FUEGO:
Need, Background, Capabilities

FUEGO Original Vision:

- A fire of ~10 square meters is found from space.
- Early detection coupled with early suppression increases probability fire can be handled by initial attack efforts.

➢ *Still a goal but we have expanded.*

FUEGO Immediate Vision:

We can mobilize existing sensor, platforms, software, and communications system to start to reduce the damage now!

Fuego Vision Expanded

- Shovel-ready
  - Mountain Top Cameras for Smoke Detection
  - Maximize Use of Existing Satellite Systems
  - Mobilize COTS thermal cameras at several wavelengths to provide first systematic mapping system capable of day/night real-time production of analyzed common operating picture (COP).
  - Mobilize modern, redundant communications pathways to communicate COP up and down command structure.
- Longer Horizon
  - Cube-Sats or other less expensive yet effective Space Systems
  - High Altitude Autonomous Systems: Balloons, UAVs, or Hybrid
  - Improve fire prediction/simulation models via high spatial/temporal resolution data; leading to a robust data-assimilation driven prediction system.
  - Help Agencies utilize modern intelligence tools and techniques

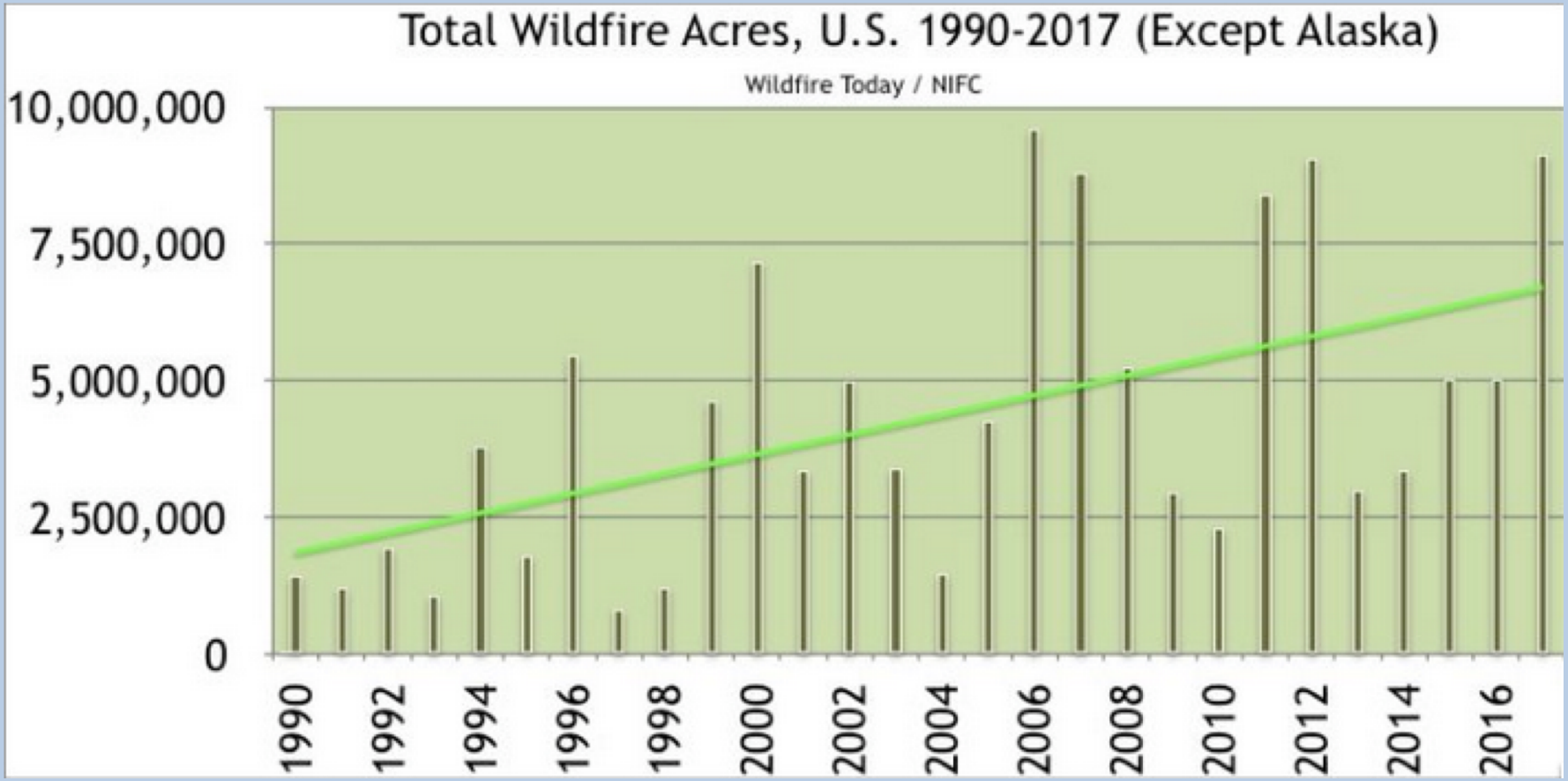
Why Should DOE Care: Climate Change!

