NOAA's Wildland Fire Observations, Research and Services

Mike Pavolonis, NOAA National Environmental Satellite, Data and Information Service (NESDIS)

NOAA

OAR
NESDIS
NWS

November 29, 2022

NOAA Line Office Partners:
National Weather Service (NWS)
Office of Oceanic and Atmospheric Research (OAR)

NWS Fire Weather Focus is Operational

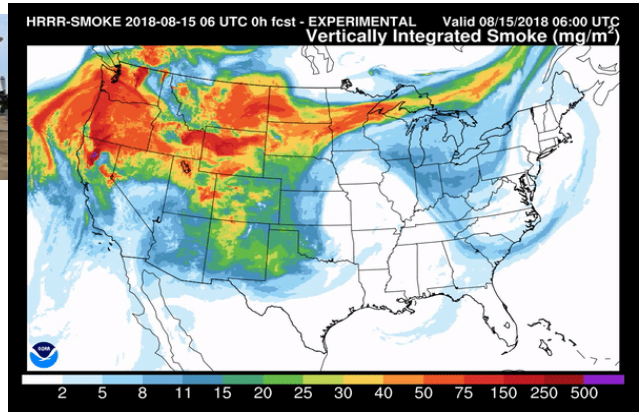
- NWS **forecasts weather conditions** that affect the fire environment **on seasonal and sub-seasonal time scales**
- **Provides one, two and 3-8 Day Outlooks,** 24/7
- Issues daily **fire weather forecasts**
- Is the authoritative source for **Spot Forecasts, Fire weather watches and Red Flag Warnings.**
- **Provides direct briefings and consultations to partners**
- **Issues National Fire Danger Rating System Forecasts**
- Dispatches **Incident Meteorologists (IMETs) to fires**

NWS forecasts rely on observations and models

NOAA Office of Oceanic and Atmospheric Research

Field Studies

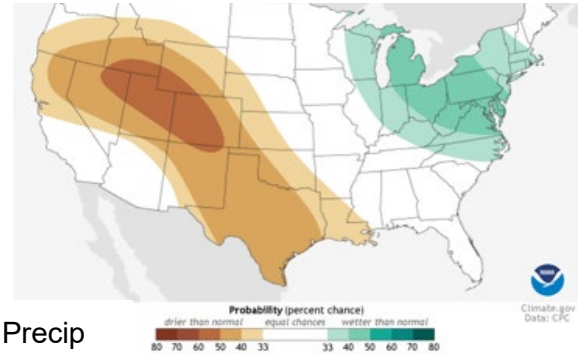
Integration of remote sensing and models



