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STATUS OF NEW WMO NORTH AMERICAN REGIONAL VEGETATION FIRE AND SMOKE POLLUTION WARNING AND ADVISORY CENTRE

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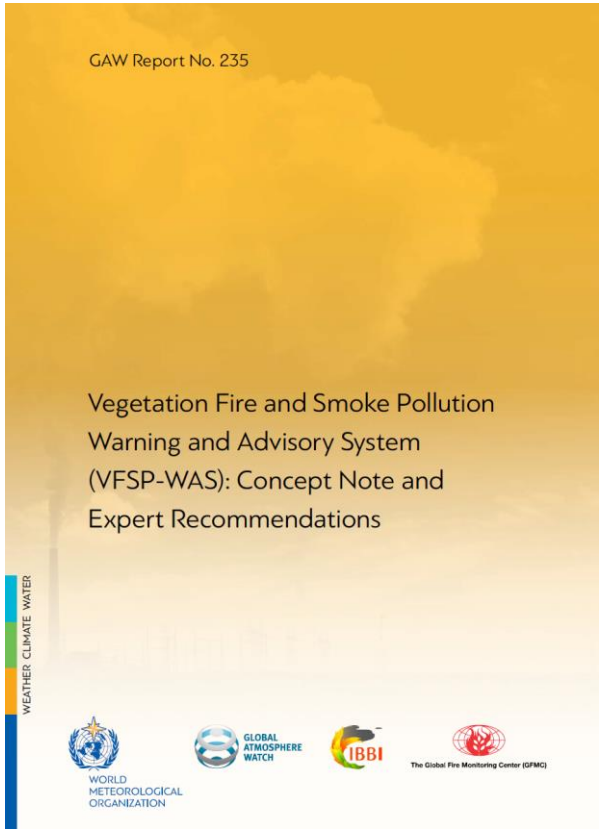
CONCEPT OF VFSP-WAS AND RVFSP-WAC

- This idea emerged after an international workshop on “Forecasting Emissions from Vegetation Fires and their Impacts on Human Health and Security in South-East Asia” in 2016.
- WMO members in several regions impacted by wildfires had a keen interest in this topic and discussed vegetation fire smoke emissions, smoke transport, related air quality changes and its impact on human health.
- In 2018, the WMO Global Atmosphere Watch Program (GAW) produced a report to provide guidance and expert recommendations on the creation of the Vegetation Fire and Smoke Pollution Warning and Advisory System (VFSP-WAS) and related Regional VFSP-WAS Centres (RVFSP-WAC), an idea inspired by the Sand and Dust Storm Warning Advisory and Assessment System (SDS-WAS), established in 2007.