Greenhouse Gas Contribution:

In 2015, California Fires are speeding up climate change and, as 5% to 7% of California's $C0_2$ comes from wildland fires (from a UC Berkeley study – http://news.berkeley.edu/2015/04/15/california-carbon/).

Wildland fires will be an increasing proportion of CO_2, as we get more fires and we reduce our usage of fossil fuels.

California Urgently Needs to Try to Reduce the Growing Damage and Loss of Lives from Wildland Fires



The State

Fire Insurance Payouts Could Reach $3 Billion

State and industry figures show that last month's blazes were the costliest since flames ravaged San Francisco after the 1906 quake.

November 18, 2003 | Kenneth Reich | Times Staff Writer

State government and insurance industry sources said Monday that insurance payouts from the Southern California wildfires could hit $3 billion and that more claims are being filed than originally predicted.

This would make the October wildfires the costliest conflagration since 1906, when a great fire that followed the massive earthquake in San Francisco caused $5.7 billion in damage, in inflation-adjusted dollars.

Norman Williams, a spokesman for state Insurance Commissioner John Garamendi, said that 12,769 claims have been filed so far in the recent wildfires and that the total policy limit under those claims is $3.45 billion.

But not every claim may entitle a policyholder to the maximum benefit. The Personal Insurance Federation, a leading industry lobbyist in Sacramento, is estimating that total payouts will range from $2.5 billion to $3 billion, according to Jerry Davies, a spokesman for the group.

FROM THE ARCHIVES

Modesto prosecutors to retry 72-year-old man in...
May 7, 2013

Man serving life sentence for 1997 arson deaths ordered...
April 12, 2013

Paying for unemployment

Example 1:

Oakland Fire, 1991: 25 People died, 150 injured, 3,000 dwellings destroyed. Financial impact > $1.5 billion

