DBI-Berkeley Meeting on FUEGO and Related Topics

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LBNL Berkeley, CA

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What is *FUEGO?*

Fire Urgency Estimator from Geosynchronous Orbit

(and Associated Data Systems, Airplanes, and hoped-for UAV steps in between…)

Supported by the Vice Chancellor for Research, UC Berkeley

- Early detection and *on-going management* of wildland fires
  - natural; accidental; terrorist
  - The Fire Data Cube
- Potentially valuable for the United States and world!
- Geosynchronous orbit for 24/7 coverage
- Supplement ground & air observations
- Provide real time input for models for prediction and resource allocation
- Supplement other space-borne geo/leo observatories
- Requires real-time assessment of **urgency.**
  - Urgency is the key ingredient! *Must* be made quantitative!
  - Requires tight integration with **Geographic Information Systems**

Some Goals of this meeting (hopefully understated):

1. Learn common interests of DBI and Berkeley Teams
2. Update all on progress
3. Understand steps to funding
4. Initiate FUEGO CLUB
5. Discuss Business Models and steps to make a company/FUEGO Club that might rapidly build FUEGO at all altitudes for an international company
6. Establish beginnings of shared work plans!

A Simplified View/Issues of United States Fire Prevention Landscape

No single Public or private agency or Department is mandated to prevent small fires from becoming big fires using snazzy technology from the air or space. It is hard for agencies/Departments to undertake "paradigm shifts."

- Such well-run existing agencies (USFS,BLM, NASA,NPS, etc.) typically do not work well with other agencies on a probably risky, R&D project
- This is sometimes frustating for other parts of government – e.g., White House and Congress and people of the United States We live in an age of typically shrinking federal and state R&D funding, and agencies usually want to preserve their own, well-thought-thru programs.
- Example: one major western US state fire agency had its fire R&D budget zeroed out a few years ago.

Some Goals of FUEGO Systems:

1. Early Detection of Small Fires
2. Real-time management of on-going fires
3. Somehow contribute to the momentum for very high quality GIS systems.
4. Use inputs from the GIS, FUEGO imaging, and micro- climatic algorithms (patent pending) into fire simulation programs.
5. Eventually lead to the development of a robust business that can do a good cross-jurisdictional, internatioal job at fire prevention and management

FUEGO Data Product Goals (from Bill Kruse)

- Day, night, frequent updates, wide coverage
- Information designed for fire detection & management
- Data products are simple to understand
- Integrates with complimentary GIS and fire applications
- Support existing fire management protocols
- Low cost (free?), on-demand, easy to use
- Long-term persistent operation over many fire seasons
- High value, not disruptive, quick learning curve

FUEGO System Architecture (from Bill Kruse)

- Multi-Sensor support
  - FUEGO native sensor & sensors of opportunity – video & image
  - Sensor data processing, compression, calibration, control
- Full time remote IP connectivity for data and control
  - For autonomous/manual local/remote control operation
- Cloud based tasking, processing, products and control
  - Automated near-real-time product availability
  - Soft fail/recovery for interrupted connectivity or data bottlenecks
  - Utilize networked GIS support data layers
- Support existing cloud based wildfire applications
  - NICS - Next-Generation Incident Command System
  - Wifire - Wildfire behavior simulation, prediction and visualization
- Provide online data access for desktop applications
  - ArcGIS, Farsite, …

Updates/Progress:

1. MOU for joint work with other groups has been agreed upon by UC Berkely – now in hands of Los Angeles County, San Diego County, UC Merced, UC San Diego, State of California Fire Department (CalFire), and others.

2. Continual progress/innovation on camera designs, platforms, collaborators, customers, funding schemes, etc.

3. Possible low cost airborne system may be in test phases as soon as agreements are in place CA Air National Guard RC 26's.

