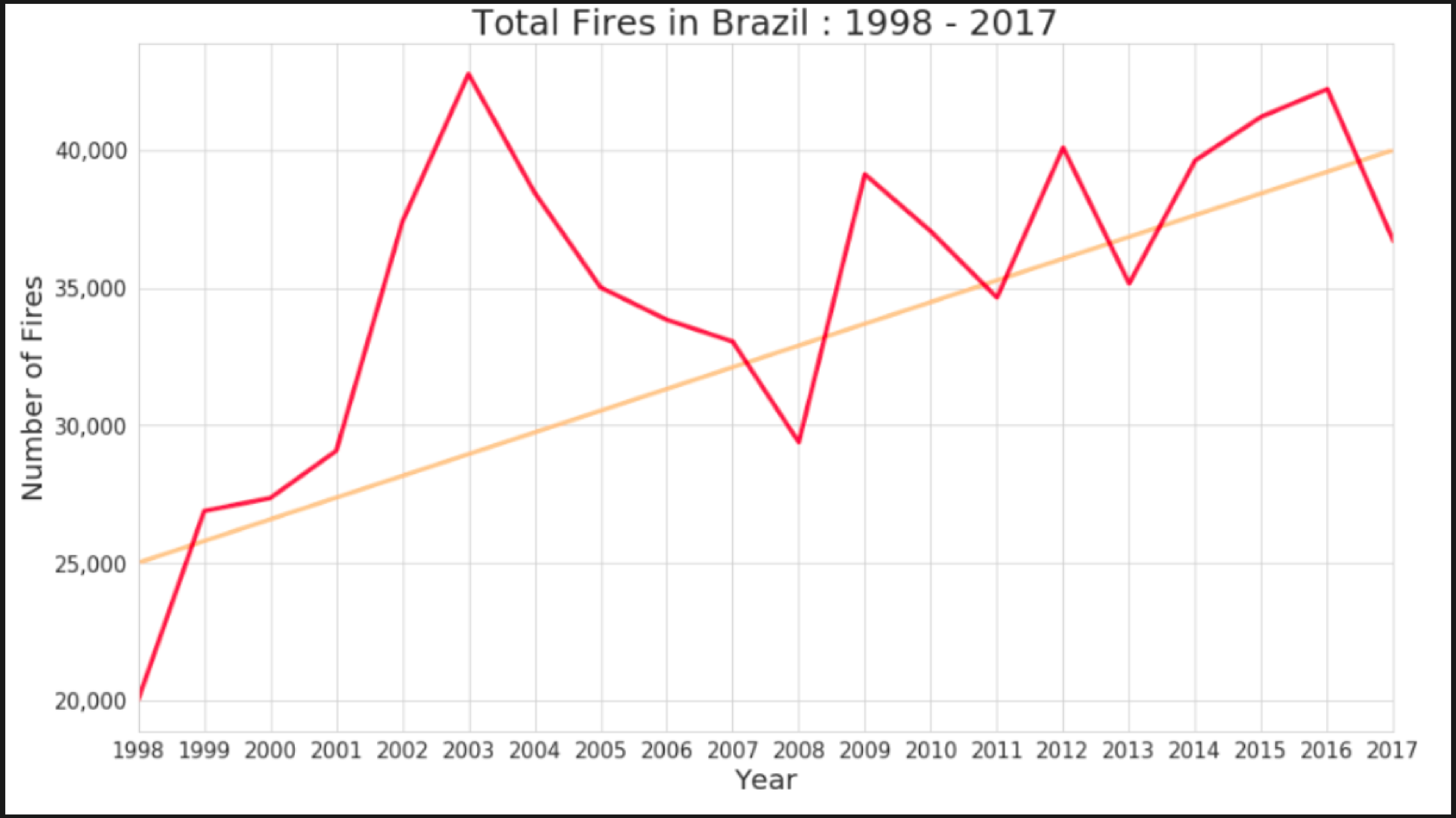
Better integration of fire-fighting teams

Ecosystem restoration and Post fire recovery Programs

Improved Communication among several Executive bodies

Case Study 3: Brazil

Understanding the forest fires in a time series can help take action to prevent them.

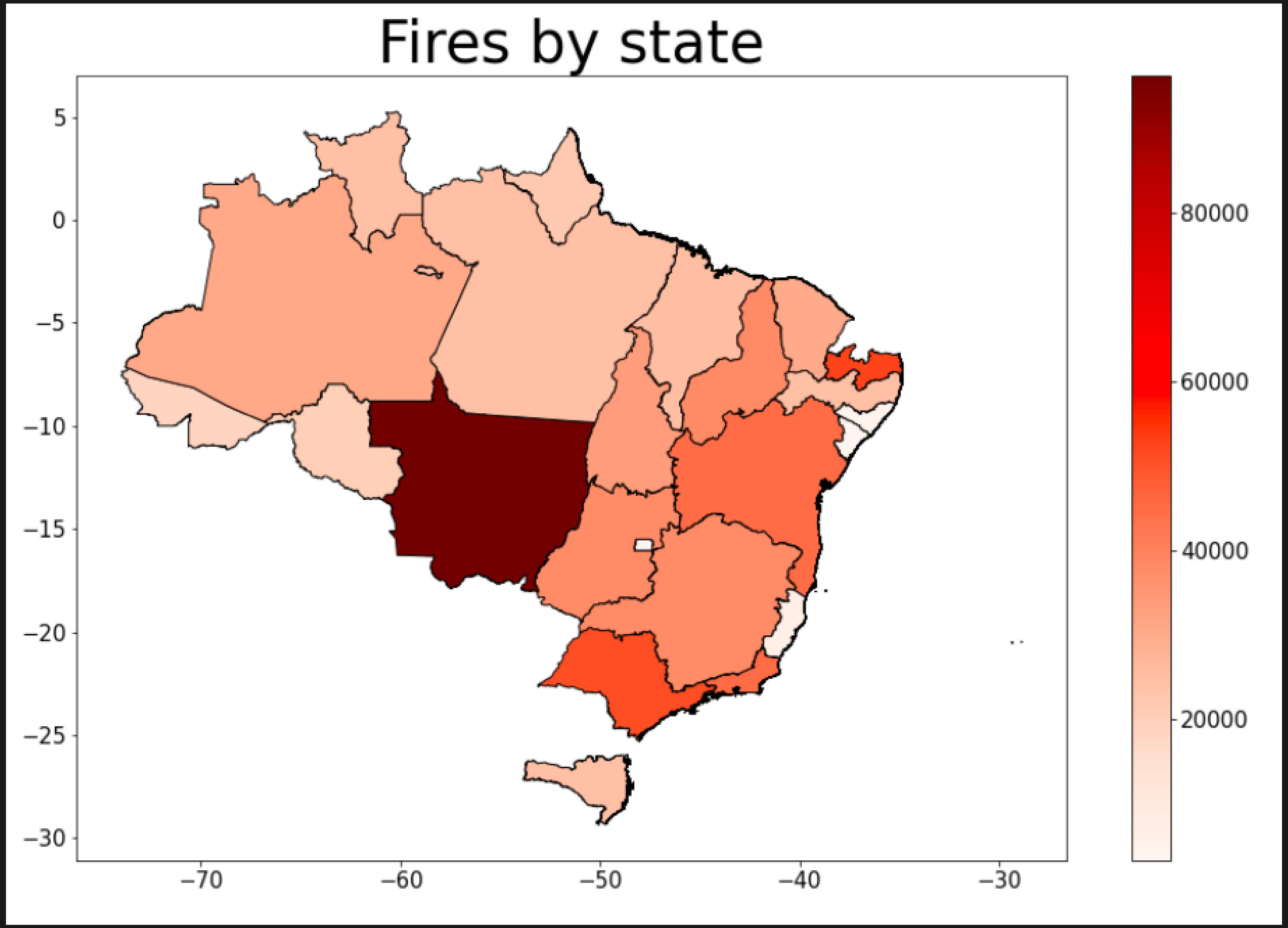


- Average - 4.8k fires per year
- The number of forest fires increased dramatically from 20k in 1998 to 40k in 2016
- The largest number of fires was in 2003, 2015 and 2016.

About the dataset

- This dataset reports the number of forest fires in Brazil divided by states
- 20 years (1998-2017)
- Obtained from the official website of the Brazilian government

# year	A state	A month	# number	date
Year when Forest Fires happen	Brazilian State	Month when Forest Fires happen	Number of Forest Fires reported	Date when Forest Fires where reported

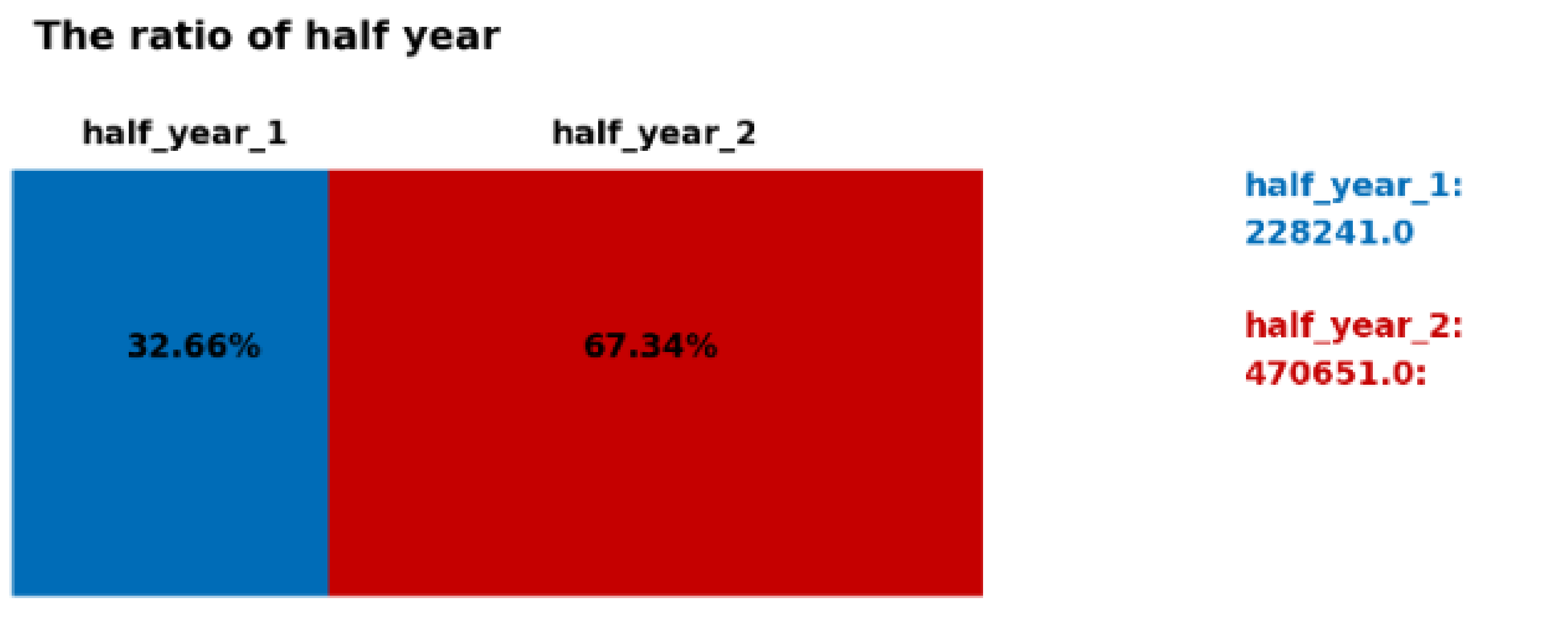


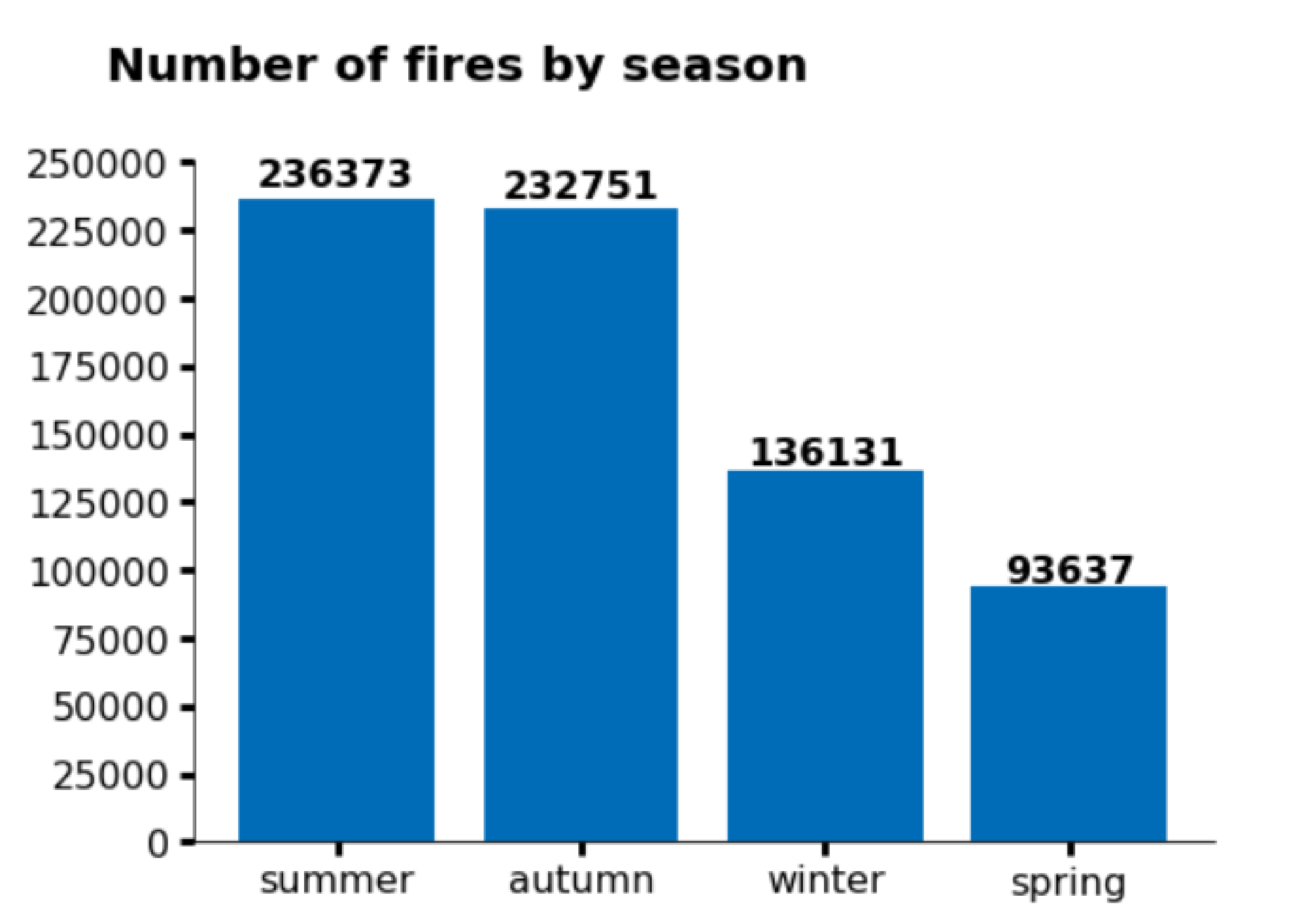
Fires by state

- Mato Grosso - the state with most fires
- Sergipe - the state with least fires

From **2001** to **2021**, **Mato Grosso** had the highest rate of tree cover loss due to fires with an average of **129kha** lost per year.

1	Mato Grosso	129kha
2	Pará	112kha
3	Bahia	35.1kha
4	Amazonas	34.7kha
5	Maranhão	29.8kha





Seasonality

- The graph shows that almost 70% of the fires occurred in the 2nd half of the year.
- The largest number of fires in summer and autumn ~ 23k.
- Least number of fires in spring - 9.3k.
- The highest number of fires was in July.

