The State of Smoke Tools

Sim Larkin, Tara Strand, Robert Solomon, Miriam Rorig, Candace Krull
(US Forest Service AirFire Team)

Dana Sullivan, Sean Raffuse, Daniel Pryden, Chris Ovard, Lyle Chinkin (Sonoma Technology)

Susan O'Neill (NRCS), Lawrence Friedl (NASA), Ray Knighton (USDA CSREES)

May 13, 2008
Salt Lake City, Utah

Lots of different applications

Planning a burn

long-range, need to compare options (what if)

Lighting a burn

real-time (right now!), need to compare options (what if)

Breathing the air

real-time (right now!), best guess (just what is going to happen)

Diagnosing what happened

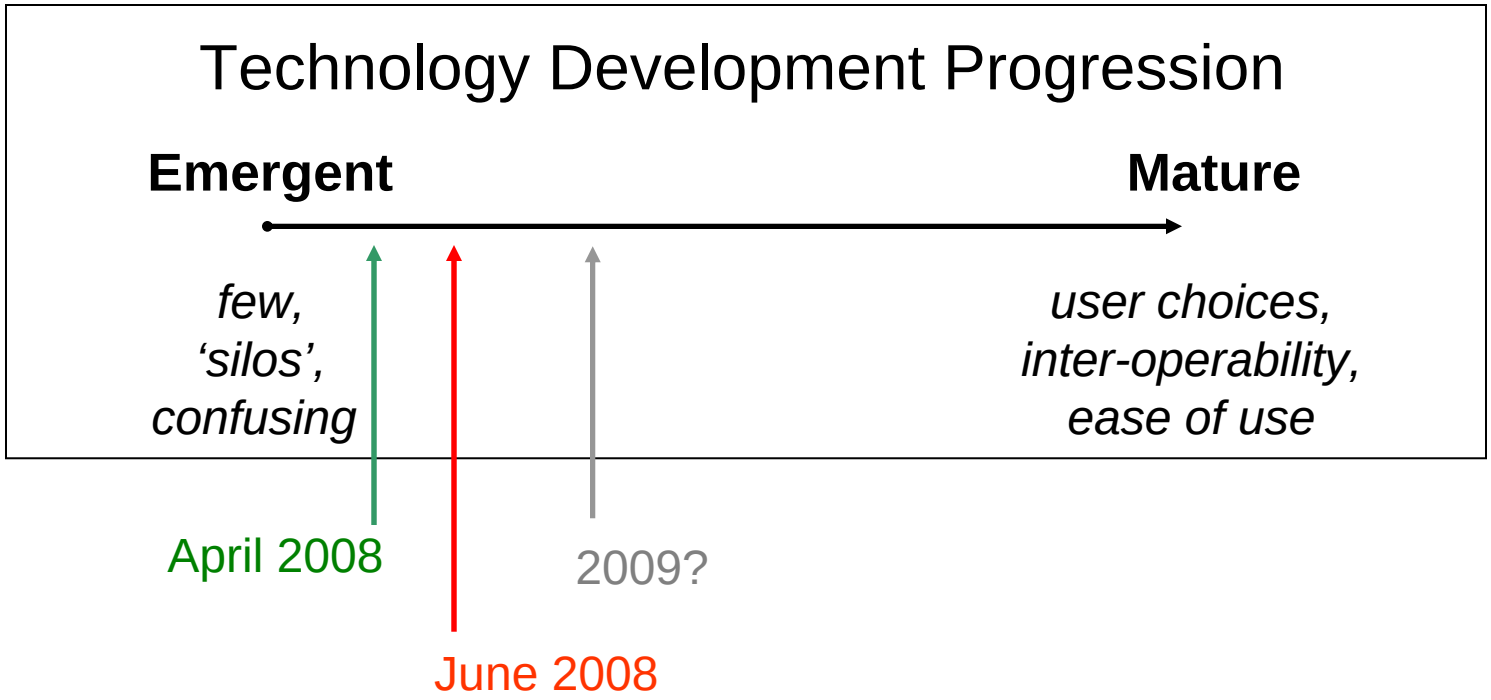
historical, best guess (just what happened)

