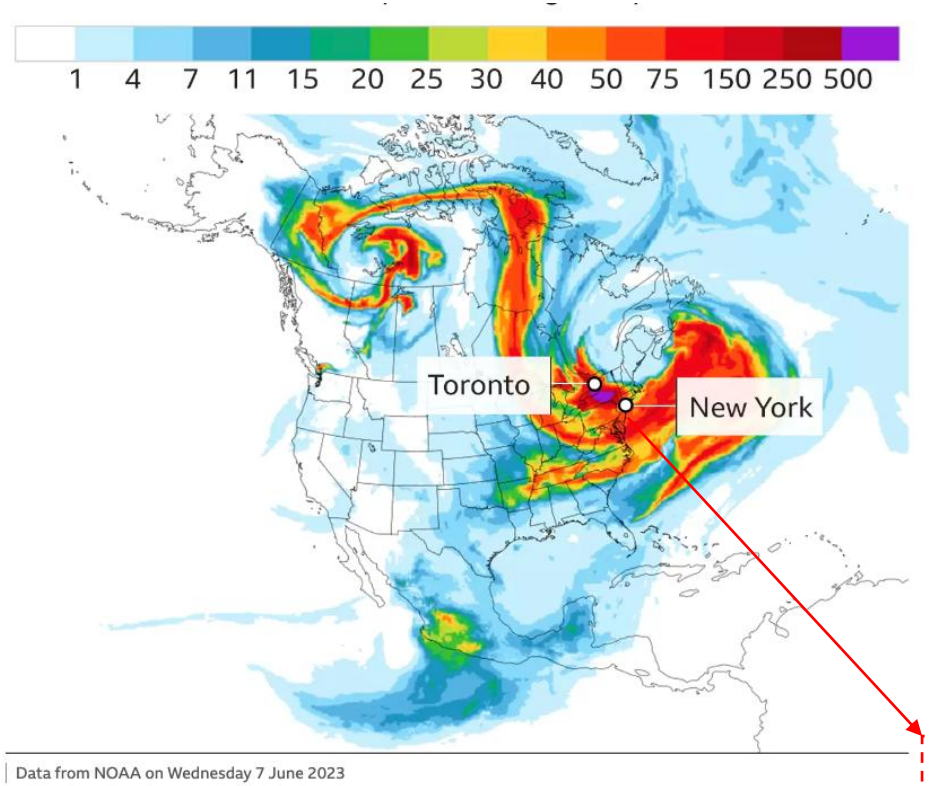
Preparing communities for smoke exposure
Or How Satellites Power Wildfires and Smoke Early Warning Systems

Sara Basart, sbasart@wmo.int
Scientific Officer
WMO Science, Services and Capacity Building Department
Global Atmosphere Watch (GAW) Programme

