FASMEE

Fire and Smoke Model Evaluation Experiment

http://fasmee.net

A Large Integrated Multiagency Fire Study

Project Leads

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***Adam Watts*, DRI; *Susan Prichard*, U Washington, Seattle**

JOINT FIRE SCIENCE PROGRAM

ESTCP

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

Michigan Tech Research Institute

DRI Desert Research Institute

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

NASA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DEPARTMENT OF ENERGY

Outline

- FASMEE Overview
- FASMEE Process and Phase 1 Activities and Status
- FASMEE burns: timing, locations, and logistics
- Coordination with NOAA & NASA

FASMEE

Science Question and Goal

Joint Fire Science Program: "Research in response to the emerging needs of policymakers and fire managers"

How do fuels, fire behavior, fire energy, and meteorology combine spatially and at the burn-unit scale to determine the dynamics of near-source plumes and the long-range transport of smoke and its chemical evolution?

To use <u>innovative</u> and <u>efficient</u> measurement techniques to collect critical observational data necessary to evaluate and advance operationally used fire and <u>smoke modeling</u> systems and the underlying scientific models and framework.

FASMEE Overview

- Large field campaign
  - >500 acre prescribed burns
  - Intensively instrumented
    - 120 + scientists & technicians
    - 20 + government agencies and Universities
  - High end of fuel load and intensity
- Study sites in the
  - Southwest US
  - Southeast US
- Interrelated disciplines
  - Fuels and consumption
  - Fire behavior and energy
  - Plume development and meteorology
  - Smoke emissions and chemistry
  - Modeling

- Core set of targeted measurements
  - Designed by discipline and modeling leads
  - Fuel and fire characterized to support plume and smoke measurements
- Integrating with FIREX (NOAA), FIREChem (NASA), and EPA
- Opportunity for additional measurements and agency partnerships to further the impact of the effort (i.e. ECOFASMEE)

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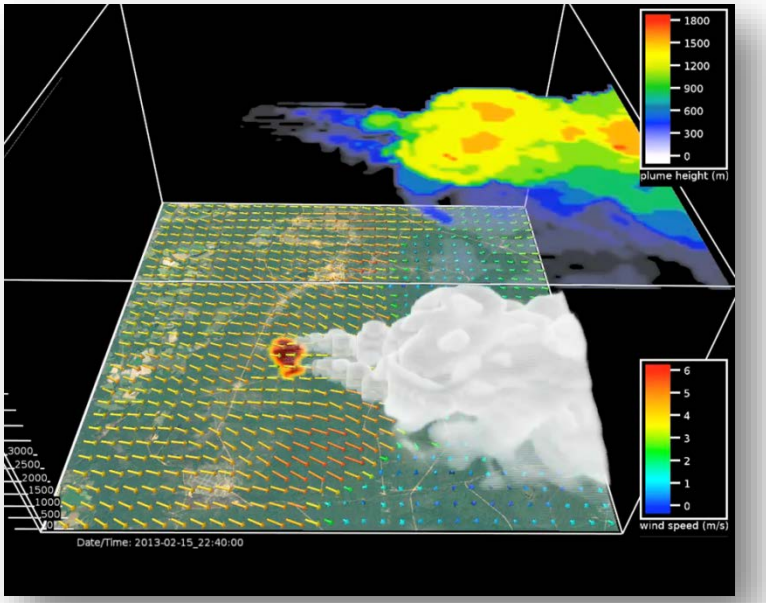
Targeted modeling areas