4. Briefings to others in State of CA being planned – viz. State Insurance Commission

1. (wait for CalFire MOU to be signed)

2. Haas Busines School students complete good study of economics of Fires

3. Discussion on-going of FUEGO Club and Business Models and steps to make a company that would rapidly build FUEGO at all altitudes for an international company
4. Air Force still trying to get funding to UC Berkeley to continue study FUEGO

Study Team Members (partial list)

- Marek Jakubowski, College of Natural Resources, UCB
- Robert Tripp, Lawrence Berkeley National Lab
- Mike Lampton,LBNL and UC Berkeley Space Sciences Lab
- Mark Blair, Optus
- Maggi Kelly, Geographic Information Systems,UC Berkeley
- Robiin LeFever, SSL/LBNL
- Bill Kruse, Kruse Imaging
- Scott Stephens, Wildland Fires, College of Natural Resources, UC Berkeley
- Tom Coate , USAF, CHIRP Satellite
- Jie Jacquot, CHIRP Satellite
- William Derr, US Forest Service (Ret)
- Gen. Larry Grundhauser (Ret.), Boeing Aerospace
- Carl Pennypacker, UC Berkeley Space Sciences Lab/LBNL
- Chris Schmidt, U. Wisc, GOES Satellite Fire Team
- Donn Walklet, Terra-vista, Inc.
- Alex Held, CSIRO, Australia
- Claire Poppett, Space Sciences Lab, UC Berkeley

Enabling Technology and IP:

1. Large Format, much less expensive infrared imagers
2. Very high speed and inexpensive and lightweight computing power, including FPGA's and GPU's.
3. UAV progress and potential
4. Much better software
5. Progress in command and control systems (WiFIRE)
6. Simulation Programs developing/improving
7. Momentum towards better GIS data
8. Geosynchronous Platforms: 5x-10x cheaper way to build FUEGO in Geo.
9. FUEGO Patent: All 47 claims passed PCT "novelty test"

Political and Government Affairs:

1. We are endeavoring to point out to our leaders that the case for FUEGO is a near “no-brainer.” Probably need one fire we spot early and suppress before we get as much huge attention as we like. But stepwise PR fine and we will get.

2. Looking forward to dialog wih State Insurance Commissioner

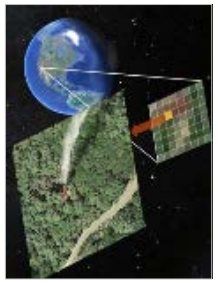
3. Good preliminary CalFire Contact now in discussions

4. CA Air National Guard in discussioons with us – RC-26’s might be goog use in 2015-2016, pending politics

5. Briefings to others in state and federal government on-going

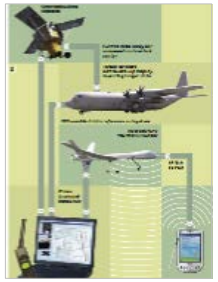
From Haas Business School students: Fuego drastically reduces impact through early detection, better intelligence and control capabilities

- Fuego capabilities and impact



Fire detection
- Quick identification and localization of fires

Data analysis & Fire management
- More complete intelligence and imagery to decision makers in (de)centralized HQ
- Analysis of property / land at risk
- Simulation and monitoring



Better command & control capabilities
- Faster deployment of airborne ground suppression force
- Better communication between remote units and central command centre

A reduction in the number of large fires resulting in:

A **FINANCIAL IMPACT**

... a reduction of USD 90-110 m in emergency funds deployed

B **ECONOMIC IMPACT**

... a multiple of that in avoided property loss, lost economic activity, etc.

Source: Fuego

Experience in recent large fires shows that early detection and coordination can make a lot of difference