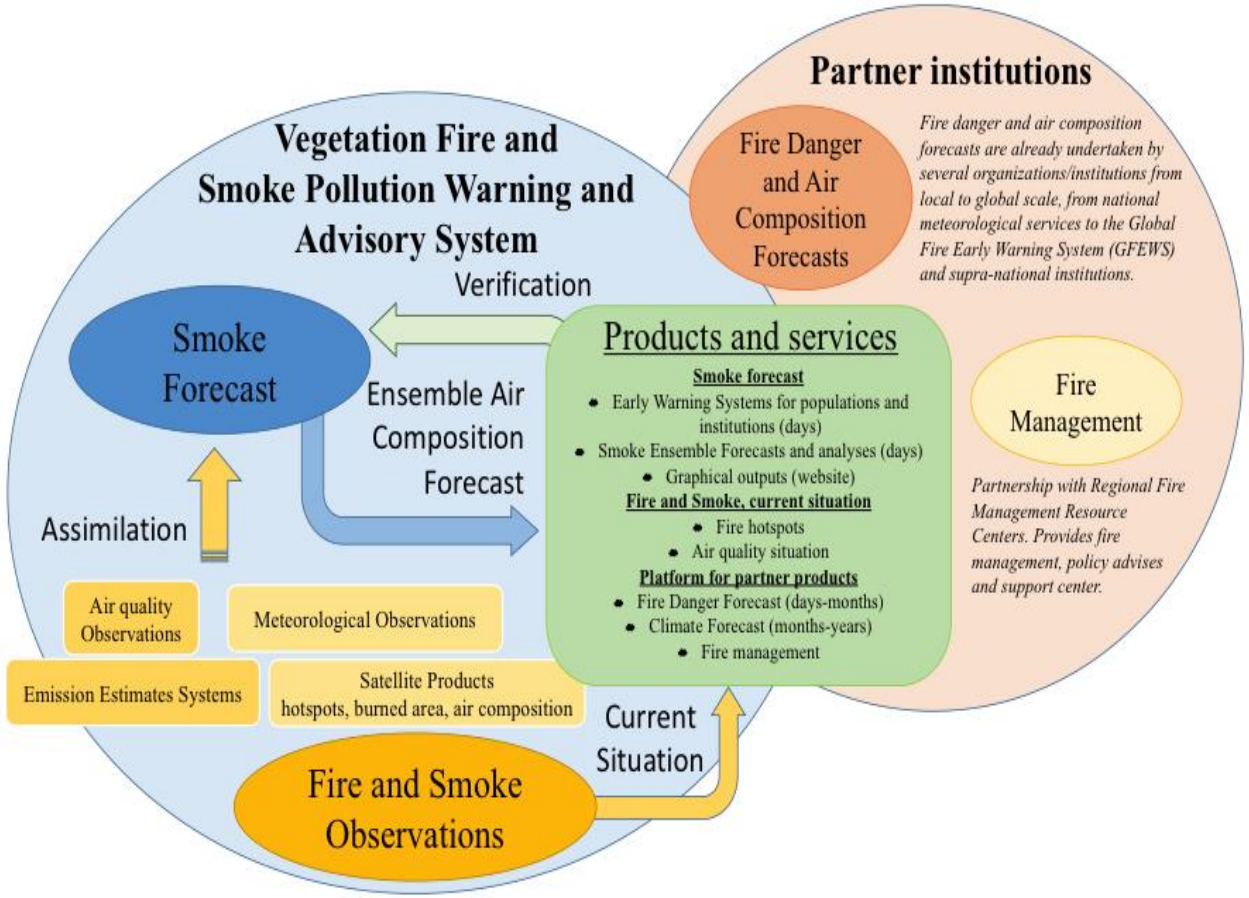


WMO GAW Report No. 235
https://library.wmo.int/opac/index.php?lvl=notice_display&id=20244

MISSION

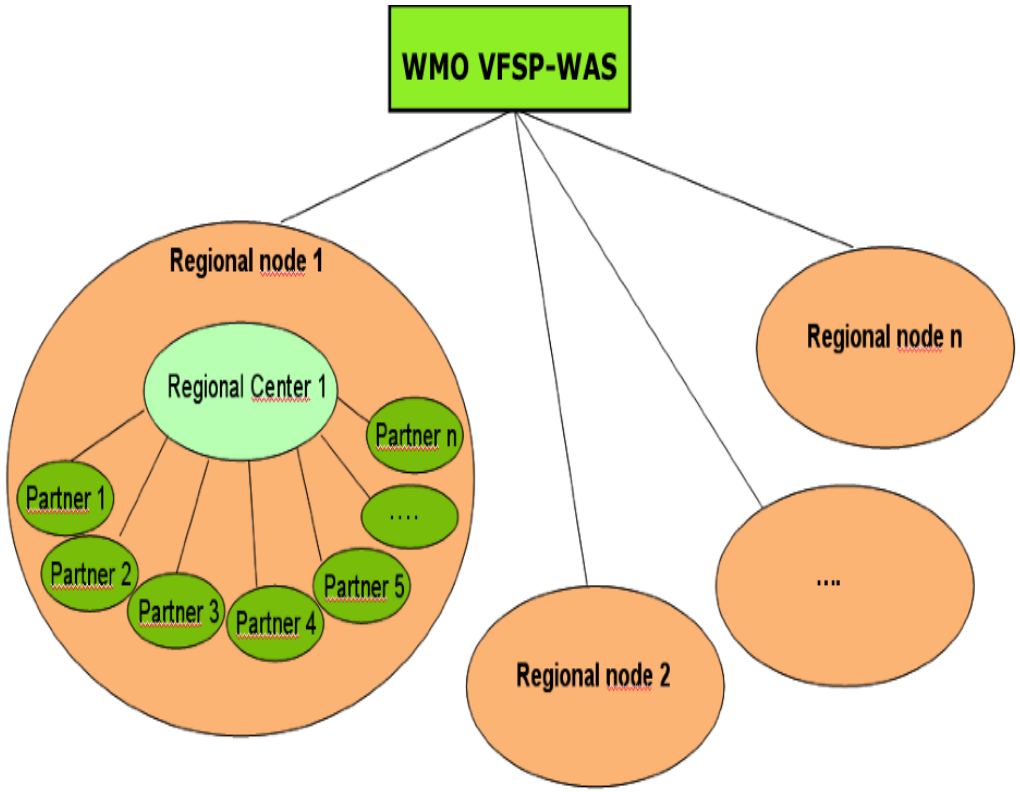
- Mission: The WMO VFSP-WAS aims to enhance the ability of countries to deliver timely and quality vegetation fire and smoke pollution forecasts, observations, information and knowledge to users through an international partnership of research and operational communities.

- End-users may be
  - regional, national or local decision-maker for emergencies, policies or strategies in the context of public health, fire management and law enforcement
  - forecasters
  - the public



ORGANIZATION

- The WMO VFSP-WAS is organized as a federation of regional nodes with their respective regional centre.
- At the regional node level, the organization is again a federation of regional partners coordinated by the Regional Centre.
- At the moment two RVFSP-WAC exist:
  - The first is covering the Southeast Asia region and is hosted by the Meteorological Service of Singapore. https://www.mss-int.sg/vfsp-was
  - In 2019, ECCC was approached by the WMO to host the North American (NA) RVFSP-WAC.



DEVELOPMENT OF THE NA RVFSP-WAC

- A public NA RVFSP-WAC demo web page has been available since late 2020.
  - Collects some existing fire-related products
  - Provides a centralized web portal for data access
  - Displays accessible, user-friendly and comprehensive graphical products

- This center is still very much at an early phase, in R&D, with many improvements to come in future years.

- The creation of this Regional WMO Centre was done in collaboration with numerous national and international collaborators.