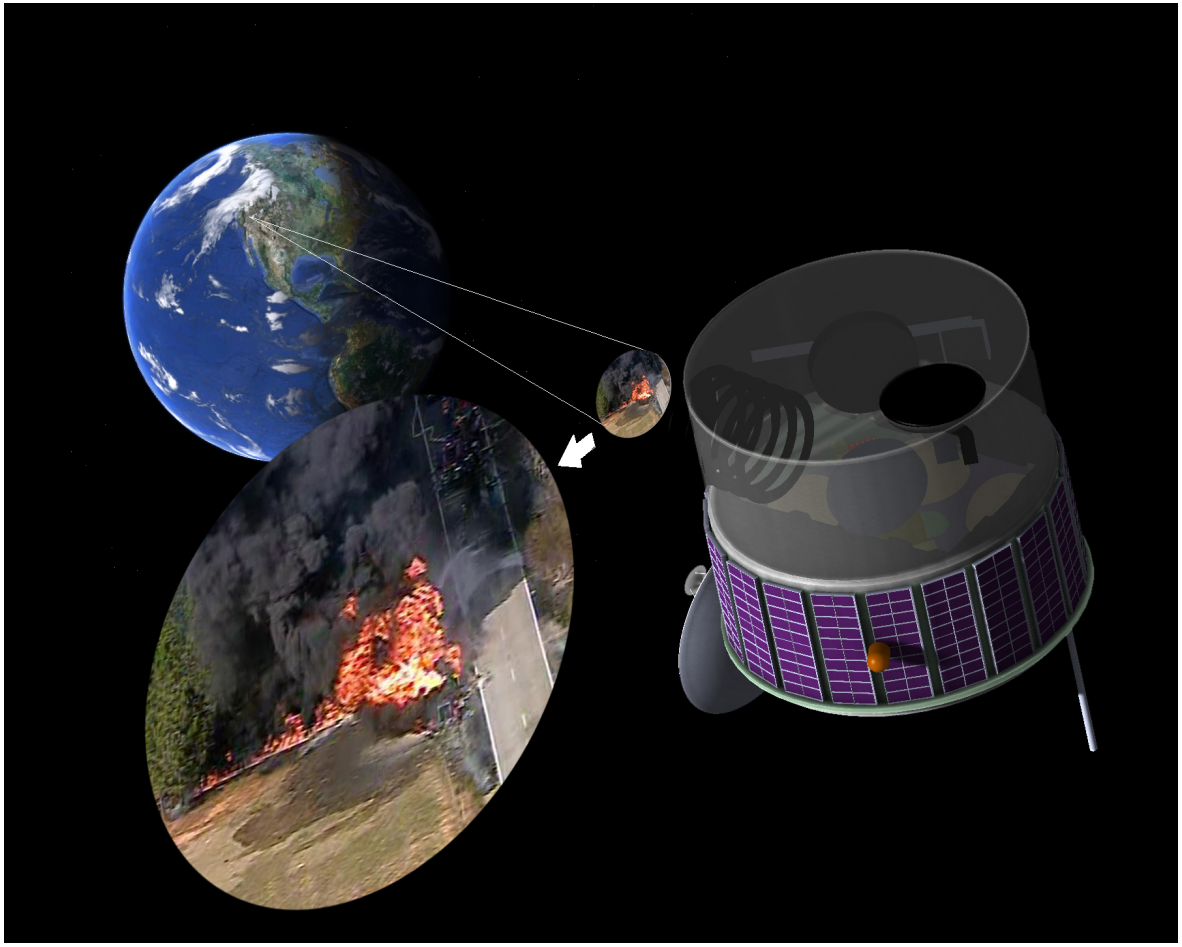
THE 1923 BERKELEY FIRE

On the morning of September 17, 1923, a grass fire spread from Wildcat Canyon over the hills into Berkeley. Driven by hot, dry winds, the fire spread rapidly across the northeast residential districts of the city, burning as far south and west as this downtown block.

In just a few hours, nearly 600 homes and dozens of entire blocks burned north of the University of California campus and east of Shattuck Avenue. Downwind, a rain of blowing embers started small fires and endangered buildings throughout the business district and in central, west, and south Berkeley.

The 1970 Fish Ranch fire would have been a repeat but for an aggressive attack.

Background of FUEGO
Fire ***U***rgency ***E***stimator on ***G***eosynchronous ***O***rbit