Advanced Forecast Systems and Decision Support Tools

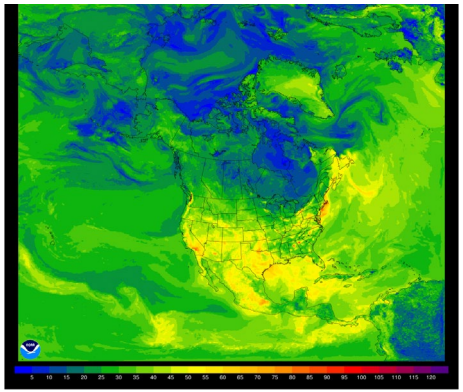
Observations and Monitoring

The Climate and Wildfire Connection



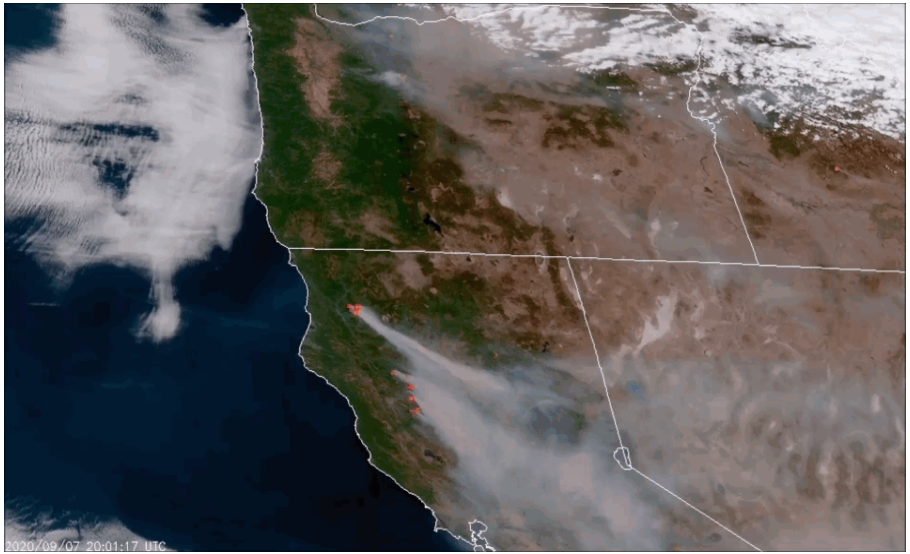
Precip

Air Quality and Fire Weather Modeling

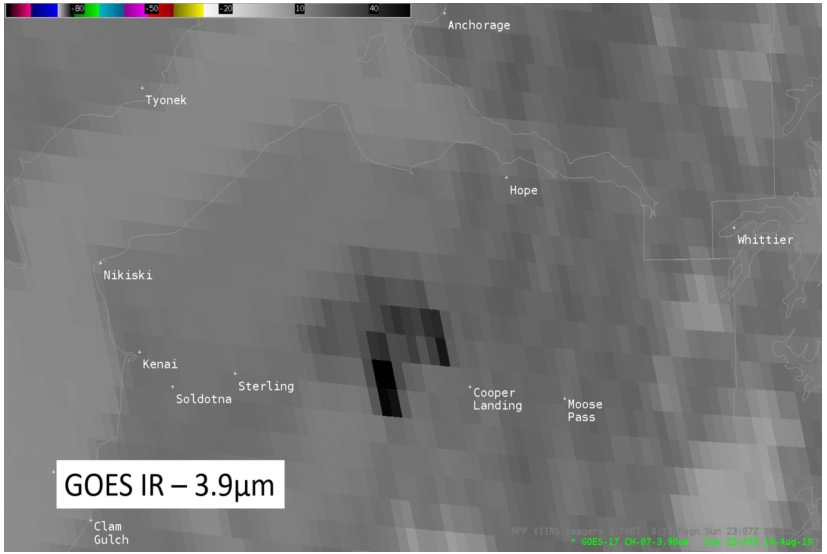


NOAA Satellite Capabilities

GOES-R Series - Geostationary



JPSS Series - Polar orbiting



NESDIS has operational fire product requirements for GOES-R, JPSS, and partner satellites (e.g., Meteosat, MetOp-SG)

NOAA Satellite Update

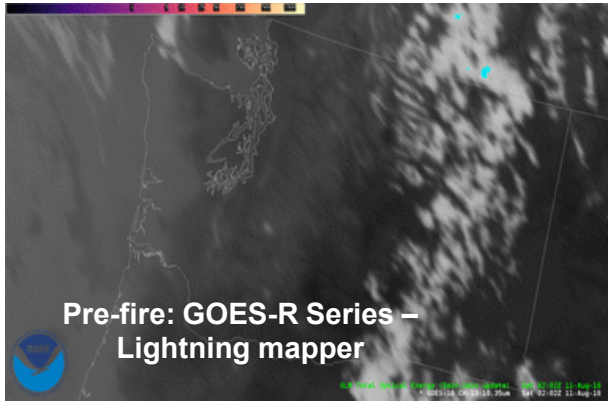
- GOES-18 is scheduled to replace GOES-17 as the operational GOES-West satellite on 4 January 2023

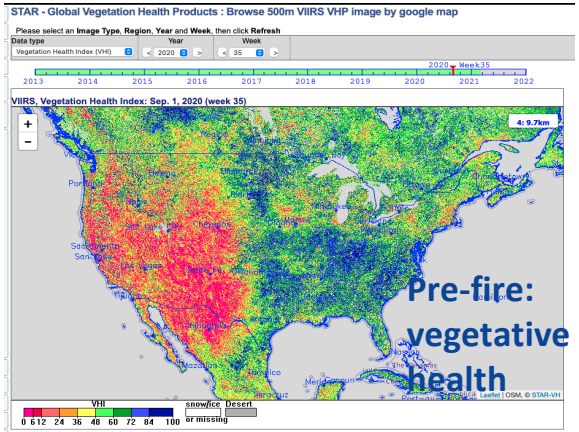
- JPSS-2 (now NOAA-21) was successfully launched on 10 November 2022 and will fly ~50 minutes ahead of NOAA-20 and ~25 minutes ahead of SNPP (NOAA-21 VIIRS radiances and imagery are expected to be fully validated by June 2023; full maturity for the active fire algorithm is expected by June 2024)

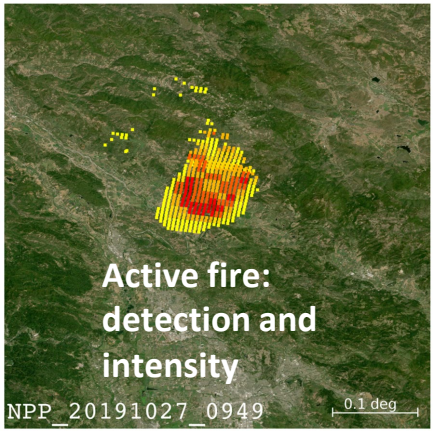
- Formulation of the next generation of GOES (GeoXO) is underway: fire user needs influenced requirements

