

UAS Planning for the Fire and Smoke Model Evaluation Experiment (FASMEE)

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NASA Ames/Mountain View, CA

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DRI

Fire And Smoke Model Evaluation Experiment (FASMEE)

<http://fasmee.net>

Project PIs

Roger Ottmar, USFS, Seattle, WA
Tim Brown, DRI, Reno, NV
Sim Larkin, USFS, Seattle, WA

Technical leads

Nancy French, MTU, Houghton, MI
Adam Watts, DRI, Reno, NV



Background of FASMEE

- Grew out of a need for a collaborative data set across the research community to:
 - Evaluate current fire models
 - Develop next generation fire models
 - Assess new measurement techniques

2008 Core Fire Science Caucus & 2011 RxCADRE did this informally

- Formalized through several JFSP grants:
 - RxCADRE (2012), FL
 - JFSP Smoke workshop (2013), Reno
 - FASMEE (2015)

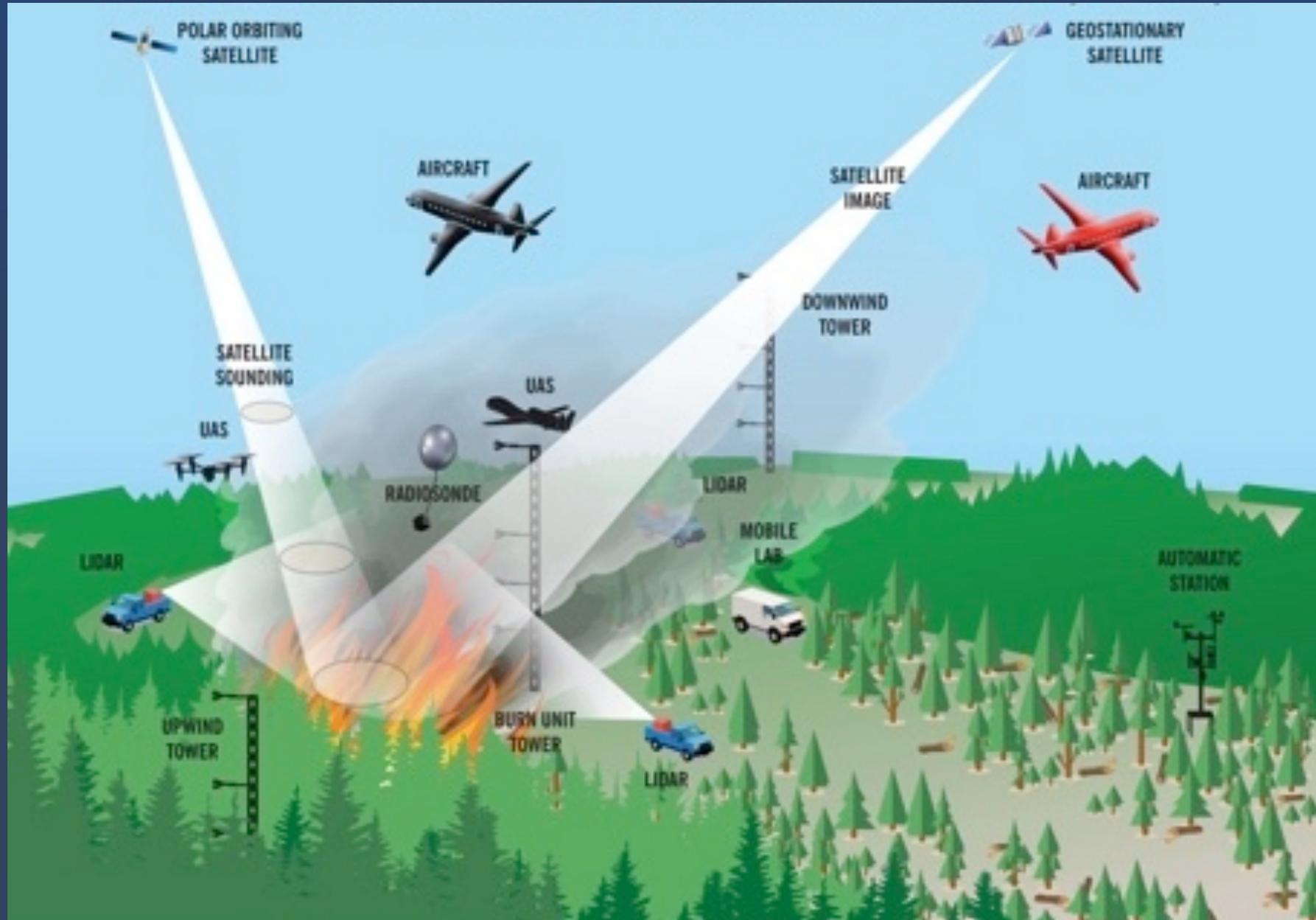


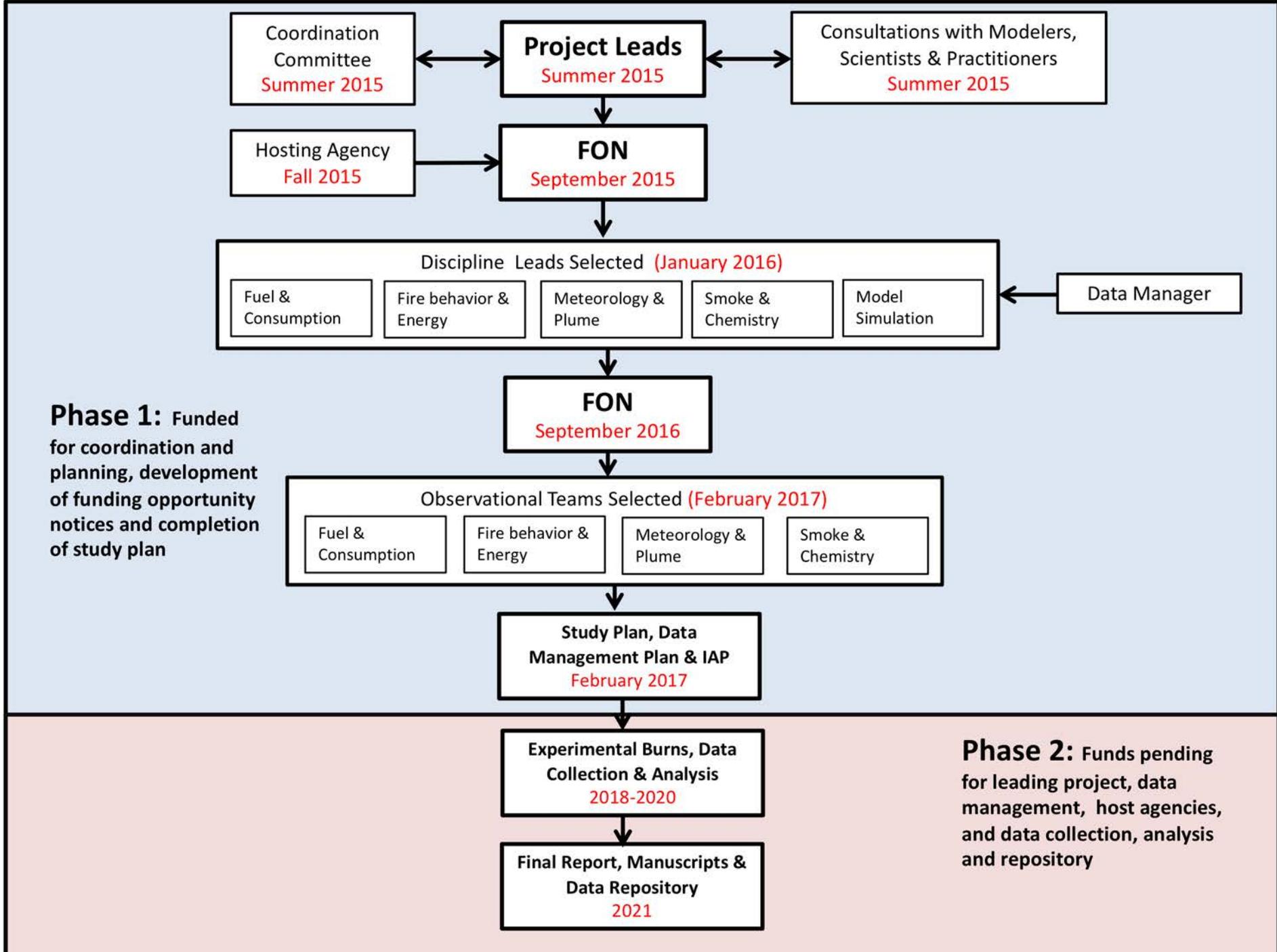
FASMEE Quick Overview - Ideas

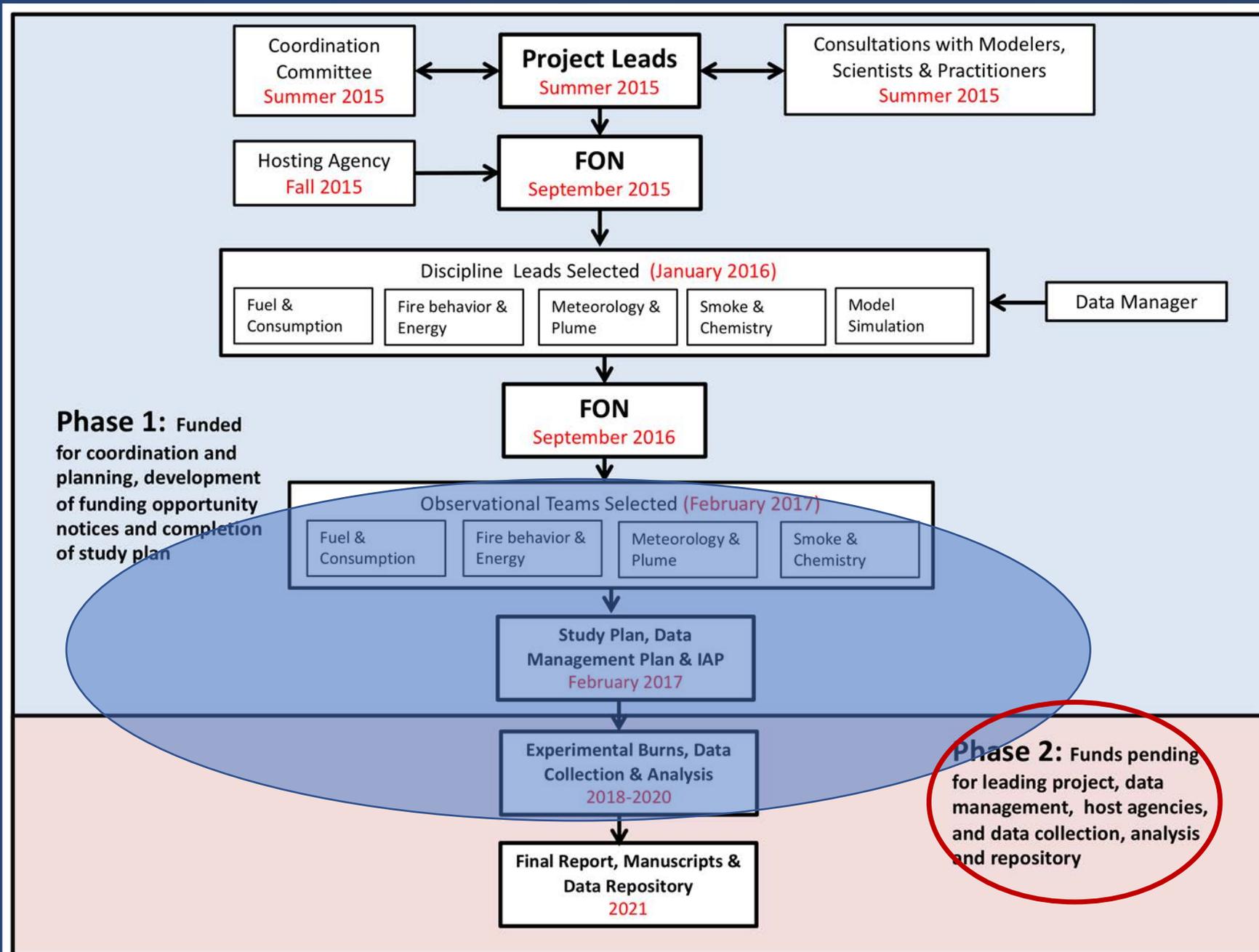
- **Perform a sequence of large (>500 acre) prescribed burns**
 - Intensively instrumented
 - High end of fuel load range
 - High end of fire intensities
- **At least two locations**
 - Southeastern U.S.
 - Western U.S.
 - Maybe Canada*
- **Key observations across 4 disciplines**
 - Fuels and consumption
 - Fire behavior and energy
 - Plume development and meteorology
 - Smoke emissions and chemistry
- **Burns will also provide an opportunity for additional, externally funded measurements**