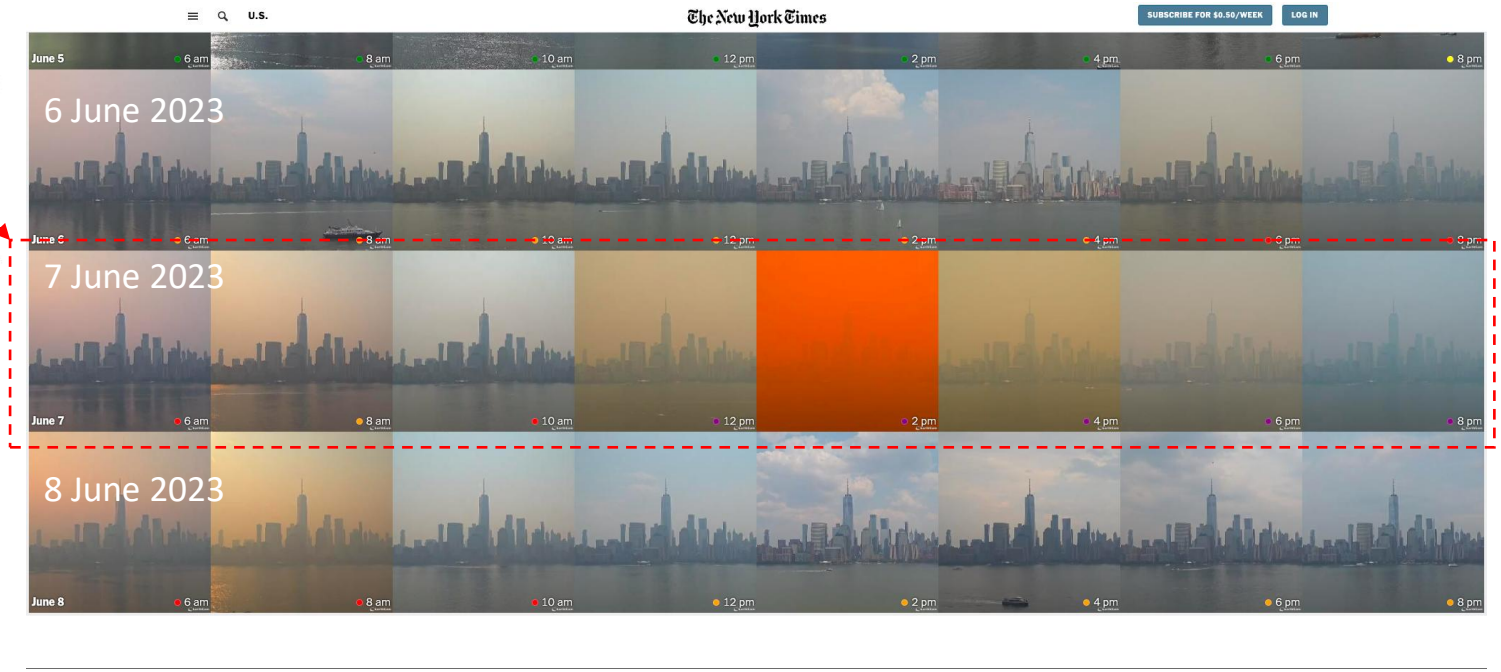
WORLD METEOROLOGICAL ORGANIZATION

North America June 2023

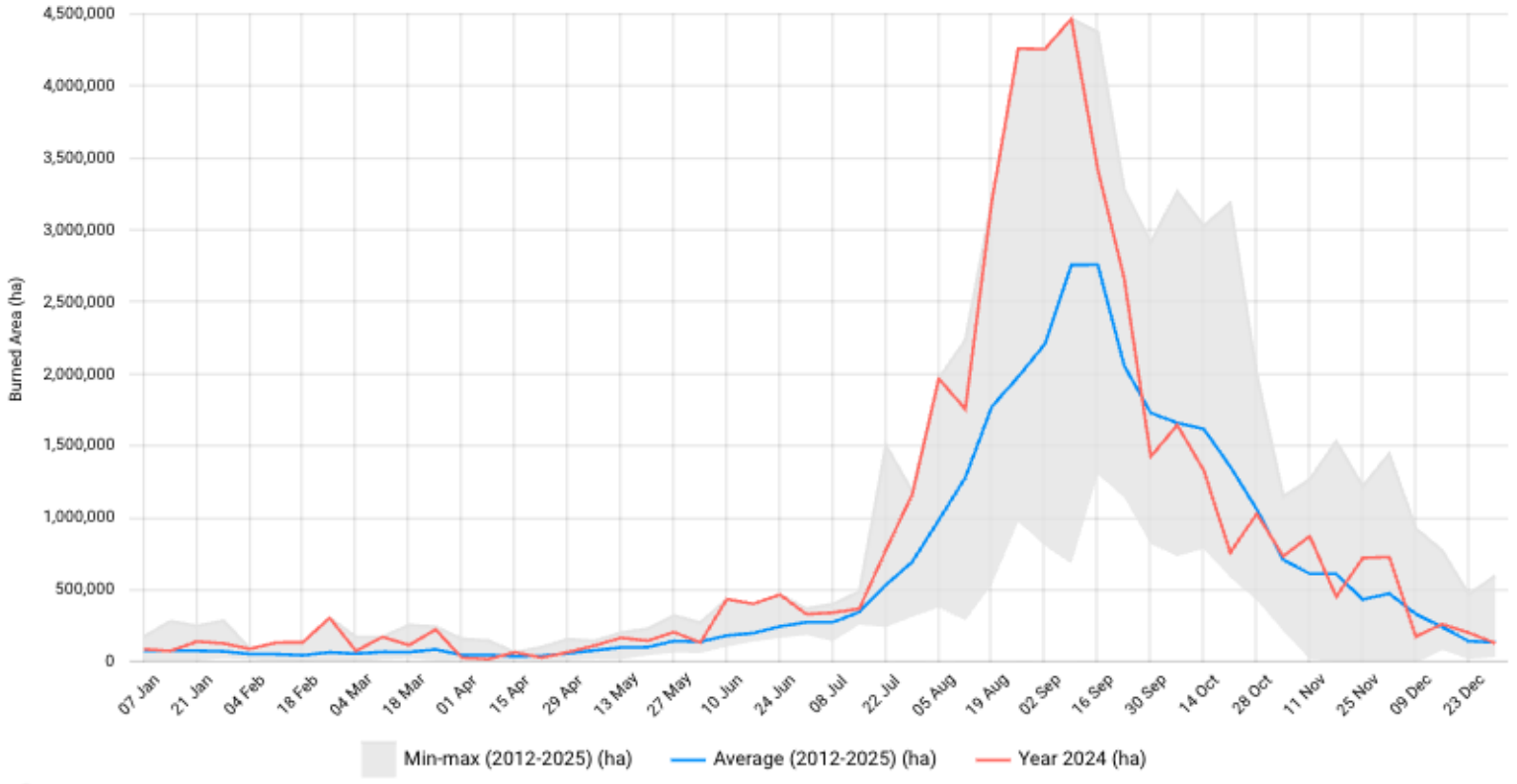


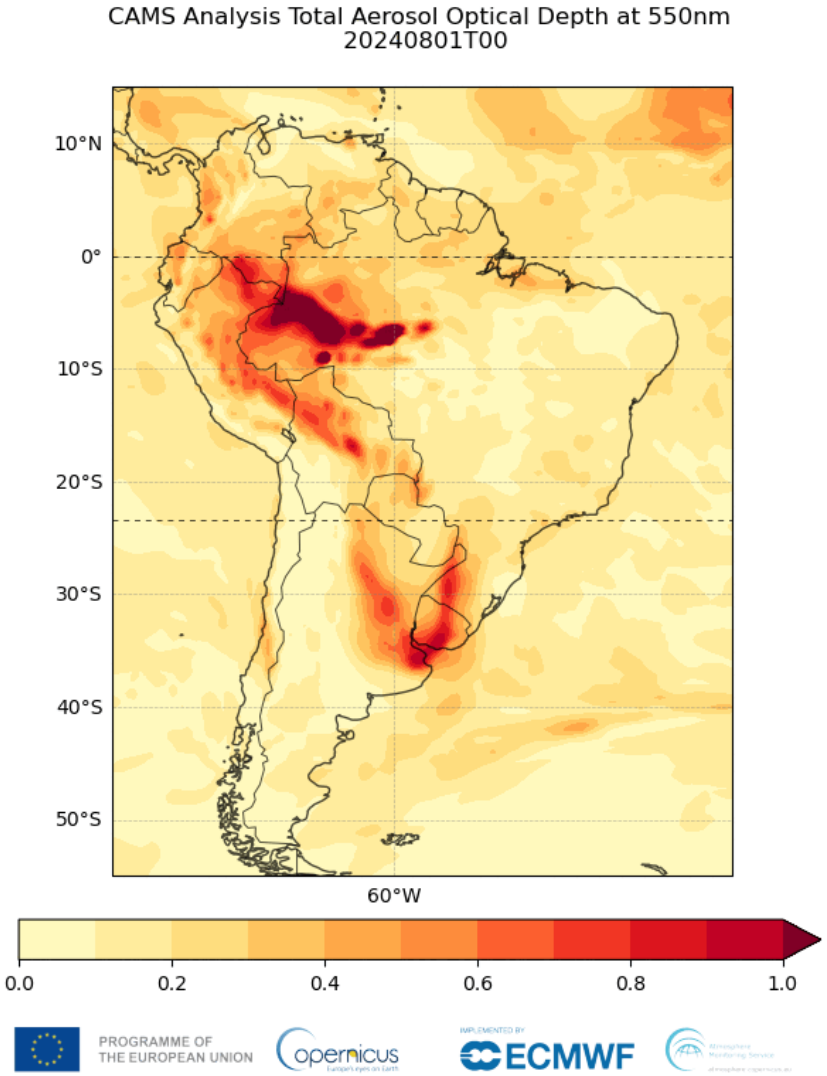
Vegetation fires release large amounts of **particulate matter (PM) and toxic gases** including carbon monoxide, nitrogen oxides, and non-methane organic compounds into the atmosphere (WHO Air Quality Guidelines)

Source Twitter, @antonioguterres: *"At our @UN Headquarters in New York, we can feel the deteriorating air quality as smoke from the wildfires in Canada moves south." June 2023*