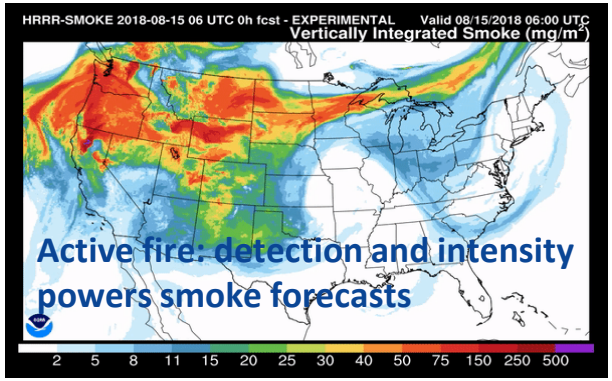
GOES-T (now GOES-18) launch on March 1, 2022

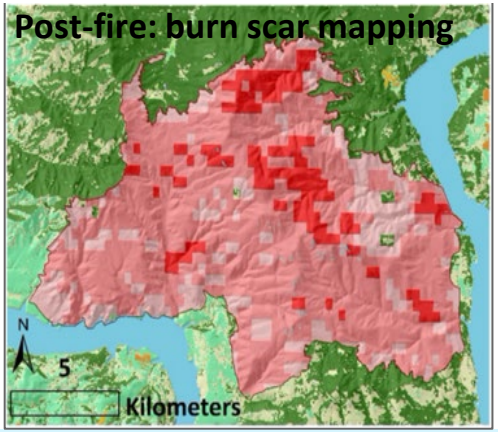
NOAA Satellites for Fire Information

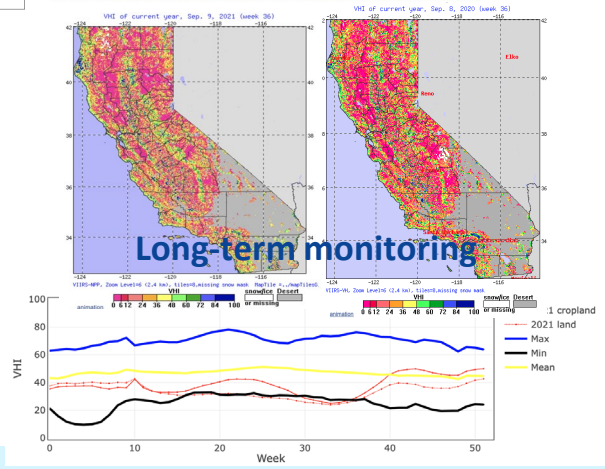












See backup slides for full list of current operational NESDIS fire products

NOAA Fire Weather Customers / Partners

Local

Regional

Geographic Area Coordination Centers

National

NGOs
Consortias

Academia

Media

Research

New NOAA Wildland Fire Initiatives

1. **NOAA Fire Observation, Research, and Services Team (FOReST):** provides guidance and strategic implementation recommendations to enable NOAA to be deliberate and effective in undertaking its wildland fire missions and in building resilience within the wildland fire enterprise

1. **FY22 Disaster Relief Supplemental Appropriations (DRSA) and Bipartisan Infrastructure Law (BIL) projects:** Projects dedicated to improving wildland fire service delivery (includes a dedicated testbed for demonstrating new capabilities)

1. **NOAA/NESDIS Wildland Fire Program:**
    a. Coordinate all NESDIS wildland fire activities in support of the overall NOAA strategy
    b. Efficiently deliver actionable information and analysis ready data (set R2O priorities)
    c. Effectively leverage and strengthen partnerships (serve as entry point into NESDIS for Wildland Fire)

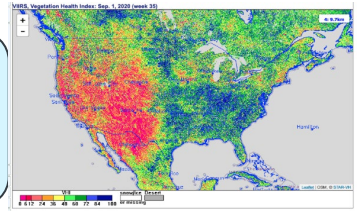
NOAA FOReST Wildfire Strategy

Engage the broader fire community

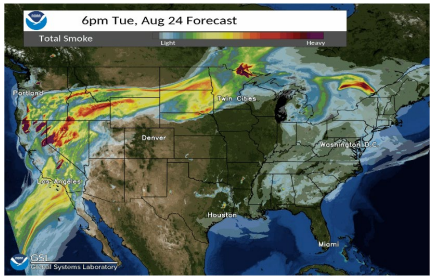
Deploy new observation systems

Equip IMETs with new systems and technologies

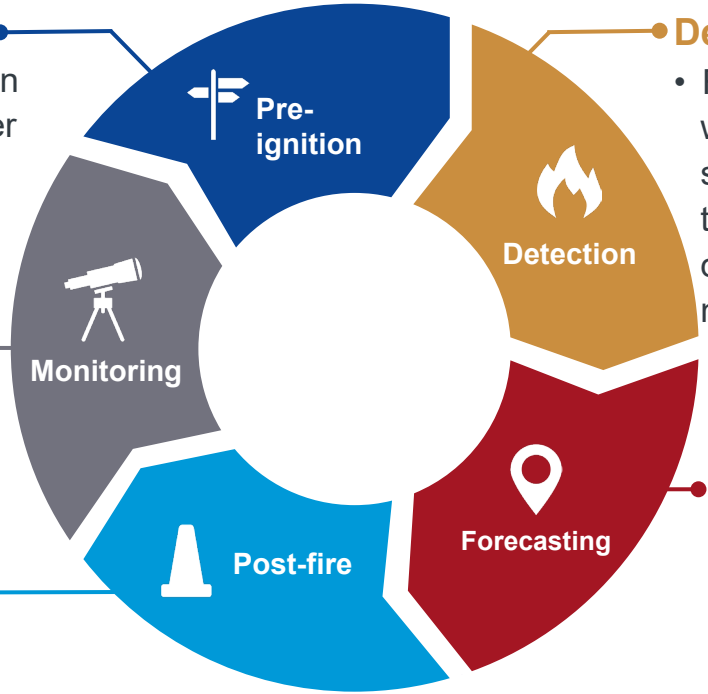
Advance early detection tools & predictive capabilities