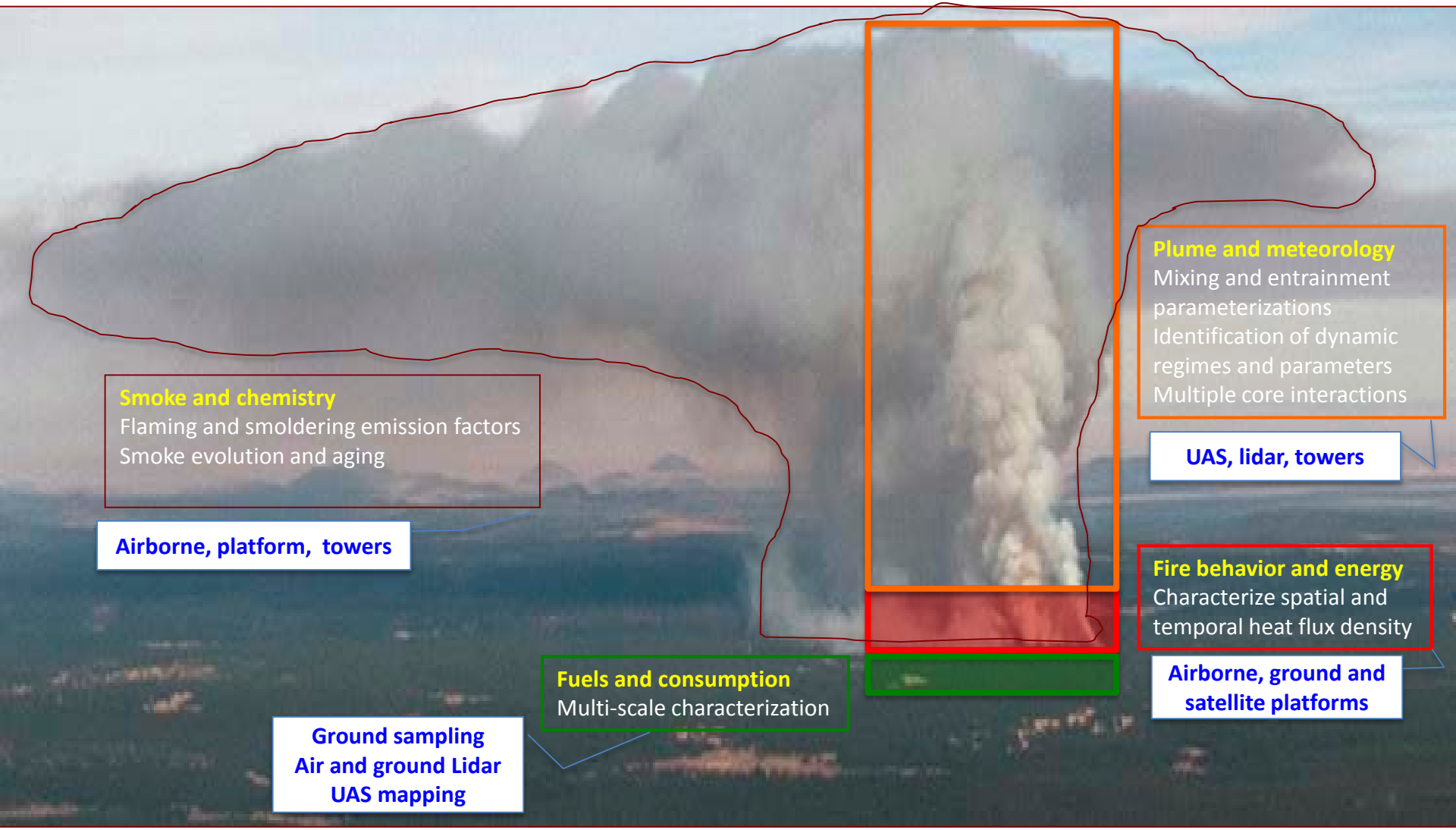
Important to FASMEE Goal:

- **Coupled fire-atmosphere behavior**
- **Fuel consumption and emissions**
- **Fire growth/progression**
- **Fire energy and plume development**
- **Smoke chemistry & transport**
- **Smoke impacts/air pollution**

Not a part of FASMEE (but could benefit from FASMEE):

- **Fine-scale fire behavior modeling**
- **Fire effects**
- **Fire ecology**
- **Fire behavior management**