Data-fusion logistics concept (original plan)







Changes 2016-2019:

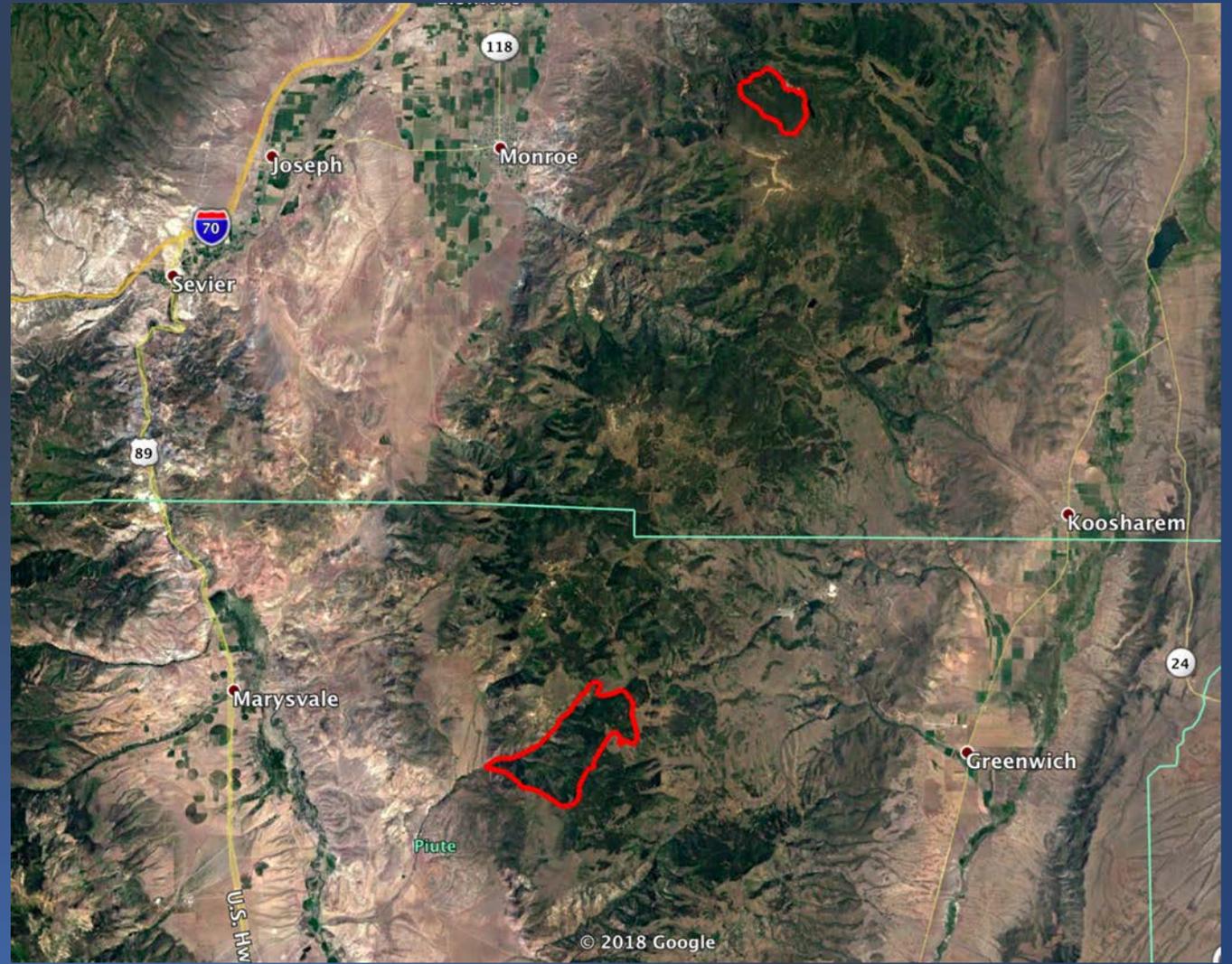
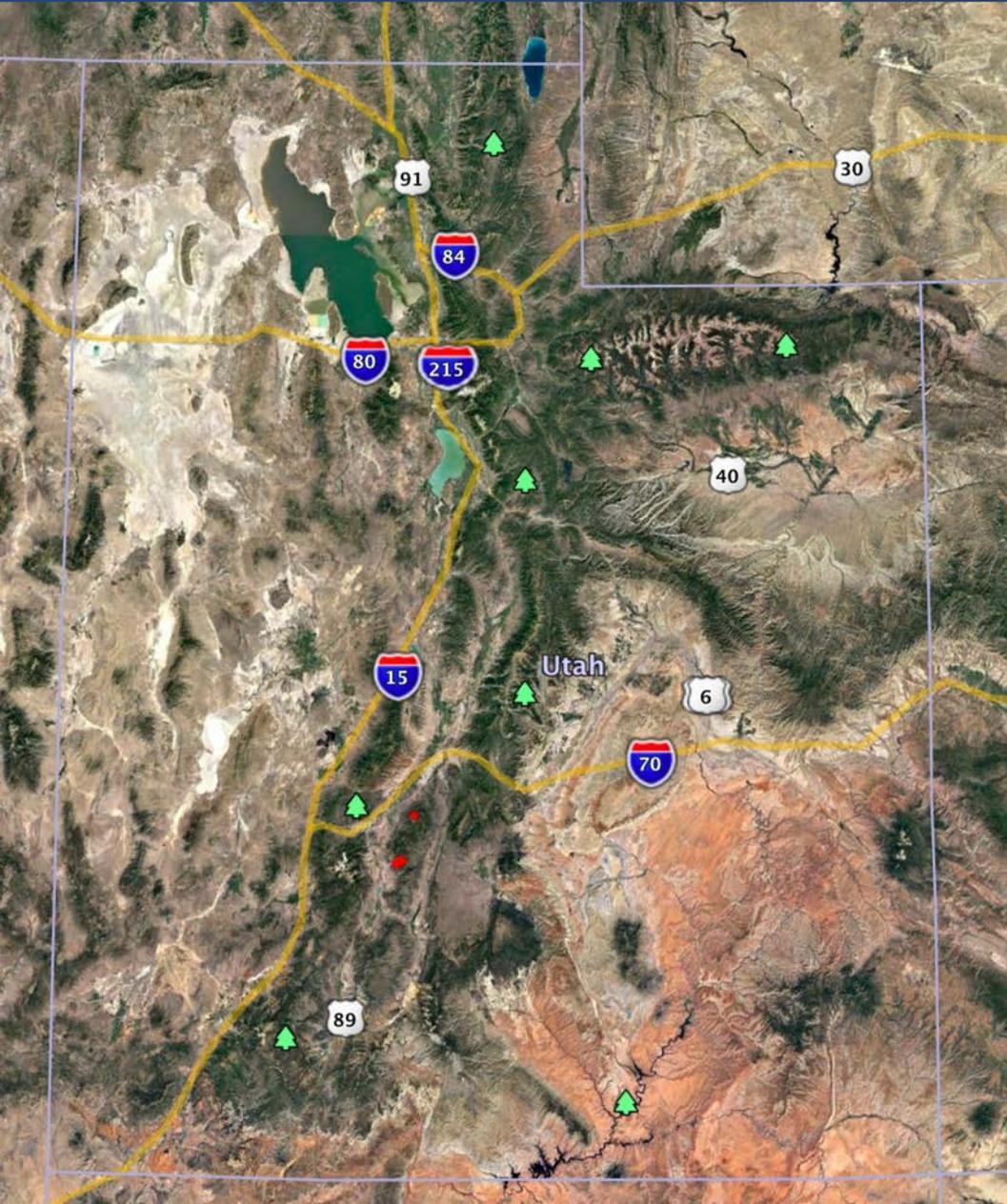
-Original FASMEE budget estimate: \$7-20M