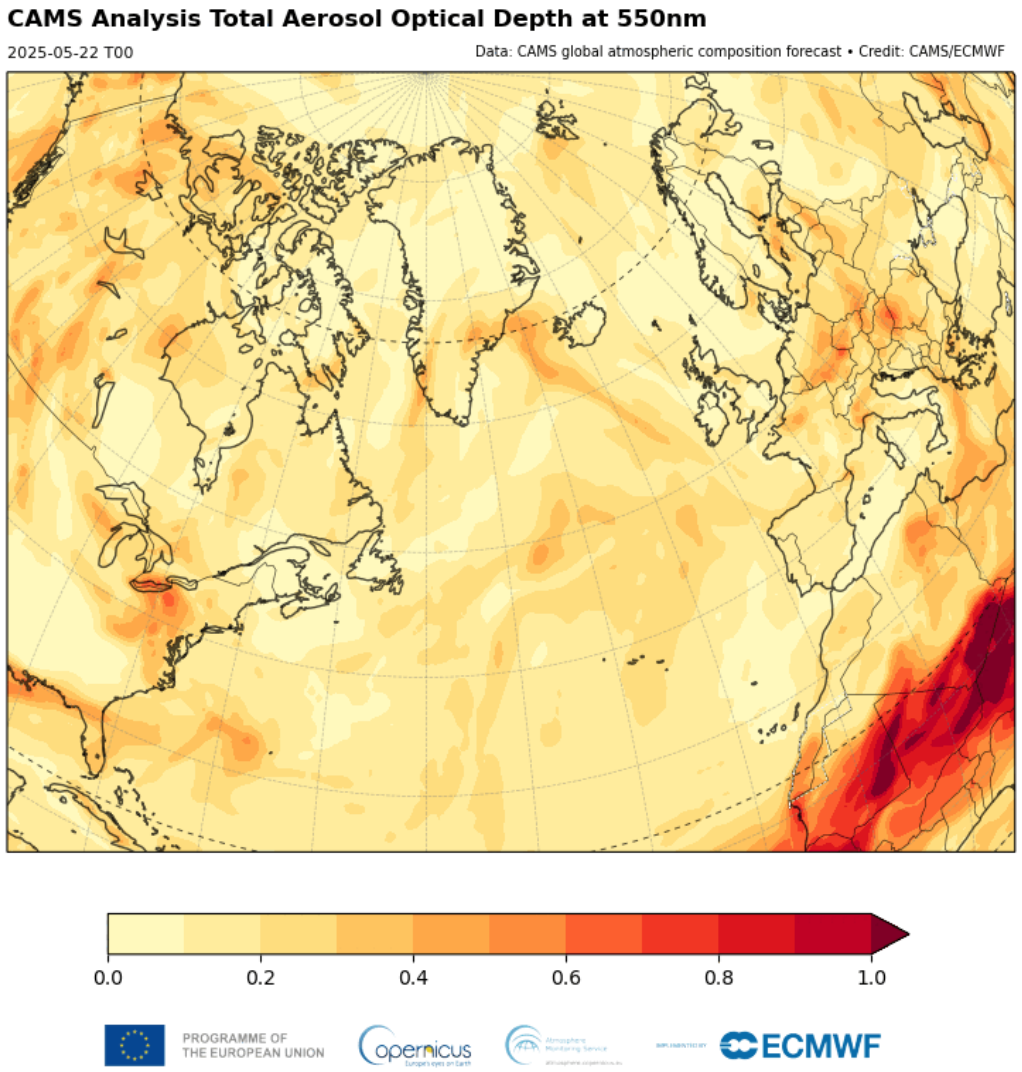
South America 2024

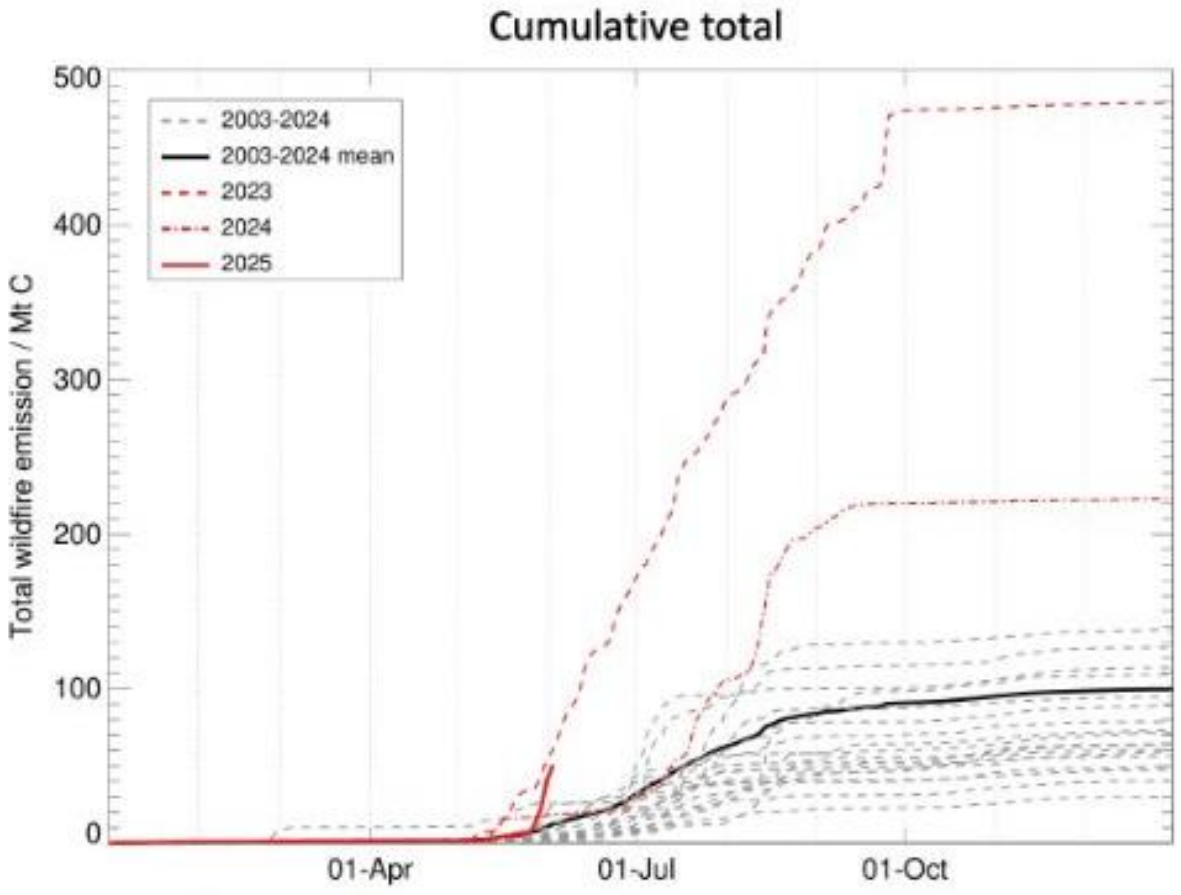




https://gwis.jrc.ec.europa.eu/

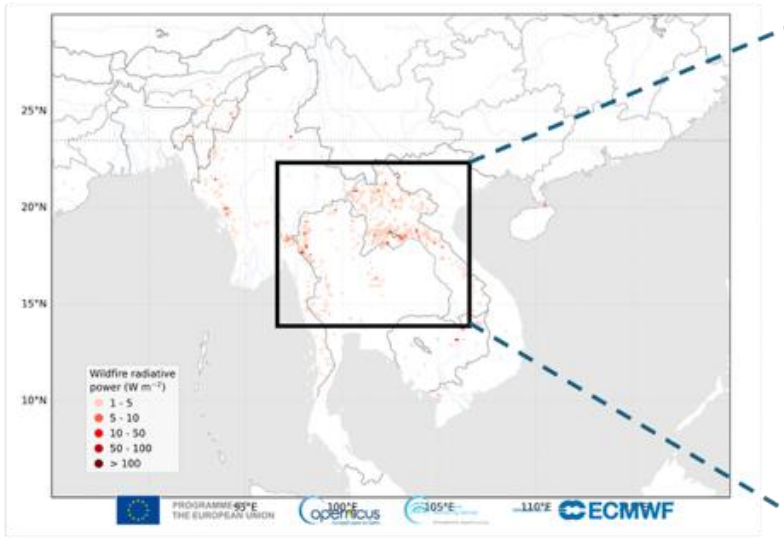
Northern Hemisphere June 2025

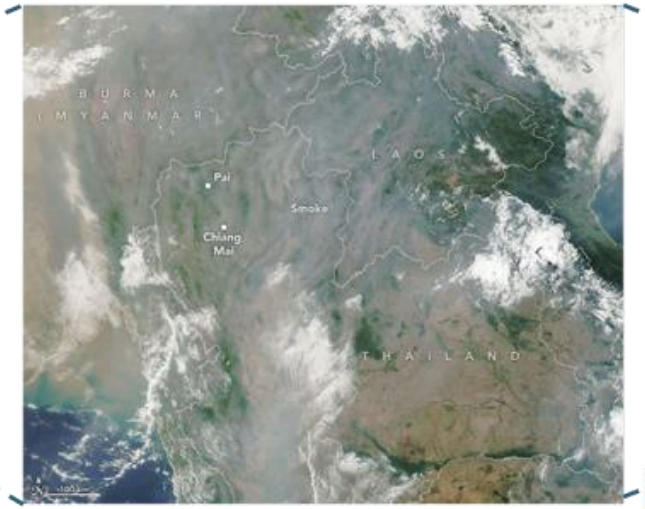


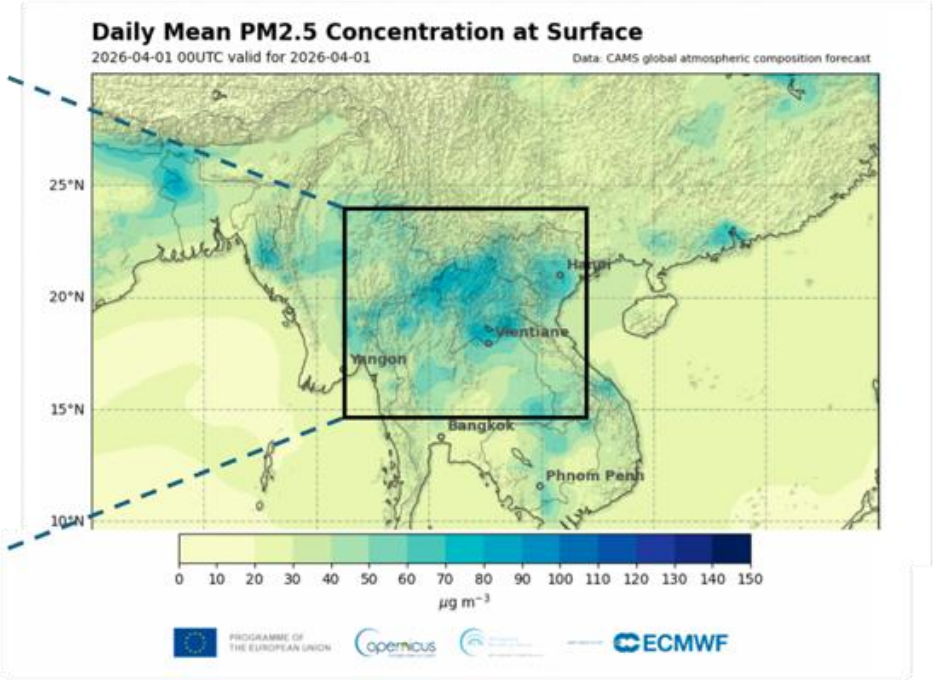


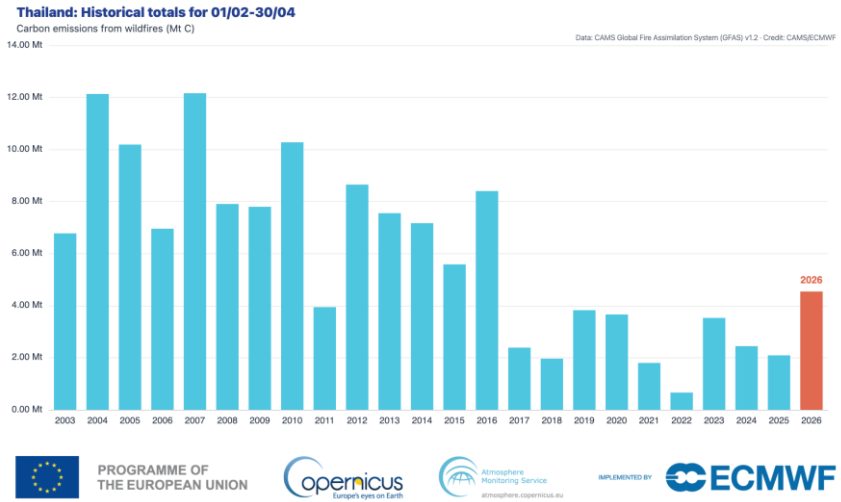
CAMS GFASv1.2 daily total fire radiative power. Source: CAMS