Key model improvements and evaluation



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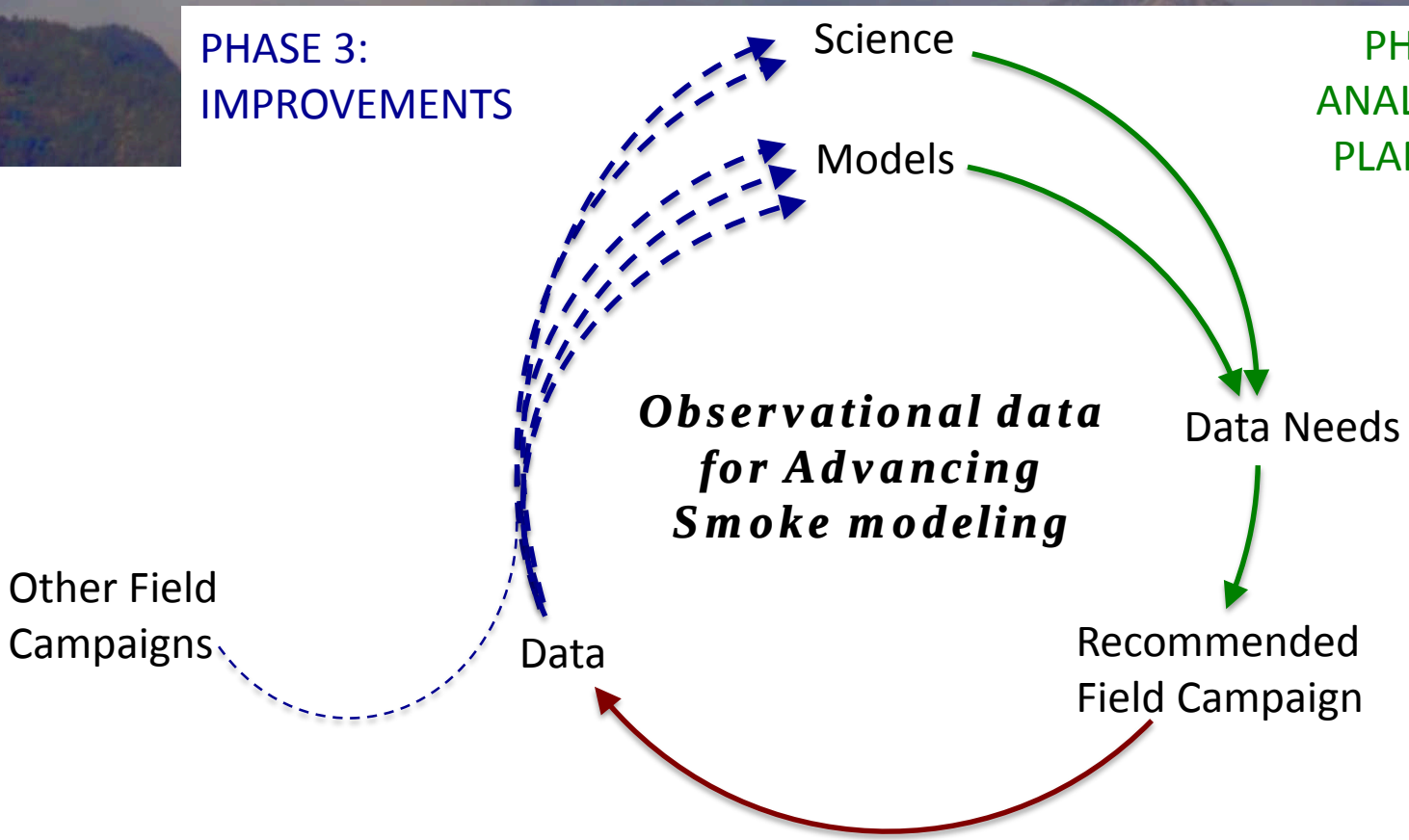
Fire and Smoke Model Evaluation Experiment

Phases



PHASE 2: FIELD CAMPAIGN

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Fire and Smoke Model Evaluation Experiment

Phase 1 Science Team

http://fasmee.net

Modeling Lead(s) – WRF-SFIRE/WRF-SFIRE-CHEM	**A. Kochanski**, U of UT (PI) **A. Fournier**, CU (co-I); **M.A. Jenkins**, York U / U of UT (co-I); **J. Mandel**, U of CO (co-I)
Modeling Lead(s) – WFDS/FIRETEC	**W. Mell**, USFS PNW (PI) **R.R. Linn**, LANL (co-I)
Modeling Lead(s) – CMAQ / EI / EPA regulatory modeling	**K.R. Baker**, EPA (PI) **B.K. Gullet**, EPA (co-I); **T.E. Kleindienst**, EPA (co-I); **T. Pierce**, EPA (co-I); **G. Pouliot**, EPA (co-I); **M.S. Landis**, EPA (co-I); **R. Mathur**, EPA (co-I); **V. Rao**, EPA (co-I); **A.F. Vette**, EPA (co-I)
Modeling Lead(s) – Prescribed fire / southeastern modeling	**Y. Liu**, USFS RMRS (PI) **G. Achtemeir**, USFS (emeritus, co-I); **T. Oddman**, U of GA (co-I); **S. Goodrick**, USFS RMRS (co-I)

Leadership Team:
Roger Ottmar, USFS
Sim Larkin, USFS
Tim Brown, DRI
Nancy French, MTU
Adam Watts, DRI
Susan Prichard, UW

Fuels Discipline Lead(s)	**A. Hudak**, USFS RMRS (PI) **R.E. Keane**, USFS RMRS (co-I); **E.L. Loudermilk**, USFS SRS (co-I); **R.A. Parsons**, USFS RMRS (co-I); **S.J. Pritchard**, UW (co-I); **C.A. Seielstad**, U of MT (co-I); **N.S. Skowronski**, USFS NRS (co-I)
Fire Behavior Discipline Lead(s)	**M. Dickinson**, USFS NRS (PI) **B.W. Butler**, USFS RMRS (co-I); **W.M. Hao**, USFS RMRS (co-I); **J.J. O'Brien**, USFS RMRS (co-I); **W. Schroeder**, UMd (co-I)
Meteorology and Plume Dynamics Discipline Lead(s)	**B. Potter**, USFS PNW (PI) **C. Clements**, SJSU (co-I)
Smoke Emissions and Chemistry Discipline Lead	**S.P. Urbanksi**, USFS RMRS (PI)

