Science Saves: Atmospheric research in support of wildfire management
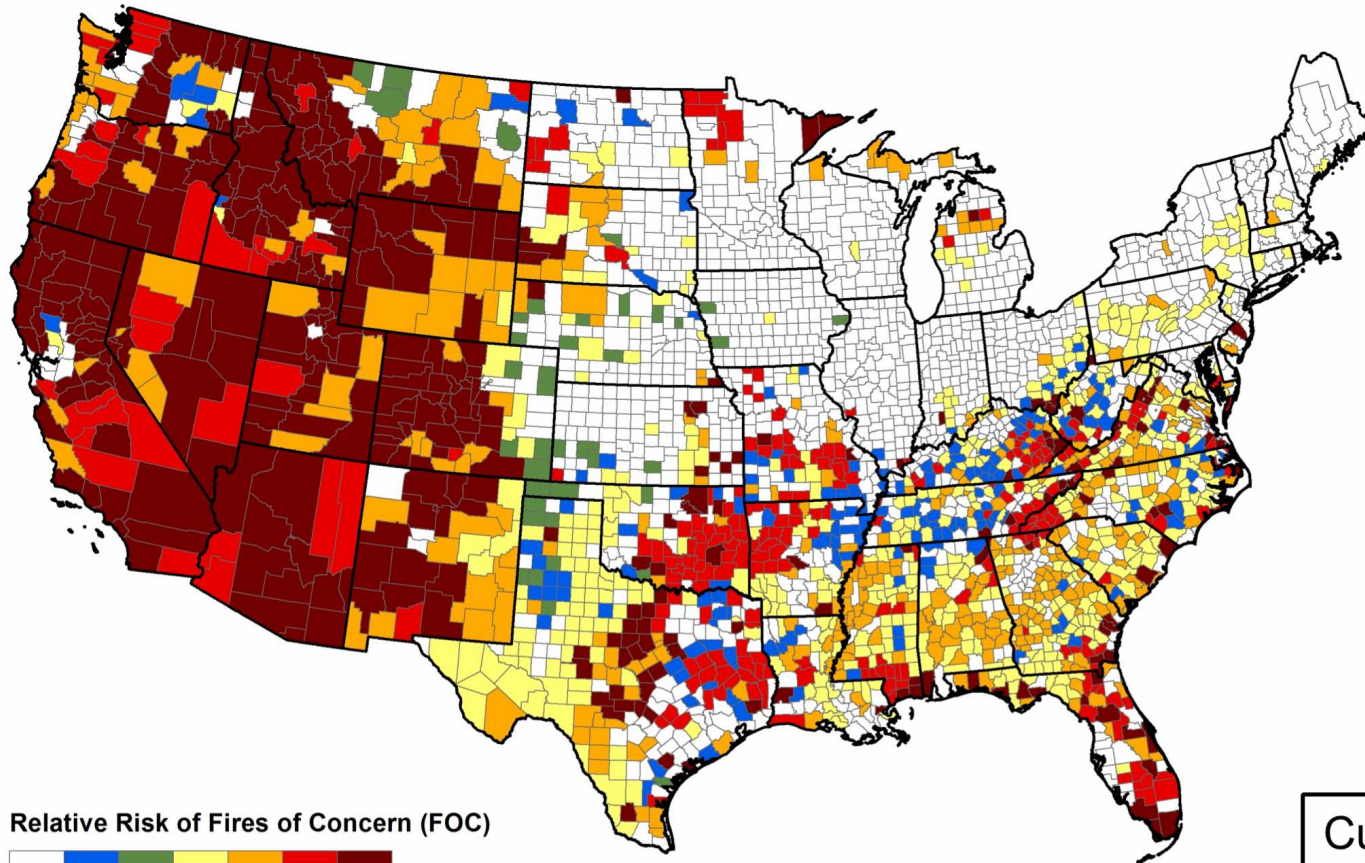
Dr. David W. Fahey, Director of the Chemical Sciences Division
and
Dr. James M. Roberts, Research Chemist