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Natural Resources Canada
Ressources naturelles Canada

PRODUCT CATEGORIES

- **Fire Risk**
  - Fire Danger Risk
  - Fire Weather Index
  - Sub-Seasonal Temperature and Precipitation Anomalies Outlook

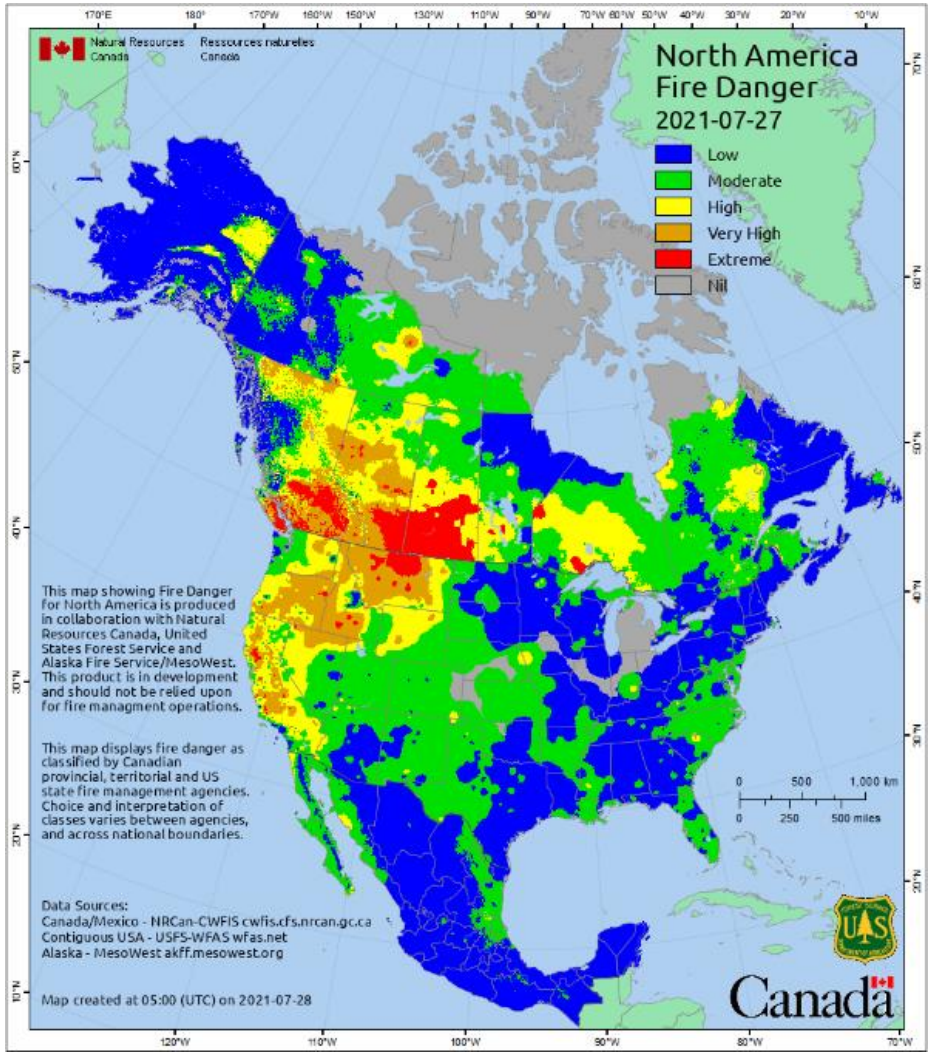
- **Detected Fires and Smoke**
  - Detected Hotspots
  - Additional Satellite Imagery products from GOES (planned)

- **Smoke forecasts**
  - AQ forecasts from 6 different operational AQ systems covering North America
  - AQ Multi-Model Ensemble Statistics from these 6 systems
  - Model Performance Verification (planned)
  - Smoke Aerosol Optical Depth Forecasts

FIRE DANGER

- Fire Danger is a rating system used to express a variety of factors for fire potential, such as ease of ignition and difficulty of control, and is based on risk, weather, fuel characteristics, and topography.

- Combining the fire danger maps produced by Natural Resources Canada (NRCan), the US Fire Service (USFS), and Alaska Fire & Fuels (AKFF). Choice and interpretation of classes varies between agencies, and across national boundaries.