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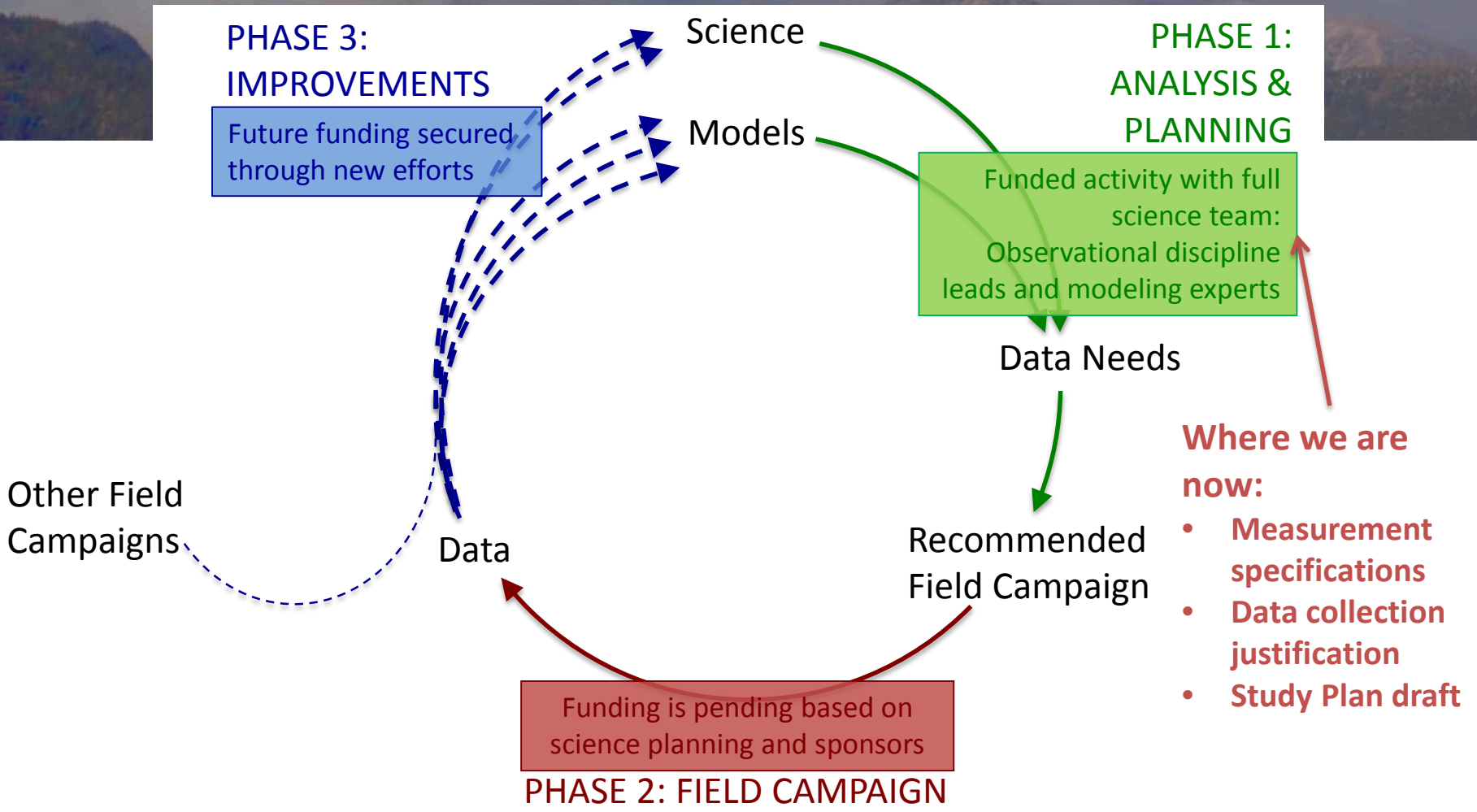
Fire and Smoke Model Evaluation Experiment

Phases



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Fire and Smoke Model Evaluation Experiment

Process

Phase 1

- **Choose Science Team Leads (done)**
- **Scope out and write FASMEE Observational Study Plan**
  - Discuss FASMEE focus/foci & how to attain goals (done)
  - Visit & choose sites (done)
  - Write draft & final plan documents & other documentation
- **Funding Opportunity Notice (JFSP) released for proposal application**
- **Choose FASMEE Phase 2 projects & team members (who will be planning, collecting, analyzing, writing up, organizing data, etc.)**

Phase 2 (if funded)

- **Finalize Study Plan**
- **Do the FASMEE burns & science**
- **Distill and archive data sets**