Accelerate the development of user specific decision support tools



High Priority NESDIS Wildland Fire Program R&D Activities



Pre-ignition

- Datasets required to train and calibrate fire weather prediction models and assess threat potential

Detection

- Fully utilize weather satellites for timely fire detection and notifications

Monitoring

- Information rich database to support long-term monitoring of trends and patterns

Post-fire

- Multi-satellite burn scar database

Forecasting

- Optimize satellite derived information for fire behavior and smoke forecasting (includes FRP and high-level products for incident monitoring and nowcasting)

Overarching: effective dissemination and interoperability, with robust user interfaces

NESDIS Next Generation Fire System (NGFS)

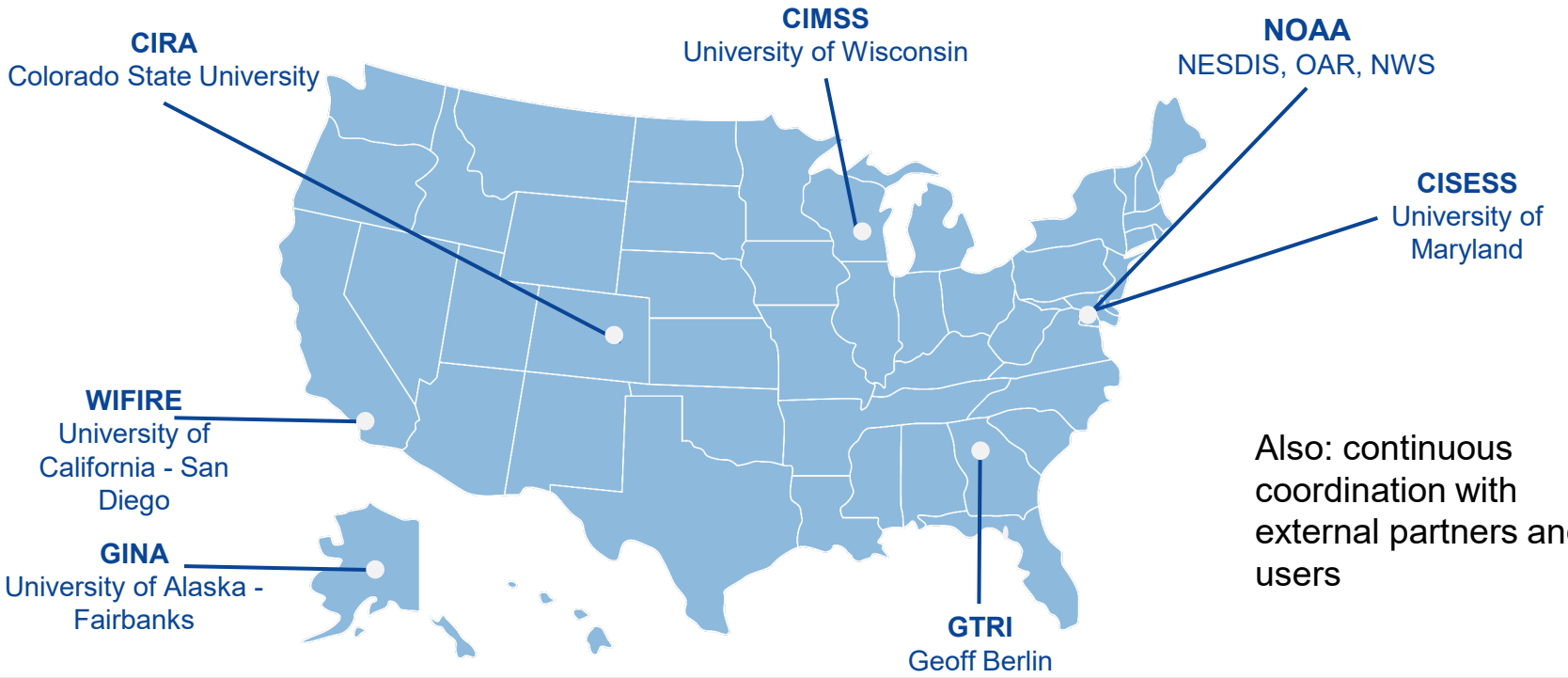
Single or multi-source GEO or LEO satellite data + supplemental data

