*Public Webinars*

May 8, 2017 at 1 pm EDT

May 16, 2017 at 8 am EDT

# Wildland Fire Sensors Challenge

Partnering federal organizations:

# Wildland Fire Sensors Challenge

**Outline:**

- Brief introduction
- Perspectives from partnering federal organizations
- Challenge details

# Wildland Fire Sensors Challenge

## Motivation and Background:

- Air quality is an issue of public health concern in the United States. A number of common pollutants are regulated under the health-based, National Ambient Air Quality Standards:
  - Ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, lead, particulate matter ($PM_{2.5}$, $PM_{10}$)

Ongoing challenges to meet ozone and $PM_{2.5}$ requirements

Ozone is produced through the reaction of two pollutants (NOx, VOCs) in the presence of sunlight – a "secondary" pollutant.


**Ozone**

Fine particles ($PM_{2.5}$) generally are produced both directly from emissions as well as through reactions in the atmosphere – a "primary" and "secondary" pollutant.

**Particulate matter**

# Wildland Fire Sensors Challenge

## Motivation and Background:

- Wildland fires can produce significant air pollution, which may pose a risk to those in close proximity (first responders, residents in nearby areas) as well as downwind populations.
- Some important air quality measurements of interest during these events include:
  - Particulate matter ($PM_{2.5}$) – background air pollution plus PM produced by wildland fires
  - Carbon monoxide (CO) – produced by wildland fires
  - Ozone ($O_3$) – background air pollution, which in combination with wildland fire smoke may create greater public health concerns.
  - Carbon dioxide ($CO_2$) – combined with CO, is an indicator of fire phase (smoldering vs. flaming)

# Wildland Fire Sensors Challenge

## Motivation and Background:

- Quickly deploying air pollution measurement stations has, to date, been limited by the cost and complexity of implementation.
- Emerging technologies including miniaturized direct-reading sensors, compact microprocessors, and wireless data communications provide new opportunities to detect air pollution in real-time.
- Most research and development has been focused on general air quality levels ("ambient"), which are generally lower concentrations than during major wildland fire events.

e.g., community air sensor system developed by EPA Office of Research and Development

# Wildland Fire Sensors Challenge

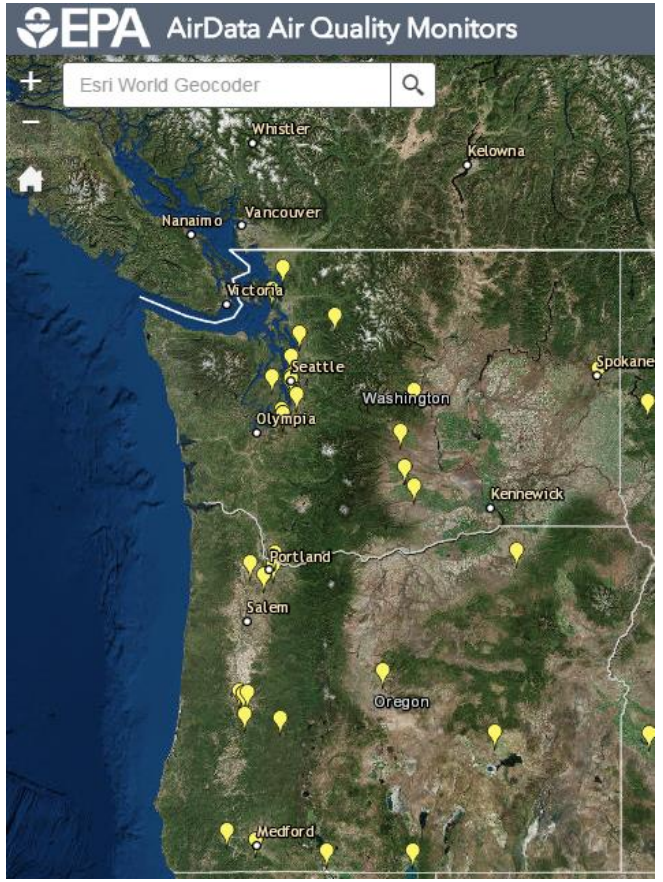
## Shared vision by partnering organizations:

A desire to advance air measurement technology to be **easier to deploy**, suitable to use for **high concentration events**, **durable** to withstand difficult field conditions, and able to report data **continuously and wirelessly**. Desired measurements: $PM_{2.5}$, $O_3$, CO, $CO_2$.