-New funding levels expected to be ~\$250,000

Summary of FASMEE changes:

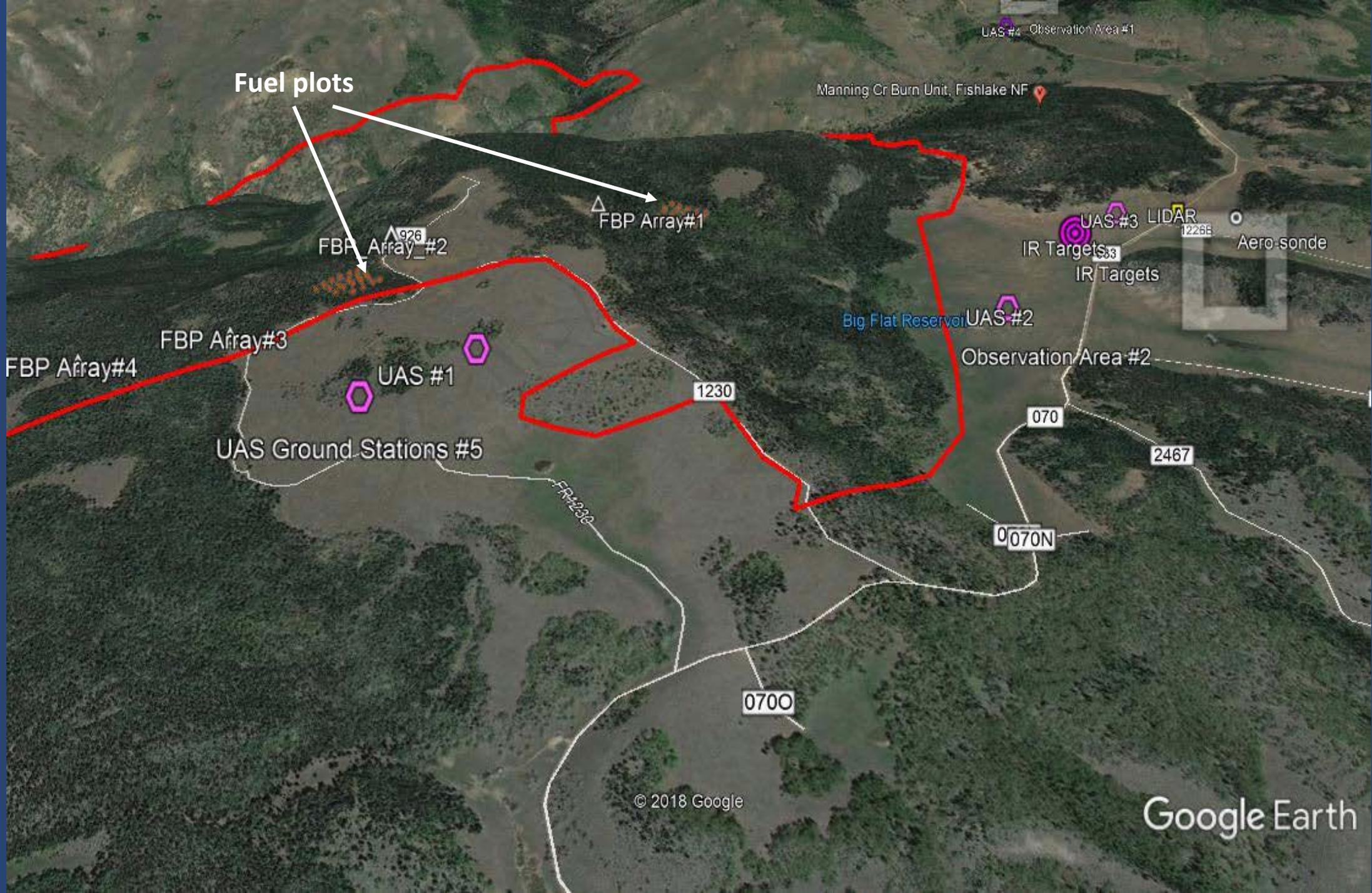
- “FASMEE Lite” will include fewer investigators per team
- Disciplines largely the same; Fire Effects added
- Aviation component smaller; UAS provide the only airborne observations/sampling for Spring 2019 burns
- Investigators mostly self-funded
- Spring 2019 weather a challenge
- Some integration with FIREX-AQ (Fall 2019 flights)
- Proceeding with plans assuming 2020-2021 burns in SEUS