NESDIS Fire Information System

NESDIS Fire Storefront

Fire Software Repository

NESDIS NGFS Development Team

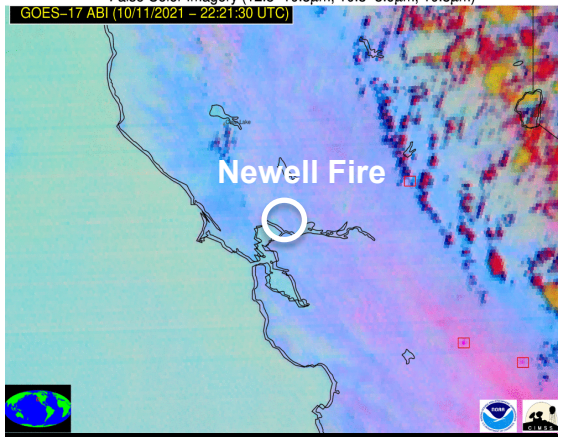


Also: continuous coordination with external partners and users

Key NESDIS Capability Development and Demonstration Activities (present-2024)

- Sensor agnostic detection algorithm that emulates human expert analysis and tracks thermal anomaly events **(NRT testing)**
- Near continuous monitoring of fire intensity (FRP) **(NRT testing)**
- Alerting and dashboard for potential new fire detections **(NRT testing)**
- Event-based data model with automated matching to NIFC incidents **(NRT testing)**
- Incident dashboard and wildfire map and data access tools **(under development)**
- Testing of NGFS products in fire and smoke prediction workflows **(under development)**
- Hazard Mapping System upgrades, including support for large wildfire mapping **(under development)**
- Testbed demonstrations **(2023+)**
- Start transitioning successfully demonstrated NGFS capabilities to operations within the NESDIS Common Cloud Framework **(2024+)**

Example New Satellite Applications



Red boxes: highlight automated fire detections

Early automated detection of new fires in weather satellite data and tracking of known events

Dashboard interface for potential new fire detections

Automated analysis of wildfire incident intensity

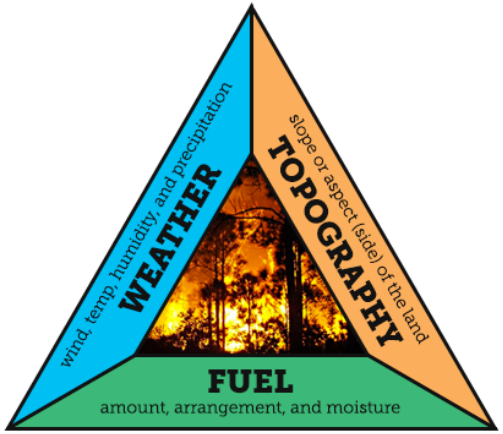
NOAA–20 VIIRS: 01 July 2022 @ 21:30 UTC

HOG BUTTE: 6522 MW	CURKY: 5843 MW	HURON: 5769 MW
SWIFT RIVER: 5544 MW	KOKTULI RIVER: 2794 MW	DOOR MOUNTAIN: 2385 MW
PADDLE: 2103 MW	SCHILLING CREEK: 1706 MW	TANANA RIVER: 1310 MW
CLEAR: 1176 MW	MINTO LAKES: 1175 MW	SNOHOMISH: 1090 MW
PACK: 1026 MW	MUD RIVER: 947 MW	TROUBLESOME: 885 MW
DONUT: 834 MW	LANSING CREEK: 824 MW	DOUGLAS: 687 MW
NORTH FORK: 573 MW	BITZSHITINI: 517 MW	GOOSE: 502 MW
DOOR CREEK: 477 MW	TATLAWIKSUK: 476 MW	PORCUPINE CREEK: 437 MW
YUKON CREEK: 360 MW	KONESS: 350 MW	CHITANANA: 269 MW
HILLTOP: 142 MW	CENTRAL CREEK AIRSTRIP: 129 MW	RADIO CREEK: 116 MW
CAMP CREEK: 63 MW	SUBMARINE CREEK: 60 MW	PIKE CREEK: 54 MW
GAGARYAH RIVER: 45 MW	BISHOP CREEK: 18 MW	LEAF: 16 MW

> 10,000 MW (0)	> 1,000 MW (13)	> 100 MW (17)
> 0 MW (6)	Undetectable (0)	

NOAA Services of the Future

The future is full integration of NOAA fire weather services with land management agency partners for **fire environment decision support services** that are comprehensive of the entire fire environment.



