Global, ASEAN and Thailand Forest Fire, Smoke and Haze

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Disasters: Natural vs Man Made

• What are differences?
  • **Caused by nature**, and men have no control over them. **Can only be minimized the effects!!** e.g. earthquakes, tsunamis, storms (hurricanes/typhoons), storm surge, droughts, volcanic eruptions, floods, wildfires, landslides, etc.
  • **Caused by human beings.  Might be able to avoid if carefully plan!!** e.g. hazardous material spills, explosions, chemical or biological attacks, nuclear blasts, wars, terrorist, etc.

• What are these then?
  • Floods, wildfires, smoke and haze, drought, landslides, glaciers melting

Climate Change/Crisis and Extreme Events

The #StateofClimate in 2015-2019, the hottest 5 year period on record;

- Extreme Weather
- Sea Level Rise
- Ocean Temp and Acidity
- Greenhouse Gases
- Sea Ice, Glaciers
- Storms, High Intensity Rainfalls and Floods
- Land Temp, Heat Waves, Drought and Megafires

Source: https://t.co/p4VyVinasl
2019 Concludes A Decade Of Exceptional Global Heat And High-Impact Weather

Disaster Information Technology and Management by Copernicus Program

1. https://confluence.ecmwf.int/display/FCST/Severe+Event+Catalogue
2. https://cds.climate.copernicus.eu/#!/home
5. https://www.ai4copernicus.org/
Severe Event Catalogue

Created by Florian Pappenberger, last modified by Linus Magnusson on Aug 27, 2019

On this space we collect material for evaluation of severe/extreme weather events. The focus is on the meteorological conditions and the forecast performance. The amount of material differs from case to case, and we are not claiming to give the full picture of the cases here. Users are welcome to contribute with material for the cases by using the comment function in the bottom of each page. To suggest a new case to evaluate, please contact us at the email address given below. If you have any initial comments and material, please include them in the mail.

Contact email address  servicedesk@ecmwf.int

(Please note that some of the links on the pages are only accessible from ECMWF.)
Trying to understand extreme events, to be more ready to face them.

- 201809 - Tropical cyclone - Florence
- 201809 - Tropical Cyclone - JEBI
- 201809 - Tropical Cyclone - Mangkhut
- 201809 - Windstorm - Bronagh / Knud / I
- 201810 - Rainfall/Windstorm - Italy
- 201810 - Rainfall - Calabria
- 201810 - Rainfall - France
- 201810 - Rainfall - Spain
- 201810 - Tropical cyclone - Leslie
- 201810 - Tropical cyclone - Michael
- **201812 - Rainfall - Sri Lanka**

- 2019
- Calibration
- Chart dashboard
- IFS blacklist information for conventional obs
- New wave parameters introduced in CY46R1
Copernicus Program: https://cds.climate.copernicus.eu/#!/home
Global Forest Fire Situation,
2019 Was The Year The World Burned

“Wildfires burned around the world this year from Australia, the Amazon, California, Russia and Indonesia. These forest blazes are part of nature but climate change is making them more frequent and more intense”.
By Laura Paddison

“This is not an isolated event,” Julien Jreissati, a campaigner at Greenpeace Lebanon, told The Ecologist, “as 2019 has been a year of unprecedented forest fires from Siberia to the Amazon, from the Canary Island to Indonesia, sending clear signals that our planet is burning and it is time to act like it.”

Source: https://www.huffpost.com/entry/wildfires-california-amazon-indonesia-climate-change_n_5dcd3f4ee4b0d43931d01baf
In 2019, Main Wildfires Happened Around The World

**Africa:** Canary Islands wildfires-Spain

**Asia:** Bandipur forest fires-India, Goseong Fire of 2019-South Korea, Siberia wildfires-Russia, Vietnam forest fires, Sumatra Island-Indonesia, A series of wildfires contributed to the Southeast Asian haze in 2019.

**Europe:** United Kingdom wildfires,

**North America:** Deshka Landing Fire-Alaska-USA, Alberta wildfires-Canada, California wildfires-USA, Washington wildfires-USA,

**Greenland:** July-August wildfire between Sisimiut and Kangerlussuaq at Kangerluarsuk Tulleq

**Oceania:** Australian bushfire, Nelson fires-New Zealand

**South America:** Amazon wildfires

Past and Current Fire Regime

![Maps showing past and current fire regime](image)

**Figure X:** Distributions of satellite-derived emissions of smoke total particulate matter (TPM) or particulate matter of 2.5 μm or less aerodynamic diameter (PM2.5) from different major global fire emissions datasets, namely: GFED v4.1s, IS4FIRES_v2.0, FINN_v1.6-MOZA, GFAS_v1.2, FEER_v1.0-G1.2, FLAMBE-ARCTAS, QFED_v2.5r1. Left column: July 1-7, 2016

Source: Draft of Active Fire by the Global Observation of Forest Cover/Global Observation of Landcover Dynamics (GOFC/GOLD) Fire Programme, March 2019.
Past and Current Fire Regime

Figure 1. Global landscape fire geographic distribution and radiative ‘strength’, as derived from satellite Earth observation active fire (AF) remote sensing approaches.