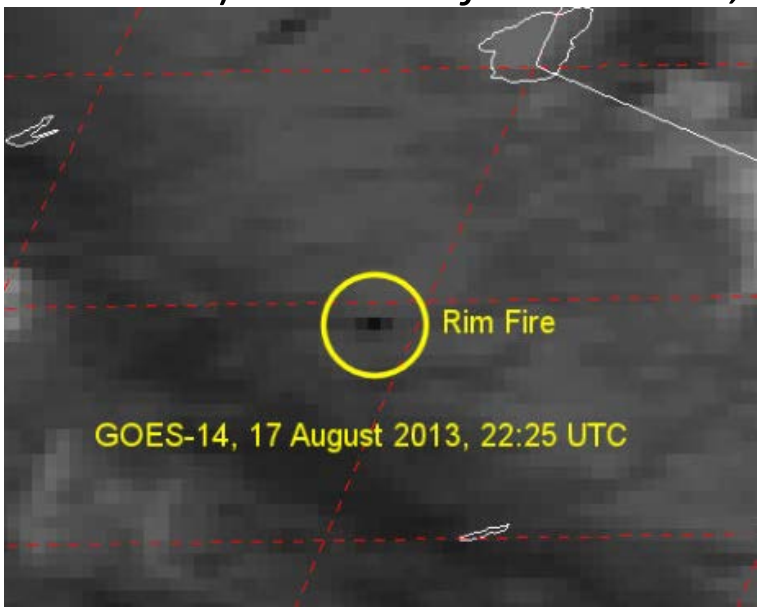
- Reasons for escalation, recent examples

	Rim Fire (2013)	**San Diego County Fires (May 2014)**
		
Location	Sierra Nevada, California	San Diego, California
Date	17 Aug 2013 – 24 Oct 2013	5 May 2013 – 22 May 2013
Damage	257k acres, 10 injuries, 112 structures	30k acres, 6 injuries (1 fatal), 55+ structures
Costs	USD 127 m (75% funded by FEMA)	USD 60 m
	• Hunter's illegal fire went out of control • Detected by fire plane on its way elsewhere • Forces diverted to another fire on 3rd day • Grew to 100k acres within 4 days • **Fuego could have enabled early action on the ground through better intel on safety**	• The complex involved a total of 20 fires • 8 major fires burned simultaneously • Fires intensified within hours after starting fueled by Santa Ana winds • **Fuego could have provided intel to support prioritization across different jurisdictions**
	TOO LATE	**TOO COMPLEX**

Source: NASA, US Forest service, Inciweb, AP, NBC, Fuego, expert interviews

Aspects of Rim Fire Story

- Hunter's Campfire, 3:25 PM, August 17 (GOES saw it at 3:25), and "discovered/reported" after 4:30 pm (estimate)
- Reported/discovered by phone an hour or two later than expected FUEGO threshold
- Turned into California's 3rd biggest fire -- 260,000 square acres (400 square miles) *BTW: California is 100,000,000 acres area*



Aspects of Rim Fire Story
Suppression $'s !!

Aspects of Rim Fire Story (3)
Damage to Ecosystem $'s !!