NOAA Earth System Research Laboratory
Boulder, Colorado

NOAA's Approach: Observe, Understand, Model, and Predict the Earth System

Photo: June 2012 Zach Dischner

# The issue: Living with wildfires and wildfire risk

Relative Risk of Fires of Concern (FOC)

Low Moderate High

Note: A fire of concern is greater than 1 square mile in extent and requires two weeks or more to contain

The National Strategy

The Final Phase in the Development of the
National Cohesive Wildland Fire Management Strategy

April 2014

• Wildfire smoke has recognized health effects from reduced air quality:
- • Acute respiratory impairment
- • Cardio-vascular stress

• The importance of air quality may increase in managing future wildfire
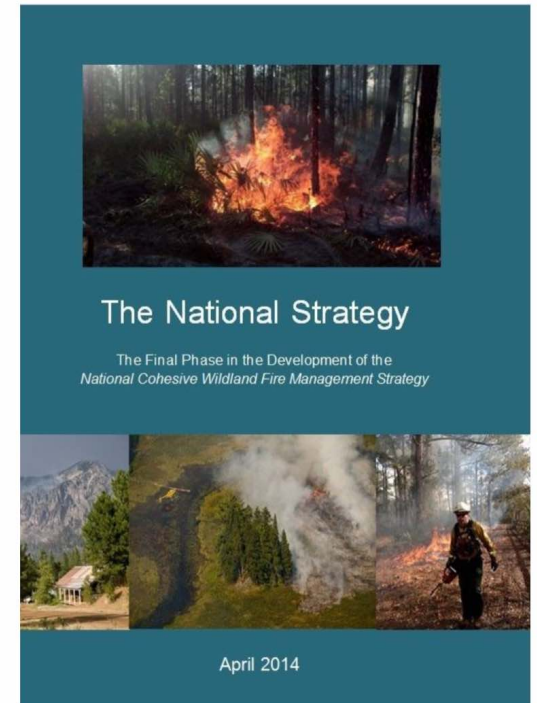
Current policy: "*To safely and effectively extinguish fire when needed; use fire where allowable; manage our natural resources; and as a Nation, live with wildland fire.*"

Department of Agriculture
Department of the Interior

Value of wildfire research

NOAA's research into understanding wildfires provides information and research at all scales to minimize damage to life and property and manage Wildfire Impacts.

For example: Where is the fire/smoke going to go, and how bad will it be?

➤ Wildfire incident-scale providing immediate guidance to local responders and health officials

- National Weather Service incident meteorologists
- Smoke transport models
- Satellite-derived products

➤ Regional to Continental-scale information

- Smoke transport models
- Photochemistry models

Provide the basis for predicting and attributing ozone (O_3) and secondary organic aerosols (SOA) (PM2.5) to wildfire sources.

Wildfires in British Columbia, Washington and Oregon

MODIS satellite instrument August 22, 2015

Seattle, Washington

Seattle Times: August 23, 2015
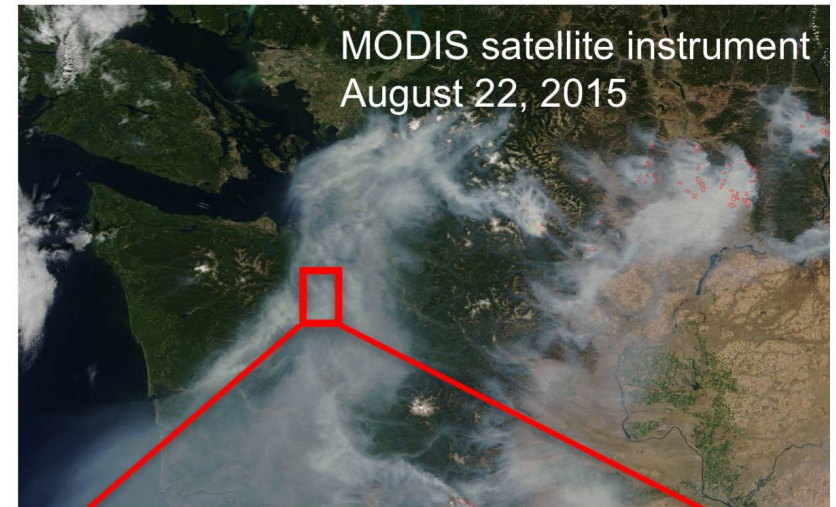
NOAA studies fire close-up

