A Large Integrated Multiagency Fire Study

Project Leads

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Outline

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

Science Question and Goal

*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 **innovative** and **efficient** measurement techniques to collect critical observational data necessary to evaluate and advance operationally used fire and **smoke modeling** systems and the underlying scientific models and framework.

*Joint Fire Science Program: “Research in response to the emerging needs of policymakers and fire managers”*
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)
FASMEE

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

Smoke and chemistry
Flaming and smoldering emission factors
Smoke evolution and aging

Fuels and consumption
Multi-scale characterization

Plume and meteorology
Mixing and entrainment parameterizations
Identification of dynamic regimes and parameters
Multiple core interactions

Airborne, platform, towers

Ground sampling
Air and ground Lidar
UAS mapping

Fire behavior and energy
Characterize spatial and temporal heat flux density

Airborne, ground and satellite platforms
Observational data for advancing smoke modeling

PHASE 1: ANALYSIS & PLANNING

PHASE 2: FIELD CAMPAIGN

PHASE 3: IMPROVEMENTS

Data

Science

Models

Data Needs

Recommended Field Campaign

Other Field Campaigns
**Leadership Team:**
- Roger Ottmar, USFS
- Sim Larkin, USFS
- Tim Brown, DRI
- Nancy French, MTU
- Adam Watts, DRI
- Susan Prichard, UW
**PHASE 1: ANALYSIS & PLANNING**
- Funded activity with full science team: Observational discipline leads and modeling experts
  - Data Needs

**PHASE 2: FIELD CAMPAIGN**
- Recommended Field Campaign
- Funding is pending based on science planning and sponsors
  - Other Field Campaigns

**PHASE 3: IMPROVEMENTS**
- Future funding secured through new efforts

Where we are now:
- Measurement specifications
- Data collection justification
- Study Plan draft

**DATA**
- Science
- Models
- Recommended Field Campaign

**DATA NEEDS**
- Measurement specifications
- Data collection justification
- Study Plan draft

**OTHER FIELD CAMPAIGNS**
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
FASMEE
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 \( \rightarrow \) Science Team)
• Provide ideas on scope (Science Team \( \rightarrow \) Board)
FASMEEE
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**
FASMEE
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)
FASMEEE
Site Hosts (DoD, USFS, NPS)

• Receptive to research
• Cooperation
• Coordination
• Logistical support
• Planned burn units that meet FASMEEE 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/Junue-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)
Burning these two areas in spring 2017 to prep larger unit for free running fire in fall of 2018.

Main Manning Creek unit could be burned as a free running fire lit at the bottom, 1000 acres+

Potential (TBD) small “knob units” for pilot burns

Fishlake NF
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
Example of how simulations can help measurement design

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

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
FASMEEE Burn Timeline Options

**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

Timing

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<th>2018</th>
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FIREX
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