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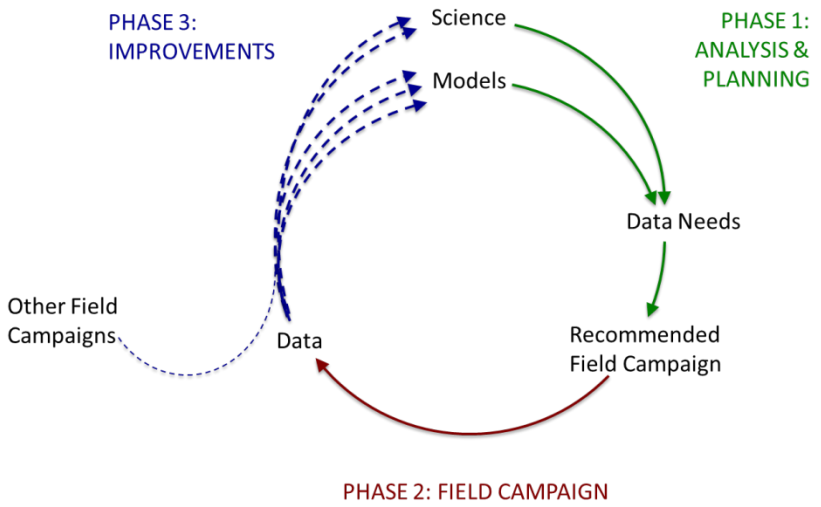
Phase 1 Activities

Site Reviews and Selection

- Two site visits
  - North Carolina/Georgia
  - Utah/Arizona
- Coordination with hosting agencies and personnel
- Specific site selection for development of measurement plans & feasibility



Coordination with JFSP Board of Directors

- Understand expectations (2-way)
- Set general guidance (Board → Science Team)
- Provide ideas on scope (Science Team → Board)

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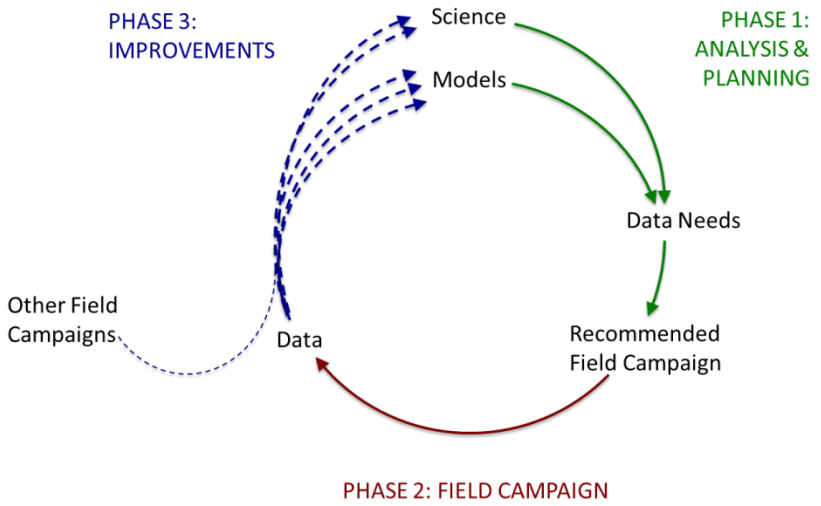
Phase 1 Activities

Study Plan Development



- **Background and context**
- **Modeling needs**
- How will models use the data collected in FASMEE Phase 2?
- **Recommended measurements and justification**
  What each measurement is for:
  - How it connects to model issues
  - Why this quantity/spatial & temp resolution is optimal
- **Use of observational data to address science questions and model needs**
  - for model improvement/development
  - to address the science questions
- **Logistics and Specialized sub-plans**

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Phase 1 Activities

Modeling & simulations

- Provide help in defining measurement specifications
- Help demonstrate need for measurement (justification)
- Explore value of new measurements in model improvement (including benchmarking)

FASMEE
Site Hosts (DoD, USFS, NPS)

- Receptive to research
- Cooperation
- Coordination
- Logistical support
- Planned burn units that meet FASMEE requirements
- Incident Action Plan
- Budget for host agency

Site Selection

- FASMEE research areas
  - Southwestern US
    - Mixed conifer/dry ponderosa fuel load (20-150 t/a)
    - Stand replacement/higher intensity fires
    - September/October-2018, May/June-2019
  - Southeastern US
    - Long-leaf pine plantation, 3-5 year rough (20+ t/a)
    - February–April 2020-2021