Widely Applied Particle Astrophysics – the Berkeley Supernova Searches

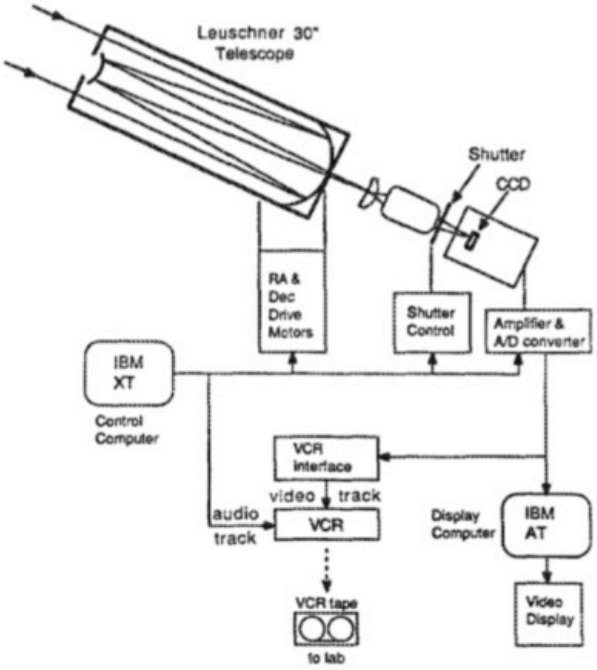
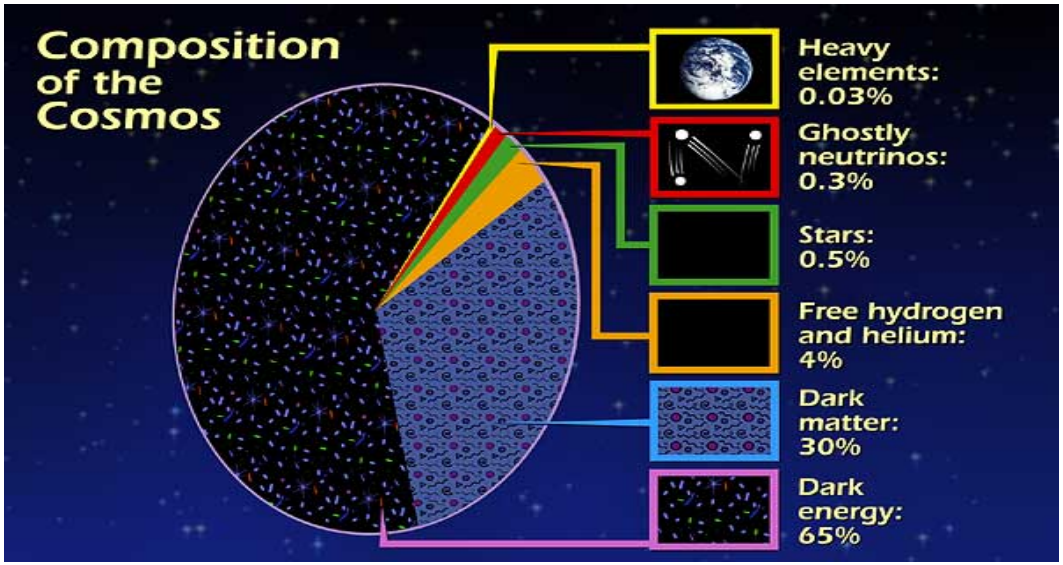


FIG. 1. Design of the Berkeley system—overview. The Berkeley system shown uses a computer-controlled, fast-slewing telescope and charge coupled device (CCD) camera to collect images of galaxies; these images are compared in the lab to stored reference images by a dedicated minicomputer.

Led to Nobel Prize (Saul) , Breakthrough Prize, Gruber Prize for whole team

The **Nobel Prize** medal for Physics, Chemistry, Physiology (or Medicine) and Literature **Nobel Prizes** C...



FUEGO Timeline

- Oakland Fire – Bob Tripp and I calculate signal at a geosynchronous satellite from a fire. Nature Magazine rejects it.
- 2013: More fires – Lampton, College of Natural Resources join – FUEGO paper:

Remote Sens. **2013**, *5*, 5173-5192; doi:10.3390/rs5105173

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Remote Sensing

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Article

FUEGO — Fire Urgency Estimator in Geosynchronous Orbit — A Proposed Early-Warning Fire Detection System

Carlton R. Pennypacker [1,2,*], Marek K. Jakubowski [3], Maggi Kelly [3], Michael Lampton [1,2], Christopher Schmidt [4], Scott Stephens [3] and Robert Tripp [2]

FUEGO Timeline (cont)

- Patent Application (2014)

US 20160132714A1

(19) **United States**

(12) **Patent Application Publication**

Pennypacker et al.

(10) **Pub. No.: US 2016/0132714 A1**

(43) **Pub. Date: May 12, 2016**

(54) **FIRE URGENCY ESTIMATOR IN GEOSYNCHRONOUS ORBIT (FUEGO)**

(71) Applicant: **THE REGENTS OF THE UNIVERSITY OF CALIFORNIA**, Oakland, CA (US)

(72) Inventors: **Carlton R. Pennypacker**, El Cerrito, CA (US); **Robert D. Tripp**, Berkeley, CA (US); **Scott L. Stephens**, Walnut Creek, CA (US); **Nina M. Kelly**, Berkeley, CA (US); **Marek K. Jakubowski**, Berkeley, CA (US); **Mike Lampton**, Berkeley, CA (US)

(73) Assignee: **THE REGENTS OF THE UNIVERSITY OF CALIFORNIA**, Oakland, CA (US)