ASEAN April 2026







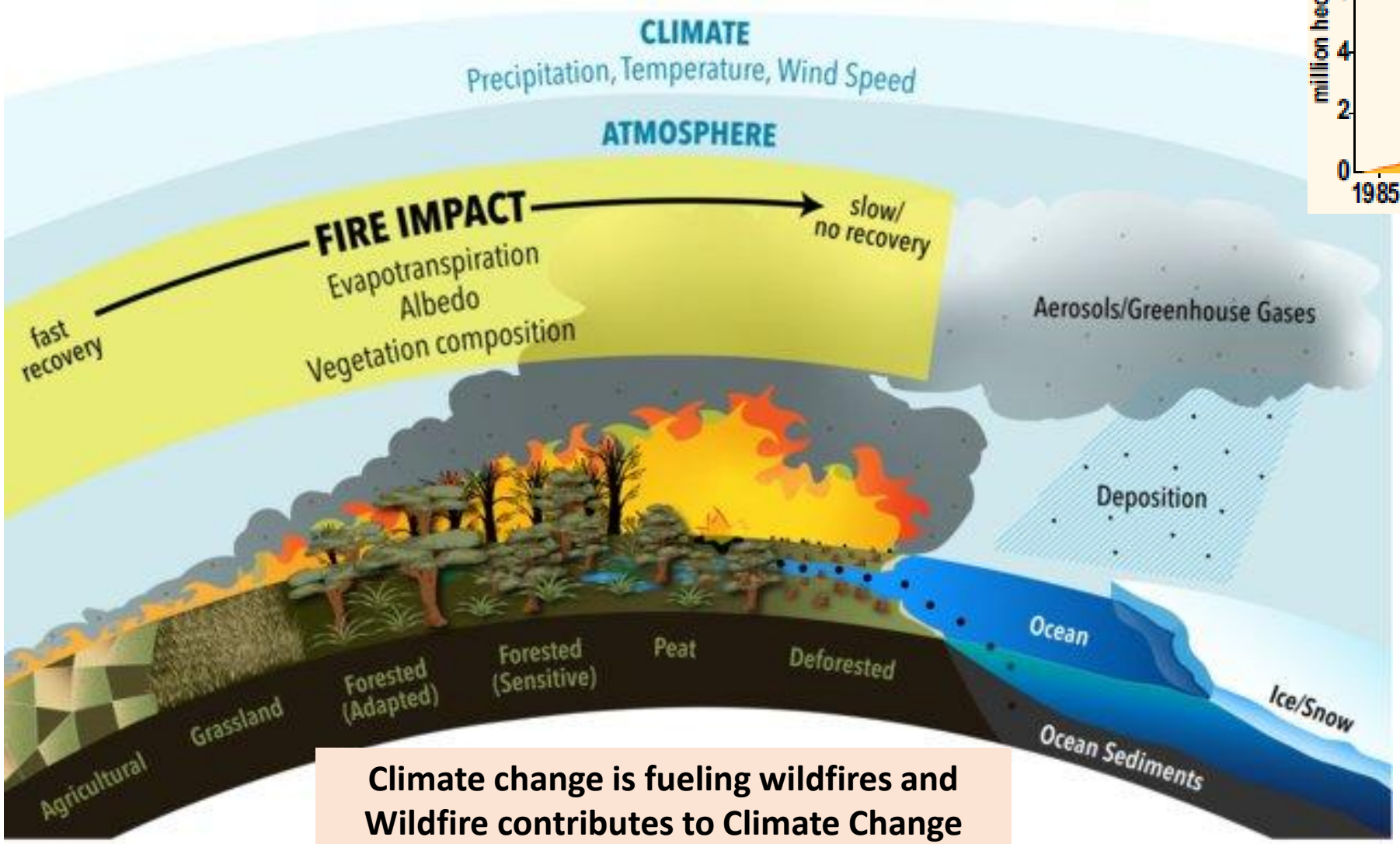


"While overall wildfire activity across much of the upper ASEAN region was below average this season, our data show that severe haze episodes still led to hazardous air quality in several major cities, where anthropogenic emissions remain a major contributor to PM2.5 pollution,

—Mark Parrington, CAMS Senior Scientist

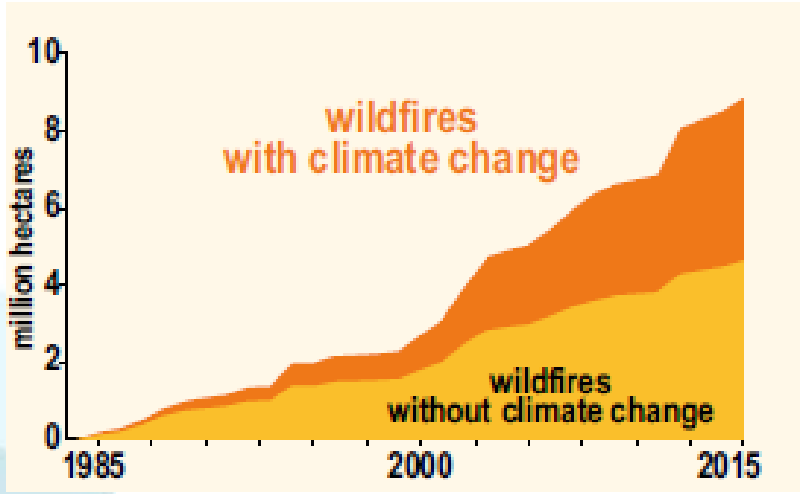
https://atmosphere.copernicus.eu/severe-haze-affects-southeast-asia-despite-below-average-wildfire-activity-april

Wildfires within the Earth System



Climate change is fueling wildfires and Wildfire contributes to Climate Change

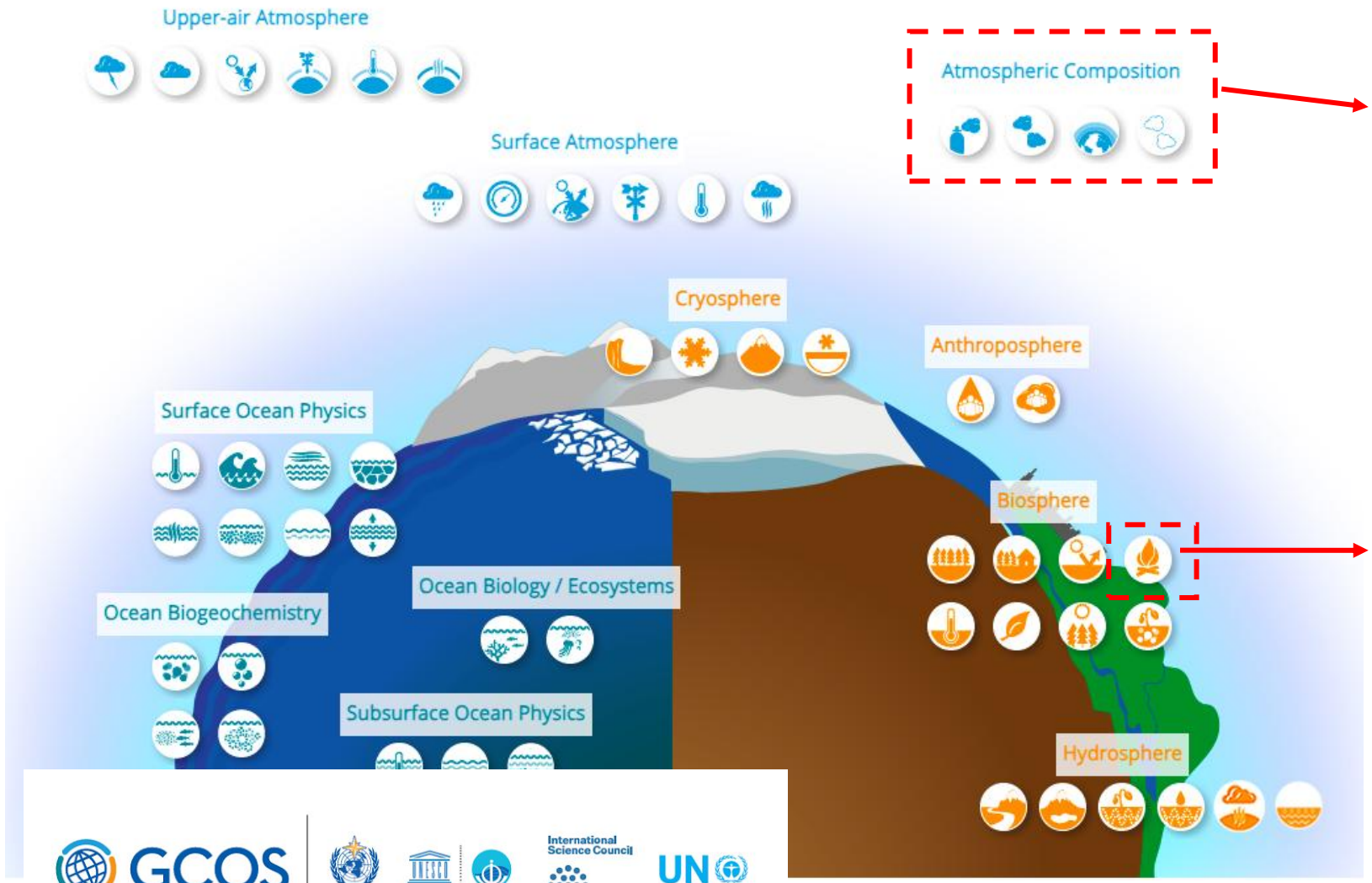
(Lasslop et al., 2019)



Lower emissions that would limit the global temperature increase to <2°C would reduce projected **increases of global burned area to 30% to 35% and projected increases of fire frequency to ~20%**.

(IPCC, 2021)

GCOS – Global Climate observing System
Essential Climate Variables (ECV)



Atmospheric composition Focal Areas

- Aerosols (chemical and physical properties, AOD)
- Carbon Dioxide, Methane & Other Greenhouse Gases
- Ozone and vertical ozone distribution
- Precursors for Aerosols and Ozone (CO, SO2, NO2)