- Hosts

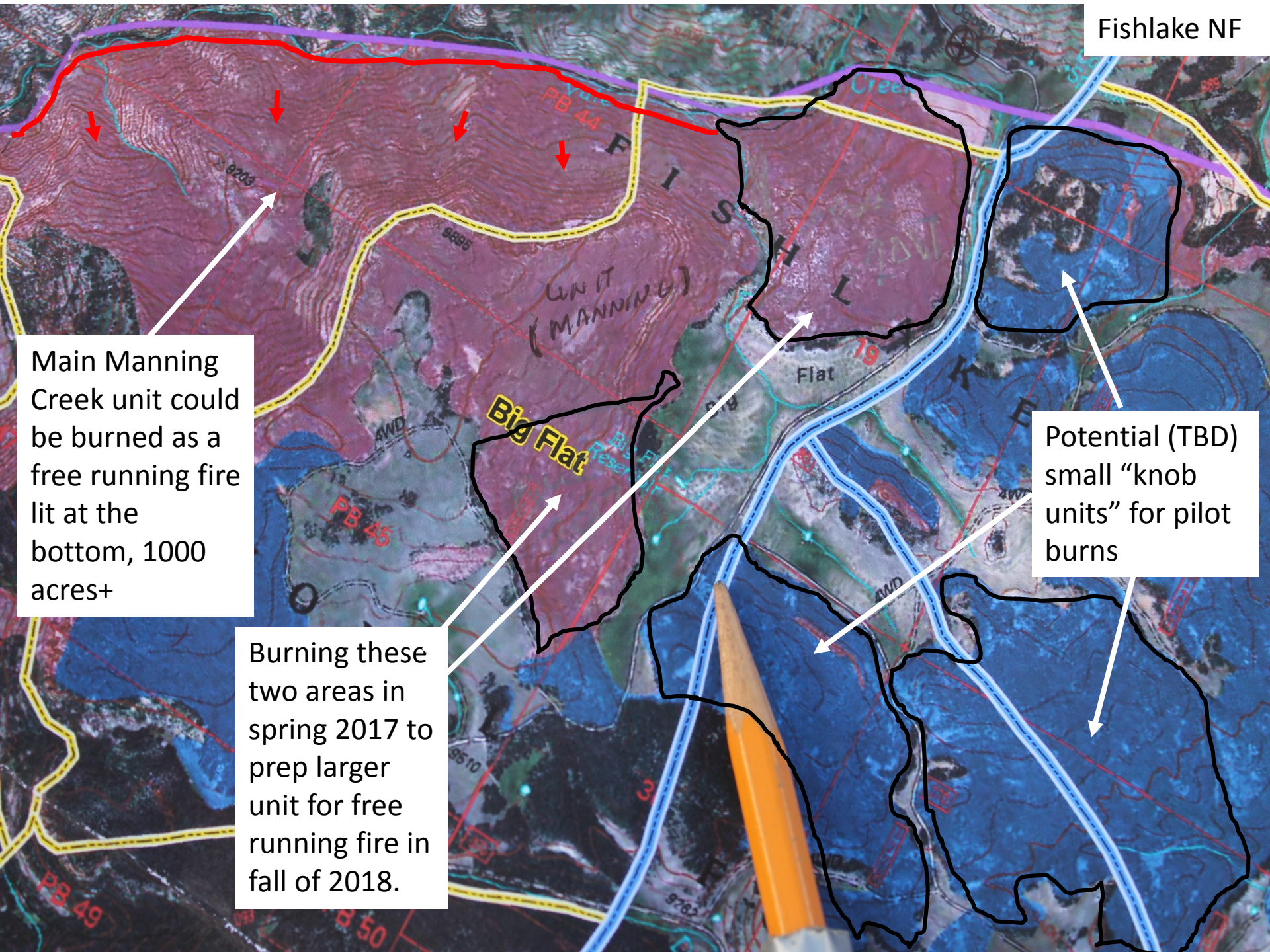
  Southwest
  - Fishlake/Dixie National Forest (mixed conifer/aspen)
  - Kaibab National Forest and Grand Canyon (Ponderosa pine or mixed conifer)

  Southeast
  - Fort Stewart (southern pine)
  - Savannah River Site (alternate)

Fort Stewart

1 – Year Rough

5 – Year Rough


Fishlake NF
Main Manning Creek unit could be burned as a free running fire lit at the bottom, 1000 acres+
Burning these two areas in spring 2017 to prep larger unit for free running fire in fall of 2018.
Potential (TBD) small “knob units” for pilot burns
Big Flat
UNIT (MANNING)
PB 44
PB 45
PB 49
PB 50
9885
9203
9510
9762
4WD