Source: Draft of Active Fire by the Global Observation of Forest Cover/Global Observation of Landcover Dynamics (GOFC/GOLD) Fire Programme, March 2019.
Australian Fires on 31 Dec 2019

Source: Mark Parrington, ECMWF-CAMS

Source: https://atmosphere.copernicus.eu/charts/cams/

Source: https://worldview.earthdata.nasa.gov/
Australian Fires until 31 Dec 2019

CAMS Daily Total Fire Radiative Power (GFASv1.2) for Western Australia

Source: @m_parrington, ECMWF-CAMS
Australian Fires until 31 Dec 2019

Source: @m_parrington, ECMWF-CAMS
Fire carbon emissions for #AustraliaBushfires based on our Global Fire Emissions Database showing the massive anomaly mostly in NSW. Global Fire Assimilation System (@m_parrington) has lower estimates for 2019 emissions for NSW: more work needed to get more precise numbers by Guido van der Werf, @GuidovanderWerf
Total column CO on 2 January 2020

TROPOMI

IASI Metop-C

Unit: $10^{18}$ molec/cm$^2$

Source: @CopernicusECMWF, @@AntjElness
Annual rainfall anomaly
Australia (1900 to 2019)

Australian Bureau of Meteorology

Australia Is Committing Climate Suicide As record fires rage, the country’s leaders seem intent on sending it to its doom.

By Richard Flanagan, Jan. 3, 2020

The fires have already burned about 14.5 million acres — an area almost as large as West Virginia, more than triple the area destroyed by the 2018 fires in California and six times the size of the 2019 fires in Amazonia. Canberra’s air on New Year’s Day was the most polluted in the world partly because of a plume of fire smoke as wide as Europe. Scientists estimate that close to half a billion native animals have been killed and fear that some species of animals and plants may have been wiped out completely. Surviving animals are abandoning their young in what is described as mass “starvation events.” At least 18 people are dead and grave fears are held about many more.

Source: https://www.nytimes.com/2020/01/03/opinion/australia-fires-climate-change.html#click=https://t.co/2o7Rl5aw3t
Northern Thailand/SEA Forest Fire, Smoke and Haze Situation
Northern Thailand 2019

Source: http://www.tmd.go.th/

Source: Tiramonkong, June 2019
PM10 & PM 2.5 9 Provinces Northern Thailand JAN-MAY 2019 by PCD

Source: Tiramongkong, June 2019
NASA Micro-Pulse Lidar Network


Photos from the plane

Source: https://mplnet.gsfc.nasa.gov/
By Dr. Mark Parrington, (mark.parrington@ecmwf.int) and Dr. Claudia Vitolo (claudia.vitolo@ecmwf.int),
R-Code for this matter is in the custom made process for Thailand and Upper ASEAN daily operation!!!!!!

Copernicus Atmosphere Monitoring Service (CAMS), Global Fire Assimilation System (GFAS), The European Centre for Medium-Range Weather Forecasts (ECMWF)
http://atmosphere.copernicus.eu/about-cams
Gray is Max & Min in 16 Years. Black is Mean of 16 Years. Red is 2019 data.

Source: @m_parrington, ECMWF-CAMS
Gray is Max & Min in 16 Years. Black is Mean of 16 Years. Red is 2019 data.

Source: @m_parrington, ECMWF-CAMS
FIRE REPORT

VIEW FIRE STATISTICS FOR ANY COUNTRY

Source: https://fires.globalforestwatch.org/home/
GREATEST NUMBER OF FIRE ALERTS BY DISTRICT
1 MAR 2019 - 31 MAR 2019

GREATEST NUMBER OF FIRE ALERTS BY PROVINCE
1 MAR 2019 - 31 MAR 2019

FIRE HISTORY: FIRE SEASON PROGRESSION
2019 MODIS Fire Alerts, Year to Date 29,193

Fire history analyses use MODIS fires data only for 2001 to present.