Why

Dry weather, wind and heat

More extreme droughts are linked to global warming

El Niño

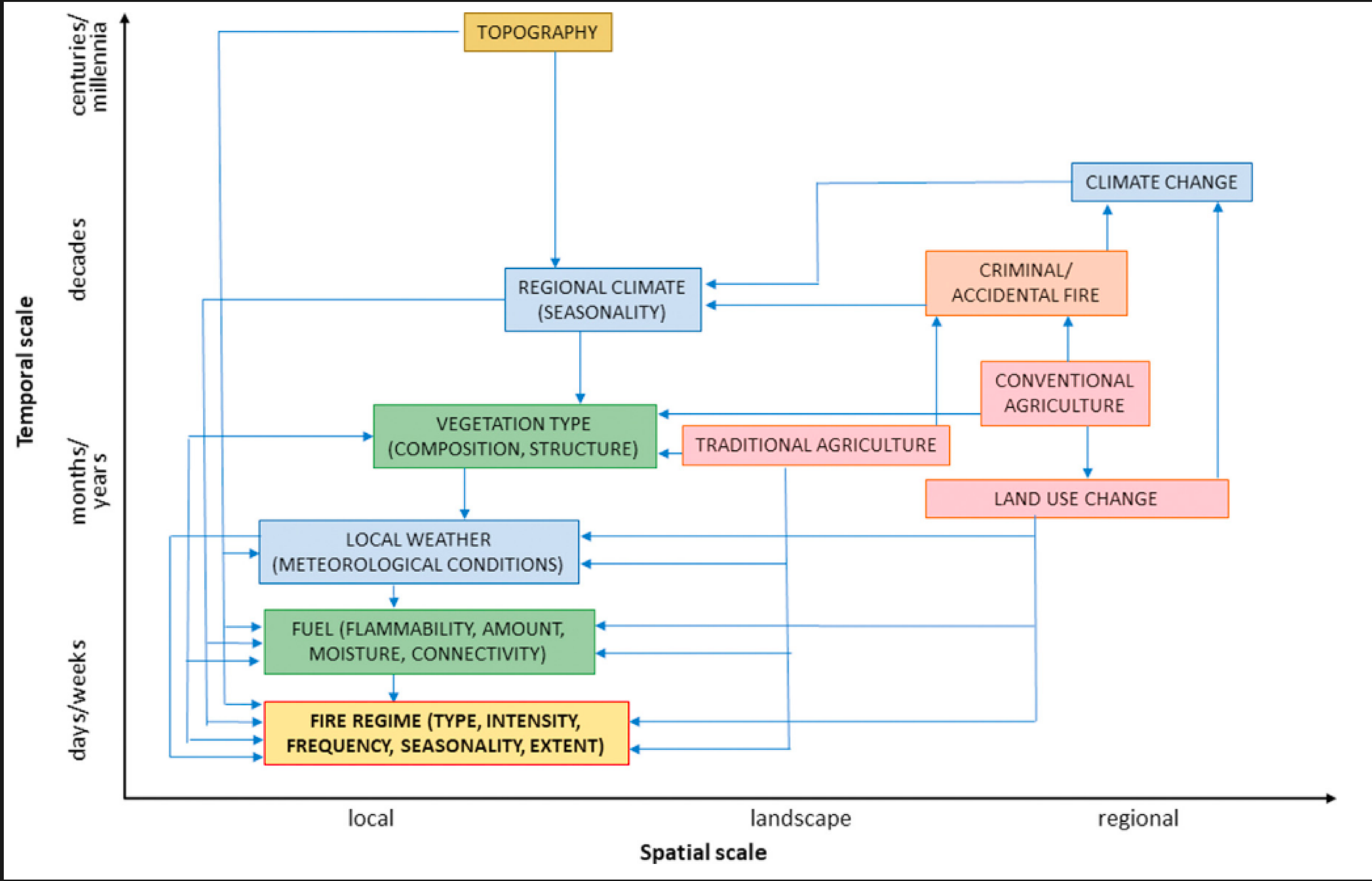
Almost one million hectare of primary and secondary forests was burned during the 2015–2016 El Niño season which led to over 30 million tonnes of CO2 emission

Accidental Forest Fires

In both Mata Grosso and southern Para, the area of standing forest affected by accidental forest fires exceeded the area of new deforestation in 1995 (Alencar et al. 1997)

Human activities

Conventional agriculture, deforestation, lack of adequate environmental policies and surveillance


TOPOGRAPHY
CLIMATE CHANGE
REGIONAL CLIMATE (SEASONALITY)
CRIMINAL/ ACCIDENTAL FIRE
CONVENTIONAL AGRICULTURE
VEGETATION TYPE (COMPOSITION, STRUCTURE)
TRADITIONAL AGRICULTURE
LAND USE CHANGE
LOCAL WEATHER (METEOROLOGICAL CONDITIONS)
FUEL (FLAMMABILITY, AMOUNT, MOISTURE, CONNECTIVITY)
FIRE REGIME (TYPE, INTENSITY, FREQUENCY, SEASONALITY, EXTENT)
Temporal scale
centuries/ millennia
decades
months/ years
days/weeks
local
landscape
regional
Spatial scale

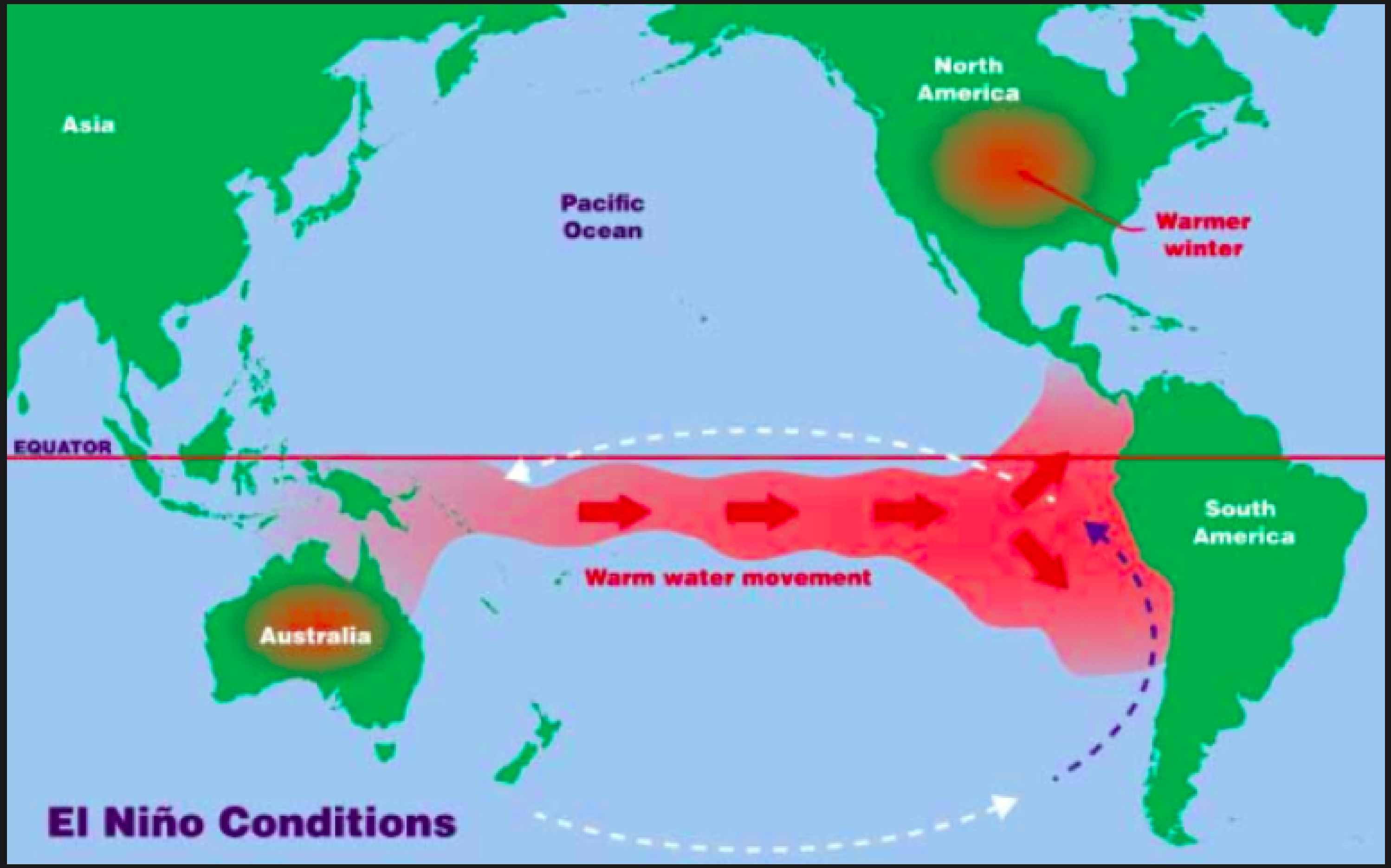
El Nino

El Niño is a climate pattern associated with a warming of Pacific Ocean currents that has a global influence on the weather.

During El Niño, dry conditions lead to even lower water tables, which makes both the forests and peat vulnerable to fire. Humans take advantage of these drought conditions to burn the woods to clear more croplands.

The intense drought made a tropical forest, one of the world’s largest carbon sinks, into a massive source of emission.

The annual mean precipitation during 2015-2016 drought periods was the lowest in 35 years.



Towards effective fire management in Brazil

Land management

Combat risk of recurrent forest fires

Command and control against illegal fires

Fire management as such can only be efficient if agencies are properly equipped, supplied and trained

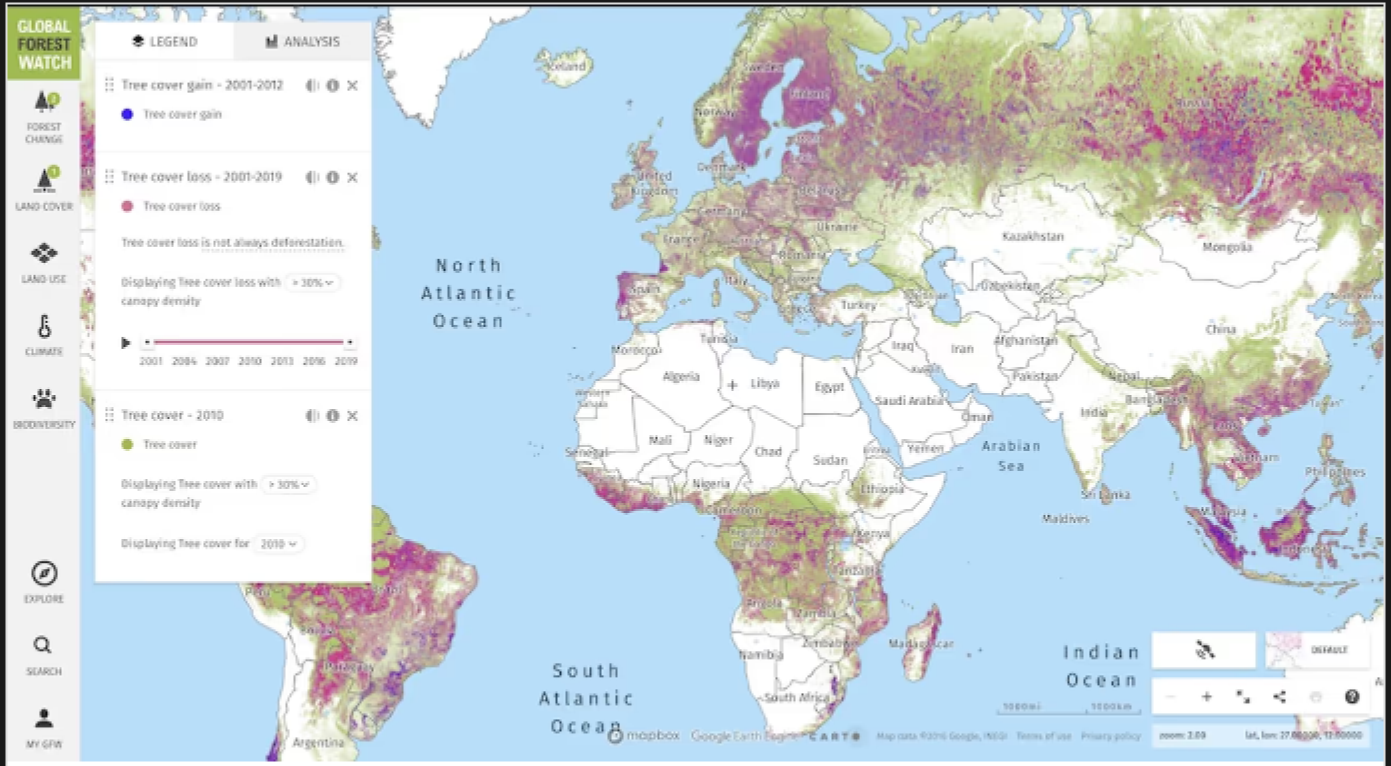
Adopt alternative land use techniques

e.g. agroforestry, crop-livestock-forest integration, rotation between crop and pasture, no-tillage cultivation, shredding of cut vegetation, allowing a transition to more sustainable and fire-free types of land use.

Development of monitoring systems

Research on fire should integrate different knowledge areas from biological to human science.

Tree cover loss on GFW



Brazil Deforestation Rates & Statistics | GFW

In 2010, Brazil had 492Mha of natural forest, extending over 59% of its land area. In{year}, it lost 2.90Mha of natural forest, equivalent to 1.70Gt of CO_2 emissions.

globalforestwatch.org /

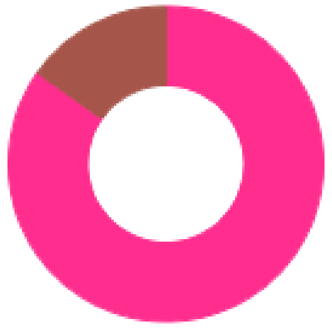
Fires were responsible for **15%** of tree cover loss in **Brazil** between **2001** and **2021**.

Tree cover loss from other sources

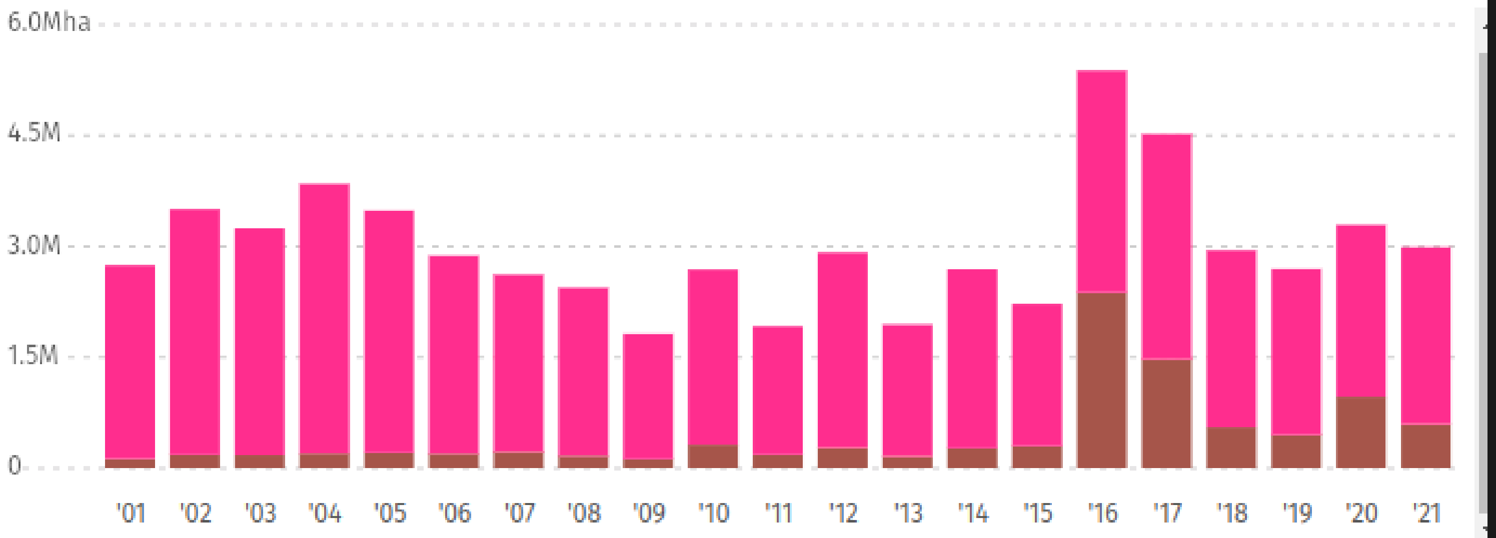
53.3Mha

Tree cover loss from fires

9.51Mha



From **2001** to **2021**, **Brazil** lost **9.51Mha** of tree cover from fires and **53.3Mha** from all other drivers of loss. The year with the most tree cover loss due to fires during this period was **2016** with **2.38Mha** lost to fires — **44%** of all tree cover loss for that year.