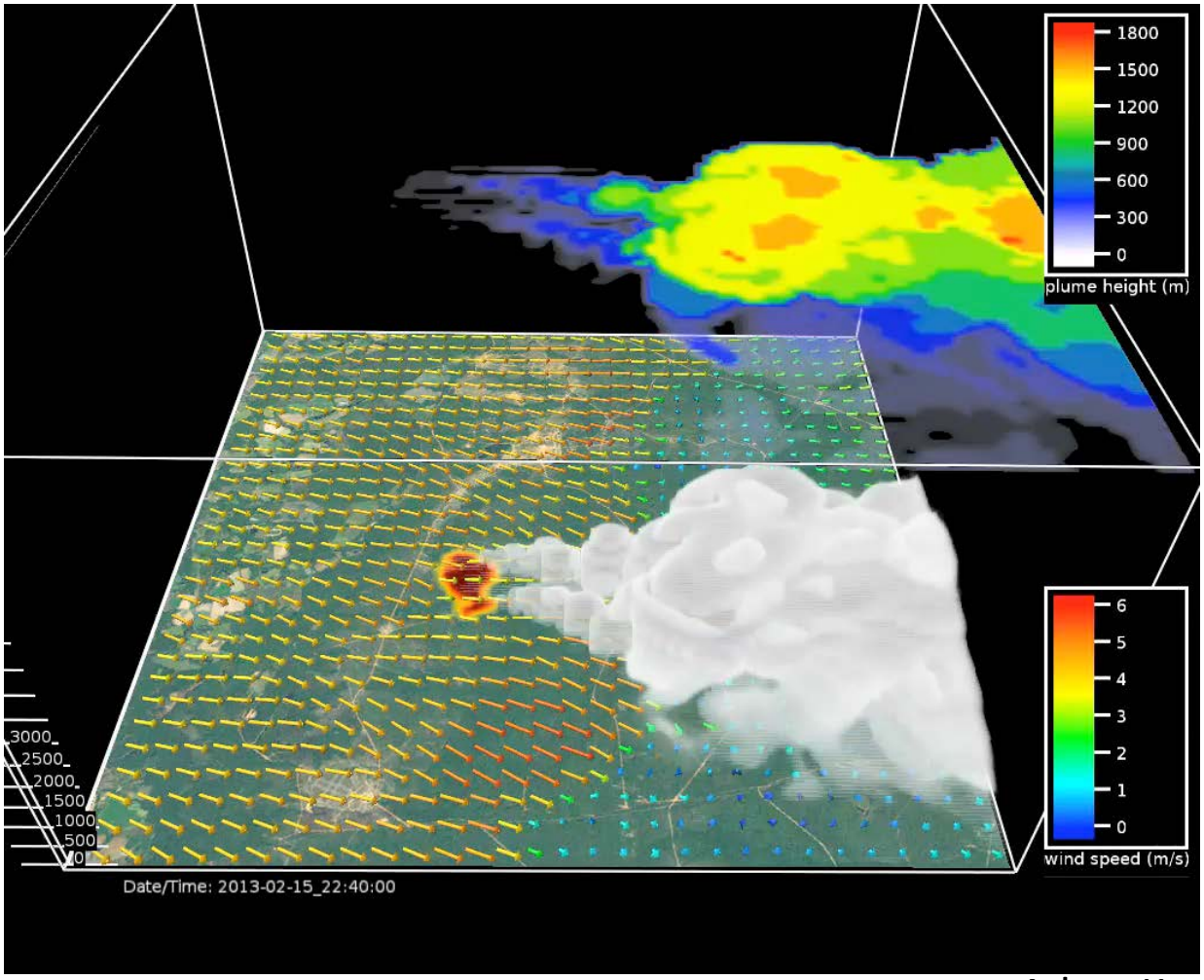
FASMEE Challenges

- **Spatially and temporally resolved measurements**
  - **Fire position/evolution**
  - **Quantitative fire radiation (need dual-band capability for airborne measurements)**
  - **Quantitative fire convection (inferred and/or measured)**
  - **Higher spatial and temporal resolution than before**
  - **Nighttime smoke and heat?**
- **Aerial data collection/UAS**
  - **Airborne data is a necessary component of most disciplines**
  - **UAS expected to be involved at all sites to varying degrees**
  - **Focus on mature, deployable/operational platforms & payloads to support data needs (not a UAS development niche)**
  - **Coordination of airspace is an important consideration**

- Matt Dickinson & Wilfrid Schroeder presented at the last TFRSAC on the use of airborne and spaceborne fire radiation measurements for fire and smoke modeling.