# Wildland Fire Sensors Challenge

## U.S. EPA - Motivation and Background:

- United States Environmental Protection Agency mission: Protect human health and the environment
- Wildland fires are important contributors to multiple pollutants regulated under the Clean Air Act – particularly fine particulate matter ($PM_{2.5}$)
- Recognition that national ambient monitoring network may not sufficiently inform air pollution exposure during major wildland fire events.




*Active $PM_{2.5}$ monitors in Washington and Oregon*

# Wildland Fire Sensors Challenge

## NASA - Motivation and Background:

- NASA is interested in improving the use of satellites for detecting fires as well as measuring fire intensity and emissions of trace gases and particles.
- We also study the transport of, and chemical transformations in, biomass burning plumes and their impact on air quality.
- Using satellite products, we strive to improve the inclusion of wildfires in air quality forecast models.

*International Space Station view of agricultural burns along the U.S. Gulf Coast.*

# Wildland Fire Sensors Challenge

## NPS - Motivation and Background:

Desirable multipollutant sensor attributes:

- Quantify air quality conditions for:
  - Visitors, employees, gateway communities
- Deployed during wildland fires and other events
  - Wildfires and prescribed fires
- Easy set-up and data retrieval
  - NPS employee or an air resource advisor

# Wildland Fire Sensors Challenge

## U.S. Forest Service - Motivation and Background:

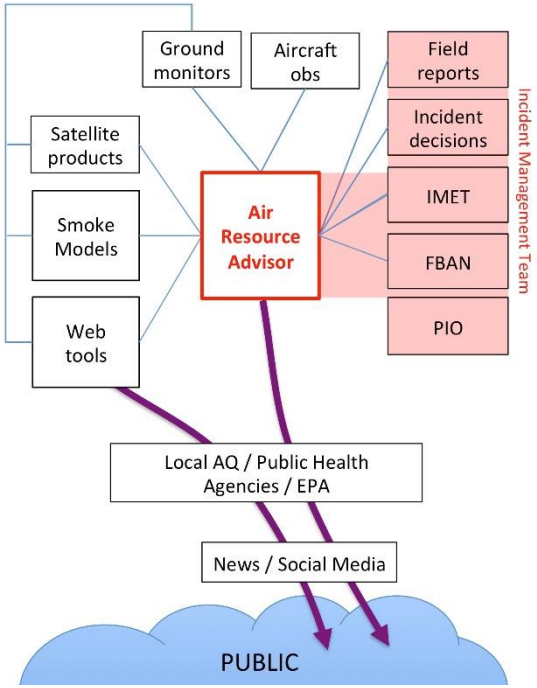
**Wildland Fire Air Quality Response Program**

- Addressing the impacts of wildfire smoke
- 1 in 3 households has respiratory challenge (asthma, COPD, emphysema, heart disease…)

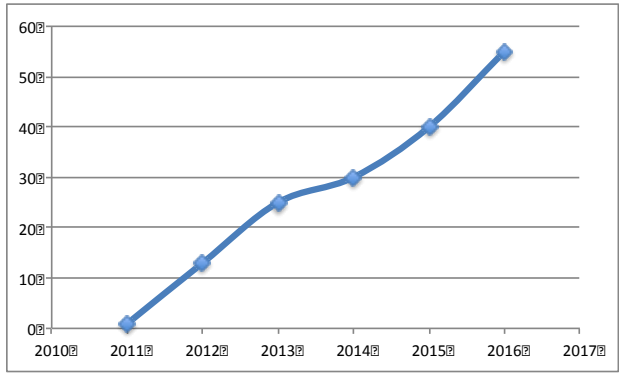
**Air Resource Advisors** are smoke specialists who support part of a wildfire Incident Management Team

- Use models to help forecast smoke impacts
- Deploy air quality monitors for public smoke outlooks, model validation, support on-fire decision-making
- Work with state/tribal/local agencies, public and communities

***New monitoring technology would aid smoke forecasting & provide better information to help the public reduce their exposure if needed.***