Source: https://fires.globalforestwatch.org/map/
January's Carbon Emissions from Wildland Fires 2018 VS 2019

CAMS GFASv1.2 total wildfire carbon emissions for January 2018

CAMS Total Wildfire Carbon Emissions (GFASv1.2): January 2019
February's Carbon Emissions from Wildland Fires 2018 VS 2019
March's Carbon Emissions from Wildland Fires 2018 VS 2019

CAMS GFASv1.2 total wildfire carbon emissions for March 2018

CAMS Total Wildfire Carbon Emissions (GFASv1.2): March 2019
April's Carbon Emissions from Wildland Fires 2018 VS 2019

CAMS GFASv1.2 total wildfire carbon emissions for April 2018

CAMS Total Wildfire Carbon Emissions (GFASv1.2): April 2019
Carbon Emission by Mark Parrington CAMS-ECMWF

Jan-April's Carbon Emissions from Wildland Fires 2018 VS 2019

CAMS GFASv1.2 total wildfire carbon emissions for January-April 2018

CAMS Total Wildfire Carbon Emissions (GFASv1.2): January-April 2019
Current R-Code provided by Claudia (CAMS) can run country by country with month by month Carbon Emission data from CAMS-GFAS.

```r
# install.packages(c("raster", "mapview"))
setwd("<ADD_HERE_PATH_TO_FOLDER_CONTAINING_NETCDF_FILES>")
library("raster")
library("mapview")

country <- raster::getData(name = "GADM", country = "Thailand", level = 0)

# Load the climatology

gfas_data_mean <- brick("gfas_0001_cfire_climatology_2003_2018.nc",
                           varname = "gfas_data_mean")
labels_clima <- substr(names(gfas_data_mean), 7, 11)
clima_area <- raster::area(gfas_data_mean) * 1000000 # in m2
clima <- gfas_data_mean * clima_area
clima <- mask(clima, country)

# Load current emissions

current_emissions <- brick("201904_Wildfire_overall_flux_of_burnt_Carbon.nc")
labels_current <- substr(names(current_emissions), 7, 11)
current_area <- raster::area(current_emissions) * 1000000 # in m2
current <- raster::mask(current_emissions * current_area, aoi)
current <- mask(current, country)

# Find indices in common
idx <- which(labels_clima %in% labels_current)

# Compute sum over the area
clima_sum <- cellStats(clima[[idx]], sum) * 86400 * 1E-9
current_sum <- cellStats(current, sum) * 86400 * 1E-9

# Grouped Bar Plot

df <- t(as.matrix(data.frame(climatology = clima_sum, current = current_sum)))
colnames(df) <- as.character(as.Date(idx, origin = "2019-01-01"))
barplot(df,
        main="Wildfire overall flux of burnt Carbon",
        xlab="", ylab="Megatones per day",
        col=c("darkgrey", "darkred"),
        legend = rownames(df),
        beside=TRUE, las = 2, border = NA)

# Create a map of emissions for the first day of the month
Emissions <- current[[1]]
mapview(Emissions, alpha.regions = 0.3)
```

Current R-Code provided by Claudia (CAMS) can run country by country with month by month Carbon Emission data from CAMS-GFAS
By Dr. Mark Parrington, (mark.parrington@ecmwf.int) and Dr. Claudia Vitolo (claudia.vitolo@ecmwf.int),
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Copernicus Atmosphere Monitoring Service (CAMS), Global Fire Assimilation System (GFAS), The European Centre for Medium-Range Weather Forecasts (ECMWF)

http://atmosphere.copernicus.eu/about-cams

Copernicus Program: https://atmosphere.copernicus.eu/charts/cams/CAMS

Filters

No filters applied

Forecasts

12 matching items

Family

- Aerosols (2)
- Fires (1)
- Greenhouse gases (2)
- Reactive gases (5)
- Solar radiation (1)

Analyses

Fire activity analyses
- For Thailand, from Jan-Apr 2019's carbon emission from active fires were not above the average 16 years (2003-2018), but the second half of Apr values were right at the average.
- Cambodia burned the most and more in Jan 2019 than 2018.
- Pattern changed in Feb where Lao PDR showed more fire activities.
- Pattern also changed in Mar where Lao PDR burned more throughout the country.
- Pattern also changed in Apr where Lao PDR burned less and Myanmar burned more.
- For the whole Upper ASEAN, there were more carbon emission in 2019 than 2018.
Upper ASEAN Carbon Emission From Fires

Since 1997 until 31st October 2019 of Upper ASEAN and by each country which are Thailand, Lao PDR, Myanmar, Cambodia and Vietnam kindly provided by Prof. Dr. Guido van der Werf (@GuidovanderWerf & http://globalfiredata.org/analysis.html).
Vietnam

Fire carbon emissions (Tg C year$^{-1}$)

Year

Source: @GuidovanderWerf
Source: @GuidovanderWerf
Fire carbon emissions (Tg C year\(^{-1}\))

Source: @GuidovanderWerf
Thailand

Fire carbon emissions (Tg C year⁻¹)

Year


15 25 21 25 25
14 12 15 17 14
10 12 11 13 8
12 21 11 12 7
15 11 11 14 13
15 15 17 22 13

Up to October 31

Source: @GuidovanderWerf
Source: @GuidovanderWerf
Global Fire Emissions Database

Fires are an important source of atmospheric trace gases and aerosols and they are the most important disturbance agent on a global scale. In addition, deforestation and tropical peatland fires and areas that see an increase in the frequency of fires add to the build-up of atmospheric CO₂.