Example of how simulations can help measurement design

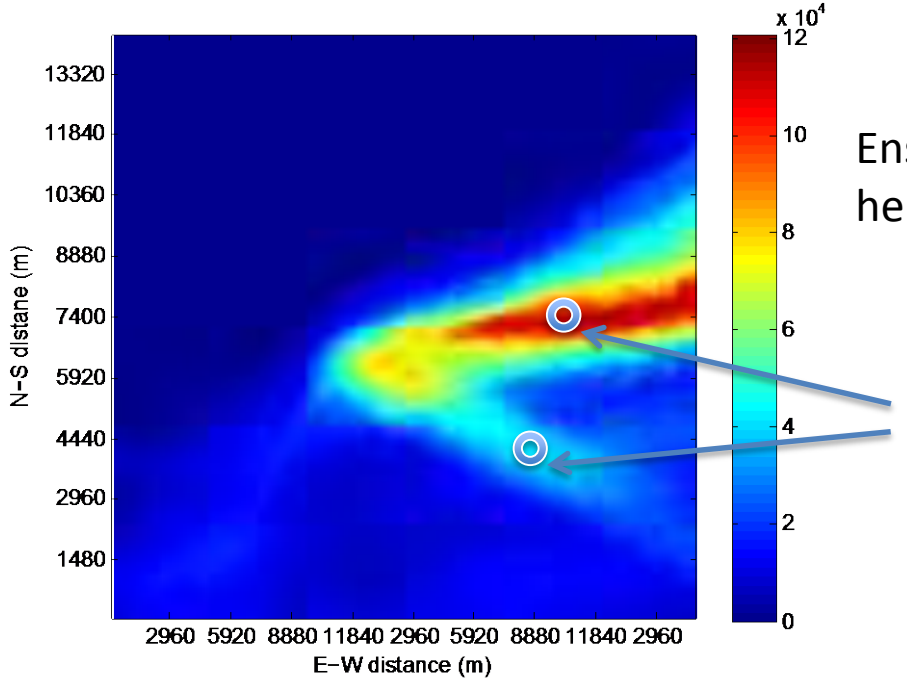
Assessing the expected plume height with WRF-SFIRE



Adam Kochanski (U. Utah)

Example of how simulations can help measurement design

Assessing most optimal horizontal placement of the sensors based on ensemble variance



Ensemble variance of the simulated plume height

Optimal locations of the sensors (places where slightly different model realization provide different results)

More ensemble variance => more constraints on the model -> more improvement.

Adam Kochanski (U. Utah)

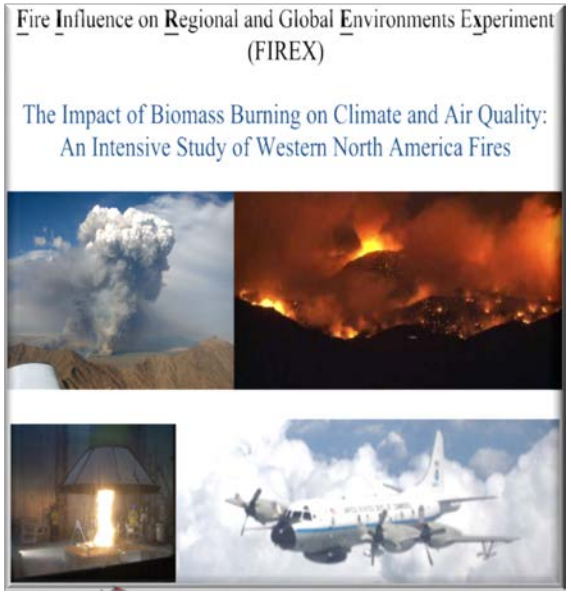
FASMEE
Coordination with FIREX & FireChem

FIREX:

- NOAA sponsored 5 year experiment
- NOAA and external scientists
- Major sources of funding:
  - NOAA CSD (int), NOAA AC4 (ext)
  - Total budget: ~$24M
- Multiple phases –
  - 2016 Fire lab burn chamber studies
  - 2017 Storm Peak lab measurements
  - 2018 Western wildfire field campaign focused on aircraft measurements
    - P3 Orion + other aircraft

FireChem:

- 2017 NASA Tropospheric Chemistry RFP
- Includes support for FIREX, FASMEE
- NASA DC8 Aircraft reserved for 2018



FASMEE Burn Timeline Options

Timing

Southwest Burn Window
Sep-Oct: both Fishlake, UT and Kaibab, AZ
May-June: Fishlake, UT only
Matches with FIREX & FIREChem campaigns

Southeast Burn Windows
Feb-March: Dormant Season, Fort Stewart, GA
April-May: Growing Season, Fort Stewart, GA
Matches with FIREChem campaign

Unique Benefits of FASMEE with FIREX and FireChem

- Characterize fuels, fire, and plume dynamics to relate to smoke, chemistry and transport
- Discipline leads and modelers draft Measurement Specifications Document
- Target burns representing southwest and southeastern fuel bed complexes
- Captures a range of fire intensity and duration typical of fires managed by land managers including burns that closely represent wildfire
- Burn windows will range across winter, spring and fall
- Exemplar of collaborative federal fire science


Questions and Discussion