Spring and Fall 2019 burn locations: Fishlake NF, Utah



Fish Lake National Forest, Utah





Fuel plots

UAS #4 Observation Area #1

Manning Cr Burn Unit, Fishlake NF

FBP Array#1

FBP Array #2

UAS #3 LIDAR
IR Targets
IR Targets

Aero-sonde

FBP Array#3

Big Flat Reservoir UAS #2

Observation Area #2

FBP Array#4

UAS #1

1230

070

2467

UAS Ground Stations #5

070N

0700

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Google Earth







UAS Lead for FASMEE

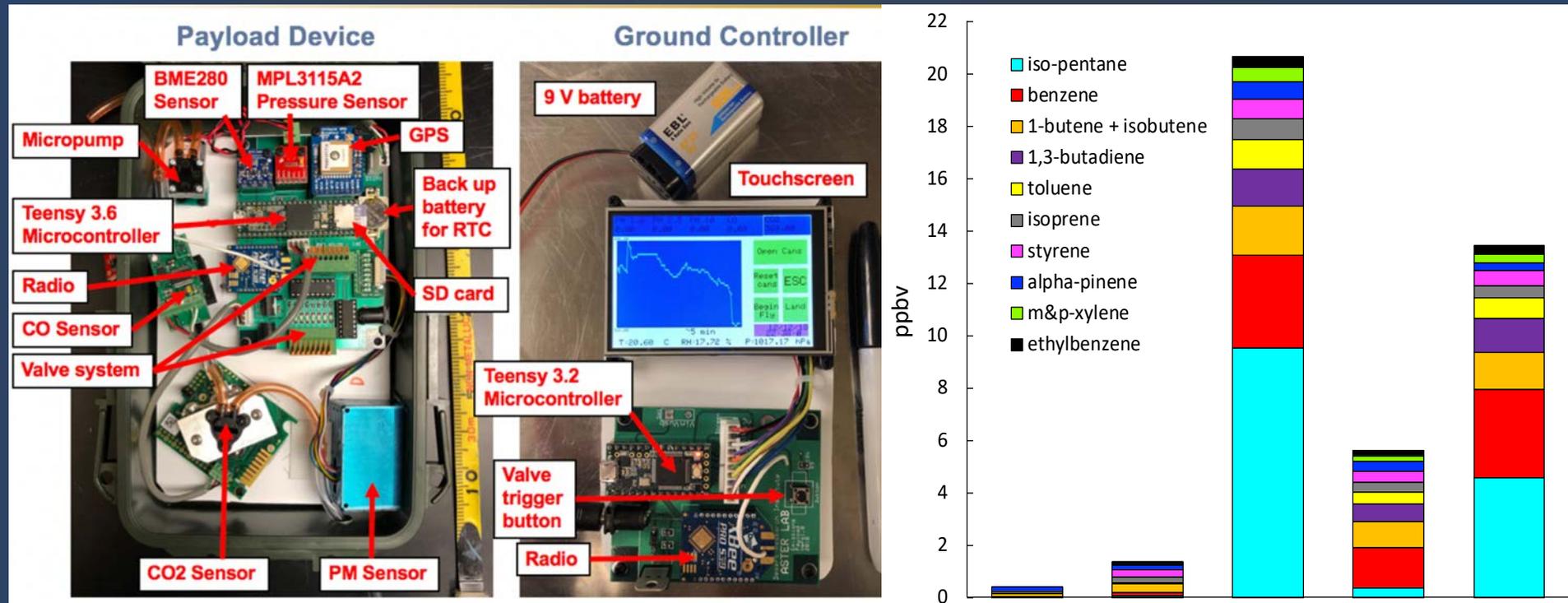
Airborne Systems Testing for Environmental Research

- FAA Test Site Node (airspace access advantage)
- UAS fleet for field deployments
- Instrument development & testing
- Local training range



Instrument and UAS payload development for fire measurements

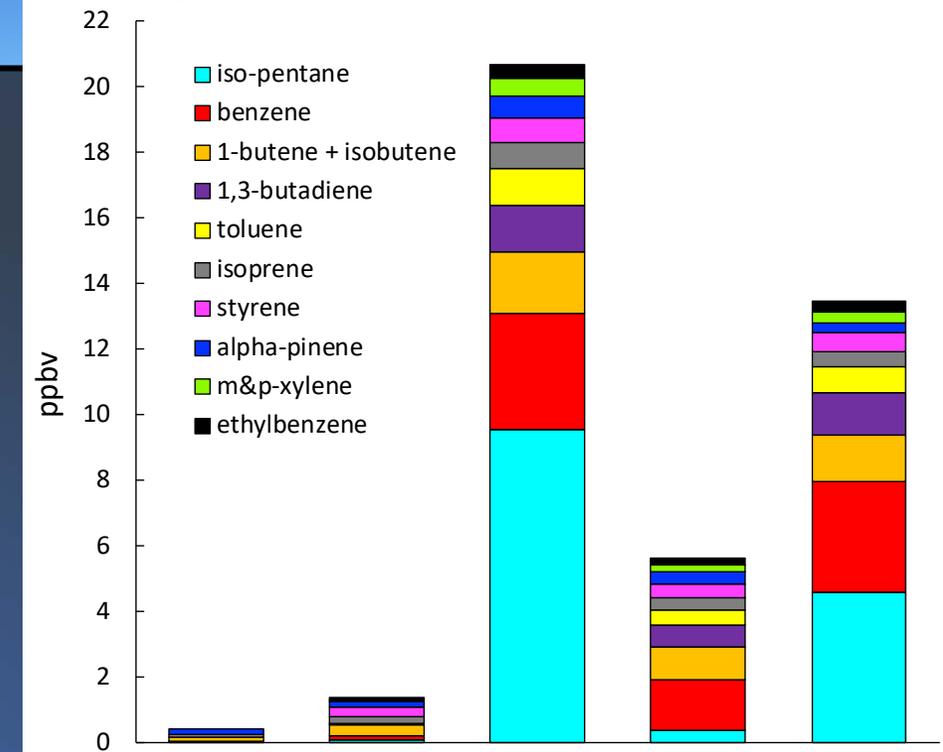
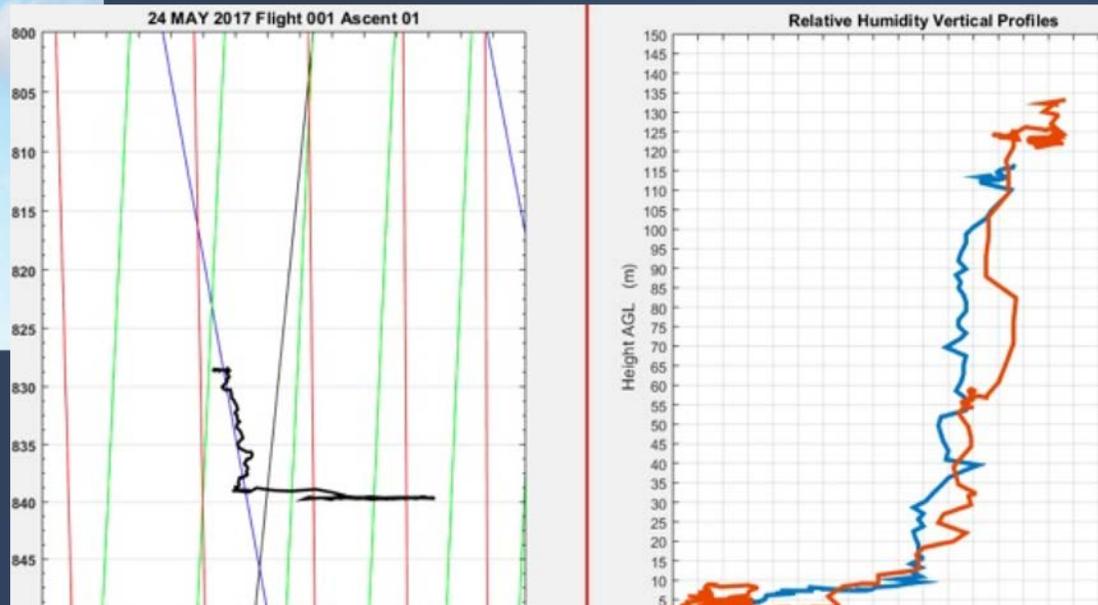
- Real-time measurement/telemetry of CO, CO₂, PM, T, rH, pressure...
 - Additional sensors possible based on desired applications
- Airborne emissions sampling payload for detailed trace-gas and VOC measurements
- Sonic anemometer
 - Repeatable, on-demand soundings
 - Weather aloft; readings across process thresholds (e.g. plume boundaries)