NOAA FIREX: Fire Influence on Regional and Global Environments Experiment: 2015 - 2020

• Sample smoke from 107 test fires of fuels from Western North America

• Conducted at US Forest Service Fire Lab, Missoula, Montana, Fall 2016

- 60 scientists and technicians
- 25 different institutions: academic, government, private sector
- $25 million worth of instrumentation

• Measurements

- Particles and chemical composition
- Toxic compounds unique to fires
- Chemical processes in smoke

Obtain *chemical fingerprints* from relevant fuels to inform fire models and air quality health warnings

Photos: Kyle Zarzana
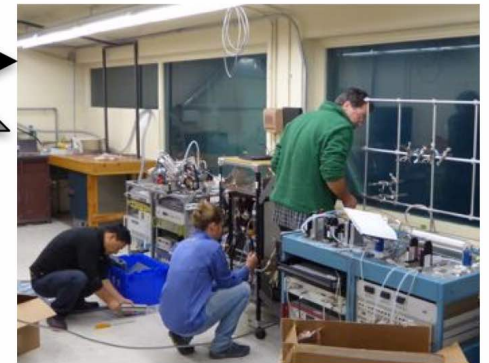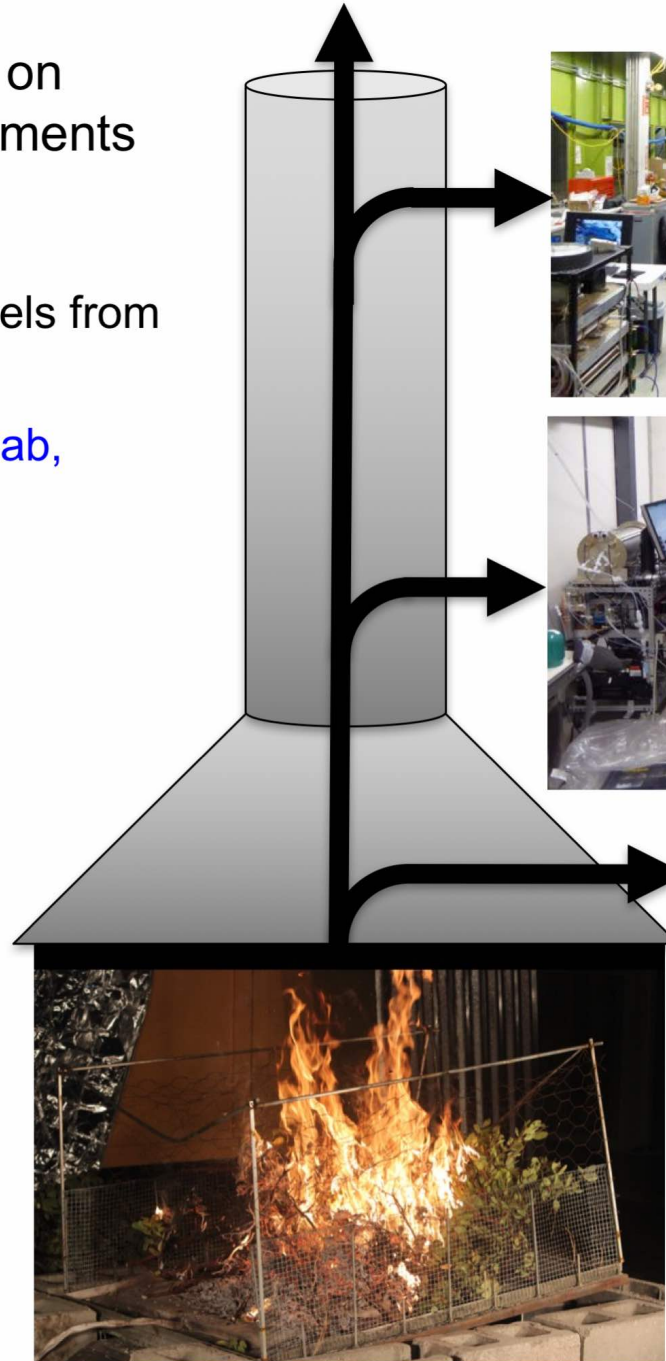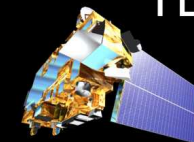
Wildfire Field Intensives
2018 -2019