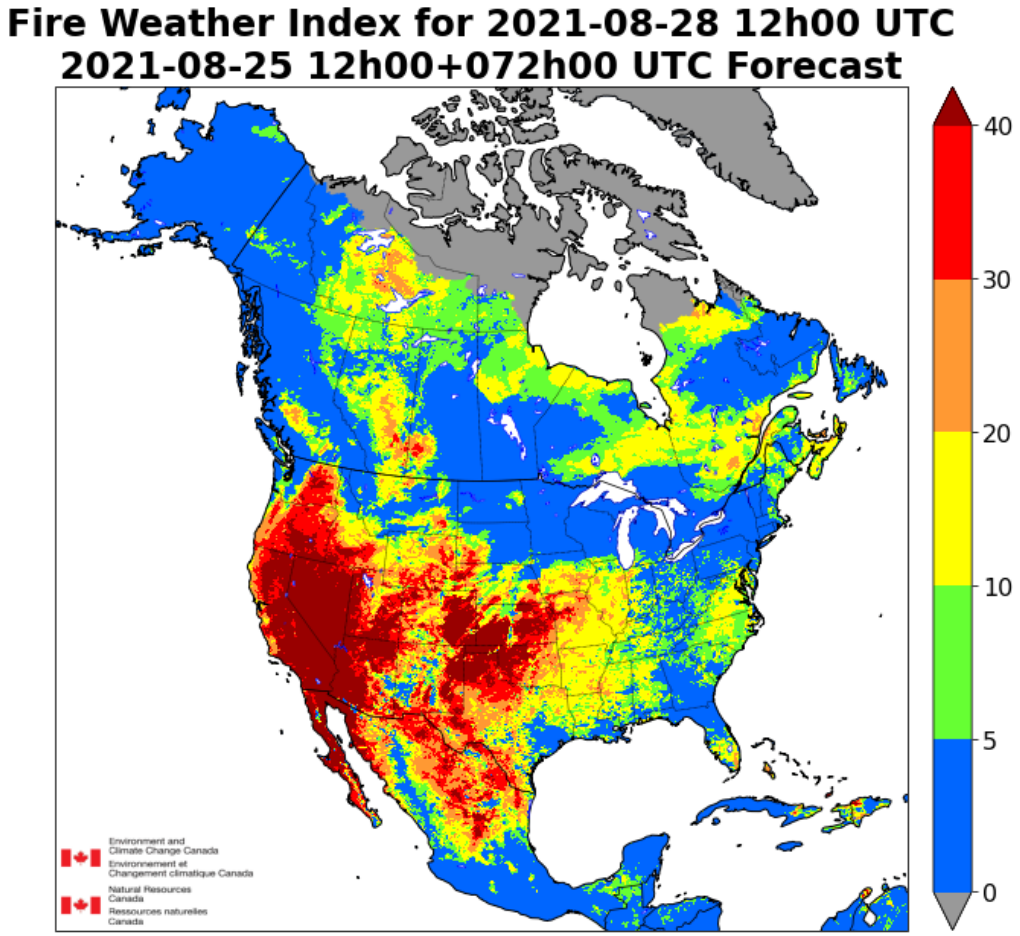


FIRE WEATHER INDEX

- The Fire Weather Index provides a numeric rating of relative potential for wildland fire, based solely on weather variables: temperature, relative humidity, wind speed, and 24-hour precipitation.

- Well-known Canadian (NRCan) equations, also used by other countries and the Global Fire WEather Database (GFWED).

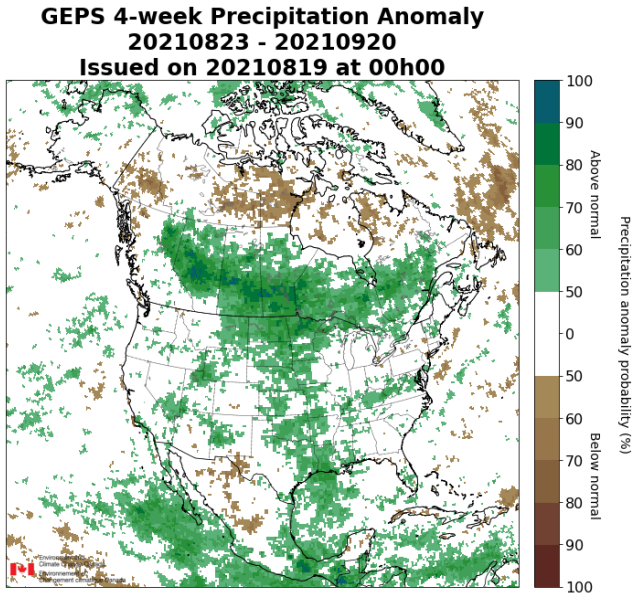
- This version is calculated using meteorological forecast fields from ECCC's Operational Regional Deterministic Prediction System (RDPS).

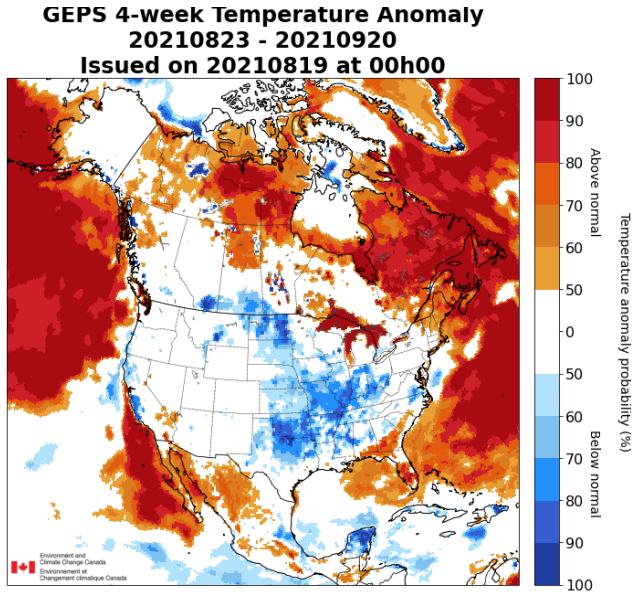


SUB-SEASONAL TEMPERATURE AND PRECIPITATION ANOMALIES OUTLOOK

- 4-week forecast of temperature and precipitation anomalies at the surface, produced every week.