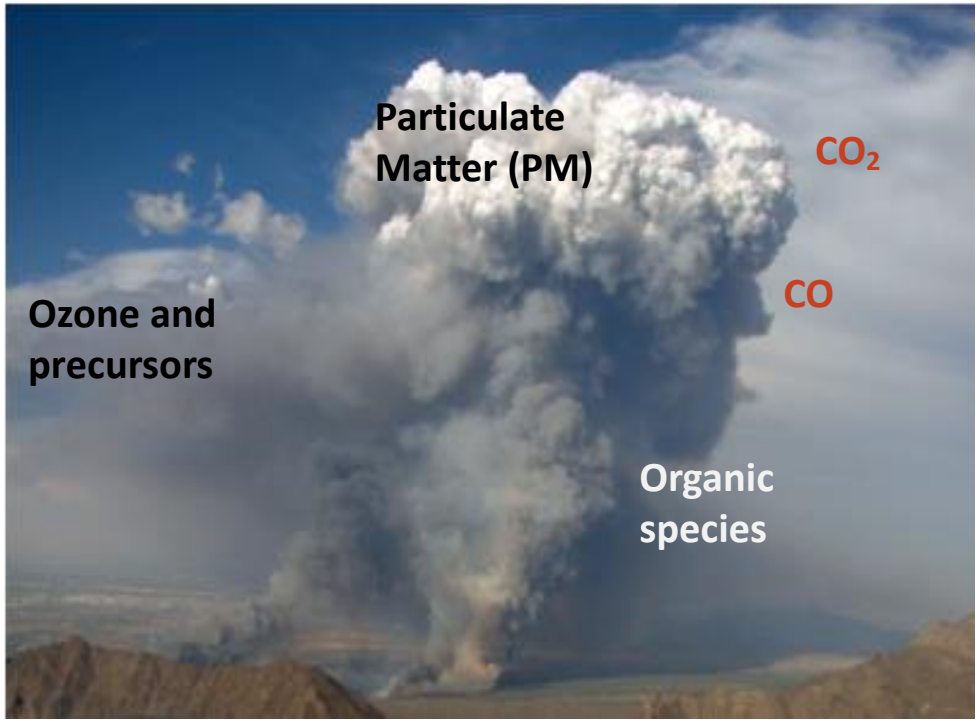

ARA Deployments by Year



# Wildland Fire Sensors Challenge

## NOAA - Motivation and Background:

- National Oceanic and Atmospheric Administration: Provide sound scientific information for decision making
- Improved understanding of wildland fire impacts requires high quality observations of emissions from fires.
- Capability for rapid deployment of air quality monitoring instruments is essential because wildfire occurrence and growth are highly uncertain.



# Wildland Fire Sensors Challenge

## CDC - Motivation and Background:

- This tool could strengthen existing situational awareness competencies at the state and local level, and expedite response and recovery efforts during wildfire smoke episodes.
- It will also allow decision-makers to plan for potential health care needs prior to and during an event.
- This will allow us to get prevention messages quickly to the people most at risk from wildfire smoke.