WMO-GAW Network and Satellites

Fire

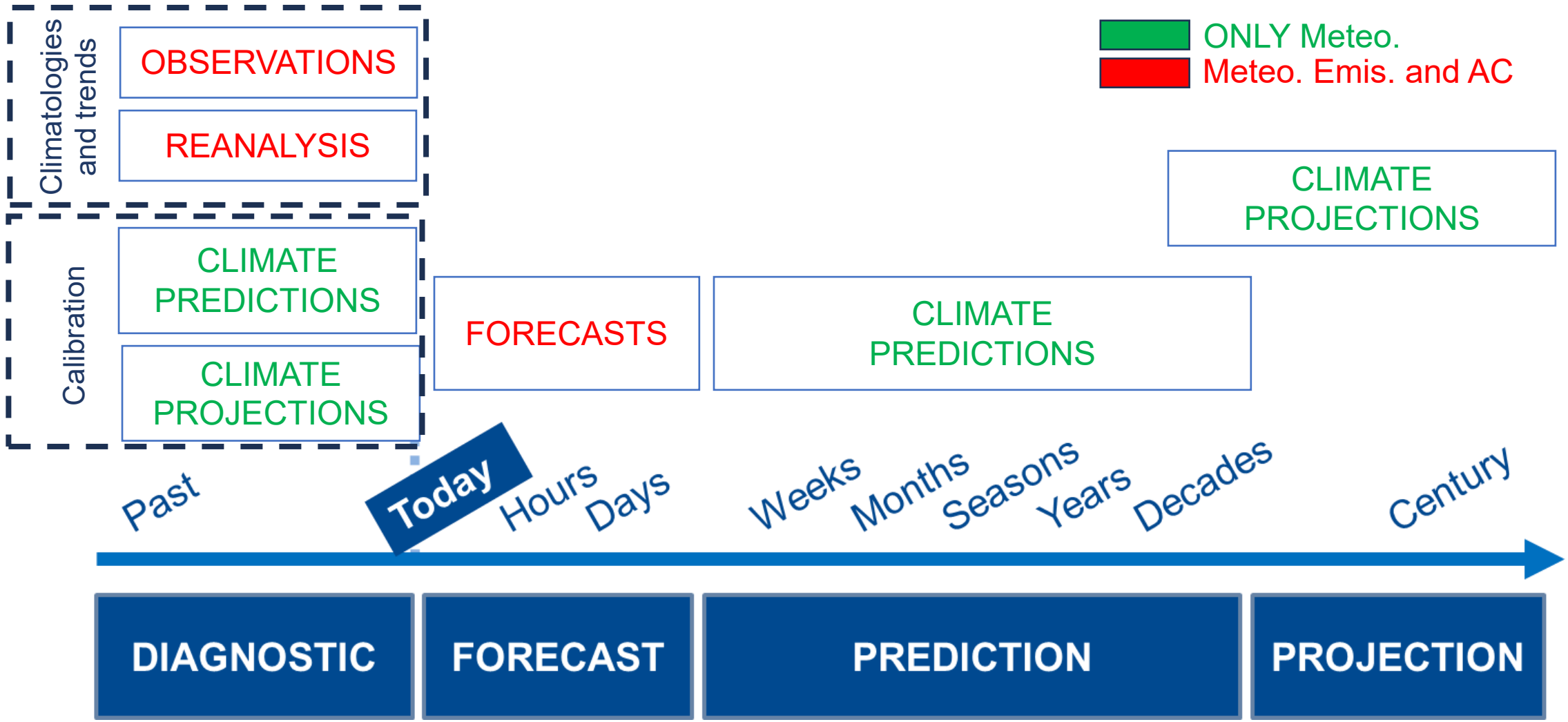
- Burned Area
- Active Fires
- Fire Radiative Power (FRP)

Satellites

Is this enough for tracking climate?

https://gcos.wmo.int/en/essential-climate-variables

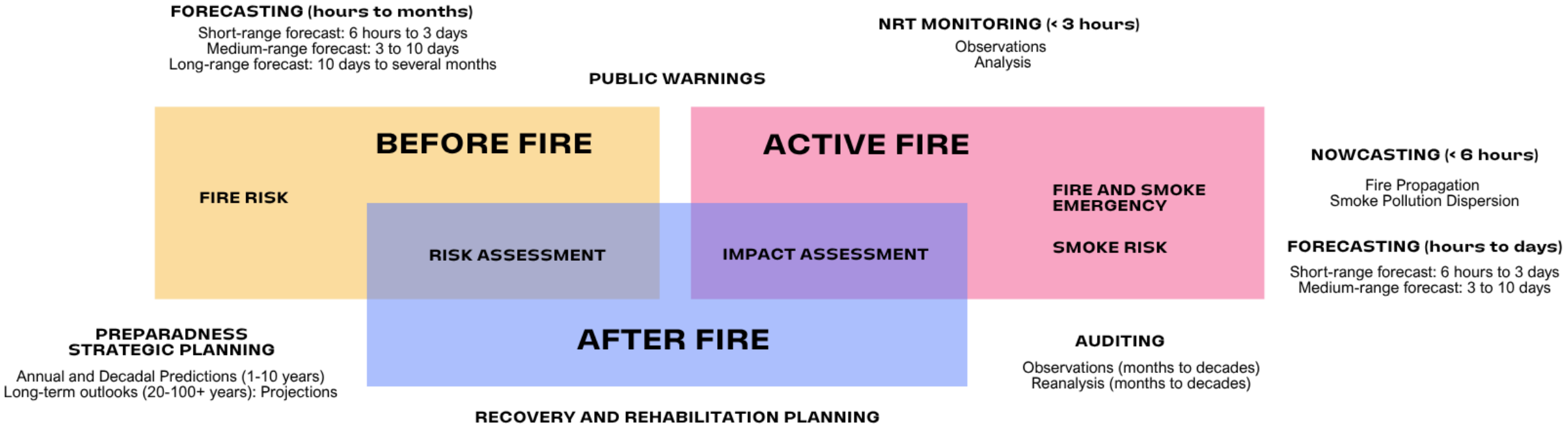
Integrating different sources of information



WORLD METEOROLOGICAL ORGANIZATION

Early Warning Systems (EWS)
WMO approach includes fires and smoke

Key words:
Timeliness
Uncertainty (*quality*)



The WMO VFPS-WAS

Smoke

Science for Services

GLOBAL ATMOSPHERE WATCH

WORLD METEOROLOGICAL ORGANIZATION

Early Warnings for All

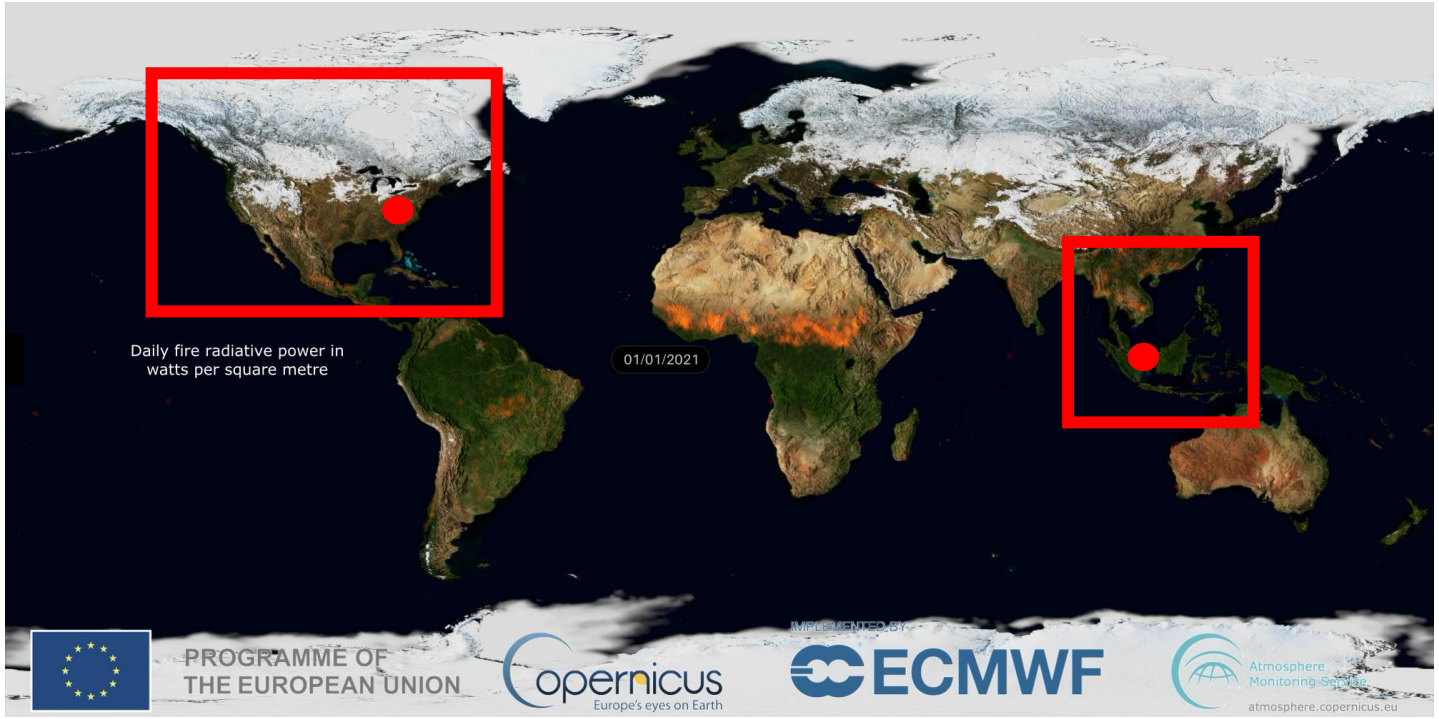
International global coordination of researchers, providers and users

Identification and assessment of smoke impacts

Promoting the use of current available products (observations and forecasts)

Building capacity and facilitate access to the available services

Dissemination and awareness



WMO Smoke Regional Centers

https://community.wmo.int/en/activity-areas/gaw

https://hpfx.collab.science.gc.ca/~svfs000/na-vfsp-was/public/dist/

NORTH AMERICAN REGIONAL CENTRE
VEGETATION FIRE AND SMOKE POLLUTION
WARNING AND ADVISORY SYSTEM

- Home
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  - Fire Danger Risk
  - Fire Weather Index
  - Sub Seasonal Outlook
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  - Partners