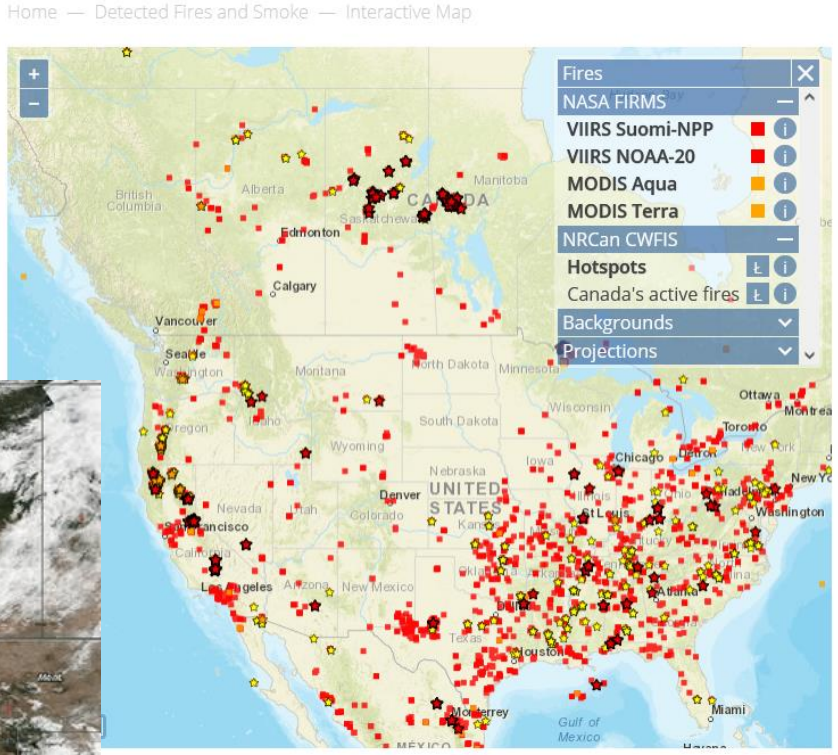
- Anomalies are derived from the average conditions forecasted by ECCC's Global Ensemble Prediction System (GEPS) compared to a 20 year climatology (1998-2017) from a reforecast of the same system.

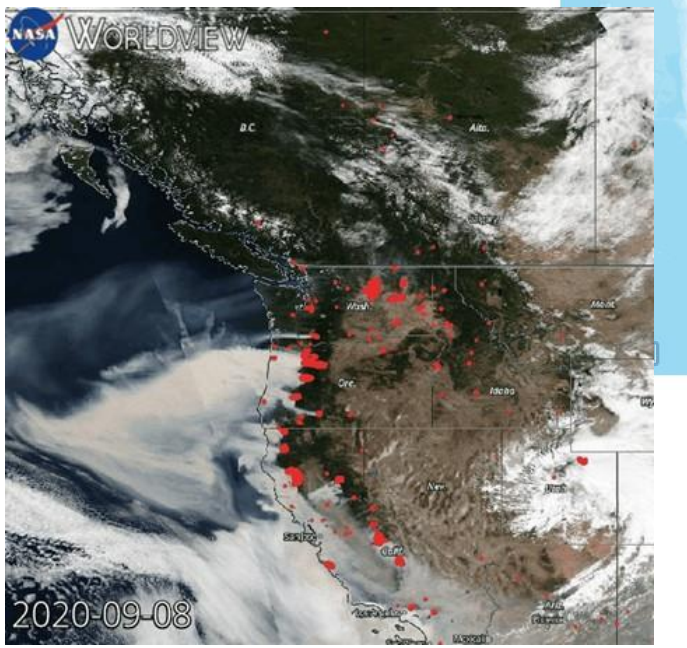




SATELLITE IMAGES AND FIRE HOTSPOTS

- A hotspot is a satellite image pixel with high infrared intensity, indicating a heat source.
- Hotspots from known industrial sources are removed; the remaining hotspots represent vegetation fires. A hotspot may represent one fire or be one of several hotspots representing a larger fire. Not all fires can be identified from satellite imagery, either because the fires are too small or because cloud cover or smoke obscures the satellite's view of the ground.
- Multiple sources, currently hotspots from NRCan CWFIS and NASA FIRMS are available on the web portal.
- Planned but not available yet - Additional Satellite Imagery products from GOES: GeoColor, Fire Temperature, Natural Color-Fire, and maybe a few more high-level products related to aerosol, smoke and fire characterization, etc.