Fire Behavior Triangle

- Weather is one piece of the fire behavior triangle - the most dynamic piece
- All elements of fire behavior must be assessed together - including the interactions between them - for a comprehensive and accurate projection (remote sensing plays a major role)
- New products and services must be developed in the same manner in which they are served => interagency integrated fire environment decision support services

Backup Slides

NESDIS Operational Active fire products: geostationary

- Geostationary Operational Environmental Satellite – R (GOES-R): Advanced Baseline Imager (ABI)
  - GOES-16 (East); GOES-17 and GOES-18 (West)
  - 2km (at sub-satellite point) Fire Detection and Characterization (FDC)
  - full fire mask (fire detections, with confidence classes, clear land, water, cloud, etc.); fire radiative power (FRP)
  - Full Disk: 10 min; Conterminous / Pacific US (CONUS / PACUS): 5 min; Mesoscale: 30 or 60 sec
- Data access
  - Amazon Web Services

    https://noaa-goes16.s3.amazonaws.com/index.html

    https://noaa-goes17.s3.amazonaws.com/index.html

    https://noaa-goes18.s3.amazonaws.com/index.html
  - NOAA CLASS (Comprehensive Large Array – Data Stewardship System): GOES-R Series ABI Products (GRABIPRD) -> Fire/Hot Spot Characterization

    https://www.avl.class.noaa.gov/saa/products/welcome
  - NOAA Hazard Mapping System (pre-screened fire data and visualization)

    https://www.ospo.noaa.gov/Products/land/hms.html
  - NOAA AerosolWatch: visualization (including aerosol/smoke products)

    https://www.star.nesdis.noaa.gov/smcd/spb/aq/AerosolWatch

NESDIS Operational Active fire products: polar

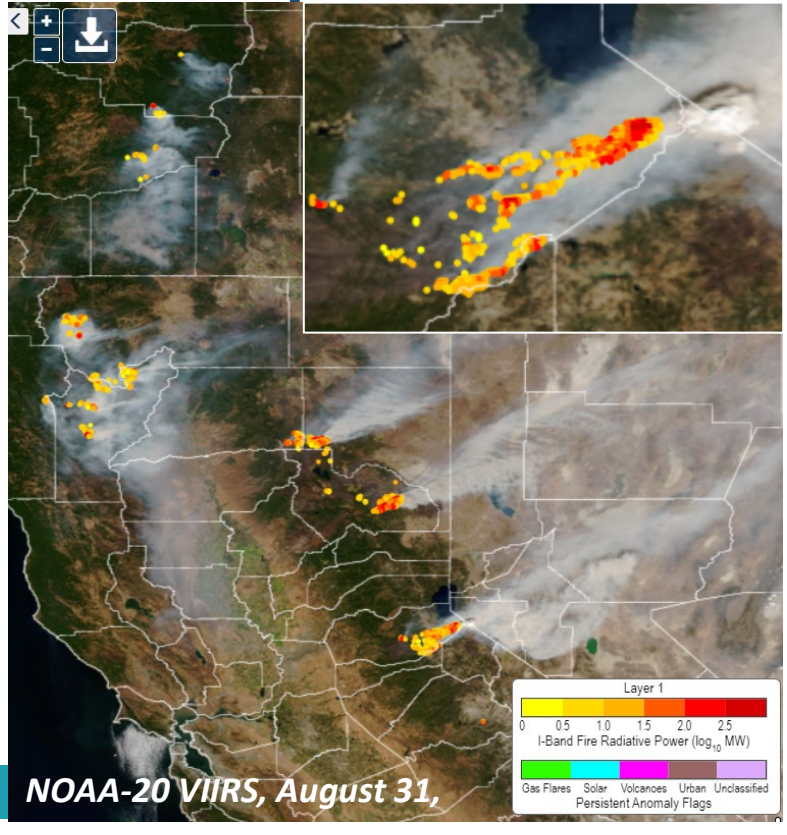
- Joint Polar Satellite System (JPSS): Visible Infrared Imaging Radiometer Suite (VIIRS)
  - Currently Suomi NPP and NOAA-20 (50 minutes apart on the 1:30 am/pm orbit); JPSS-2 -> NOAA-21 launched on 11/10/2022
  - 375m (updated; recommended); and 750m (MODIS heritage); daytime and nighttime; ~86 second granules
  - full fire mask (fire detections with confidence classes, clear land, water, cloud, etc.); fire radiative power (FRP); persistent anomaly flag (likely detection due to non-biomass burning sources of signal)
- Data access
  - Amazon Web Services: https://noaa-jpss.s3.amazonaws.com/index.html
  - NOAA CLASS (Comprehensive Large Array – Data Stewardship System): JPSS VIIRS Products (Granule)(JPSS_GRAN) -> VIIRS Active Fires I-band (or M-band) EDR

    https://www.avl.class.noaa.gov/saa/products/welcome
  - NOAA Hazard Mapping System: pre-screened fire data and visualization

    https://www.ospo.noaa.gov/Products/land/hms.html
  - JSTAR Mapper: visualization of operational VIIRS fire products (and additional products)

    https://www.star.nesdis.noaa.gov/jpss/mapper/
  - NOAA AerosolWatch: visualization (including aerosol/smoke products)

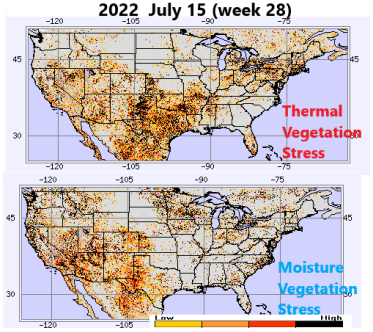
    https://www.star.nesdis.noaa.gov/smcd/spb/aq/AerosolWatch/