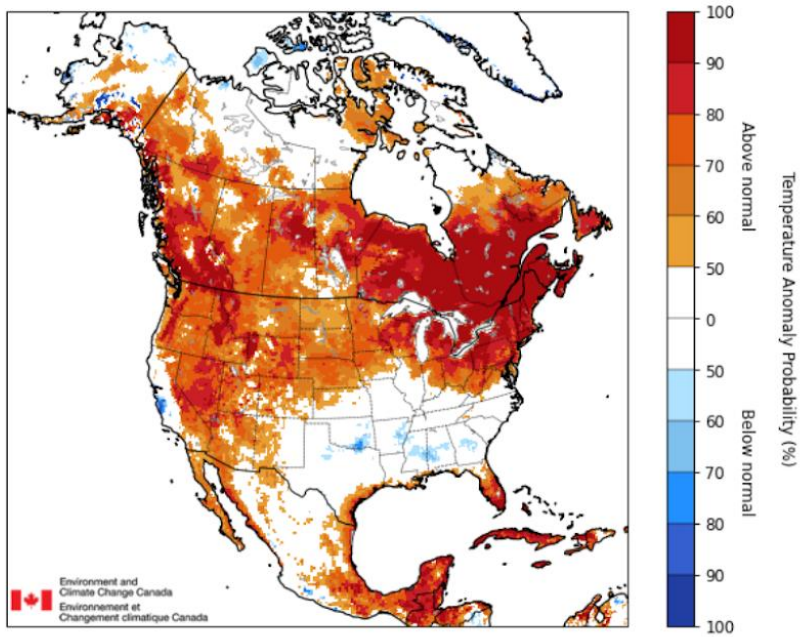
Sub Seasonal Outlook

Weeks in advance
Aslo Drought indicators

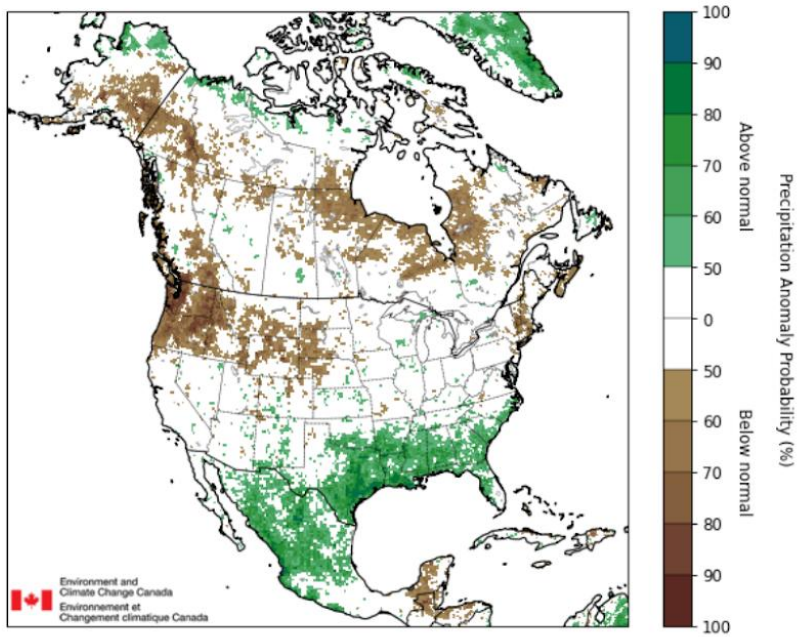
GEPS 4-week Outlook

Period: 20250609-20250707, Issued on 20250605 00Z

Temperature Anomaly Probability



Precipitation Anomaly Probability



The monthly forecast is updated each Thursday and covers the 28 days starting on the following Monday. The forecasted anomaly is produced from the average conditions forecasted over that period by the Global Ensemble Prediction System (GEPS).

A 20 year climatology (1998-2017) of this prediction system obtained from a reforecast is also used in the computation of the forecast anomaly.

https://hpfx.collab.science.gc.ca/~svfs000/na-vfsp-was/public/dist/

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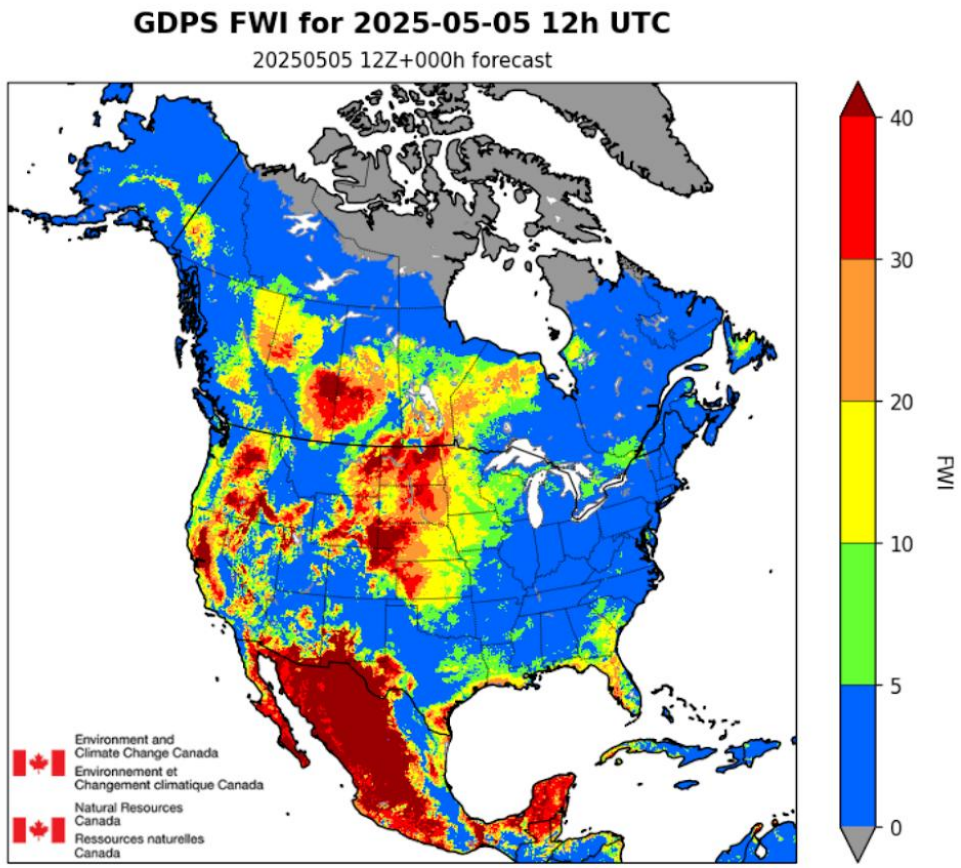
The Fire Weather Index (FWI)

Days in advance



Mon, 05 May 2025 12:00:00 GMT

Wed, 07 May 2025 12:00:00 GMT

https://hpfx.collab.science.gc.ca/~svfs000/na-vfsp-was/public/dist/

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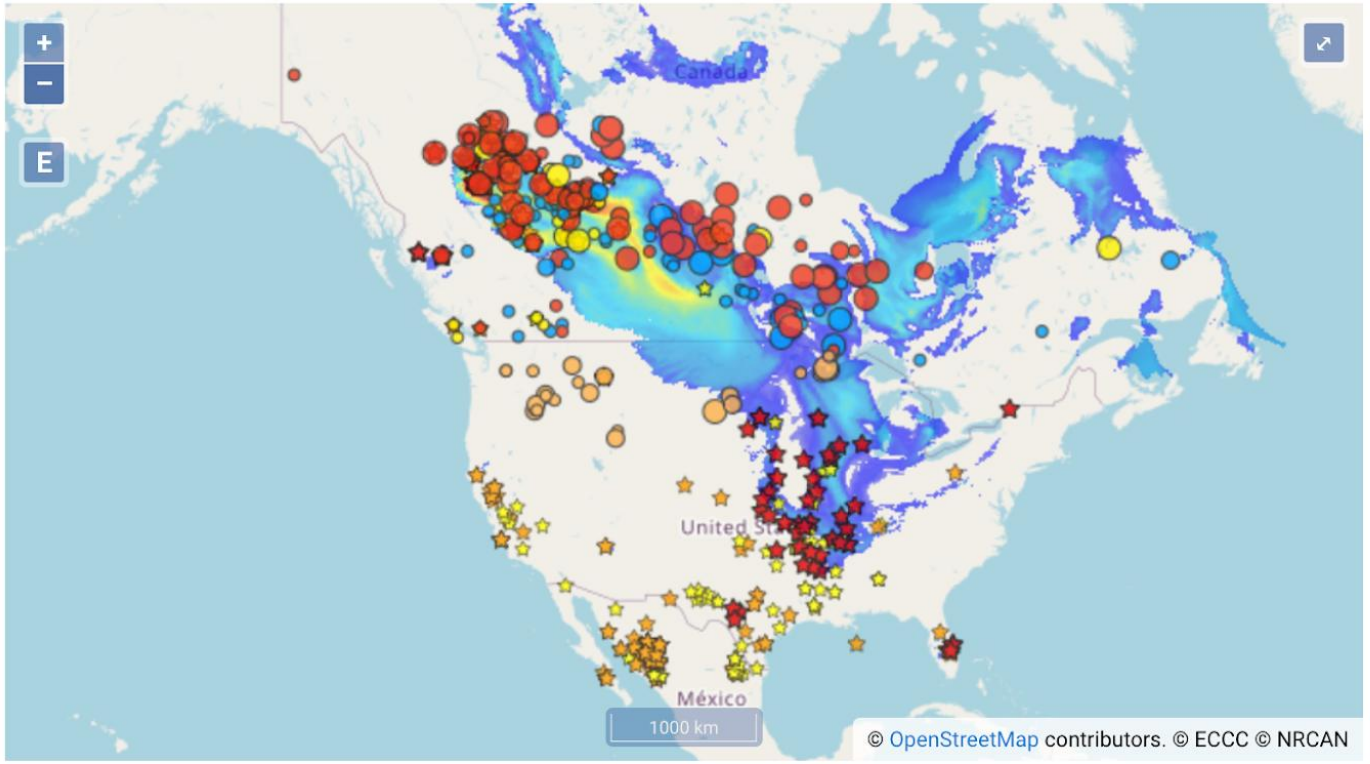

Present

Active Fires

AC (smoke) forecasting systems uses fire analysis as inputs!