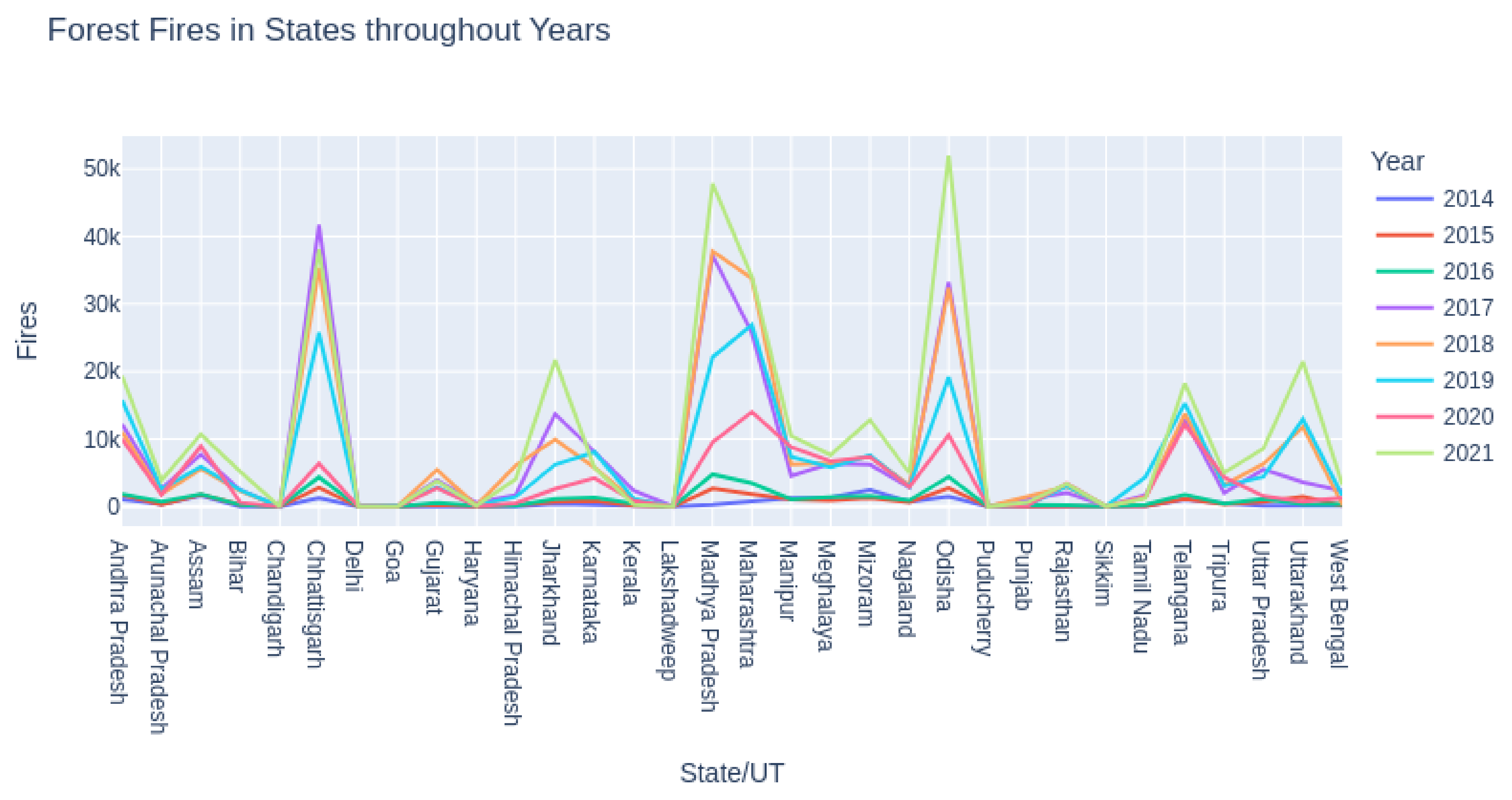
In **Brazil** the peak fire season typically begins in **early August** and lasts around **13** weeks. There were **57,098** **VIIRS** fire alerts reported between **18th of October 2021** and **10th of October 2022** considering **high confidence alerts** only. This is **high** compared to previous years going back to **2012**.

Case Study 4: India

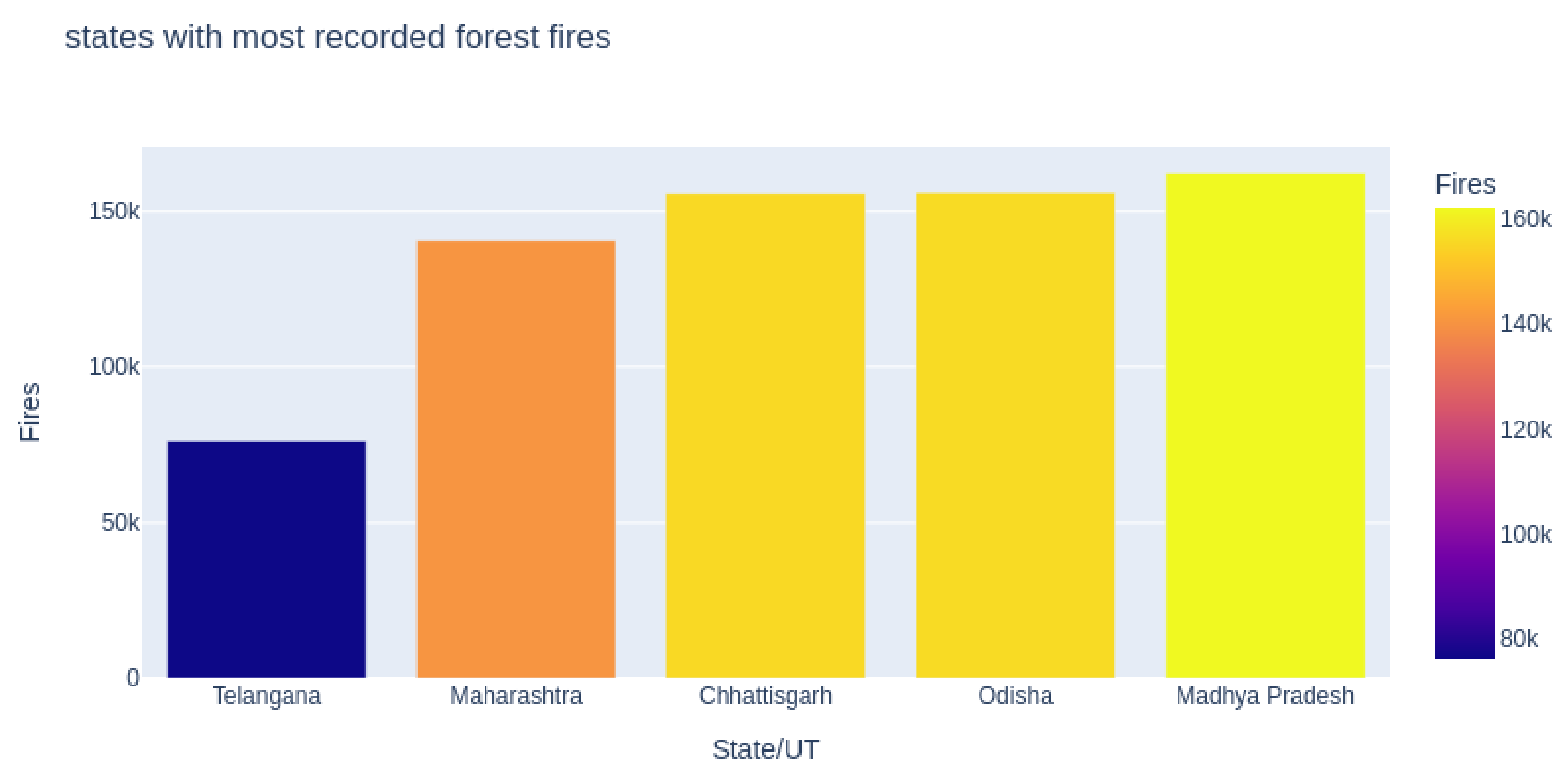
- India's geographical area - 328 Mha => 68 Mha are under forest cover: 80% => Tropical forests 64% => Tropical moist and dry deciduous forests, which are frequently affected by forest fire
- 3.73 Mha of forests are affected by fire annually
- >95% of forest fires are caused either by negligence or unknowingly by the human being

Causes:

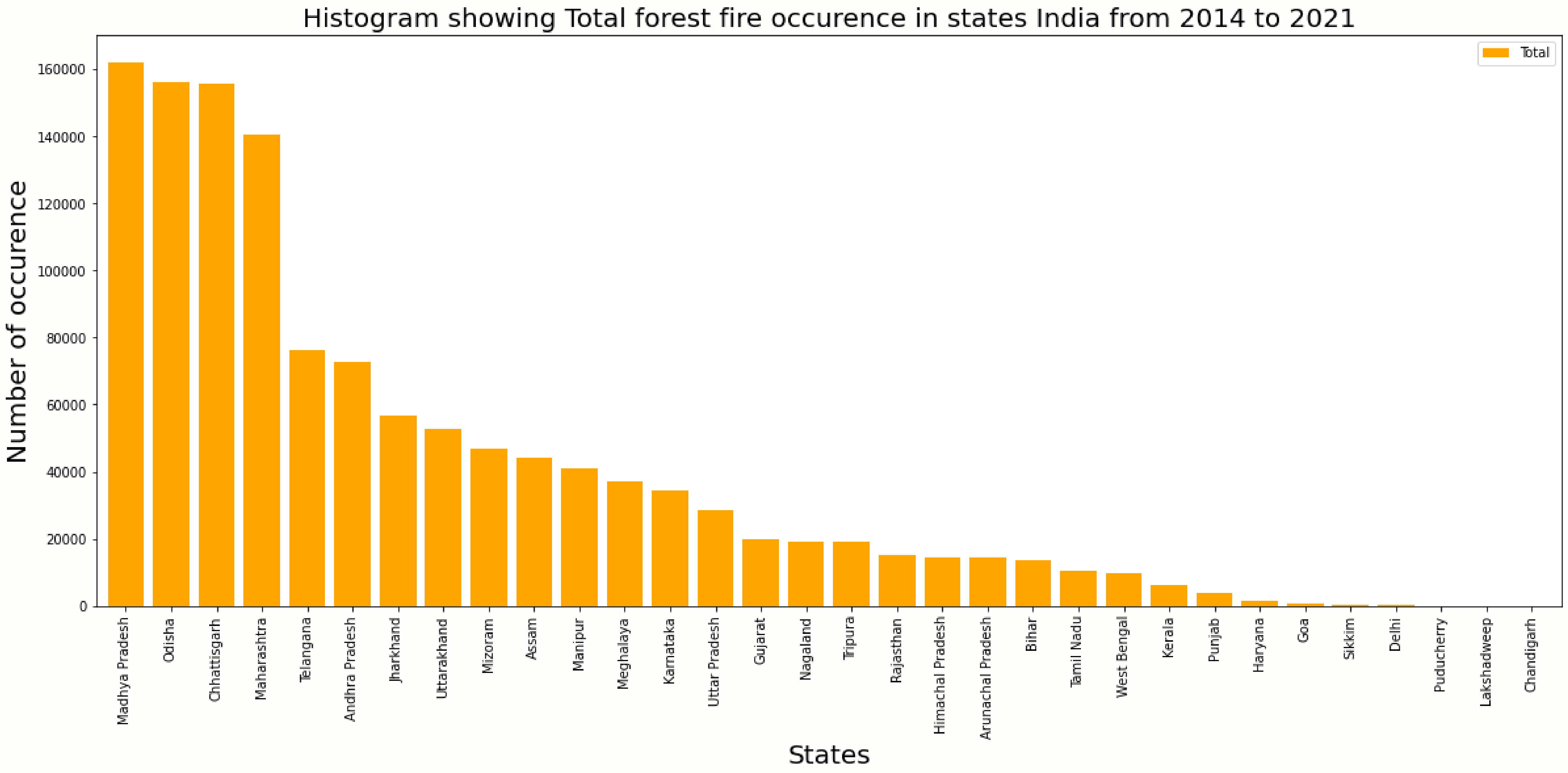
Natural	Anthropogenic	
	Deliberate causes	**Accidental causes**
1. Lightning	1 Shifting Cultivation	1 Collection of Non Timber Forest Produce
2. Friction of rolling stone	2 To flush growth of *tendu* leaves	2 Burning farm residues
3. Rubbing of dry bamboo clumps	3 To have good growth of grass and fodder	3 Driving away wild animals
4. Volcanic explosion	4 To settle score with forest department or personal rivalry	4 Throwing burning *bidi*/ cigarettes
.	5 To clear path by villagers	5. Camp fires by picnickers
.	6 To encroach upon the forest land	6. Sparks from vehicle –exhaust
.	7. For concealing illicit felling	7. Sparks from transformers
.	8. Tribal traditions/ customs	8. Uncontrolled prescribed burning
	.	9. Resin tapping
.		10. Making charcoal in forests
.		11 Extracting wine in forest
.		12. Sparks from cooking near the forest
		13 Heating coal tar for road construction in forest

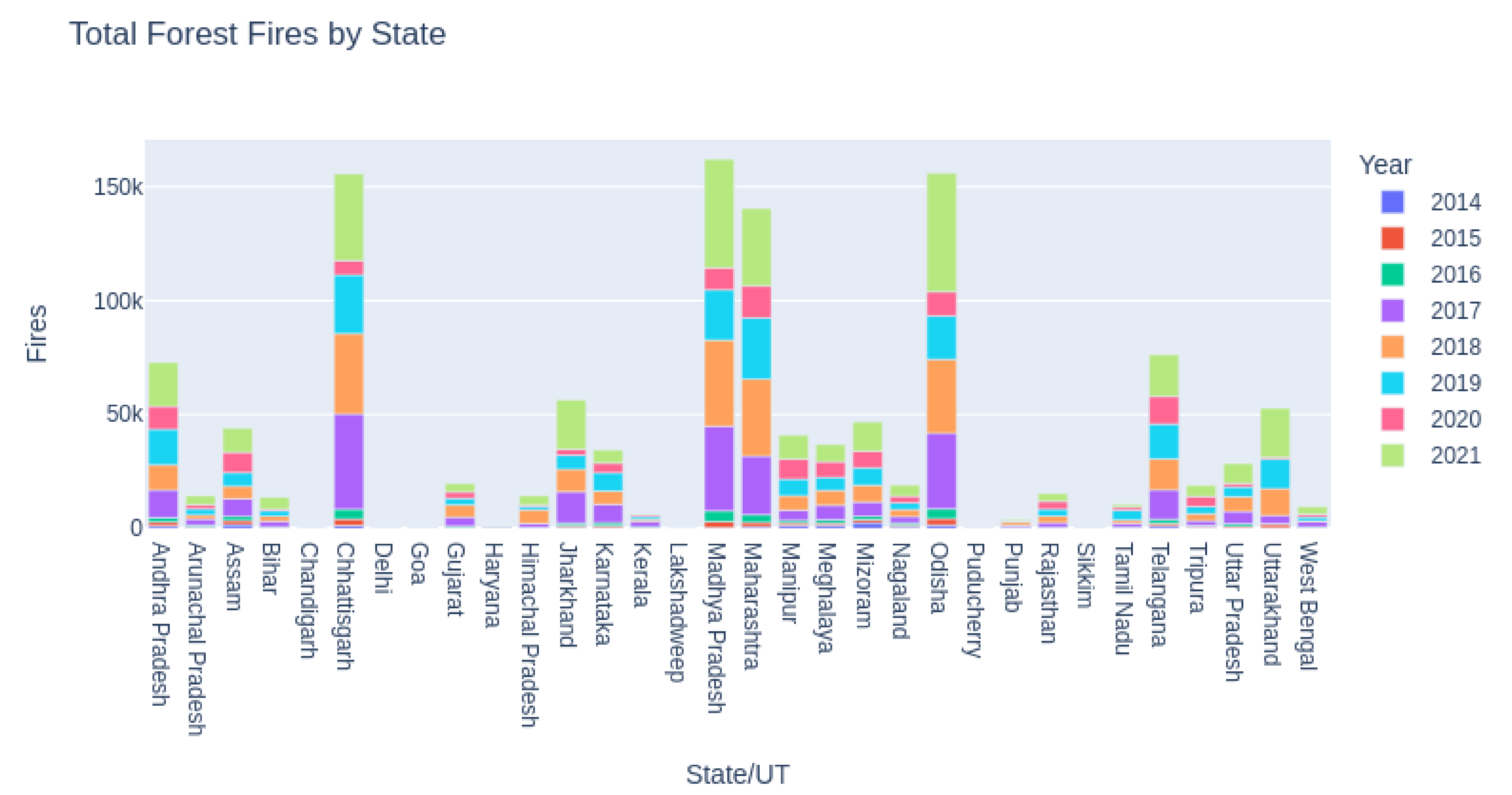


Forest Fires in States throughout Years
Fires
50k
40k
30k
20k
10k
0
Year
2014
2015
2016
2017
2018
2019
2020
2021
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jharkhand
Karnataka
Kerala
Lakshadweep
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Puducherry
Punjab
Rajasthan
Sikkim
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarakhand
West Bengal
State/UT