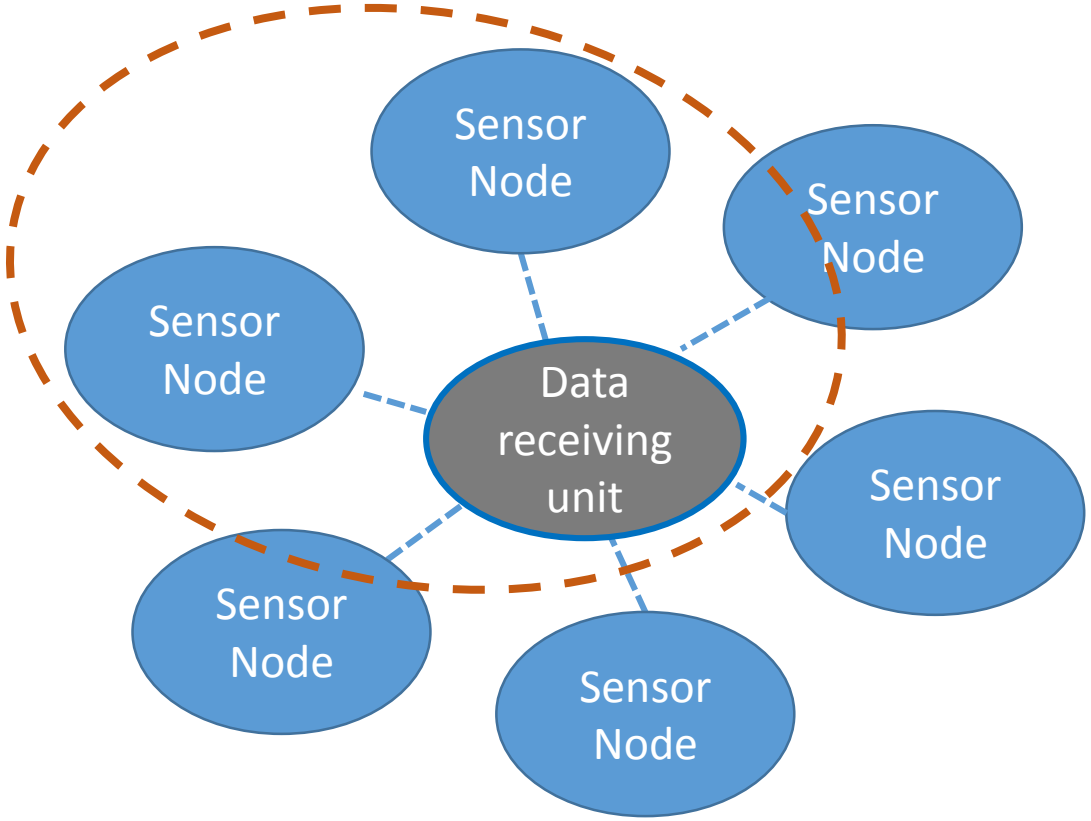
# Wildland Fire Sensors Challenge

- Prize level is a maximum of $60,000, which may be divided into multiple awards.
  - Additional benefit to participants: EPA/USFS laboratory evaluation and feedback on their submitted prototypes.
  - Possibility of a marketable product – joint sponsorship of challenge indicates a diverse set of federal organizations identify this as a technology of interest.
- Solutions: seeking actual working prototypes to be submitted
- To receive an award, the Solvers will **not** have to transfer their exclusive IP rights to the Seeker.
- All official entries must be submitted via the InnoCentive website: https://www.innocentive.com/ar/challenge/9933927

# Wildland Fire Sensors Challenge - Details

## Challenge specifications:

- Measurements: $PM_{2.5}$, CO, and $O_3$ of concern for human health, $CO_2$ is useful information to track fire phase
- Easy to use, rugged, self-powered, include location data, and wirelessly transmit data (every 5 minutes) to a central data-receiving station
- Operates without operator support for at least 15 days.
- Two nodes and a data receiving unit are requested for the submission.



# Challenge: Target Measurements

- Target measurement ranges are shown below - the large range identified for all parameters is related to the dynamic concentration levels that may be experienced.
- Solvers will not be disqualified if these targets are not exactly met – the target ranges should be considered as goals to aim towards.

| Pollutant | Target lower / upper detection limit |
|---|---|
| $PM_{2.5}$ | 10 / 1500 µg $m^{-3}$ |
| CO | 1 / 500 ppm |
| $O_3$ | 20 / 200 ppb |
| $CO_2$ | 350 / 10,000 ppm |

| Metric | Target |
|---|---|
| Accuracy | 20% |
| Linearity | 20% |
| Precision | 20% |
| Calibration error | 10% |
| Operability / durability | Qualitative |

# Challenge: Cost

- The shared vision is for an easy to deploy air monitoring tool that could be used in large quantity – therefore, cost-effectiveness is a consideration.
- A cost estimate should be estimated for a production scale, turn-key sensor network kit composed of six sensor nodes and one central data receiving unit.
- $40,000 is considered the upper price point for cost-effectiveness; however, this cost is still prohibitively expensive for many potential users (e.g., state/local agencies).