(21) Appl. No.: **14/927,137**

G06K 9/40	(2006.01)
G06T 7/00	(2006.01)
H04N 5/33	(2006.01)

(52) **U.S. Cl.**

CPC ***G06K 9/0063*** (2013.01); ***G06T 7/0022*** (2013.01); ***H04N 5/332*** (2013.01); ***G06K 9/40*** (2013.01); ***G06K 9/6255*** (2013.01); ***G06K 9/6262*** (2013.01); ***G06K 9/6202*** (2013.01); *G06T 2207/10032* (2013.01); *G06T 2207/30181* (2013.01); *G06T 2207/20224* (2013.01); *G06T 2207/20081* (2013.01); *G06T 2207/20182* (2013.01)

(57) **ABSTRACT**

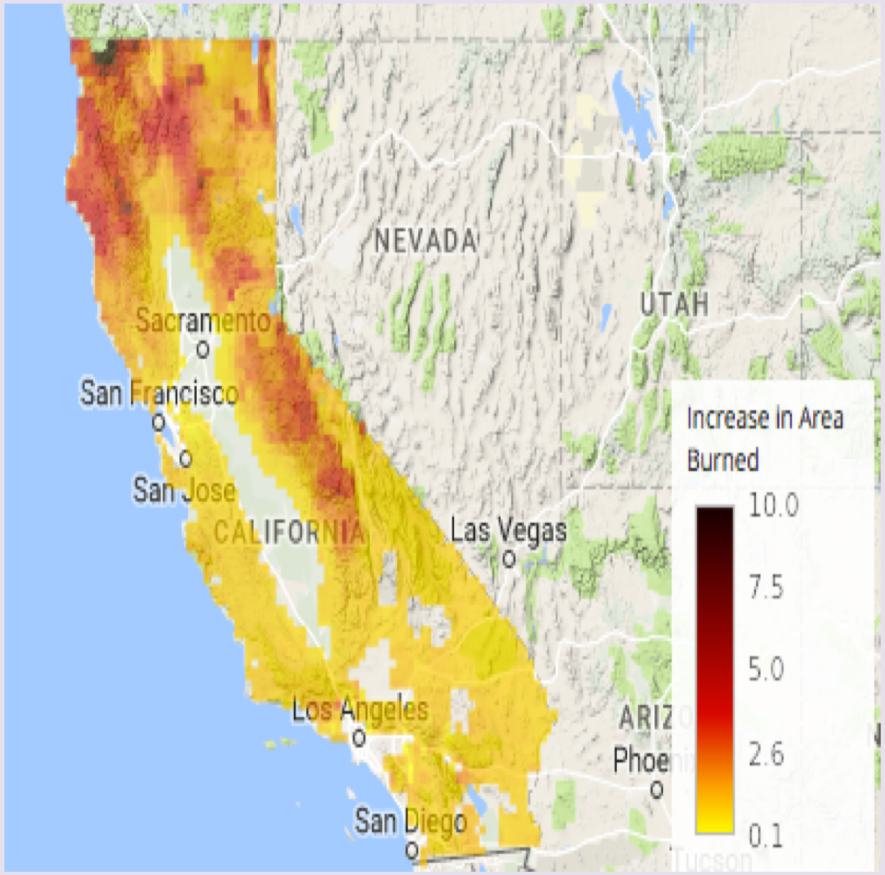
A fire detector is disclosed that successively images a particular area from geosynchronous Earth orbit satellite to attain very good signal-to-noise ratios against Poisson fluctuations within one second. Differences between such images

- 2014-2018

- FUEGO convenes three international workshops
- We begin integration into Fire community (TFRSAC, etc.)
- Four proposals to federal agencies (NASA x 2, NSF, Dept. of Commerce, etc.)
- Testimony before CA State Assembly (Nat. Resource Committee, sub 2). State Legislators are very encouraging.