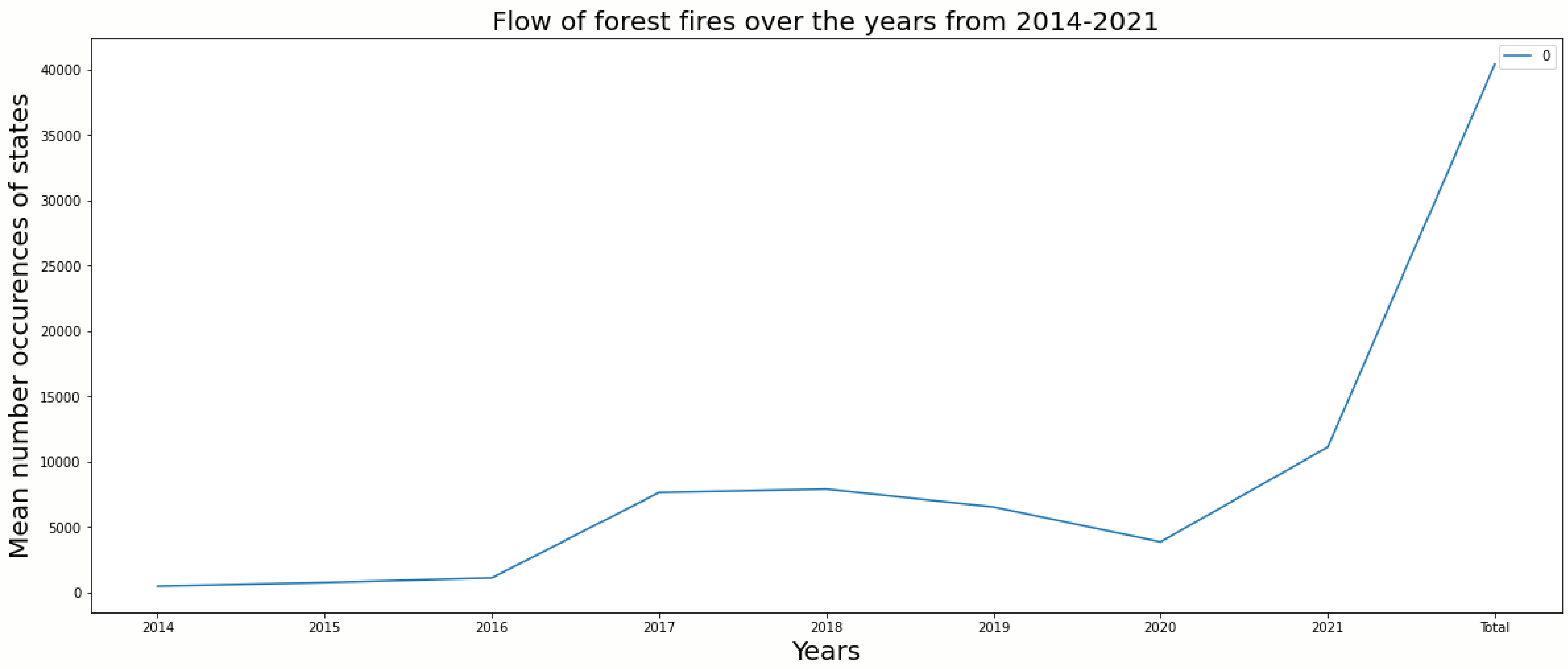


From 2017, FSI has also started disseminating alerts obtained from SNPP-VIIRS sensor. Registered users receive SMS and Email alerts having geo-coordinates of the fire location as well as a weblink to view it on their browser. By comparing the two graphs, we can see that the top 5 states with the most recorded forest fires all have above average registration for Fire alerts. This is necessarily a good thing because it shows that people are more aware of the dangers of forest fires and are prepared to face it.


Histogram showing Total forest fire occurence in states India from 2014 to 2021
Total
Number of occurence
0
20000
40000
60000
80000
100000
120000
140000
160000
States
Madhya Pradesh
Odisha
Chhattisgarh
Maharashtra
Telangana
Andhra Pradesh
Jharkhand
Uttarakhand
Mizoram
Assam
Manipur
Meghalaya
Karnataka
Uttar Pradesh
Gujarat
Nagaland
Tripura
Rajasthan
Himachal Pradesh
Arunachal Pradesh
Bihar
Tamil Nadu
West Bengal
Kerala
Punjab
Haryana
Goa
Sikkim
Delhi
Puducherry
Lakshadweep
Chandigarh

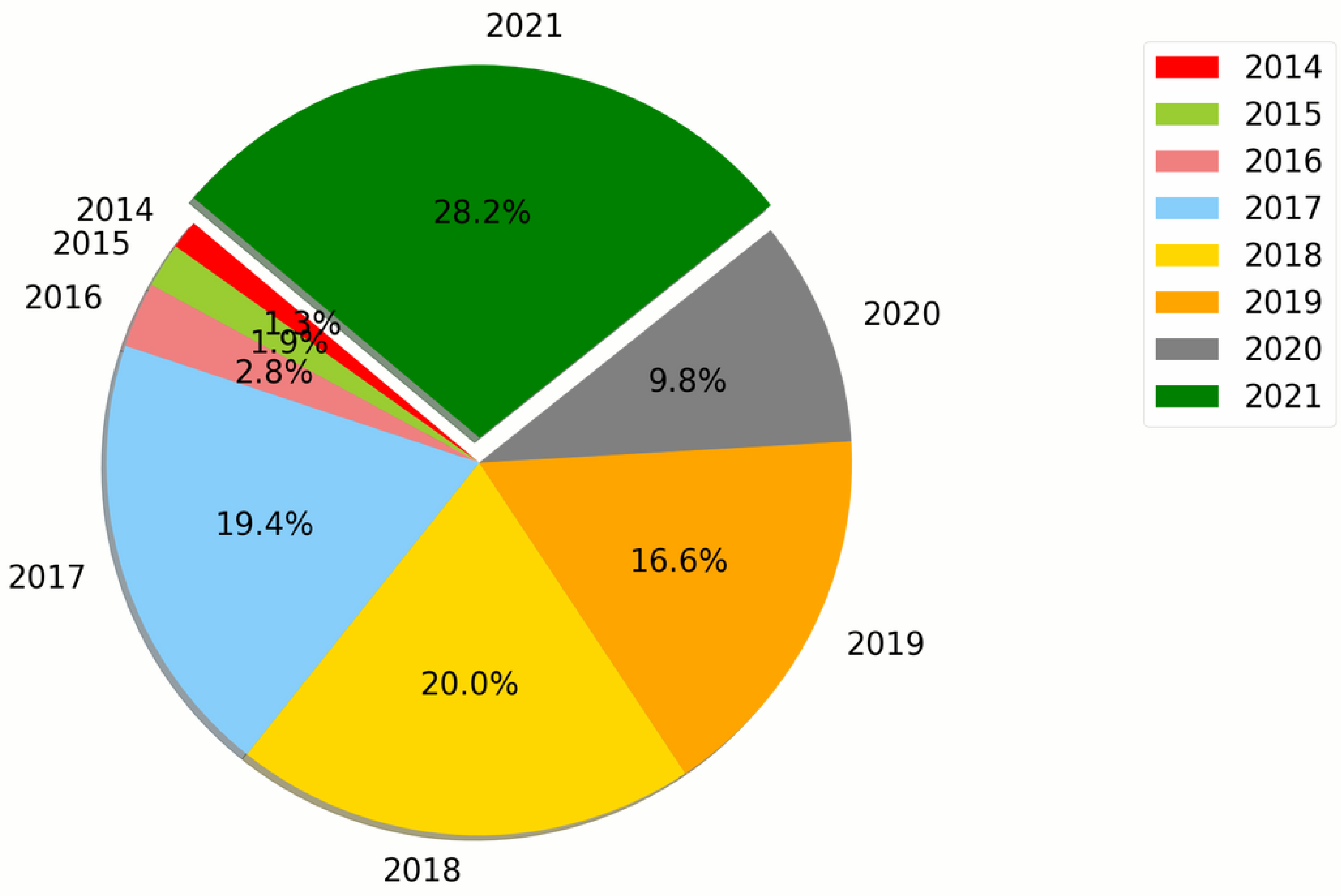


Total Forest Fires by State
Fires
150k
100k
50k
0
State/UT
Andhra Pradesh
Arunachal Pradesh
Assam
Bihar
Chandigarh
Chhattisgarh
Delhi
Goa
Gujarat
Haryana
Himachal Pradesh
Jharkhand
Karnataka
Kerala
Lakshadweep
Madhya Pradesh
Maharashtra
Manipur
Meghalaya
Mizoram
Nagaland
Odisha
Puducherry
Punjab
Rajasthan
Sikkim
Tamil Nadu
Telangana
Tripura
Uttar Pradesh
Uttarakhand
West Bengal
Year
2014
2015
2016
2017
2018
2019
2020
2021



The spike seen in the graph above from 2016 can be mainly attributed to one of the worst forest fires to ever occur in India. The 2016 Uttarakhand forest fires were a series of widespread, damaging wildfires that took place in Uttarakhand, India between April and May 2016. The fires were caused by a heatwave that spread across Uttarakhand and were the worst recorded in the region with a reported 4,538 hectares (11,210 acres) of forest burnt down.

Officials detected nearly 1,600 total fires which were brought under control by 2 May, and as rain fell the following day, it reduced the impact of the wildfires. An initial report on 4 May noted that 3,500 hectares (8,600 acres) had been destroyed by the fire.



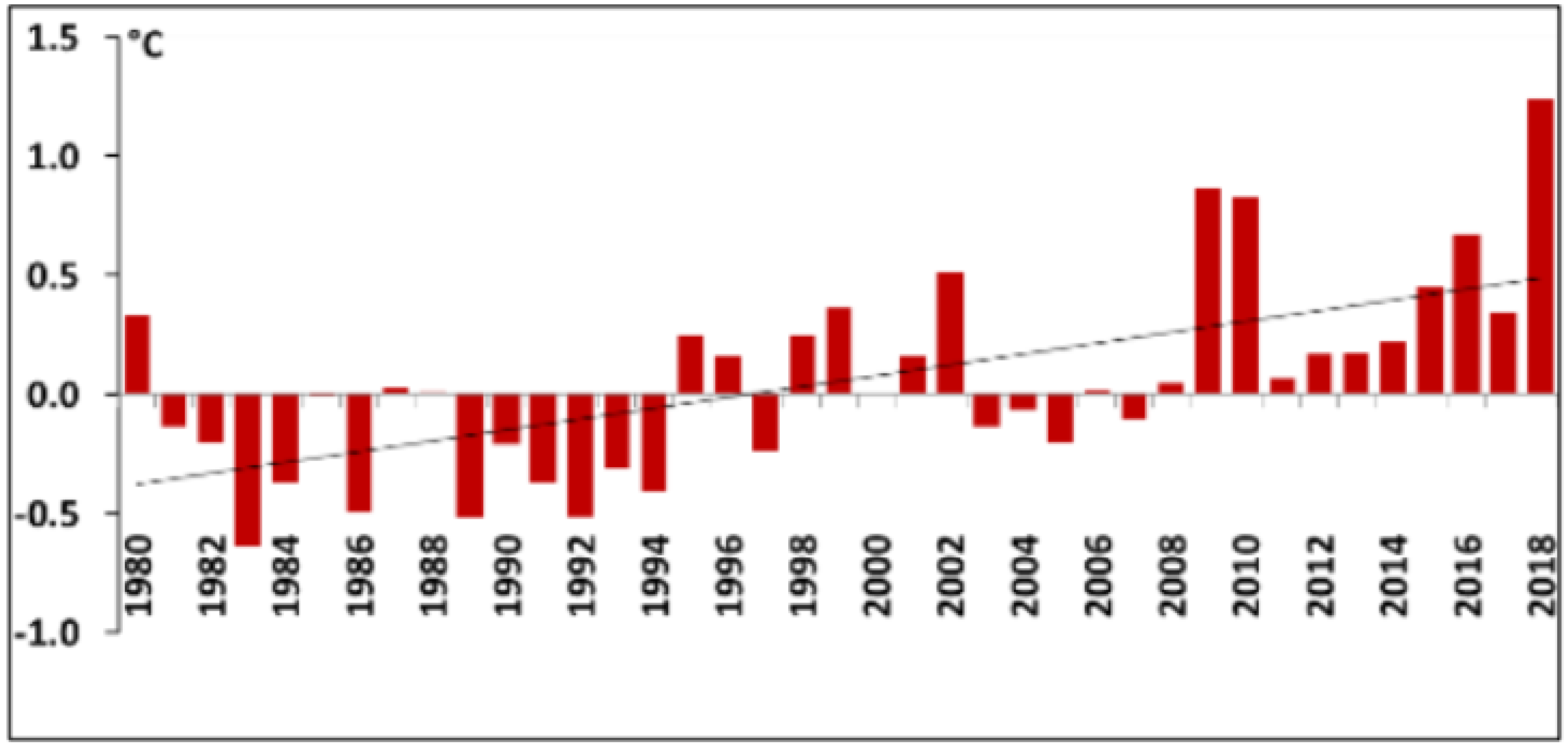
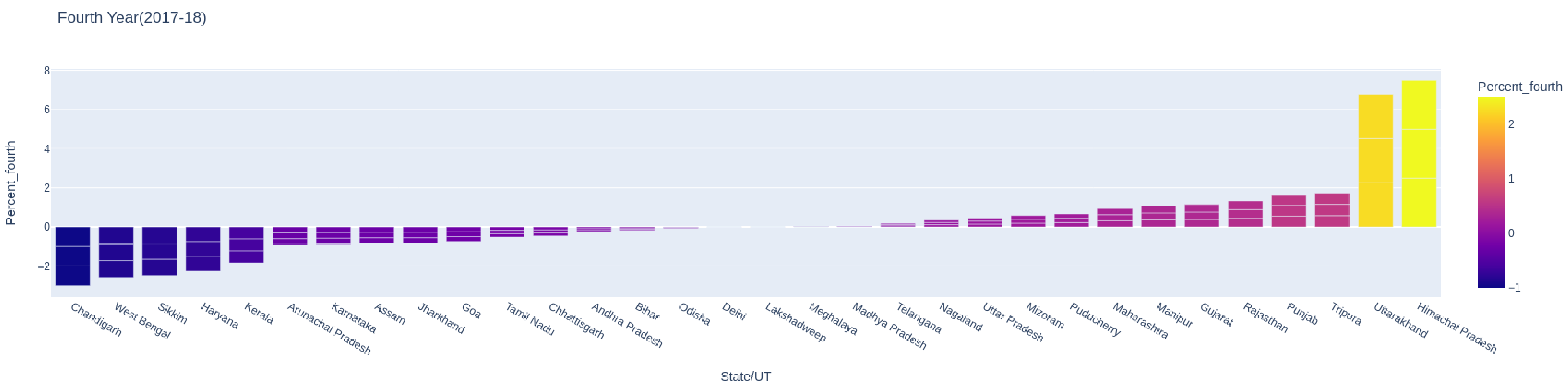
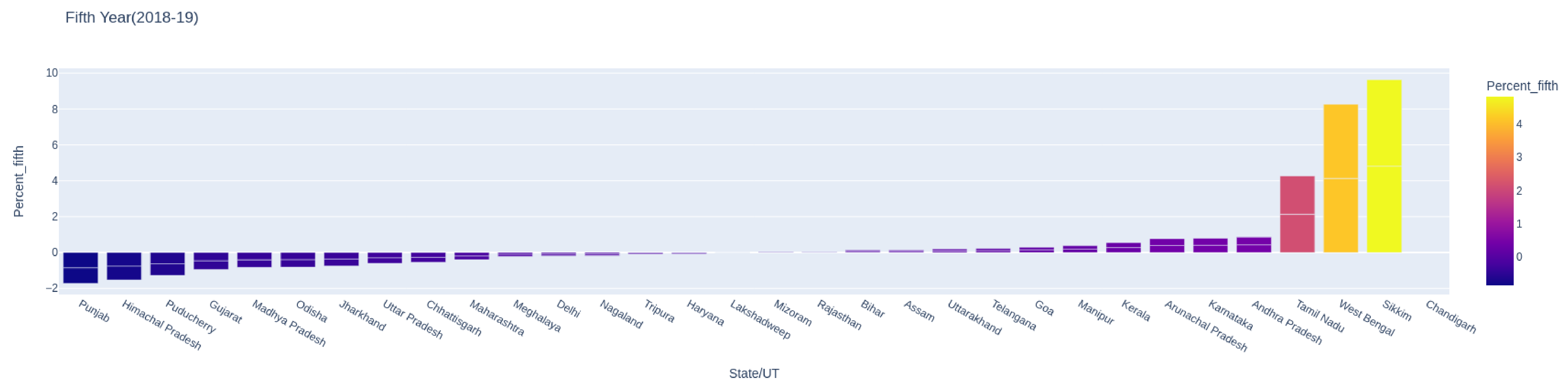