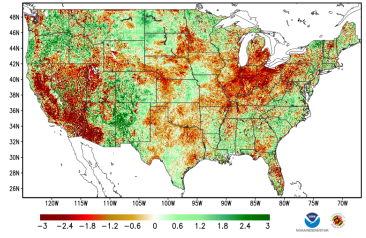


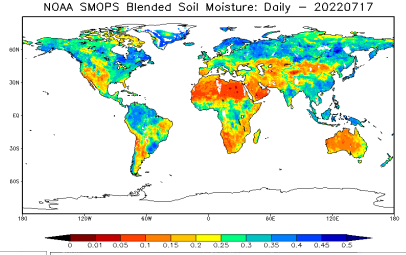
NOAA-20 VIIRS, August 31,

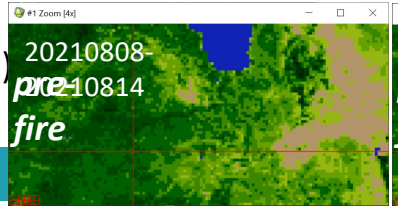
NESDIS Operational Products for pre- and post-fire assessment

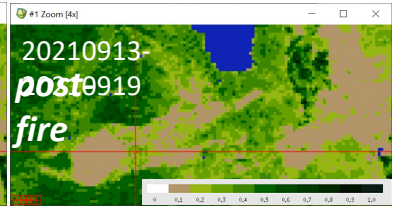
- Vegetation Health / Drought / Fire Risk (16 km, 4km, 1km)
https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/index.php
- Evapotranspiration (2km)
https://www.star.nesdis.noaa.gov/smcd/emb/droughtMon/products_droughtMon.php
- Soil Moisture
  - NOAA Soil Moisture Products System (SMOPS; 0.25 x 0.25 degree grid)
    - near-real-time: https://www.ospo.noaa.gov/Products/land/smops/)
    - archive: NOAA CLASS - Soil Moisture Operational Product System (SMOPS)
    https://www.avl.class.noaa.gov/saa/products/welcome
- JPSS Land Environmental Data Records
  - Annual Land Cover / Surface Type (1km)
  https://www.ncei.noaa.gov/metadata/geoportal/rest/metadata/item/gov.noaa.ncdc:C01472/html
  - Vegetation Indices, Land Surface Temperature (1km, 4km)
    - NOAA CLASS - JPSS VIIRS Products (Non-Granule)(JPSS_NGRN)
    https://www.avl.class.noaa.gov/saa/products/welcome



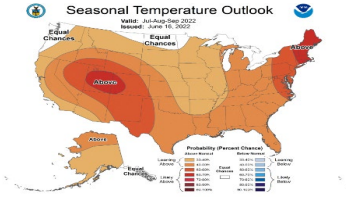


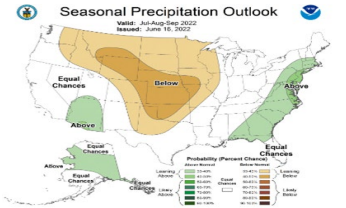


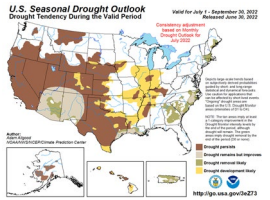


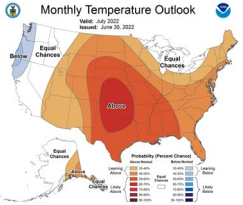


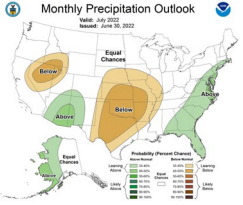
NWS Seamless Suite of Excessive Heat and Fire Weather Predictions from Climate to Weather Timescales