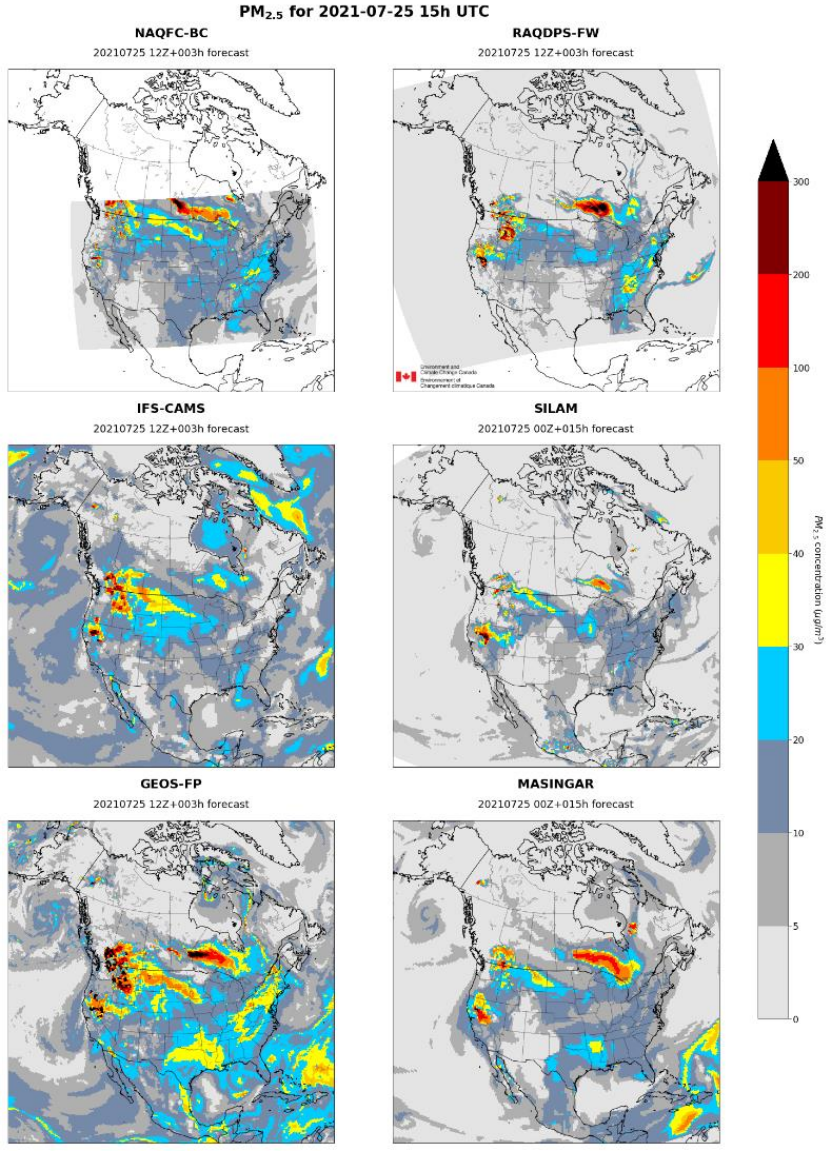
2020-09-08 NOAA-20 VIIRS Fires + True color
https://worldview.earthdata.nasa.gov
(Representation of desired imagery)

MULTI-MODEL ENSEMBLE: PM FORECASTS (1)

- Fine and coarse particulate matter ($PM_{2.5}$ and PM_{10})
- Surface level
- Biomass burning emissions, but also anthropogenic and biogenic emissions

- 6 members:

Agency	System	Domain
NOAA	NAQFC-BC	Regional
ECCC	RAQDPS-FW	Regional
ECMWF	IFS-CAMS	Global
FMI	SILAM	Global
NASA	GEOS-FP	Global
JMA	MASINGAR	Global