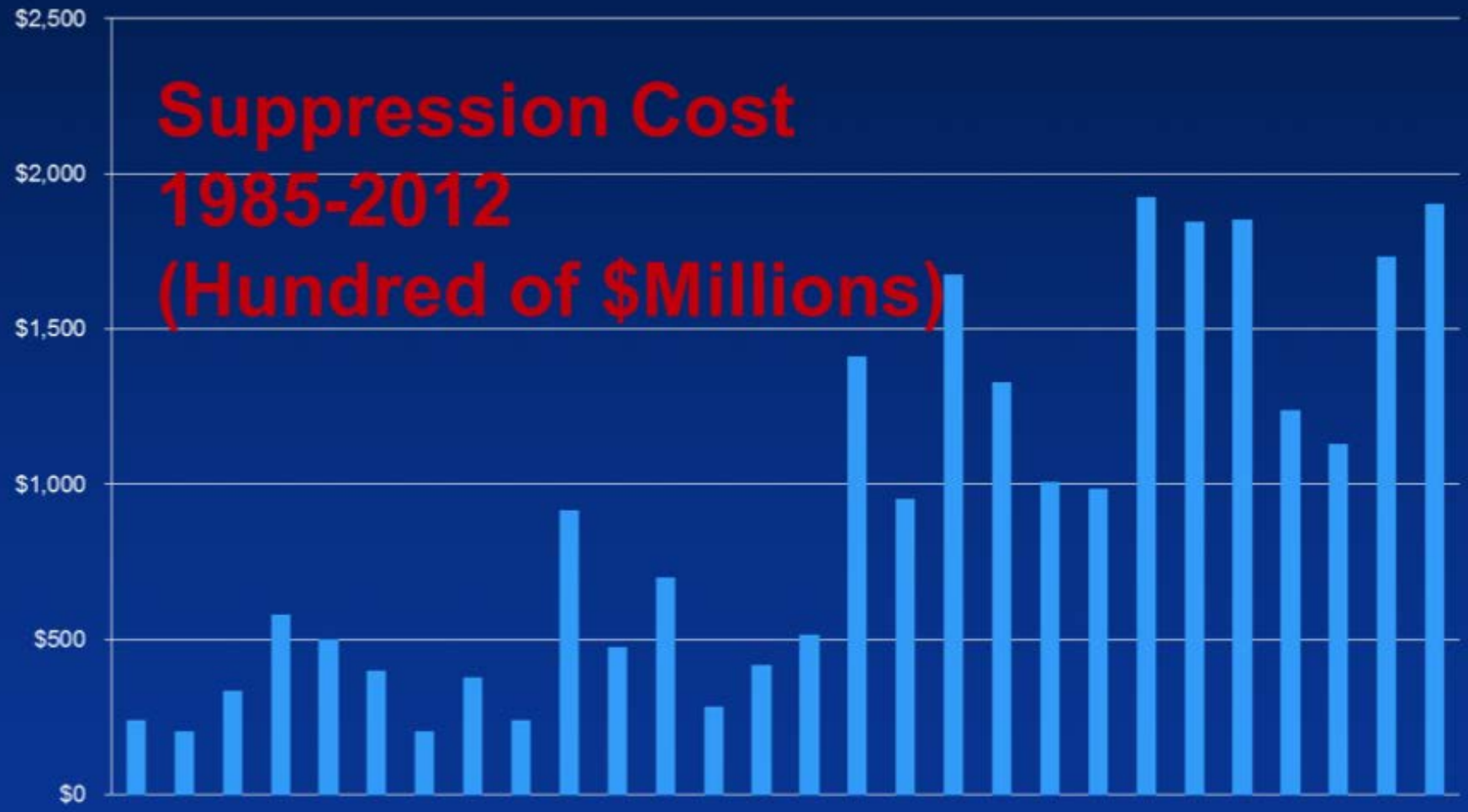
The Modesto Bee
modbee.com

Report puts $797M price tag on Rim fire's damage to ecosystem

BY JOHN HOLLAND
jholland@modbee.com December 25, 2013

Note by Carl: Economic Damage ranges from 2x to 50x suppresion costs

Federal Fire Suppression Costs



Total US Economic Damage:

Not Calculated for Every Fire,

But often we see economic damge to society 5-10x high as suppression costs as a nominal number (low as 2x, high as 50x)

Hence, cost to taxpayers/society is approximately $15B to $30B a year. But these costs are hidden.

Our Berkeley Paper:

- We are not the first to employ (a bit) or suggest such a system.
- Assembled a bigger and better growing collaboration and many new ideas (ref. on handout)

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Article

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

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Some of the Main Results of this Study:

- Small (10 sq.m.) fires could easily be seen from space
- Prospects of background rejection look substantial.
- Paper created enough of a PR evet we have built a much deeper FUEGO Collaboration.

Possible Scenarios for FUEGO Development:

- 2015-2016 – Assemble funding ($300 - $600k), use existing hardware (airplanes/cameras) for tests in Southern California. FUEGO teams adds software and systems glue. Get more evidence this all works. Detect new fires and help manage existing ones.

!

- 2017-2018: Acquire and use our own hardware, perhaps -- add develop UAV systems

- 2018-2023 – Build and launch FUEGO to Geosynchronous platform

Next Steps:

- Get money
- Establish and solidify workpns
- Solidify all collaborations
- Start building the FUEGO systems