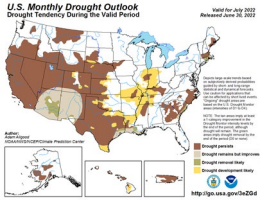


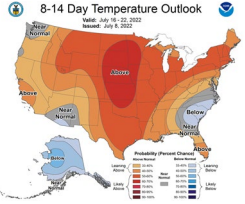


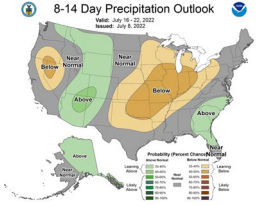


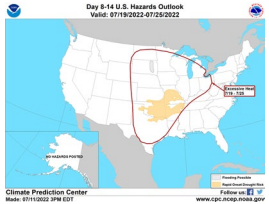


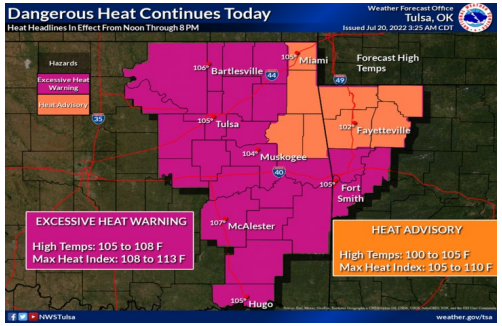


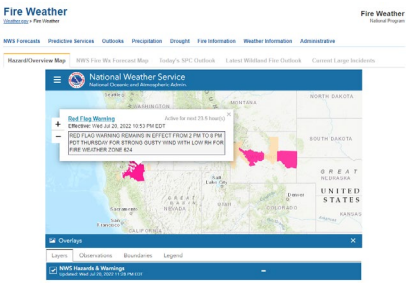












CPC Seasonal Outlooks

CPC Monthly Outlooks

CPC Week- Two Temp, Precip, and Hazard Outlooks

Fire Weather Watches and Red Flag Warnings

Overview of Outcomes from Supplemental (DRSA/BIL) Investments

Expected Outcomes:

Societal Outcome 1: Historically underserved and socially vulnerable communities, including those located in both urban and rural areas, will have equitable access to information that enables them to improve their preparedness, responsiveness and resilience to fires.

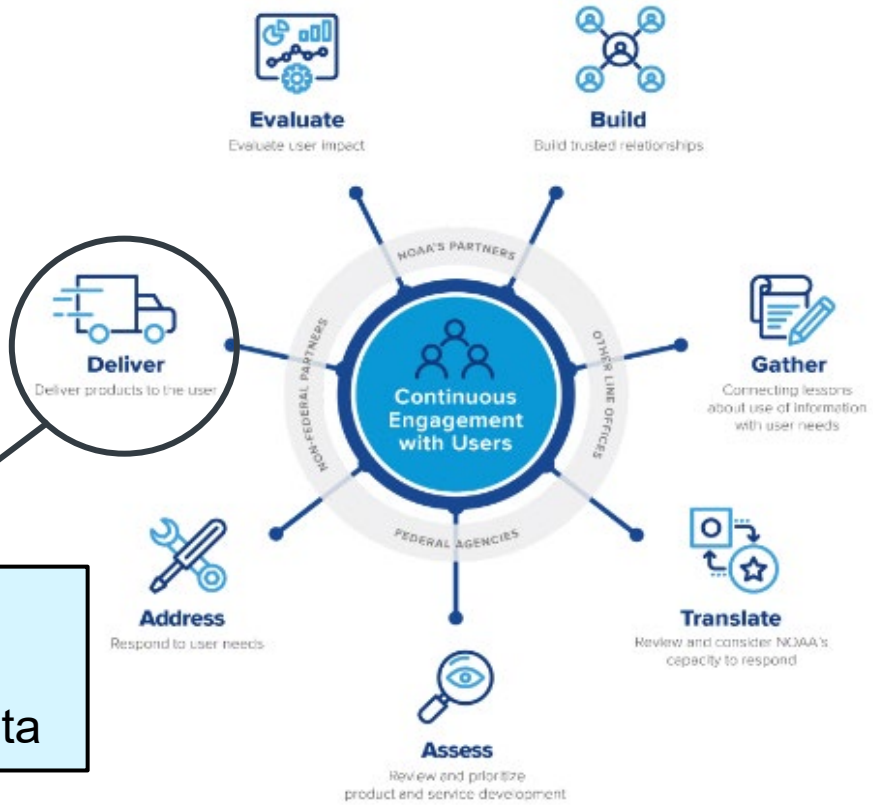
Societal Outcome 2: Fire managers will have access to more accurate forecasts for the spread of fire, including improved short-range and hourly fire and smoke forecasts, as well as extended range forecasts of smoke and air quality

Societal Outcome 3: Fire managers will have access to more accurate wildfire risk forecasts out to three months, as well as retrospective summaries, to evaluate past decisions about assets and seasonal positioning.

Societal Outcome 4: Wildland fire community will have access to timely detection and notification of newly ignited wildfires within critical fire environments that support extreme fire behavior.

Note: Societal Outcomes from WWC Strategic Plan

NOAA Service Delivery Framework



Actionable information and analysis ready data

A Future NOAA Fire Weather Testbed

Objectives

- Move advanced technologies and applications to operational platforms as quickly as possible
- Bring fire weather community together to leverage knowledge and expertise resulting in quick technological advances
- Leverage other NOAA testbeds and proving ground capabilities
- Reach beyond NOAA to build collaborations and partnerships

Anticipated Outcomes

Advanced fire weather models, products, and tools

- Better tools to detect fires early
- Advanced tools for incident-based product delivery (e.g. extreme fire behavior altering, smoke emission forecasts, improved weather forecasts at the site of a fire)
- Improved week to seasonal fire weather forecasts that incorporate climate and drought information
- Fill information gaps throughout the fire weather communities

Current NESDIS Fire Product & Services

GOES-R Ground Segment	FDC Products
NDE and CSPP	VIIRS Active Fire
Algorithm Processing Framework	E-fire
OSPO/SAB	Hazard Mapping System
NCEI	Fire data and information

Assembly required!