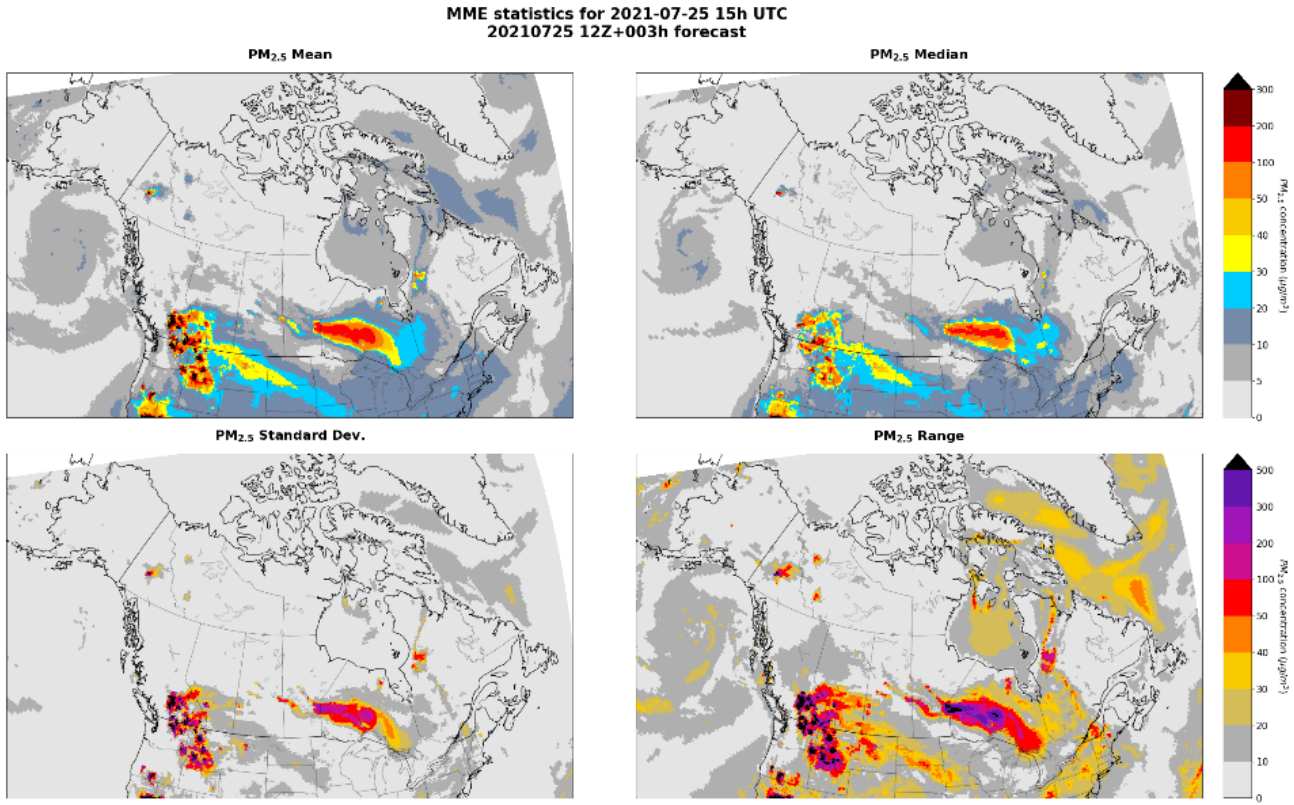


MULTI-MODEL ENSEMBLE: PM FORECASTS (2)

- Compute simple statistical fields from the members: mean, median, standard deviation, and range

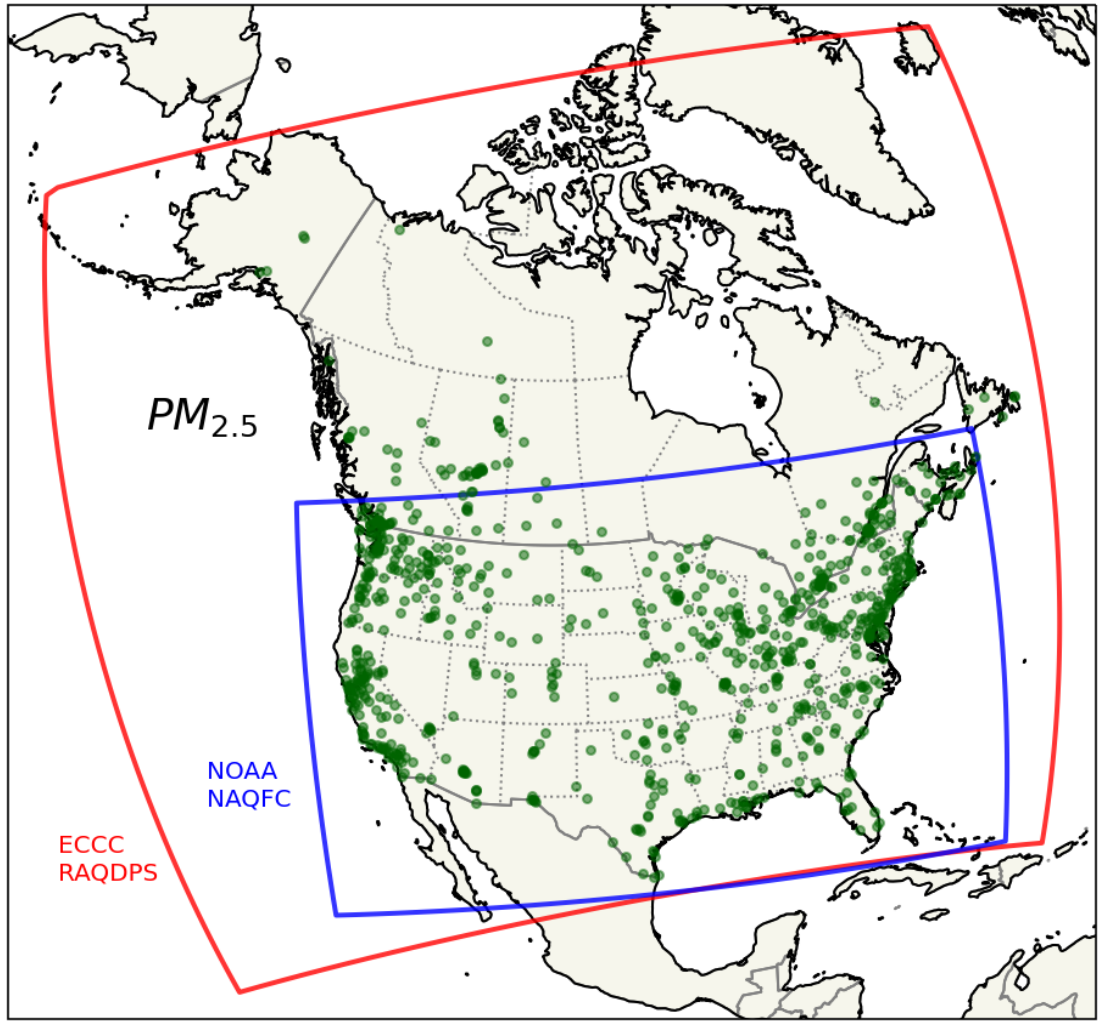
- 3 regional ensembles:
  - Canada & Alaska
  - Continental USA
  - Mexico