UAS Measurements based on FASMEE specifications

Atmospheric sensing and sampling:

- Air quality (PM, CO, CO₂, O₃...)
- Air sampling (VOCs, trace gases)
- Meteorology (soundings, modeling)
- Combustion efficiency and MCE
- Plume development & movement
- Diurnal and nocturnal measurements planned



Boehmler et al. (IAWF 2019);
Nelson et al. (in review, *Fire*)

Additional UAS payloads/missions for FASMEE:

- Airborne biological assays (airborne microbes in dust and smoke): UI collaboration
- Soundings can be integrated into detailed local forecasts & plume models: UU/NCAR collaboration
- EPA-developed emissions payload (Gullet et al.):

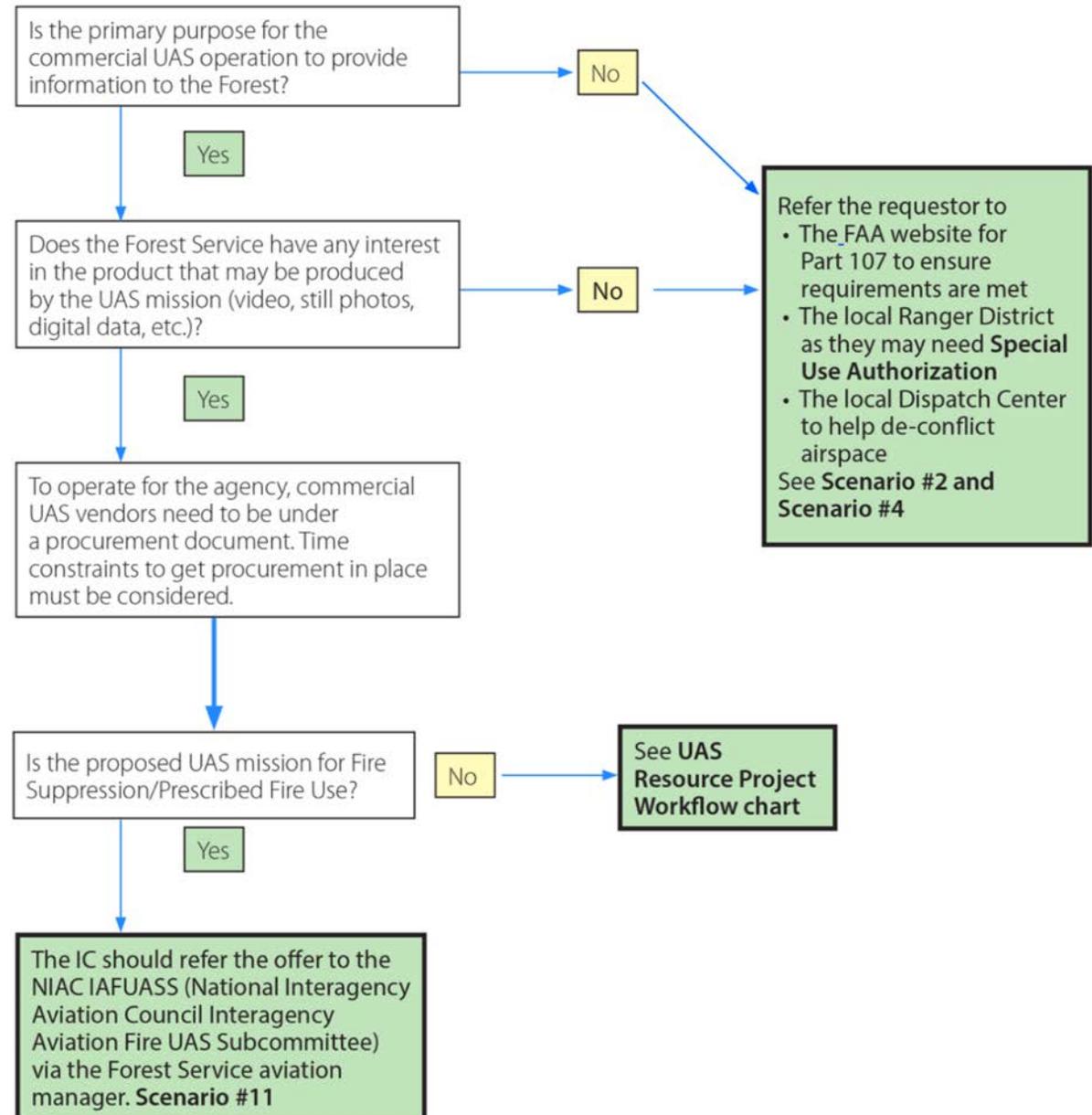


Use Case: Fire and Smoke Model Evaluation Experiment (FASMEE): UAS Operations

USFS UAS Policy

Act 2:

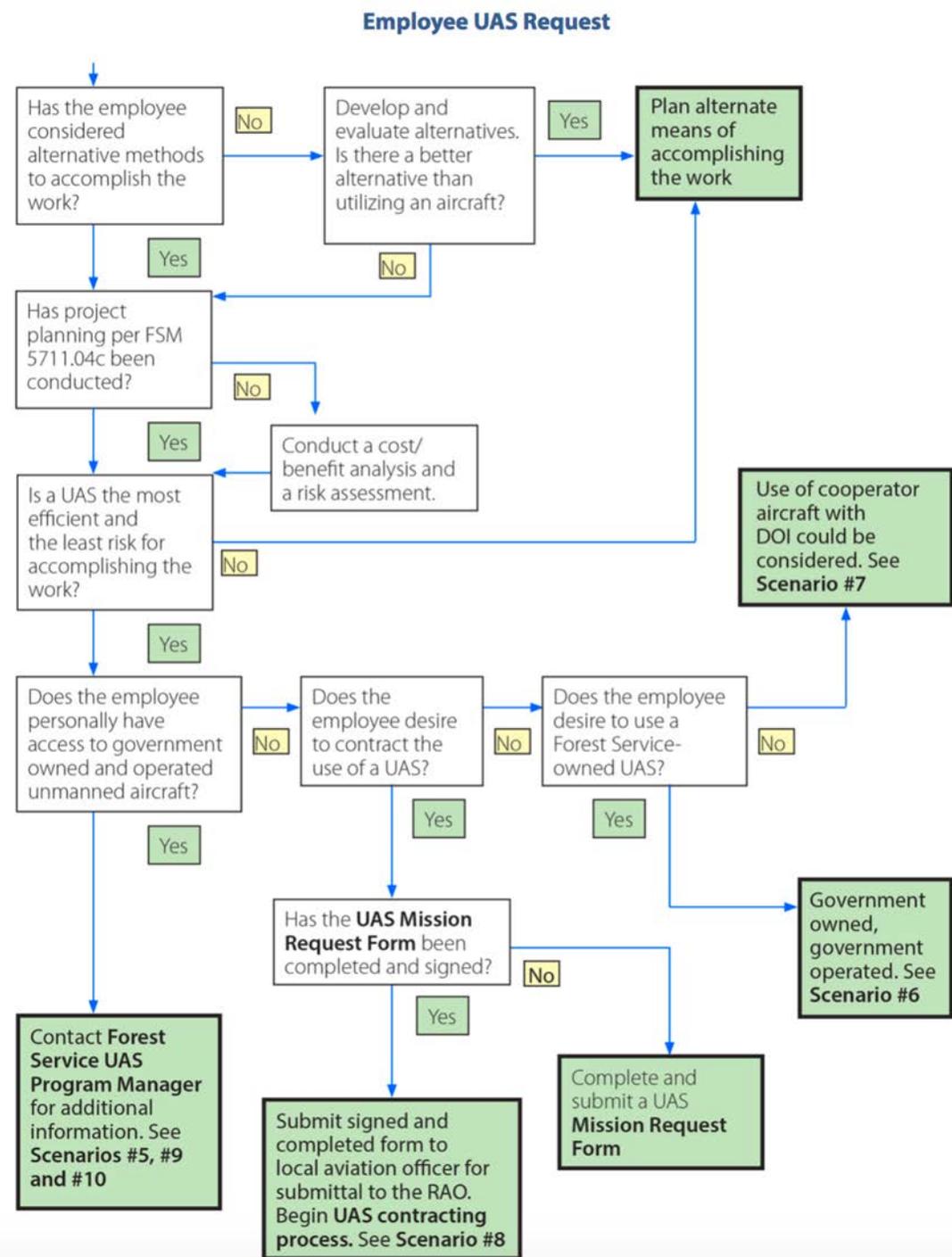
UAS Request for Commercial Purpose



Use Case: Fire and Smoke Model Evaluation Experiment (FASMEE): UAS Operations

USFS UAS Policy

Act 3:



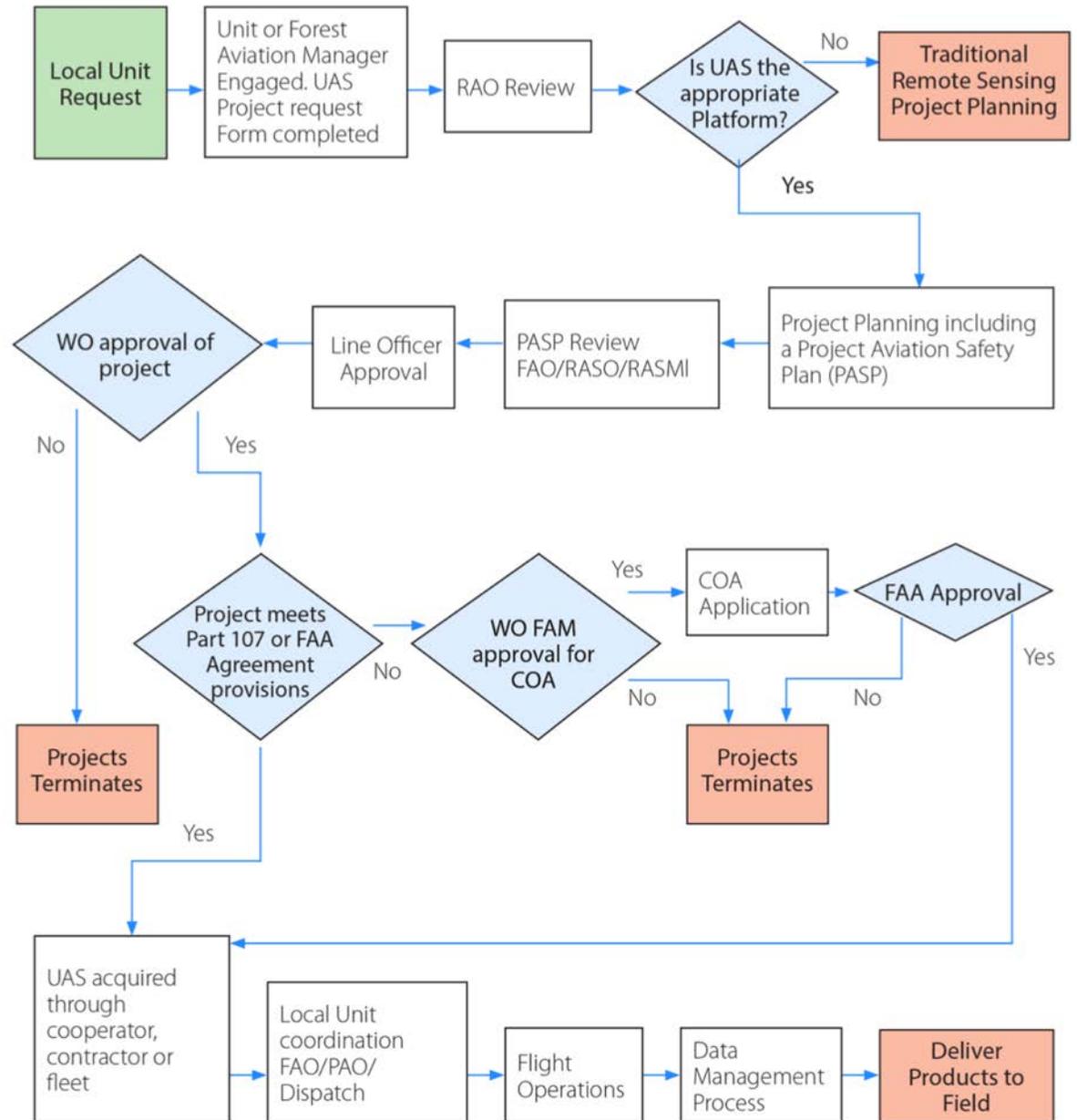
Use Case: Fire and Smoke Model Evaluation Experiment (FASMEE): UAS Operations