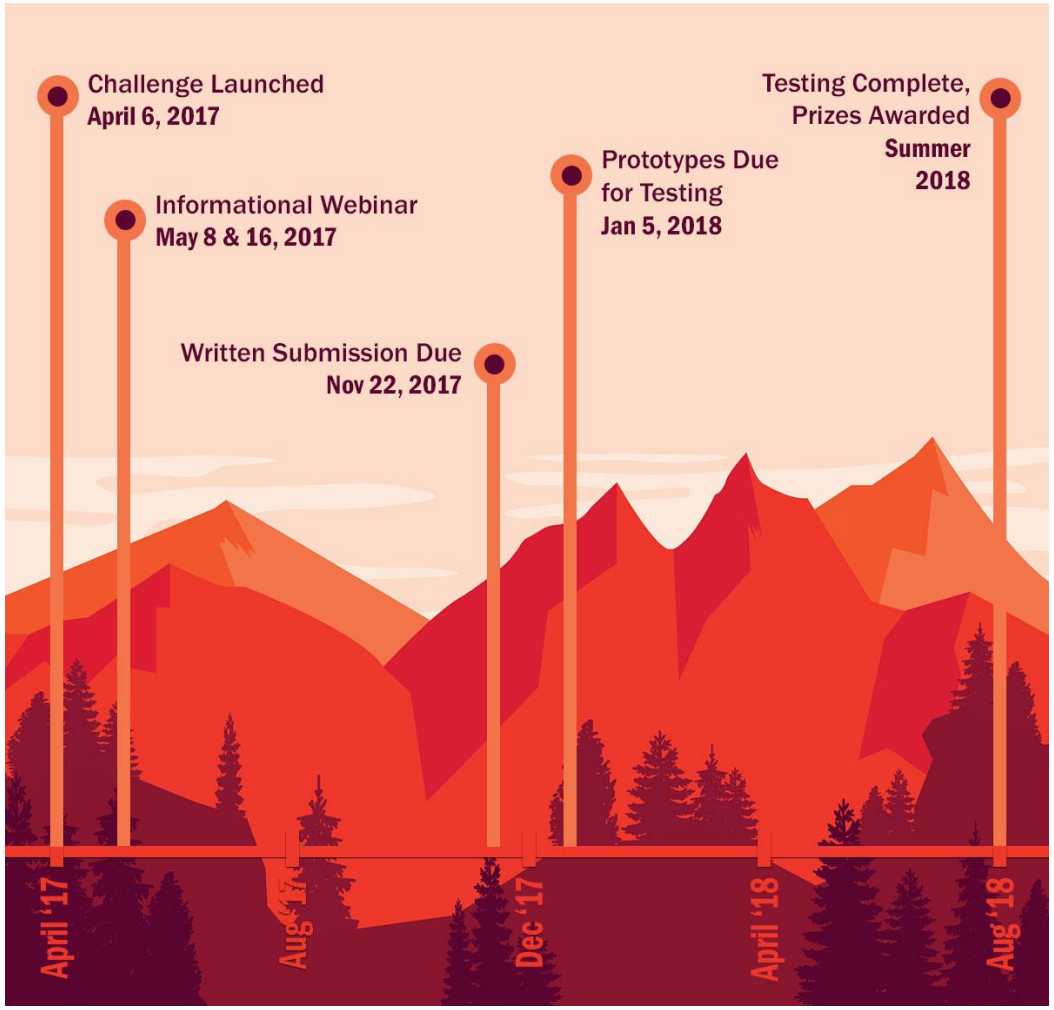
# Submissions: Steps 1 & 2

- Step 1: written preview, including
  - brief description of the measurement principle for the four target pollutants
  - size (weight and dimensions)
  - power requirements
  - maintenance procedures
  - data communications
  - cost estimate
  - photograph
- Step 2: prototype sensor system
  - prototype sensor system (2 nodes plus central data receiving unit)
  - Supporting documentation, including the following:
    1) Operation manual
    2) Description of any potential safety hazards
    3) Cost estimate

# Challenge: Judging and Award

- Candidate prototype systems will be evaluated in two research laboratories sequentially (EPA and USFS)
- Sensor performance grading towards the award will be weighted most heavily toward $PM_{2.5}$, followed by CO, and finally $O_3$ and $CO_2$.
- Evaluation will also include qualitative review of usability, durability, safety features, cost and data transmission/storage capability.
- Evaluation by EPA and USFS will result in:
  - Direct short report feedback to individual Solvers on the laboratory testing and qualitative evaluation
  - Public summary of challenge and performance testing results; Solvers' identities remain anonymous unless they opt-in to having their brand identified with their sensor system.
  - Information for full set of sponsoring organizations to determine one or more awardees

# Schedule and award




**Key deadlines for Solvers:**

1. Written preview of solution (Nov 22, 2017)

2. Shipping of prototype sensor system for testing (Jan 5, 2018)

# Thank you! Questions?

- Website for complete Challenge information:

https://www.innocentive.com/ar/challenge/9933927

Social media: #WildlandFireSensors