NORTH AMERICAN REGIONAL CENTRE
VEGETATION FIRE AND SMOKE POLLUTION
WARNING AND ADVISORY SYSTEM

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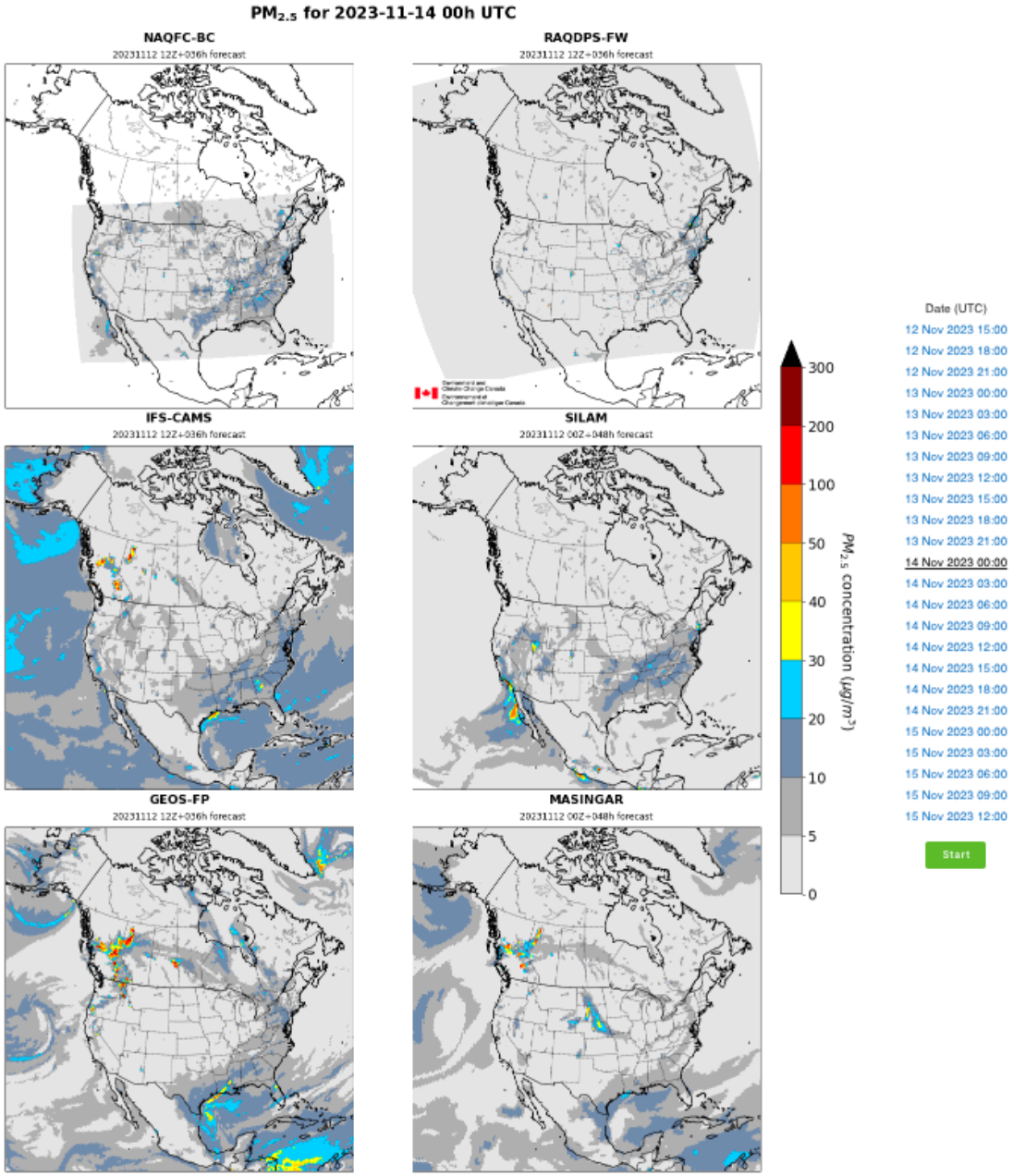
  - Data Policy
  - Contact