Figure 1.1: Mean temperature anomaly (°C) in India since 1980 (Source: IMD, Srivastava et al. 2009)

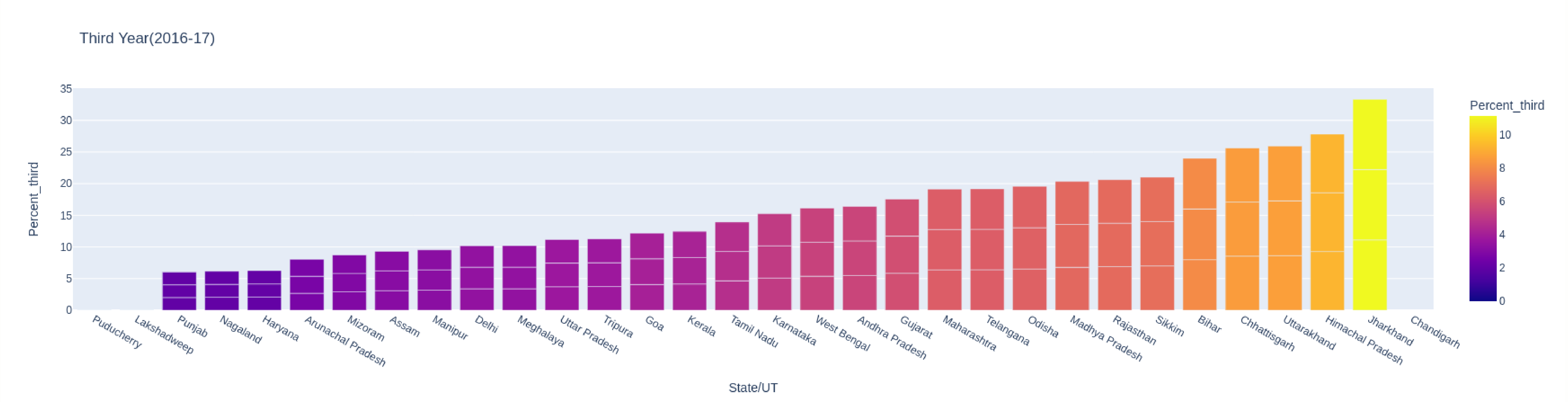
The left graph is a pie chart created with the help of a dataset given, while the right graph is taken from literature review,a report made by the Forest Survey of India(FSI). We can see that as mean temperature increases throughout the years, a similar trend is also seen in the number of forest fire occurences.



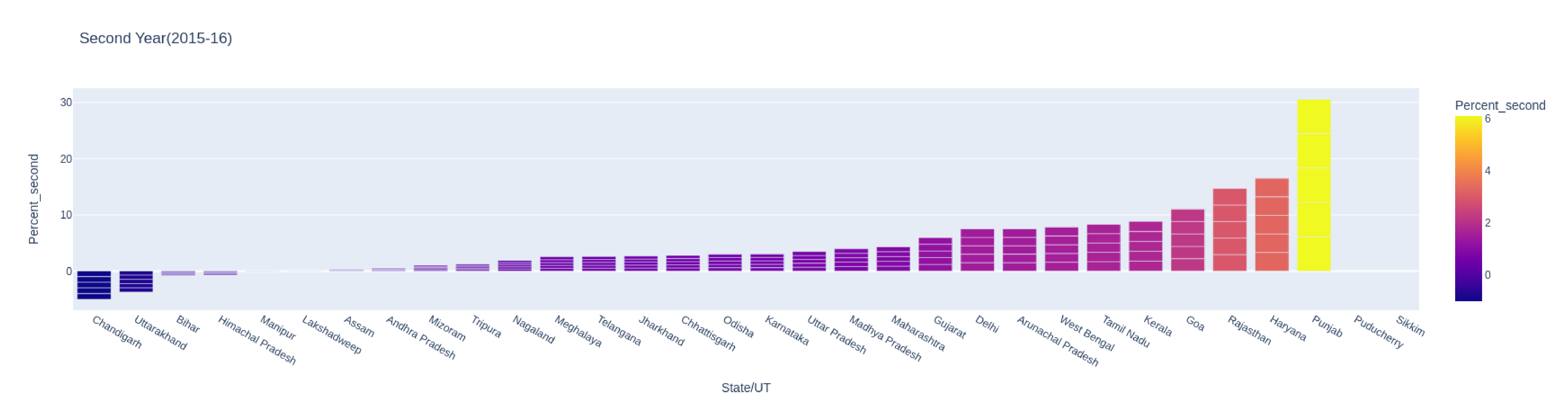
Fourth Year(2017-18)
Percent_fourth
State/UT
8
6
4
2
0
−2
Chandigarh
West Bengal
Sikkim
Haryana
Kerala
Arunachal Pradesh
Karnataka
Assam
Jharkhand
Goa
Tamil Nadu
Chhattisgarh
Andhra Pradesh
Bihar
Odisha
Delhi
Lakshadweep
Meghalaya
Madhya Pradesh
Telangana
Nagaland
Uttar Pradesh
Mizoram
Puducherry
Maharashtra
Manipur
Gujarat
Rajasthan
Punjab
Tripura
Uttarakhand
Himachal Pradesh
Percent_fourth
2
1
0
−1



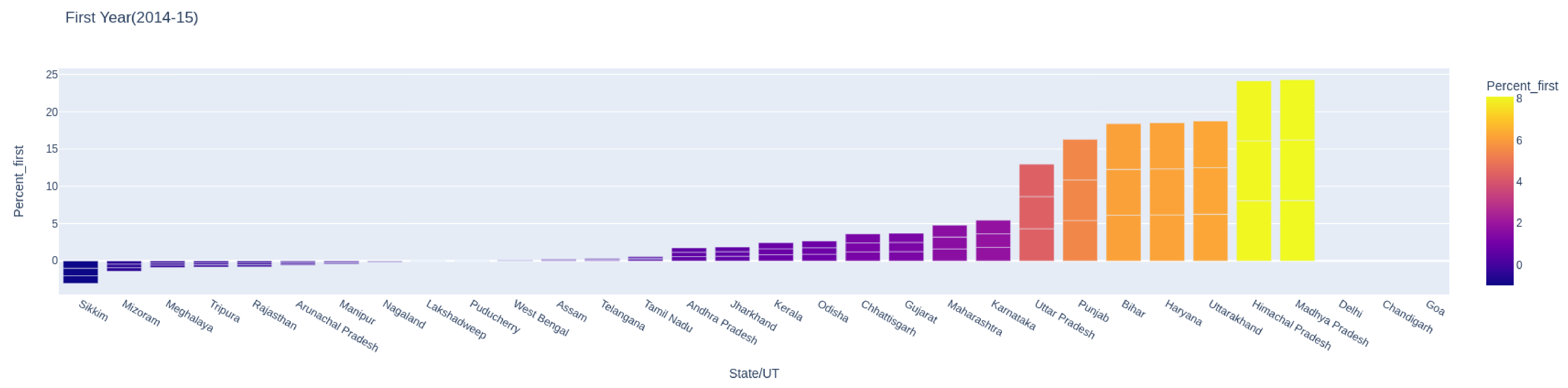
Fifth Year(2018-19)
Percent_fifth
State/UT
Punjab
Himachal Pradesh
Puducherry
Gujarat
Madhya Pradesh
Odisha
Jharkhand
Uttar Pradesh
Chhattisgarh
Maharashtra
Meghalaya
Delhi
Nagaland
Tripura
Haryana
Lakshadweep
Mizoram
Rajasthan
Bihar
Assam
Uttarakhand
Telangana
Goa
Manipur
Kerala
Arunachal Pradesh
Karnataka
Andhra Pradesh
Tamil Nadu
West Bengal
Sikkim
Chandigarh



Third Year(2016-17)
Percent_third
State/UT
35
30
25
20
15
10
5
0
Puducherry
Lakshadweep
Punjab
Nagaland
Haryana
Arunachal Pradesh
Mizoram
Assam
Manipur
Delhi
Meghalaya
Uttar Pradesh
Tripura
Goa
Kerala
Tamil Nadu
Karnataka
West Bengal
Andhra Pradesh
Gujarat
Maharashtra
Telangana
Odisha
Madhya Pradesh
Rajasthan
Sikkim
Bihar
Chhattisgarh
Uttarakhand
Himachal Pradesh
Jharkhand
Chandigarh
Percent_third
10
8
6
4
2
0

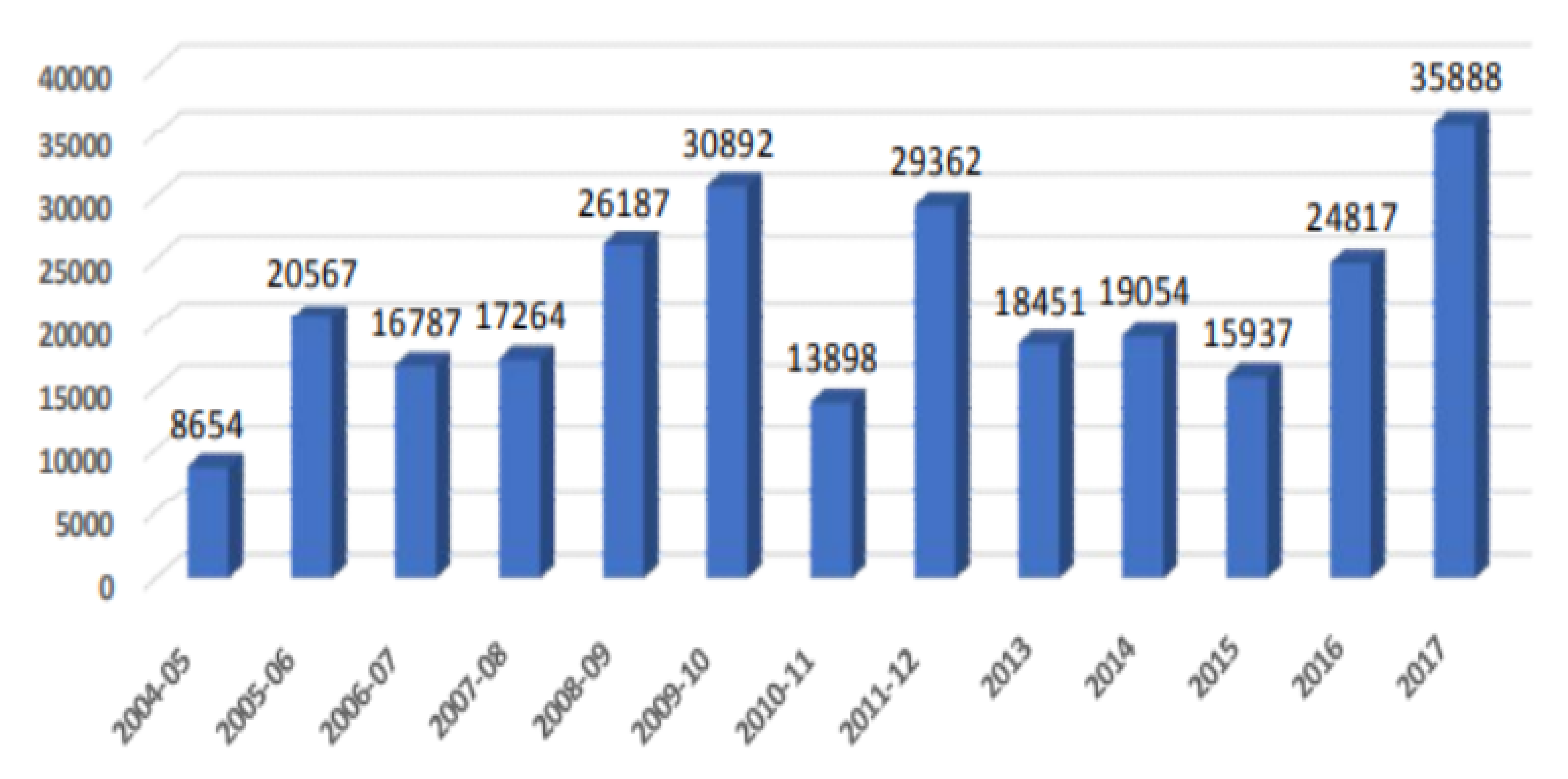


Second Year(2015-16)
Percent_second
30
20
10
0
Chandigarh
Uttarakhand
Bihar
Himachal Pradesh
Manipur
Lakshadweep
Assam
Andhra Pradesh
Mizoram
Tripura
Nagaland
Meghalaya
Telangana
Jharkhand
Chhattisgarh
Odisha
Karnataka
Uttar Pradesh
Madhya Pradesh
Maharashtra
Gujarat
Delhi
Arunachal Pradesh
West Bengal
Tamil Nadu
Kerala
Goa
Rajasthan
Haryana
Punjab
Puducherry
Sikkim
State/UT
Percent_second
6
4
2
0