- Multi-agency collaboration to study complex and understudied fire systems
- Requires multi-disciplinary effort
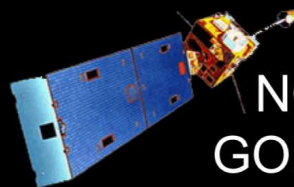
NOAA GOES-R

NOAA/NASA JPSS

NASA TERRA

Satellites: Remote Sensing

NOAA FIREX

NASA FIRECHEM

NSF WECAN

JFSP FASMEE

NASA

Aircraft: Intermediate to Continental

NOAA

NSF

Vans and Ground Sites: Local

Denver Post: wildfire near Loveland Colorado, September 12, 2010

Powerful satellite capabilities exist for wildfires

- Visible Smoke
- Fire radiative power
- Carbon monoxide
- Aerosol optical depth

[From GOES-R, Aqua and Terra MODIS satellite instruments]
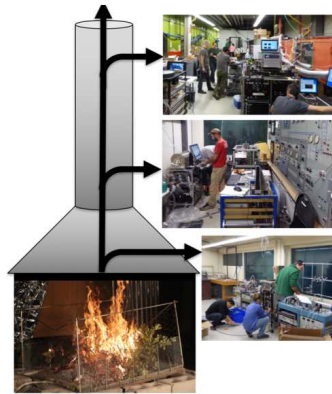[Coming: GOES-S, JPSS]

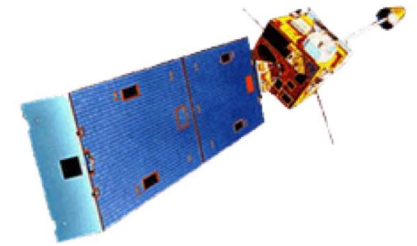- Satellite observations form the basis for smoke and air quality forecasts