Model intercomparisons

1. Promoting best practices and guidelines to be used by the international community

2. Development of probabilistic forecasts

https://hpfx.collab.science.gc.ca/~svfs000/na-vfsp-was/public/dist/

NORTH AMERICAN REGIONAL CENTRE
VEGETATION FIRE AND SMOKE POLLUTION
WARNING AND ADVISORY SYSTEM

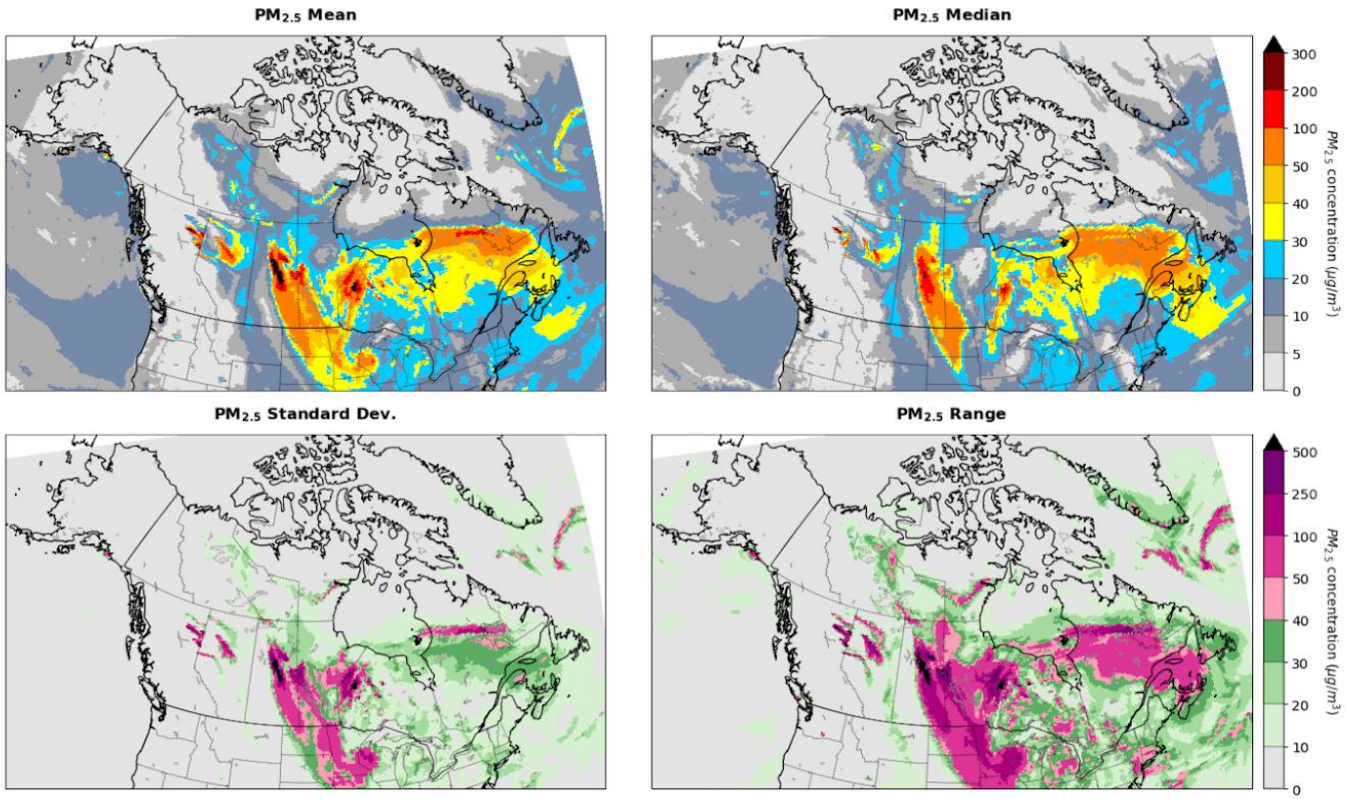
WMO

PM2.5 SURFACE CONCENTRATION | PM10 SURFACE CONCENTRATION

CANADA AND ALASKA | CONTINENTAL USA | MEXICO

MME statistics for 2025-06-09 15h UTC
20250609 12Z+003h forecast

Warning - Missing 2 members:
SILAM MASINGAR



https://www.mss-int.sg/vfsp-was

Southeast Asia Regional Centre VFSP - WAS

ABOUT FORECASTS OBSERVATIONS FIRE RISK NEWS AND EVENTS FAQ

Home > Forecasts > Forecast Evaluation

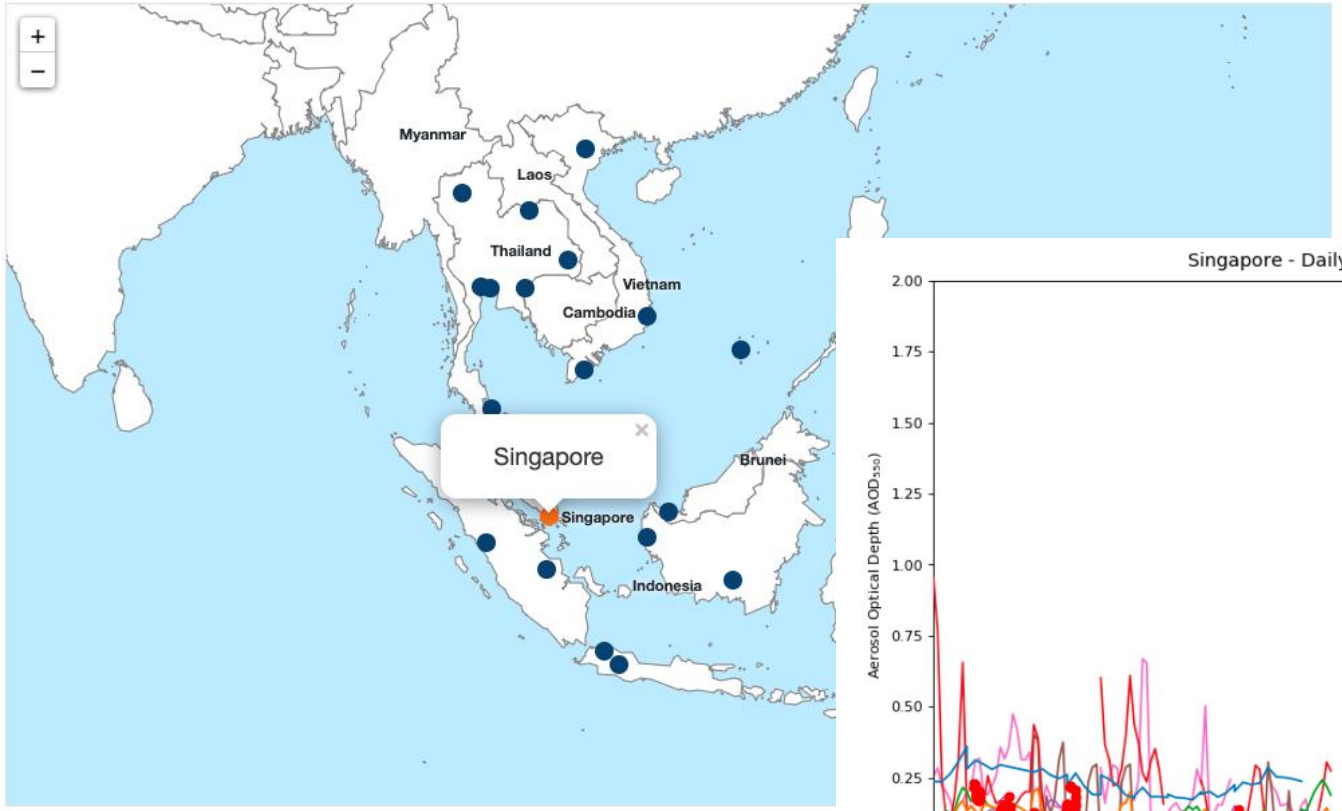
A A A

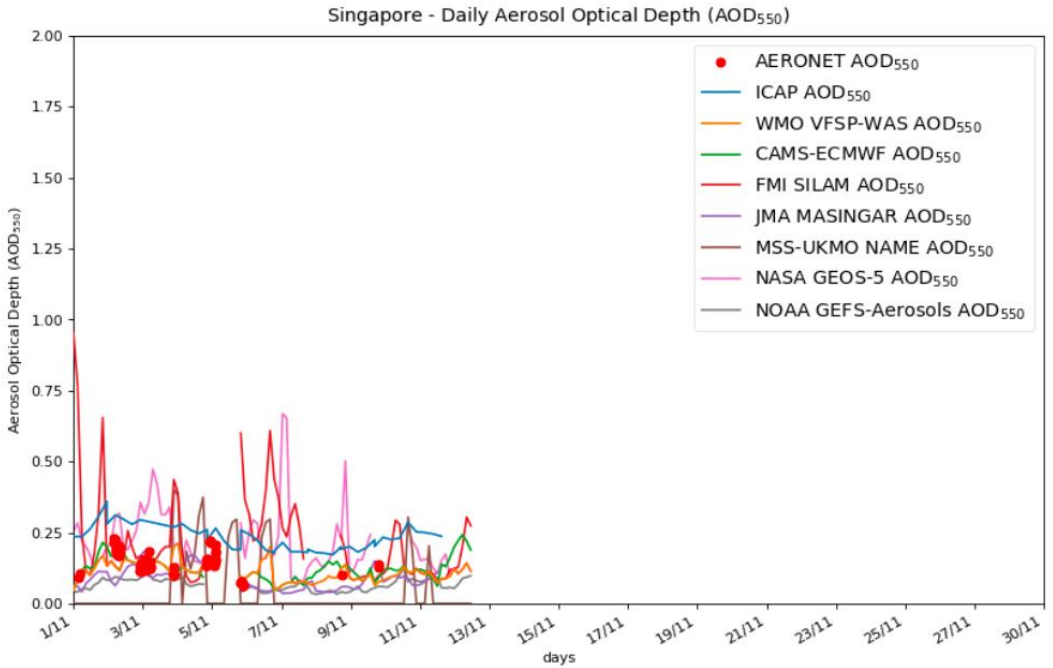
Forecasts

- Multi-Model Ensemble
- Model Intercomparison
- ICAP Ensemble
- Forecast Evaluation
- Evaluation Metrics
- NWP Forecasts
- Subseasonal Outlook

Forecast Evaluation

Near real-time comparison between model forecasts and observations of smoke aerosol optical depth (AOD).





Model evaluation

1. Need of observations
2. Definitions of common metrics

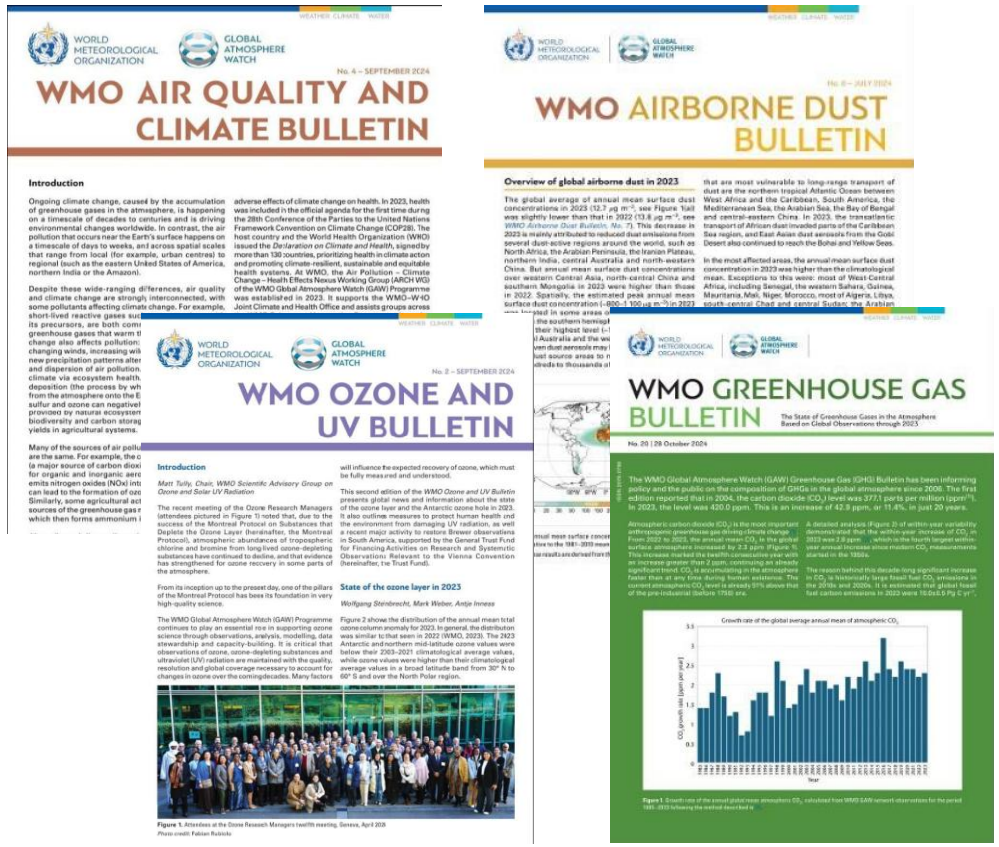
Key Messages

- Air pollution and climate change are intrinsically linked—many air pollutants from wildfires also drive global warming.
  - We need to monitor trends of wildfires and smoke pollution to understand changes in climate.
- WMO is committed to advancing science-based solutions to support EWS
  - Accurate, standardized, and science-driven data collection is essential for the assessments needed for advancing on impact-based forecasts.
  - Transparency and accessibility to data are critical for effective decision-making and coordinated action.
  - WMO plays a key role in transitioning research into operational services. Our initiatives—such as Vegetation Fire and Smoke Pollution Warning Advisory and Assessment System (VFSP-WAS)—enhance our ability to predict and mitigate air pollution hazards.

WMO is supporting international initiatives (as EW4All, the Global Fire Hub and GWIS).

Keep in Touch

WMO Bulletins in 2025



Available at: https://library.wmo.int/

WMO-GAW Newsletter

GLOBAL ATMOSPHERE WATCH

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