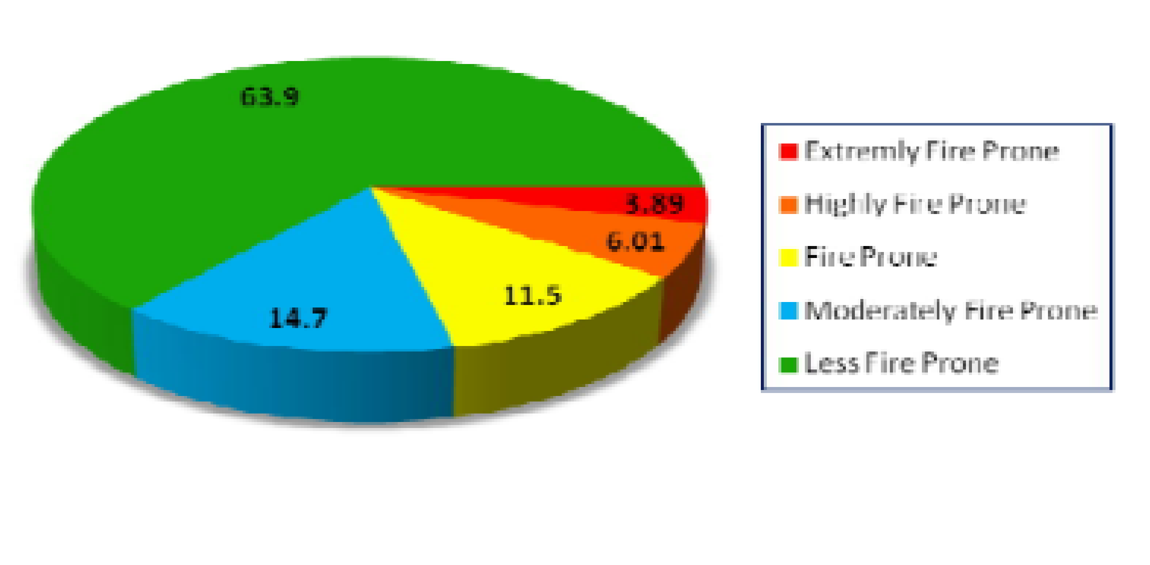
First Year(2014-15)
Percent_first
State/UT
Sikkim
Mizoram
Meghalaya
Tripura
Rajasthan
Arunachal Pradesh
Manipur
Nagaland
Lakshadweep
Puducherry
West Bengal
Assam
Telangana
Tamil Nadu
Andhra Pradesh
Jharkhand
Kerala
Odisha
Chhattisgarh
Gujarat
Maharashtra
Karnataka
Uttar Pradesh
Punjab
Bihar
Haryana
Uttarakhand
Himachal Pradesh
Madhya Pradesh
Delhi
Chandigarh
Goa

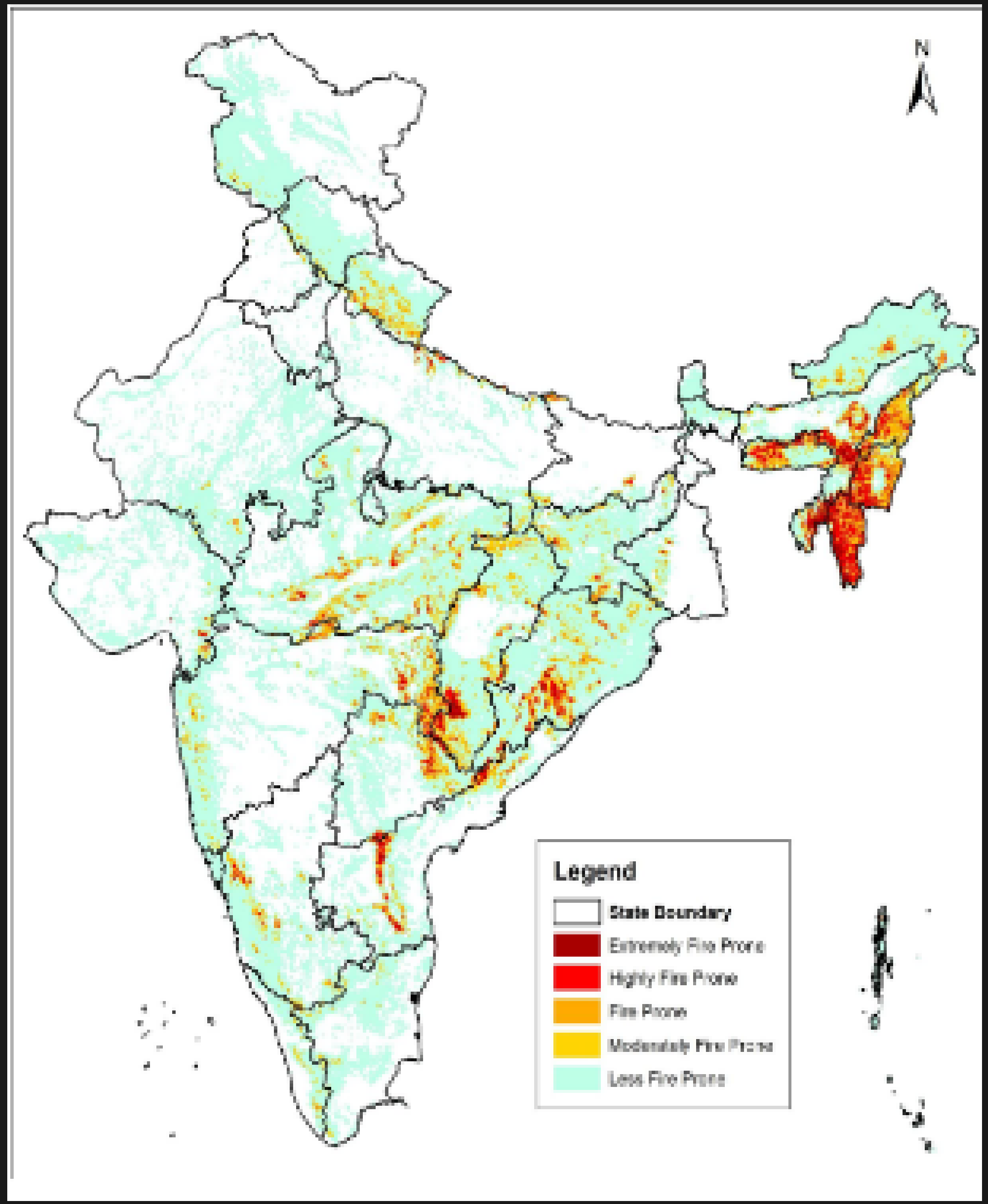
Total forest fires in the past 13 years:



Forest fire prone classes

Forest Fire prone classes	Number of grids	Forest cover(in km^2)	% of Total forest cover
Extremely fire prone	665	25,617	3.89
Highly fire prone	2259	39,500	6.01
Fire prone	3708	75,952	11.50
Moderately fire prone	5496	96,422	14.70
Less fire prone	57,489	4,20,625	63.90

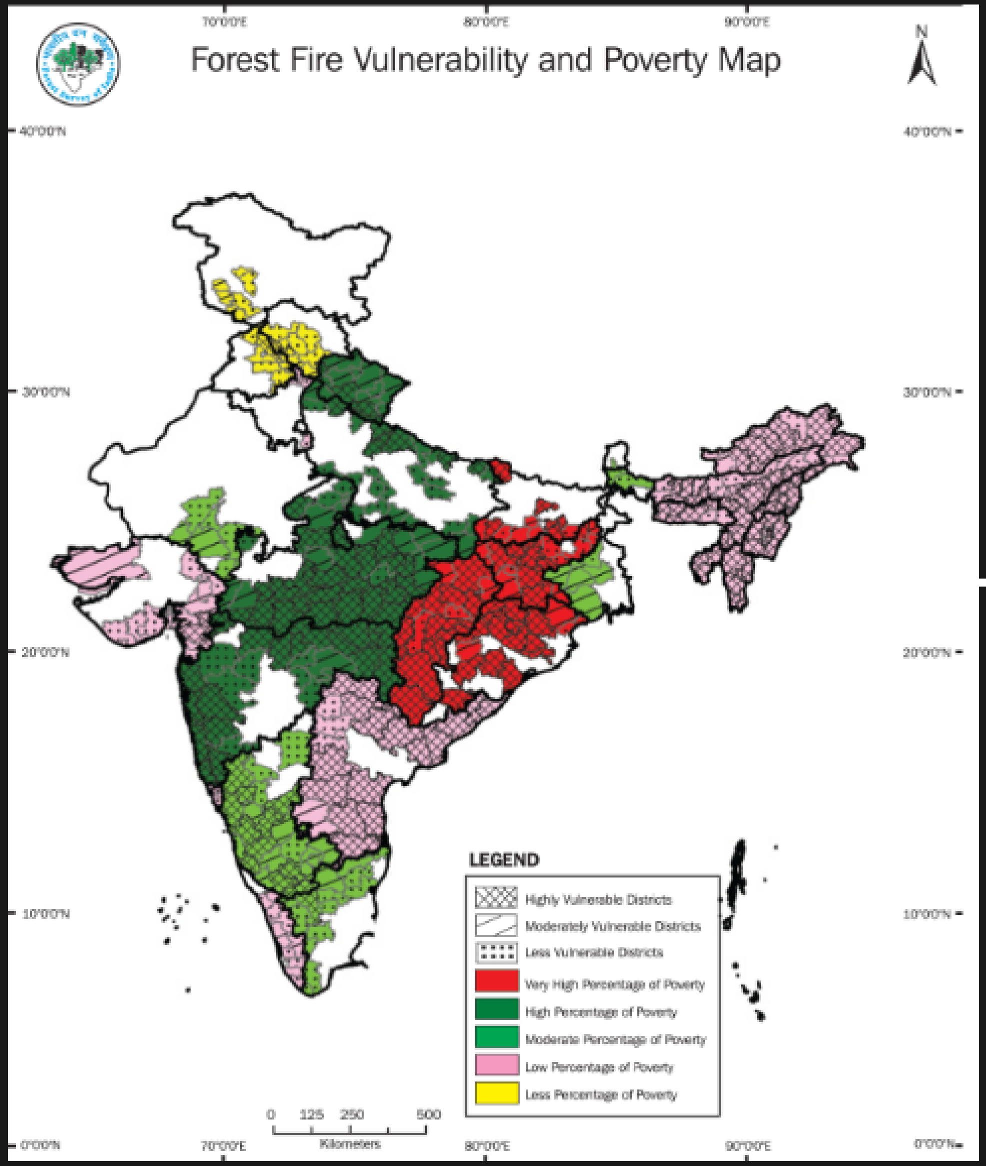




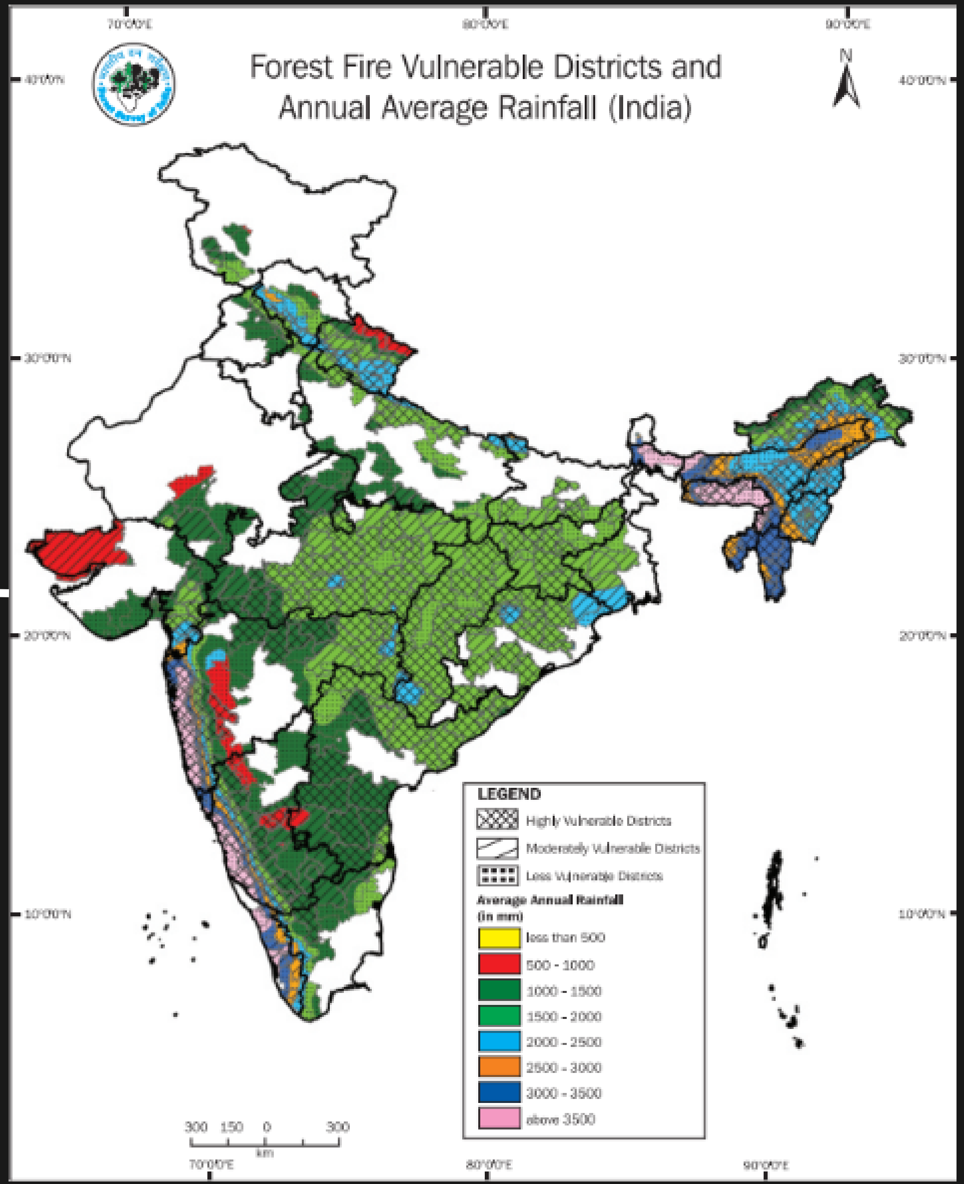
Fire vulnerable districts

- Very high vulnerable districts are in central and southern part of India, dominated by dry and moist deciduous forests
- North-eastern India is vulnerable due to socio-cultural practices - clearing forest for agriculture through burning trees
- The anthropogenic reasons behind vulnerability:
  - Biotic pressure
  - Dependency of people on forests
  - Higher temperature during summer
  - Unsuitable weather conditions
  - Poverty
  - Illiteracy

Inferences



Rainfall, poverty and forest fire vulnerability are interdependent on each other



People below the poverty line has to be overly dependent on forests for resources and any carelessness on their part easily leads to fires

Since livelihood of many people around the forests depends on forests, forest fires affect their livelihood directly, thus inflicting poverty.

Less rainfall leads to more dry forests which increases the chances of forest fires.

Smoke from wildfire affects raindrop formation in clouds, thus reducing rainfall

Initiatives

2004

Started dissemination of forest fire alerts based on MODIS data up to district level through email/FAX

2008

Initiation of SMS alerts on number of fires in State/District

2012

- Introduced KML files in email alerts up to district level along with SMS alerts
- Publication of "Vulnerability of India's forests to fires" report

2016

- Introduction of automated email alerts to nodal officers using python script
- Pilot study on country-wide burnt scar assessment for 2015 and 2016.
- Pre-warning alerts piloted for Uttarakhand, Himachal Pradesh and Madhya Pradesh

2017

- Complete automation of entire FSI Forest Fire Alert System
- SNPP-VIIRS sensor added to FSI forest fire monitoring system
- Forest Fire Alert dissemination up to beat level
- Pre-Fire Alerts piloted for pan India

2018

Introduction of improved feedback system for forest fire alerts

Simulation

Based on various inferences
from our case study,
we have developed a
2D simulation of forest fire

We used Python and
OOPS to develop the simulation

In our future work, we will be
improving the simulation by
making it more accurate.

Monitoring

We have developed a monitoring tool that maps the data collected over the previous week to the World Map

We used JavaScript and various other packages to develop it.

Impacts on biodiversity

1

Global scale

They are a significant source of emitted carbon, contributing to global warming which could lead to biodiversity changes.

2

Regional Scale

Changes biomass stocks, alters the hydrological cycle with subsequent effects for marine systems such as coral reefs, and impact plant and animal species' functioning.

3

Pyrophytic Conversion

In tropical forests, dead trees topple to the ground, opening up the forest to drying by sunlight, and building up the fuel load with an increase in fire-prone species, such as pyrophytic grasses which makes them susceptible to further burns.

4

Effect on Flora

Fire can kill virtually all seedlings, sprouts, lianas and young trees because they are not protected by thick bark which hinders recovery of the original species, in forests not adapted to fires

5

Effect on Fauna

Large scale death of forest vertebrates and invertebrates, as well as longer-term indirect effects such as stress and loss of habitat, territories, shelter and food which slows recovery rate of the forest.