GOES-R Visible Smoke

GOES-R

Sept. 4, 2017 08:02 to 16:22 Mountain Time

GOES-R, CIRA

Forecast modeling capabilities for wildfires

- Skilled models require combining lab, field, and satellite observations

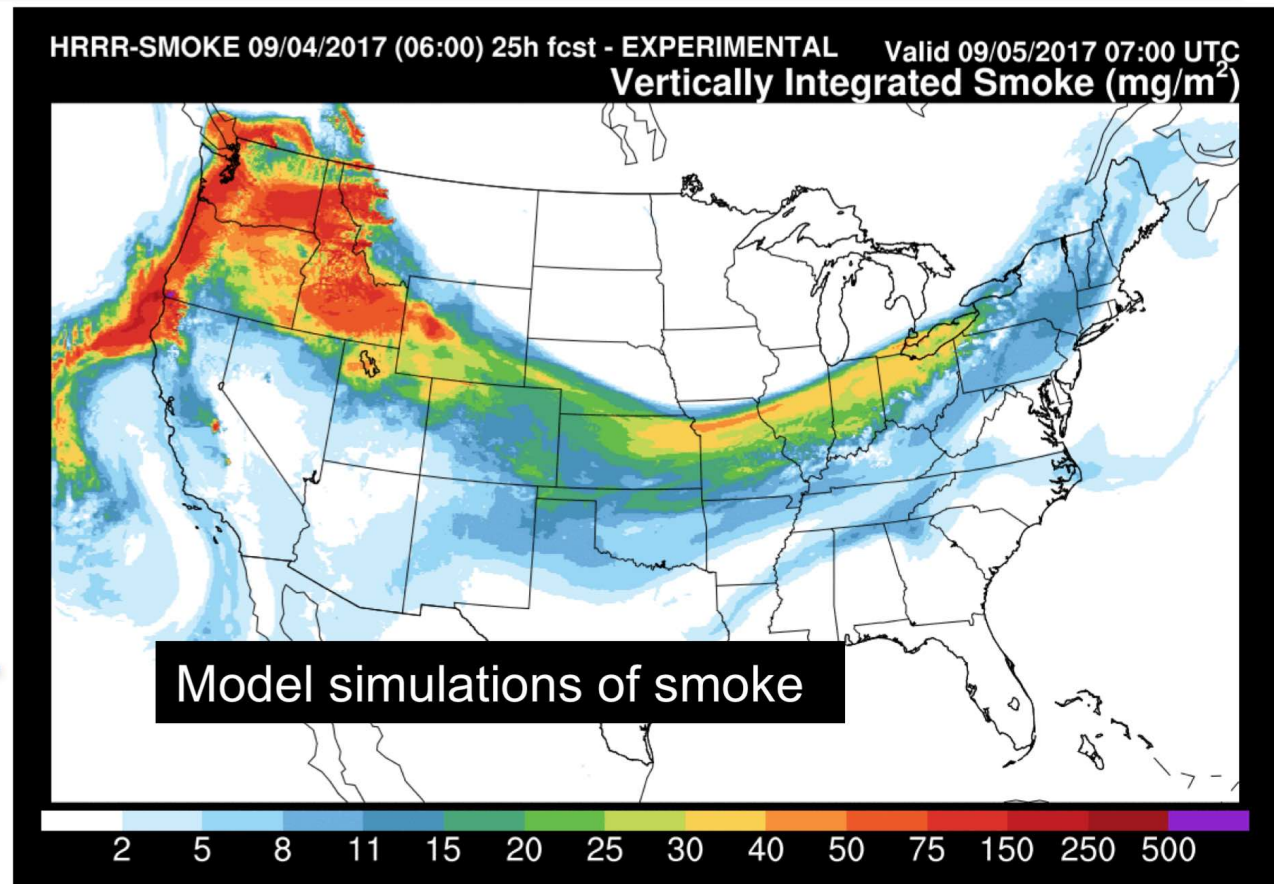**+** Aircraft: Intermediate to Continental (NASA, NOAA, NSF); Vans and Ground Sites: Local **+** GOES-R

- Skilled models are essential to understanding and predicting AQ and health impacts from fires

- Users are:
  - incident first responders
  - local health officials
  - AQ professionals, etc.

- NOAA High-Resolution Rapid Refresh Model (HRRR) – updated every 6 hours with 3-km resolution

HRRR-SMOKE 09/04/2017 (06:00) 25h fcst - EXPERIMENTAL   Valid 09/05/2017 07:00 UTC
Vertically Integrated Smoke (mg/m²)

Model simulations of smoke

2 5 8 11 15 20 25 30 40 50 75 150 250 500

Ravan Amadov, NOAA/ESRL

Concluding Remarks

Wildfire research saves lives.

NOAA, NASA, NSF, JFSP provide an expanding range of services related to wild fire management and impact assessment

- real time: forecasting and modeling tools and support

- long-term:
  - laboratory studies, aircraft and ground based field observations, model simulations
  - satellite observations

These efforts are a crucial requirement for our Nation to live with Wildland Fire

Photo: NOAA