An Introduction to Shovel-Ready Aspects of FUEGO:

There is no question fires are getting worse, as simulations have indicated for years…



Important Points from Team FUEGO:

1) Grave problems with understanding where the perimeter of the fire was and how it was moving cost lives in the Santa Rosa/Sonoma complex fires. These tragedies could be averted easily by next fire season, with existing airborne/aircraft FUEGO imaging solutions. NIROPS (existing USFS aircraft is challenged…)

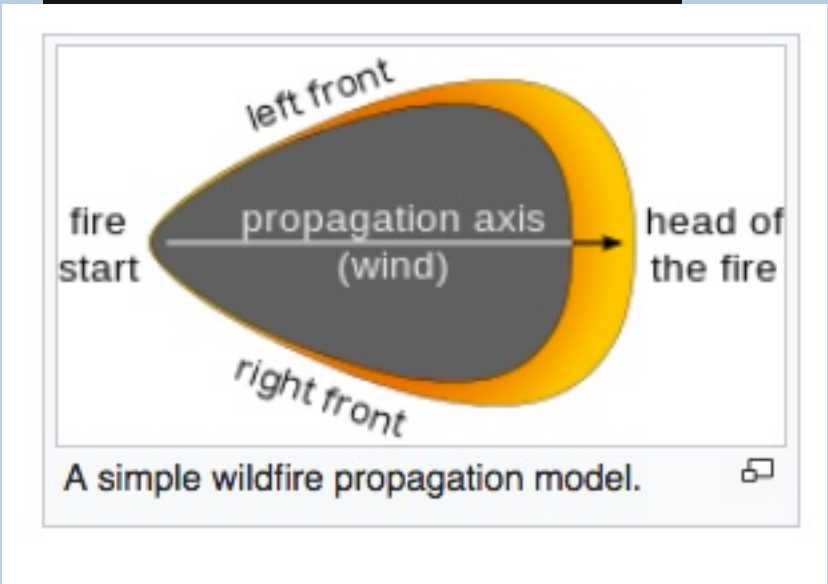
From Napa County Fire Chief Biermann

"Someone came up on the radio and said, 'Hey did you hear that?' And I said, 'No, what?' And they said, 'Within two hours that fire that started in Calistoga's going to be in the city of Santa Rosa'. And I was like, 'My gosh,' " he said.

Important Points from Team FUEGO 2:

2) Use of GOES 16 one-minute data, along with projected use of military intelligence satellites could begin to provide very early alerts for the detection of small fires.

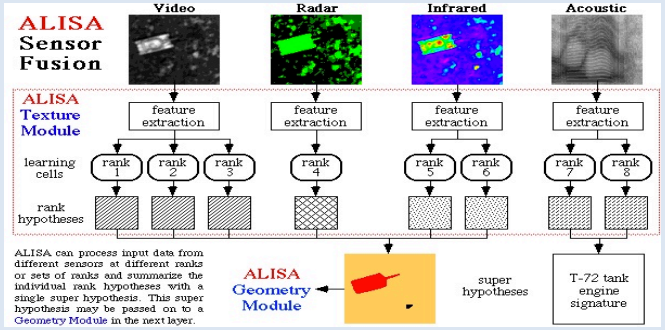
3) FUEGO collaboration simulation programs are ready to run, and when linked with the rapid updates of fire parameters, can provide a prediction system with growing utility and acceptance by Fire Incident Commanders.



A simple wildfire propagation model.

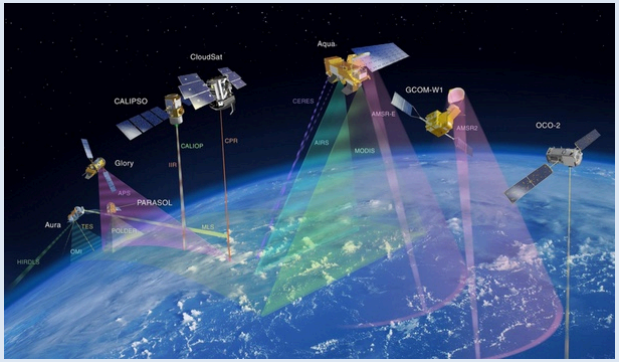
Important Points from Team FUEGO 3;

4) Cooperative cross-cueing and data fusion can be implemented this year.



5) The UCB smoke detection system, running on HP WREN and Univ. of Nevada Reno cameras is functioning now and will have greater capabilities to detect small fires.

6) Persistent and reliable intelligence on fire progress can be updated and disseminated with existing systems.



Conclusion:

There are very significant actions we can take at all altitudes, and some we can do almost immediately.

And, over the next decade, we hold the potential to stop many fires before they escape initial attack.