6

Photosynthetic Activity

Smoke from fires can block of sunlight and significantly impact photosynthesis, which can be detrimental to health of humans and animals.

How fires affect biodiversity of aquatic ecosystems and water quality?

- Fires increase runoff, erosion and nutrient transport in the boundaries of aquatic habitats, reduce macrophyte vegetation and thus increase insolation and water temperature. Water turbidity, conductance, C, N and P concentrations also change, and dissolved O2 is reduced. Ashes in high concentration can kill native fish and be toxic to invertebrates depending on their chemical composition.

How does fire affect wildlife?

- Fire effects on animals can be direct/immediate (e.g., death, harm), indirect (e.g., changing habitat and food sources), or, in the long-term, induce animal evolutionary responses to fire regimes. Animals from non-flammable ecosystems are usually much affected by wildfires, while those (some endemic) of fire-prone ecosystems are adapted or may even need fire to survive because of the ecological cascade associated with post-fire ecosystem regeneration.

Effects of fire on soil properties and soil organic matter

- Depending on the characteristics of soil, vegetation and fire effects on soil properties may vary substantially, from fertilization of the top layers due to ash deposition (which adds cations and balances pH) to changes in soil aggregate stability, pore size and distribution, water repellency, nutrients stocks and availability, and soil biota, thus influencing soil functions and ecosystem services.

Fire and grazing

- In grassy ecosystems, fire and grazers interact in positive-and-negative feedback. After burning, grasses quickly resprout, offering palatable and nutritious tissues that attract herbivores, which thus concentrate grazing in these burned patches and reduce biomass and fire risk. Less-grazed patches, with more biomass, will eventually burn, thus creating a mosaic of grazed and ungrazed patches that control fires at the landscape level. Such spatio-temporal mosaic of burned and unburned patches favors fire-dependent species, and also maintains species that are more sensitive to fire, being thus positive in terms of biodiversity conservation.

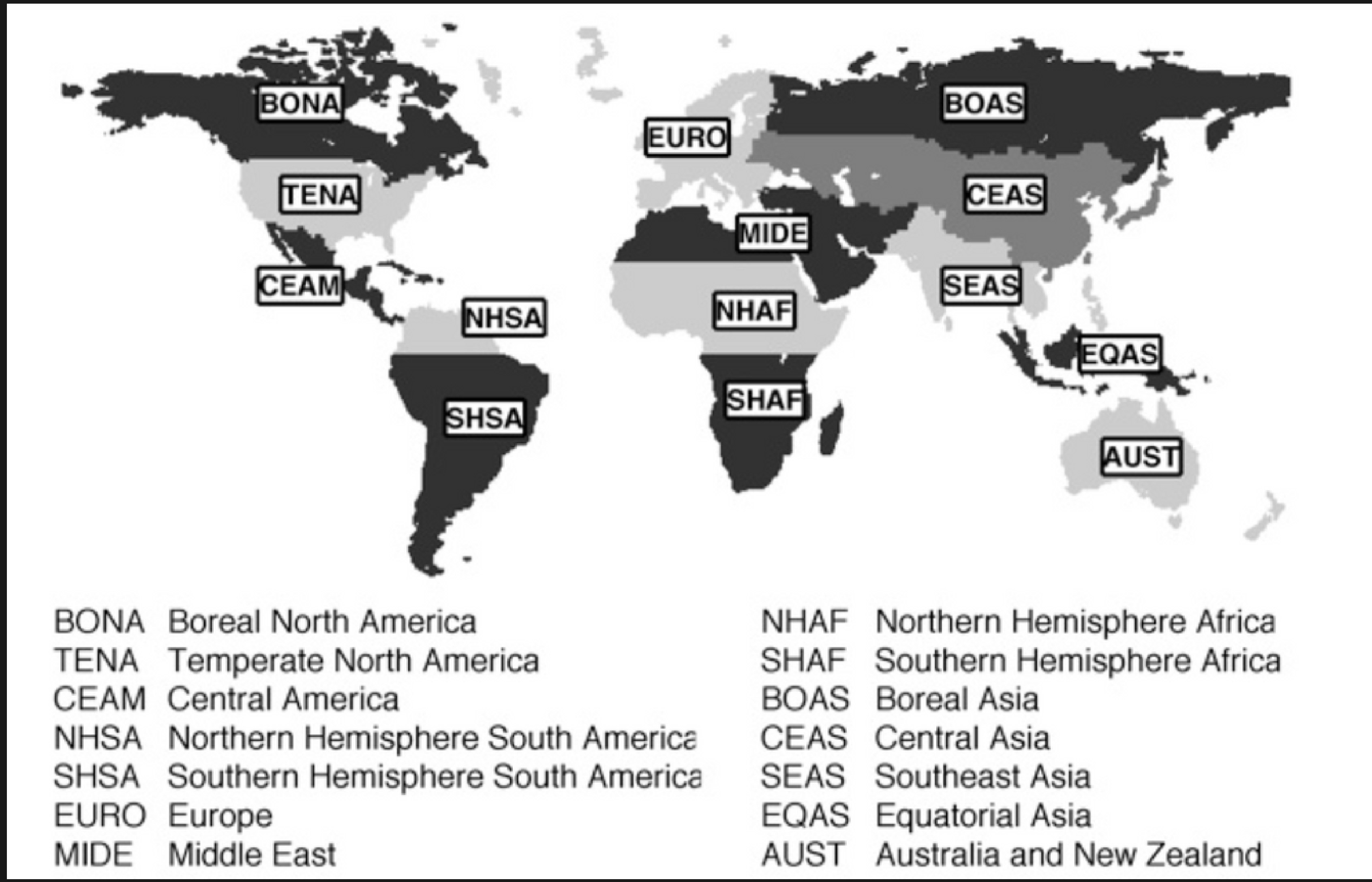
Global Emissions from Forest Fires

About the dataset

Global Fire Emissions data
https://geo.vu.nl/~gwerf/GFED/GFED4/tables/

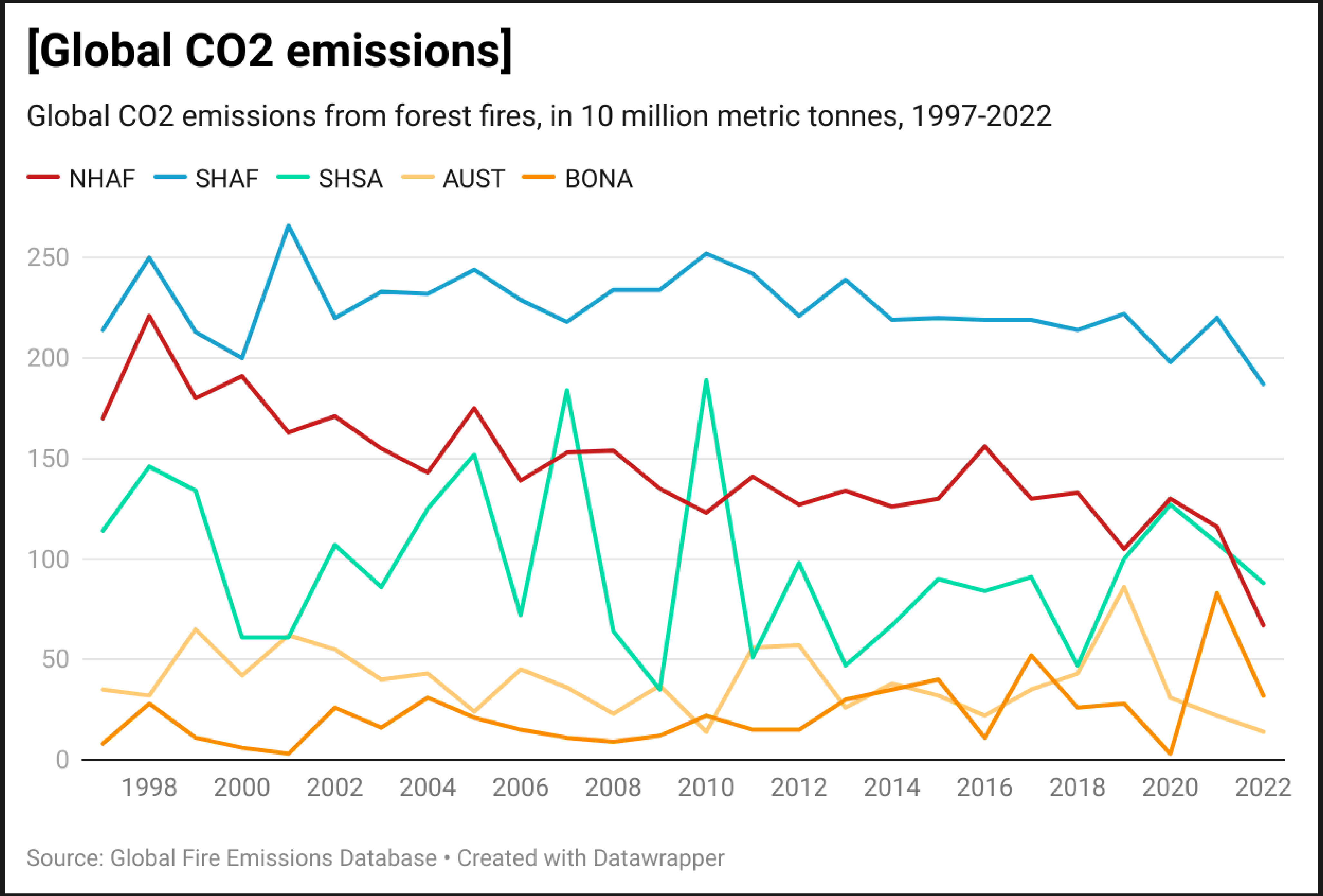
Features:

- Verified dataset split according to 14 main regions
- Contains all major emissions
- Contains relevant data from 1997-2022
- Emissions split among different fire types:
  - Savanna, grassland, and shrubland fires
  - Boreal forest fires
  - Temperate forest fires
  - Tropical deforestation & degradation
  - Peat fires
  - Agricultural waste burning



Regional CO2 emissions

We select the 5 regions with the highest level of forest fire activity and plot their emissions over the years through an overlaid line graph.



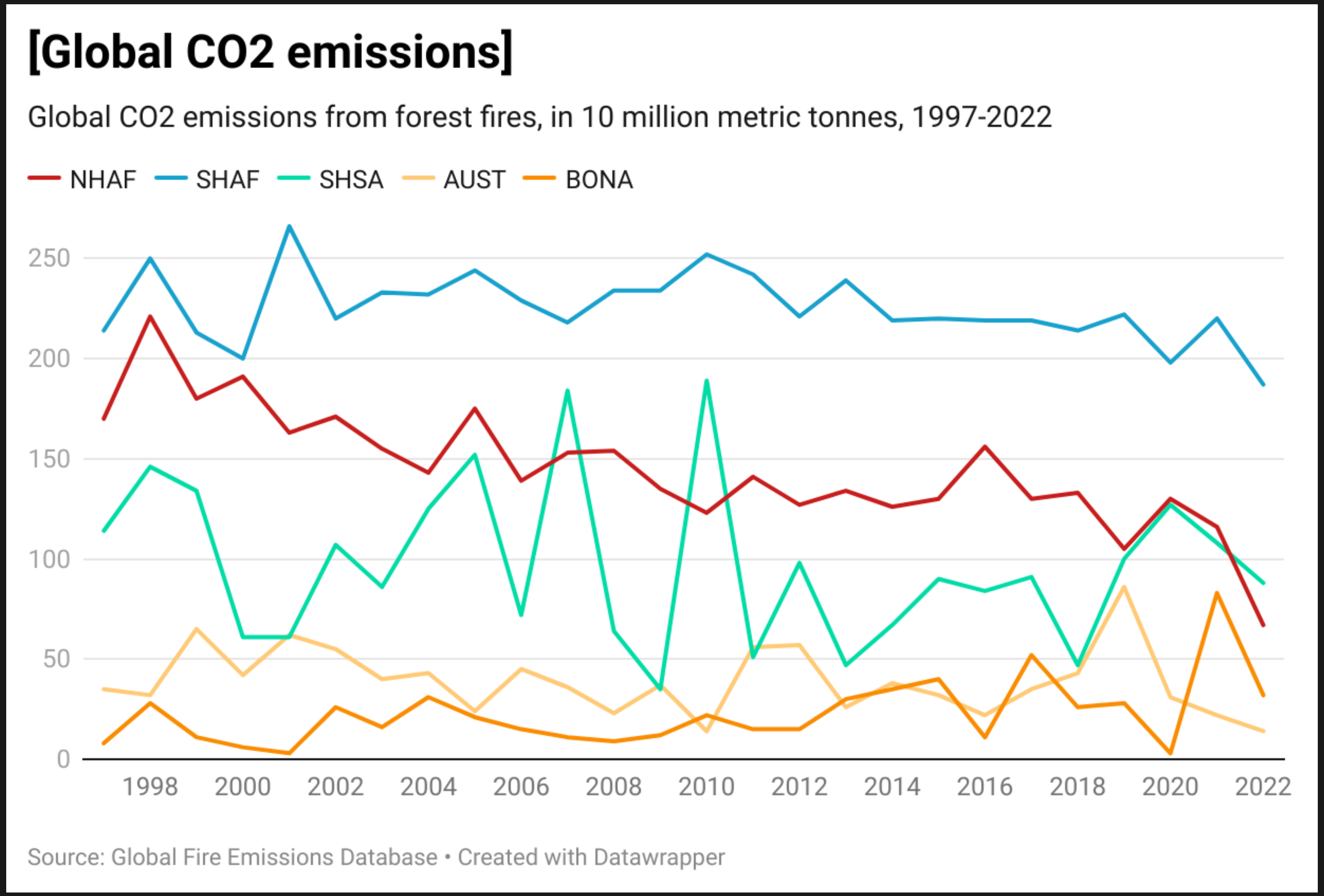
Analysis

Regional Trends:

- The largest fires occur in lower latitudes
- Decreasing fires in NHAF and SHAF
- Increasing fires in AUST and BONA

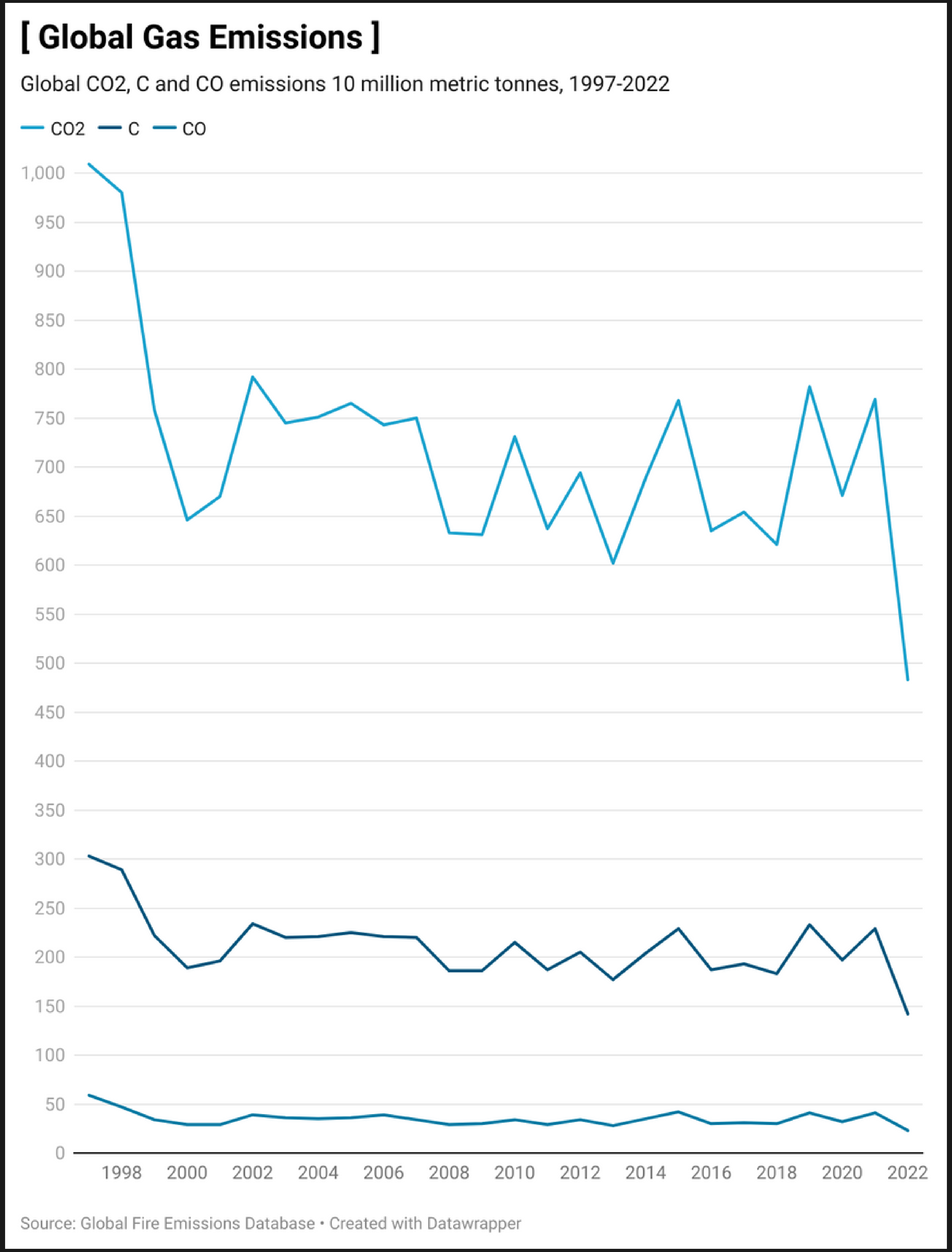
Reasoning:

- Lower latitudes with higher temperatures facilitate larger and longer fires
- Decreasing fires: High precipitation, decrease in vegetation coverage and human intervention
- Increasing fires: Rising temperature in those areas due to climate change.