- 12Z start, 72-hr lead time, 3-hr time steps



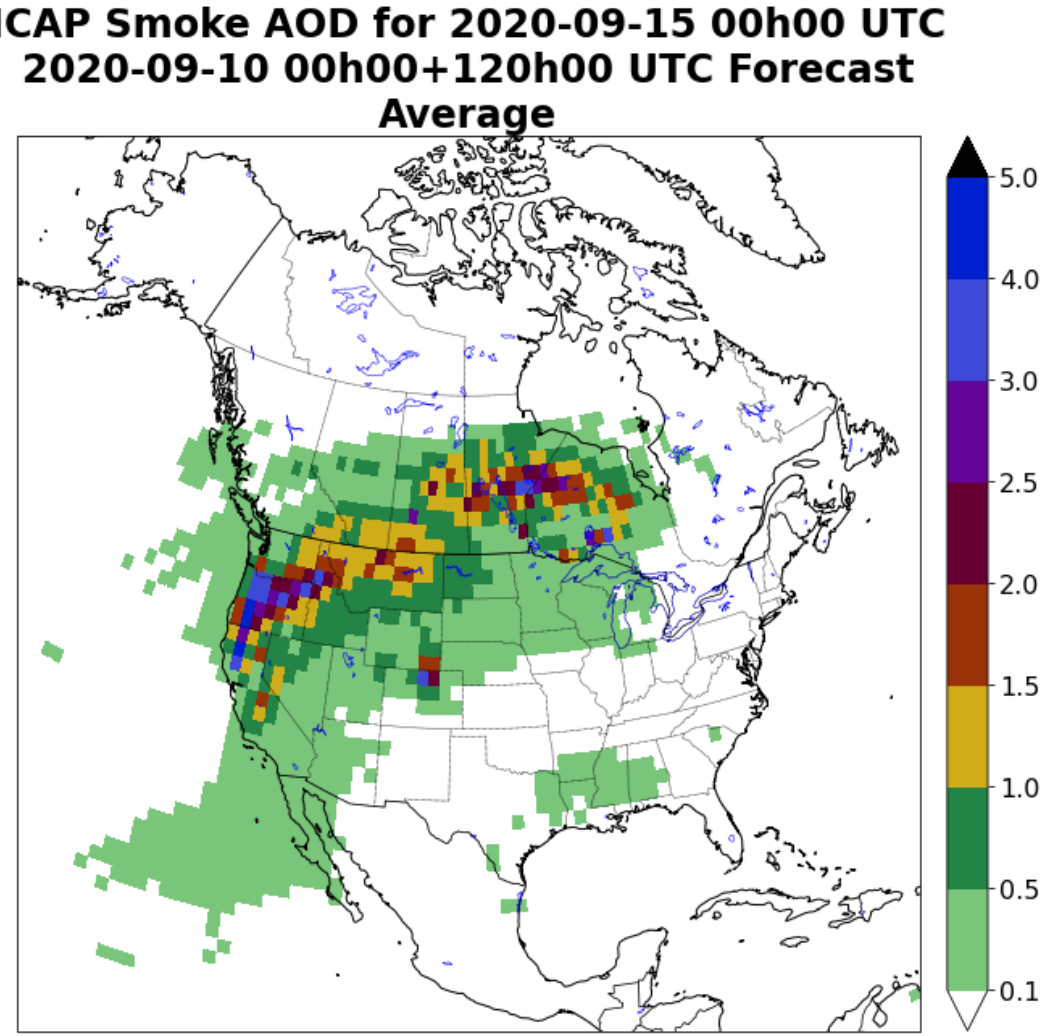
FORECAST PERFORMANCE INTERCOMPARISON

- Score the forecasts of all MME members against measurements from the in-situ AQ monitoring stations across Canada and the USA.
- Planned but currently not available on the web platform.
- A similar intercomparison is done for North America and will be the basis of this evaluation. See "Ongoing Multi-Model Evaluation of Operational Air Quality Forecasts Over North America: 2017-2020" (Moran, M.D., et al., 19th Annual CMAS Conference, Oct. 2020)
- We will leverage this work to provide multiple scores (correlation, mean fractional bias, factor-of-2 fraction, etc.) at many time scales (last day, last week, month, etc.) and for the regions of interest.



MULTI-MODEL ENSEMBLE SMOKE AOD

- Aerosol Optical Depth (AOD) is a measure of the extinction of sunlight by atmospheric aerosol particles in the vertical column.
- This product is issued by the International Cooperative for Aerosol Prediction (ICAP), which is an international forum for aerosol forecast centres, remote sensing data providers and lead system developers.
- The ICAP Multi-Model Ensemble (MME) smoke AOD is constructed from the following aerosol forecast systems: ECMWF IFS-CAMS, JMA MASINGAR, NASA GEOS-FP and NRL NAAPS. These systems differentiate smoke from the other contributions to AOD.
- Global MME forecasts up to 120-hr, 6-hr time step. Average and standard deviation statistics available.



SUMMARY AND NEXT STEPS

Summary:

- A new WMO North American VFSP-WAS Regional Centre was created recently.
- Several products related to fire risk, detected fires and smoke, and smoke forecasts are already available on a web platform or are in development.

Next steps:

- Addition of the planned products: forecast performance evaluation, GOES satellite imagery products, …
- Investigate the capacity to compute smoke-only $PM_{2.5}$ MME forecasts.

- A Steering Group was formed and met for the first time this summer and now different Working Groups are being created. Their goal will be to collect existing related information and coordinate efforts leading to new and improved services.

THANK YOU / MERCI

Don’t hesitate to send us comments/questions at na-rvfsp-wac@ec.gc.ca

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

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