We have combined satellite information on fire activity and vegetation productivity to estimate gridded monthly burned area and fire emissions, as well as scalars that can be used to calculate higher temporal resolution emissions. Most of the resulting datasets are downloadable from this website for use in large-scale atmospheric and biogeochemical studies. The core datasets are:

Source: https://www.globalfiredata.org/
FIRECAM: Fire Inventories - Regional Evaluation, Comparison, and Metrics

[Source: https://github.com/tianjialiu/FIRECAM/]

<table>
<thead>
<tr>
<th>Branch: master</th>
<th>New pull request</th>
<th>Find file</th>
<th>Clone or download</th>
</tr>
</thead>
</table>

- **tianjialiu** added SMOKE-FIRECAM Tool code
  - Latest commit: e3dbf56 on Oct 8
  - docs/imgs: add SMOKE-FIRECAM Tool code
  - fire_inv: update FIRECAM emissions, code; chart aesthetics in apps
  - fire_metrics: fix typo on GMTED resolution
  - gee_public: add SMOKE-FIRECAM Tool code
  - LICENSE: add files
  - README.md: add SMOKE-FIRECAM Tool code

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**FIRECAM**

Source: https://github.com/tianjialiu/FIRECAM/
Source: https://globalfires.earthengine.app/view/gfedv4s
Indonesia

Monthly Fire Emissions

Source: https://globalfires.earthengine.app/view/gfedv4s
Indonesia

Source: https://globalfires.earthengine.app/view/gfedv4s
CAMS 1 Aug - 22 Sept Wildfire CO₂ Emissions (GFASv1.2) for Indonesia

CAMS Daily Wildfire CO₂ Emissions (GFASv1.2) for Sumatera

Source: Mark Parrington, ECMWF-CAMS

Source: https://twitter.com/m_parrington/status/1196885990968897537

Source: @m_parrington, ECMWF-CAMS
Impacts of Wildfires on Air Quality and Health

1. Understanding Fire Behavior and Forecasting Smoke Movement and Impacts
2. Monitoring and Measuring Smoke Impacts
3. Prediction, Prevention, Assessment & Control of Health Impacts of Wildfire Smoke
4. Collaboration and Communication

Source: https://www.awma.org/wildfires
Our land is burning, and western science does not have all the answers

By David Bowman, Professor of Pyrogeography and Fire Science, University of Tasmania and Ben J. French, PhD student in Environmental Change Biology, University of Tasmania

Source: https://www.preventionweb.net/news/view/69051?&a=email&utm_source=pw_email

“There are profound cultural differences between traditional and modern fire management, stemming from different understanding of belonging, place, history, values and metaphysics.

The growing fire crisis means it’s vital western science and Aboriginal knowledge are brought together to make communities as fire-safe as possible”. 
Toward Fire Weather Understanding in Thailand

15 minutes. 1 person. No tools.

The FTS Quick Deploy portable weather station is the fire community's most widely used weather station for prescribed burns and temporary monitoring applications.

The last GOES and GPS antenna you'll ever need.

The EONX2 Q2 requires no assembly, and no aiming in most locations. Rugged by design, it is completely sealed for marine environments and dome-shaped for superior ice/snow shielding. Smaller, lighter and more durable than a Yagi.

Key Features:
- Increased readability
- No assembly
- Lasts longer (better investment than Yagi)
- Does not need aiming in most locations
- Optional alignable mount available if aiming required
- Cabinet top tilting eliminates exposed wiring
- Extremely rugged
- Optional integrated GPS antenna available
- Optional alignable mount (if required)

Real-time weather conditions on demand.

The optional ARtalk gives you mobility by allowing you to call in to the QD via any DTMF capable voice radio for current weather conditions.
- Allows multiple access codes for different sets of weather information—get only the data you need, based on the inquiry code sent.
- Minimizes air time, zeros radio power and improves safety by conserving air time for others.
- Instant voice alerts of exceeded weather parameter thresholds provide real-time decision-making, maximizing firefighter and public safety.
Take Home Messages

• **Both** natural and human disasters are increasing with more intense and severe.

• Need better understanding of **LULCC and Population Pressure.**

• Geo-informatics is just a **powerful tool** and has its limitation.

• **Climate Change** is real and becoming **Crisis, Catastrophe and Suicide:** A multidisciplinary approach to cope it is really needed.

• **Science to Policy Makers (SOP)** does not have clear path.

• Create **Disaster Resilience, Sustainable and Environmental Friendly Community!!!**

• Need to understand and use more Indigenous knowledge of fire!!!!

• Move from Conservation to Preservation then Environmentalism!!

• **Think Globally, Act Locally, Be Radical and Holistic!!!**