Global Overall Emissions

We select the most prominent emissions of forest fires and plot their global emissions in comparison.



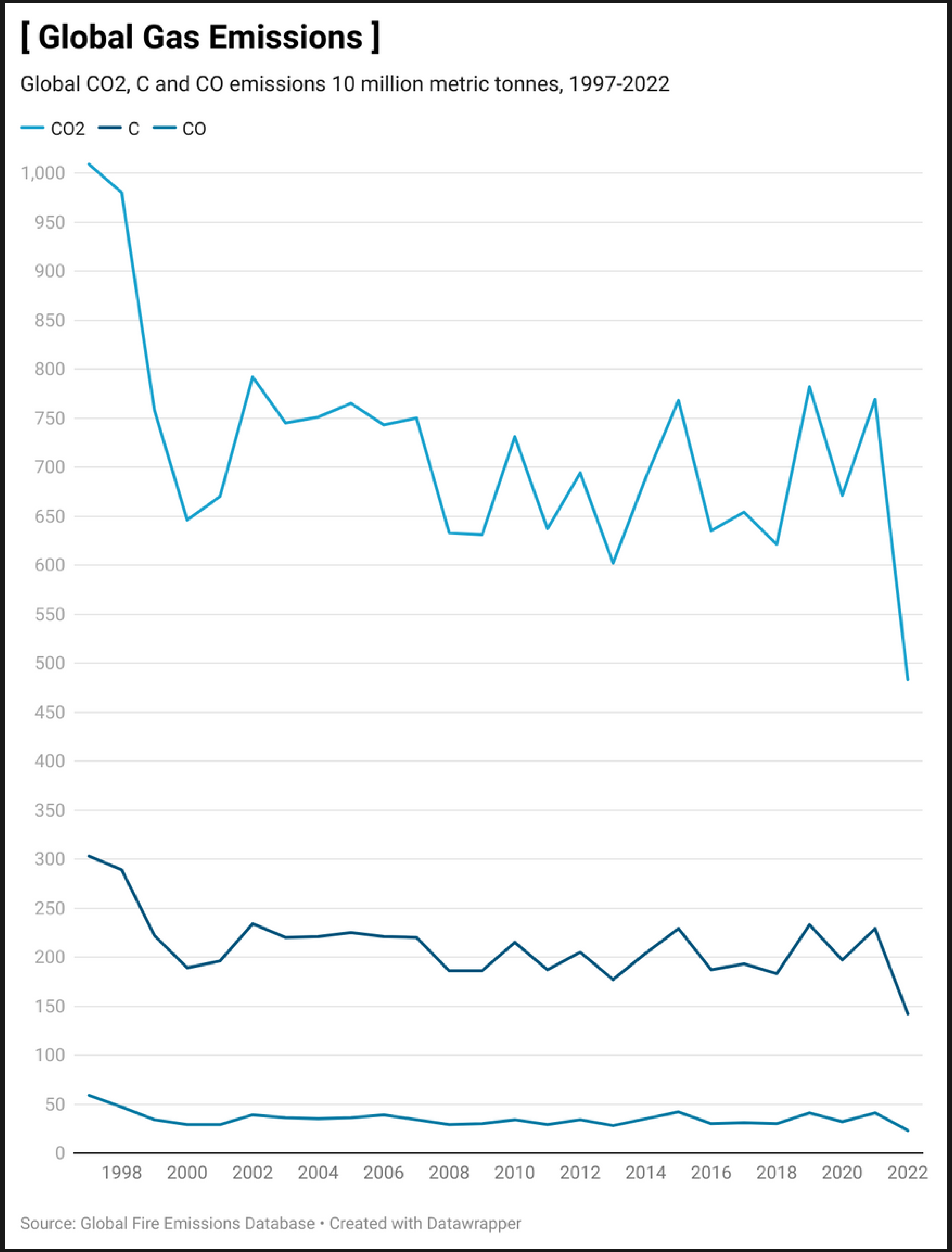
Analysis

Global trends:

- As time passes there are peaks and troughs in emissions due to forest fires.
- CO2 is the largest emitted by a decent margin followed by C and CO.
- The general trend of average emissions is mostly stagnant.

Reasoning:

- Fire size, spread, duration and speed are factors that largely influence fires and cause peaks and troughs.

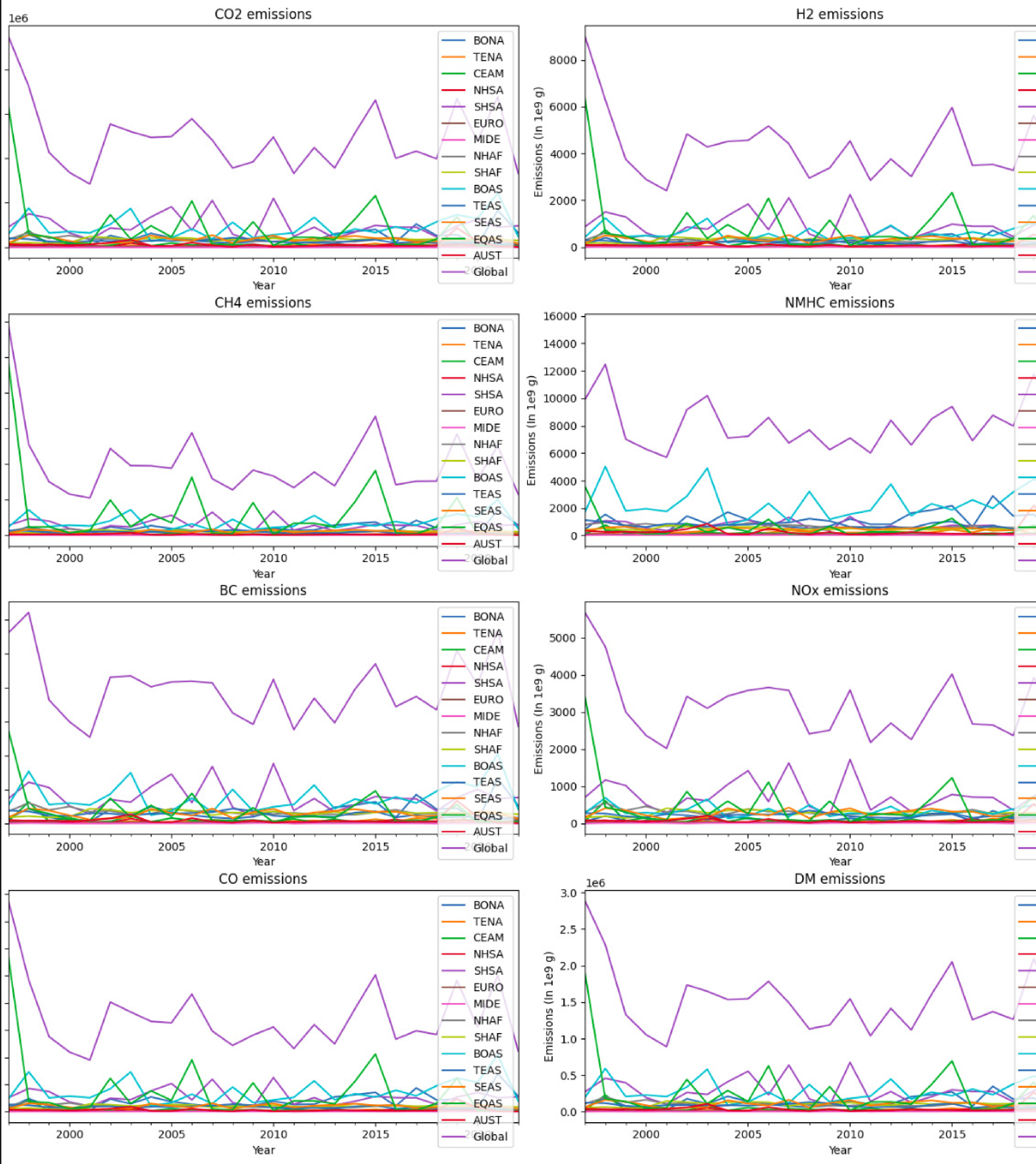


Processing the Data

- Data initially stored in difficult to use txt formats
- Data is processed such that any insignificant fire types can be reduced from the overall emissions
- Any desirable emissions can be selected easily for analysis
- Data converted to dataframes with high utility for graphing and prediction models

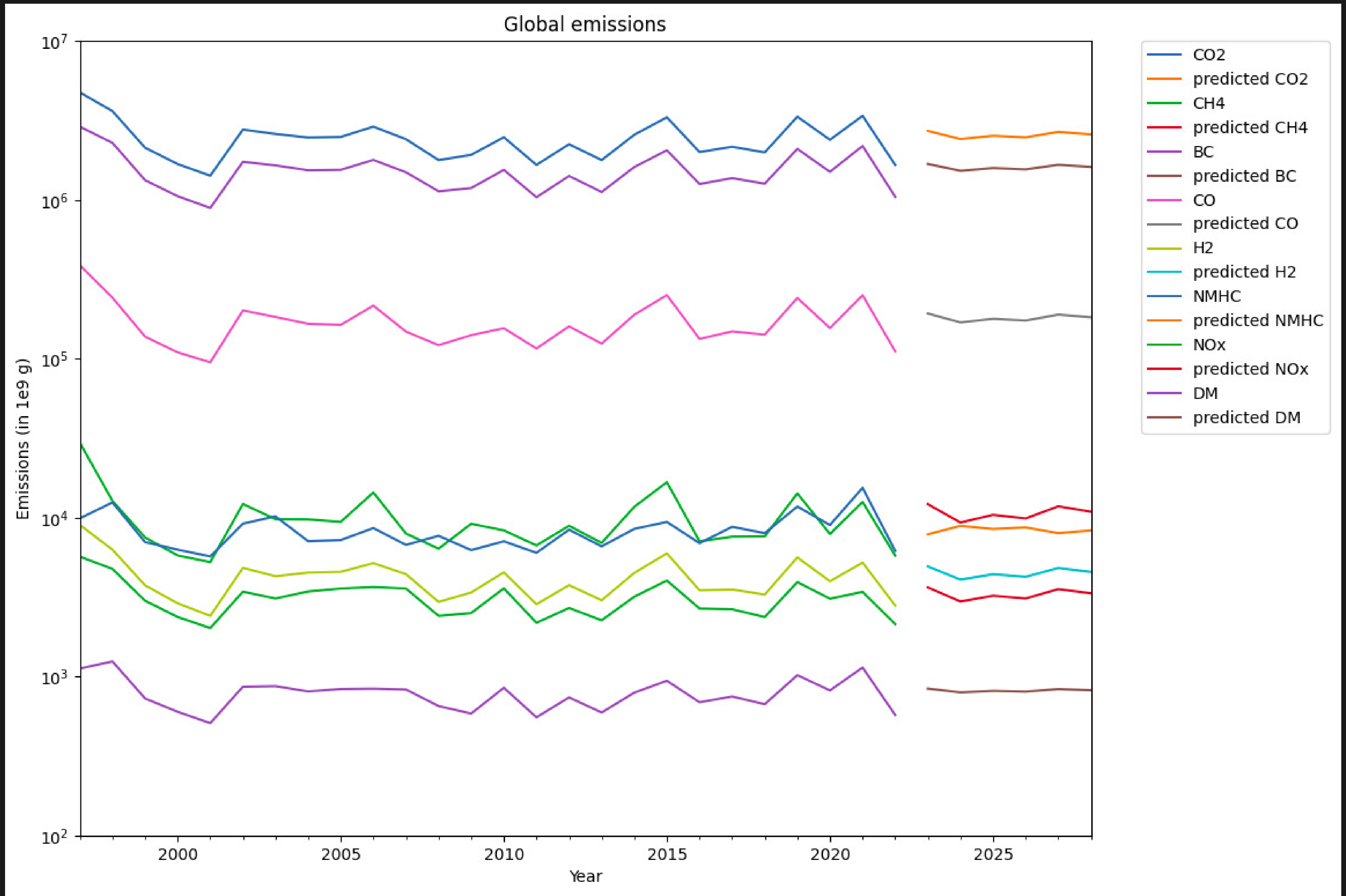
Regional Emissions

- Extending the regions to all regions and selecting 8 different emissions commonly released supports our previous analysis



Emissions prediction Model

- A Linear Regression Model was chosen since it predicts future discrete values based on independent variables
- A Logistic Regression Model was considered but since it classifies future points, it was avoided as information would be too vague
- The model supports our hypothesis that general trend in emissions is mostly stagnant



Economic Impacts: Some Stats

The costliest wildfire in U.S. history, 2018's Camp Fire, resulted in a loss of about $10 billion at the time.

Each additional day of exposure to smoke from a wildfire lowers a community's wages by around 0.04%.

In Nepal, property values in areas which get affected by severe forest fires annually decreased by 4.48% over the years.

Tourism is badly affected.

Heavy infrastructure damages are incurred

Forest Fire control efforts require significant expenditure

Forest fires result in high death tolls affecting families socio-economically as well as medically

Plan of Action

- Zero Fire Policy is a wasted effort

  Prescribed burning is suggested.

- Prevention is better than cure

  Prediction Models and Monitoring tools should be developed and used.

- Simulative Analysis and Scientific literature review

  Analysis should be done using various simulations and scientific literature and existing practices should be timely reviewed.

- Ecosystem Restoration

  Post fire recovery programmes should be implemented.

- Law Enforcement

  Prevent and combat illegal fires.

- Collaboration among stakeholders

  Various executive bodies and organizations as well as local bodies should work in full collaborative effort.

Future Work

01

Prediction Model

02

Specific Analysis on Boreal Forests

03

Improving Simulation

04

Populate Monitoring Tool with more data

Work Distribution

Harshita

- Case Study on Brazil
- Impacts on Biodiversity

Khush

- Website & monitoring tool
- Plan of Action

Rohan

- Economic Impacts
- Dataset Creation for other analysis

Siddharth

- Case Study on Portugal
- Simulation

Janardan

- Case Study on India
- Paper Reading for Simulation dependencies

Naimeesh

- Case Study on Canada
- Plan of Action

Joel

- Global emissions from forest fires
- Presentation Making

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- https://www.bioversityinternational.org/e-library/publications/detail/training-manual-on-spatial-analysis-of-plant-diversity-and-distribution/
- https://aqicn.org/data-platform/register/

Thank you!