USFS UAS Policy*

Act 4:

*Each agency has its own set of policies, regulations, procedures, and people who interpret and apply them.

UAS Resource Project Flow

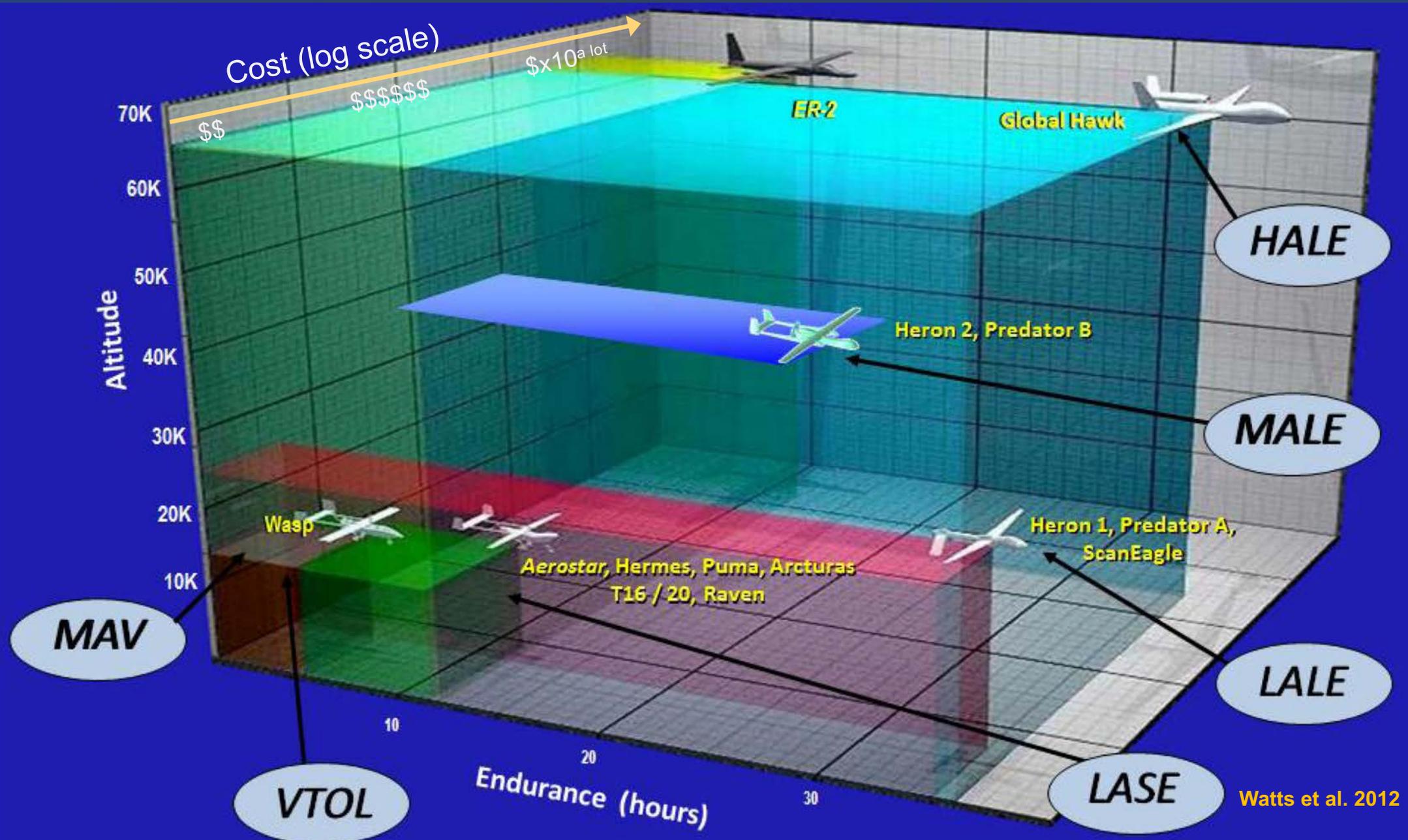


Acknowledgments

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Watts et al. 2012

Ironic results



-Poorly planned and executed UAS regulations inhibited growth of the US commercial UAS industry.

-Regulations were relaxed ca. 2017 (14 CFR 107)

-However, by then manufacturers from China presented difficult competition for manufacturers from the US and elsewhere.

-Affordable sUAS technology began to proliferate rapidly in universities, emergency management, and among DoD users...

Ironic results

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DAMO-AV

2 August 2017

MEMORANDUM FOR RECORD

SUBJECT: Discontinue Use of Dajiang Innovation (DJI) Corporation Unmanned Aircraft Systems

Some interesting cybersecurity considerations

“I have confirmed that [DJI’s] software is indeed malicious...this software creates over 1000 files and spawns multiple processes during install. During the process, it issues commands meant to disable and remove Windows Anti-virus software and the firewall:

Process "cmd.exe" with commandline "/c powershell Set-MpPreference -DisableRealtimeMonitoring \$true"

Process "powershell.exe" with commandline "powershell Set-MpPreference -DisableRealtimeMonitoring \$true"

Process "sc.exe" with commandline "sc stop WinDefend"

Process "sc.exe" with commandline "sc delete WinDefend"

At this point, I am 100% confident that the software currently provided by DJI is malicious in nature and should not be trusted. Hopefully, [FBI analysis team] will be able to provide more context—how long they have been compromised and if it is indeed a nation-state level attack.”

-DRI Information Security Officer (SANS instructor/GIAC-certified)