AIRFIRE
ATMOSPHERE & FIRE INTERACTIONS RESEARCH & ENGINEERING

The State of Smoke Tools

MODELS + USER INTERFACE = DECISION SUPPORT APP

Current State: HAPHAZARD



Promising Developments

1. Model Inter-operability
   - BlueSky Framework

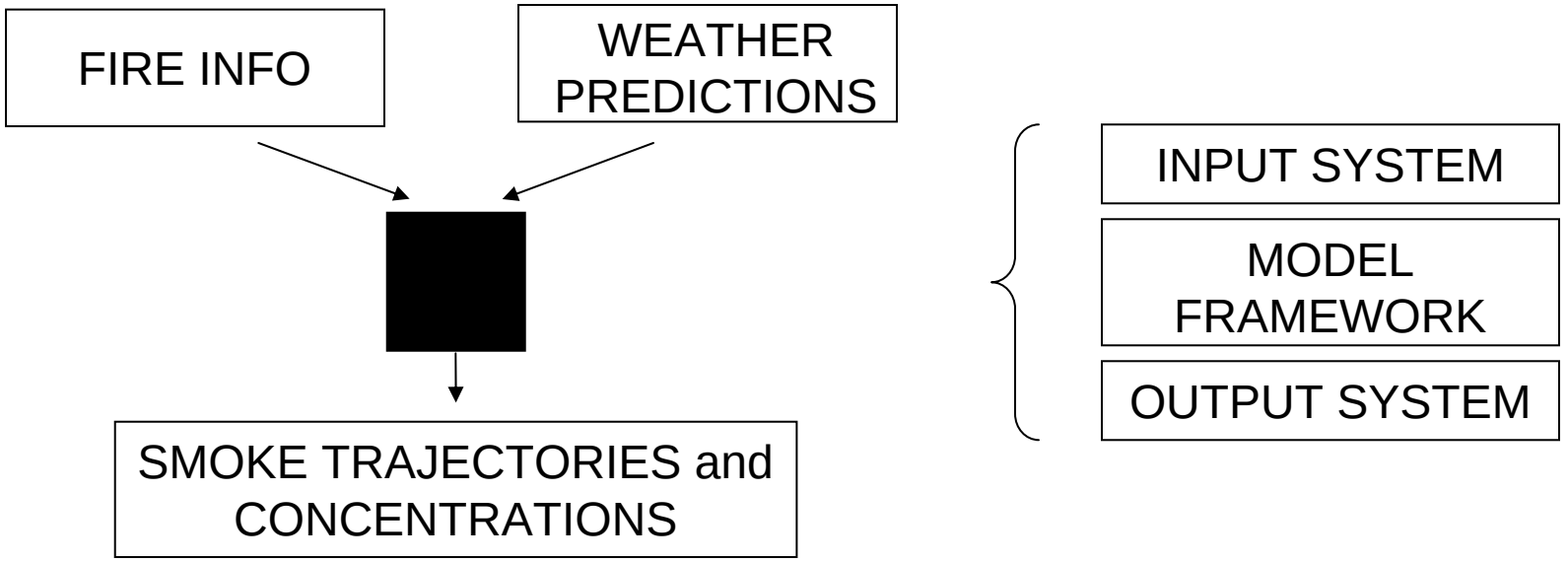
2. Nationally Consistent Products

3. New, Advanced Tools
   - for Fire Info (SMARTFIRE)
   - for Planning (AQUIPT)

4. Community Organizing
   - for Scientists (Modeling Intercomparison Project)
   - for Users (this, among others)

AIRFIRE
ATMOSPHERE & FIRE INTERACTIONS RESEARCH & ENGINEERING

Basics of Smoke Application



The New BlueSky Framework:

enabling interoperability

Fire Info

SMARTFIRE
ICS-209
Rx Sys
Manual
Other

Fuels

FCCS
NFDRS
Hardy
LANDFIRE*
Ag*
Other

Total Consumption

CONSUME 3
FOFEM
FEPS
EPM
ClearSky (Ag)*
Satellite*
Other

Time Rate

Rx / WF
FEPS
FOFEM
EPM
WRAP
Idealized
Manual
Other

Emissions

FEPS
Literature*
EPM
FOFEM
Other

Plume Rise

Briggs
Multi-core**
Daysmoke**
Other

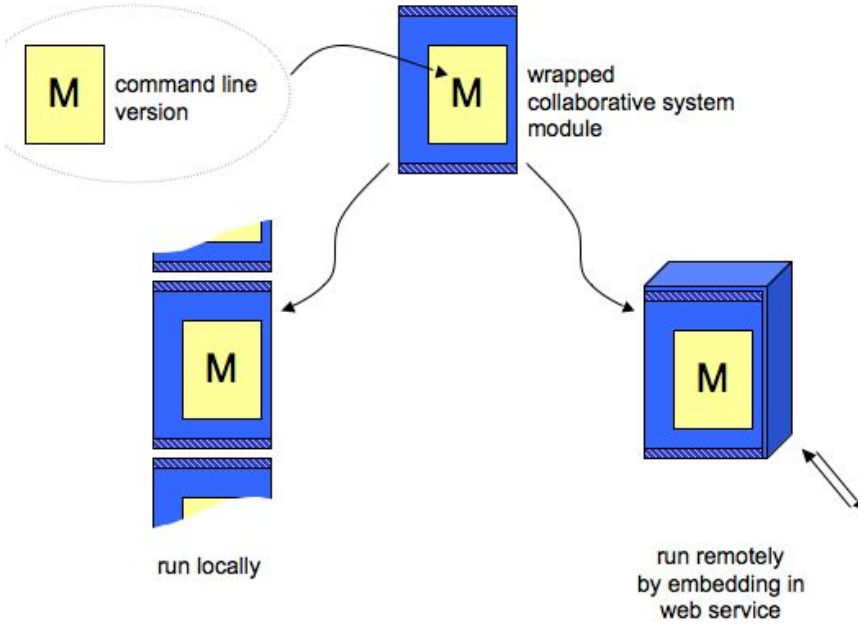
Dispersion / Trajectories

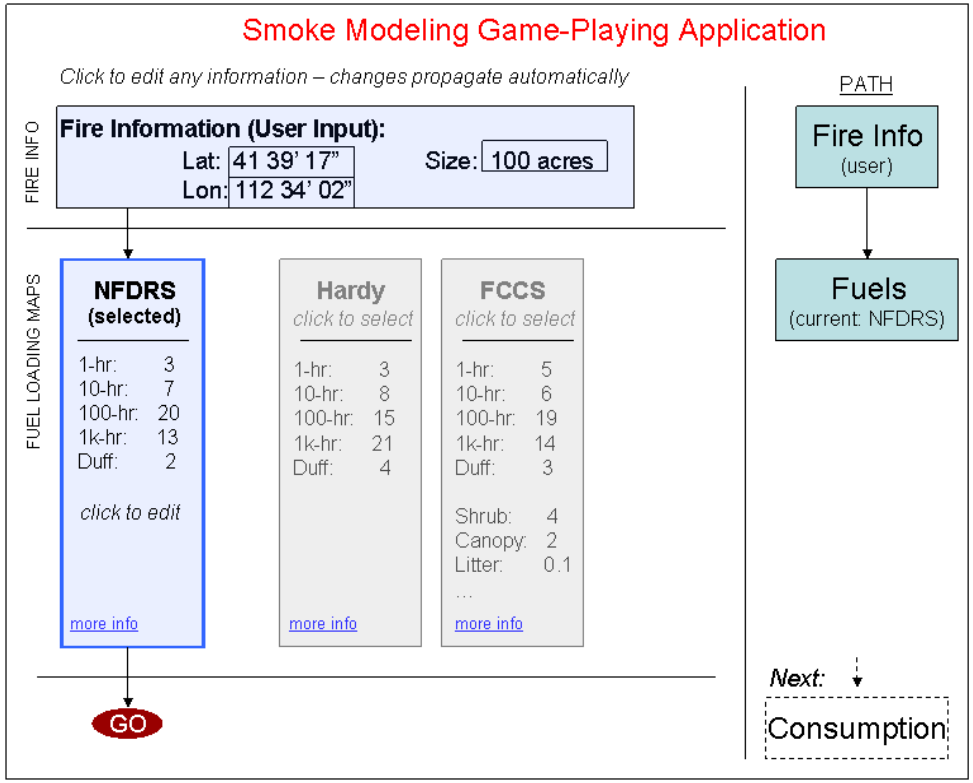
CalPuff
HYSPLIT
CMAQ
GEMAQ**

Currently 1296 different paths!

Modularity = Flexibility

leads to user choice

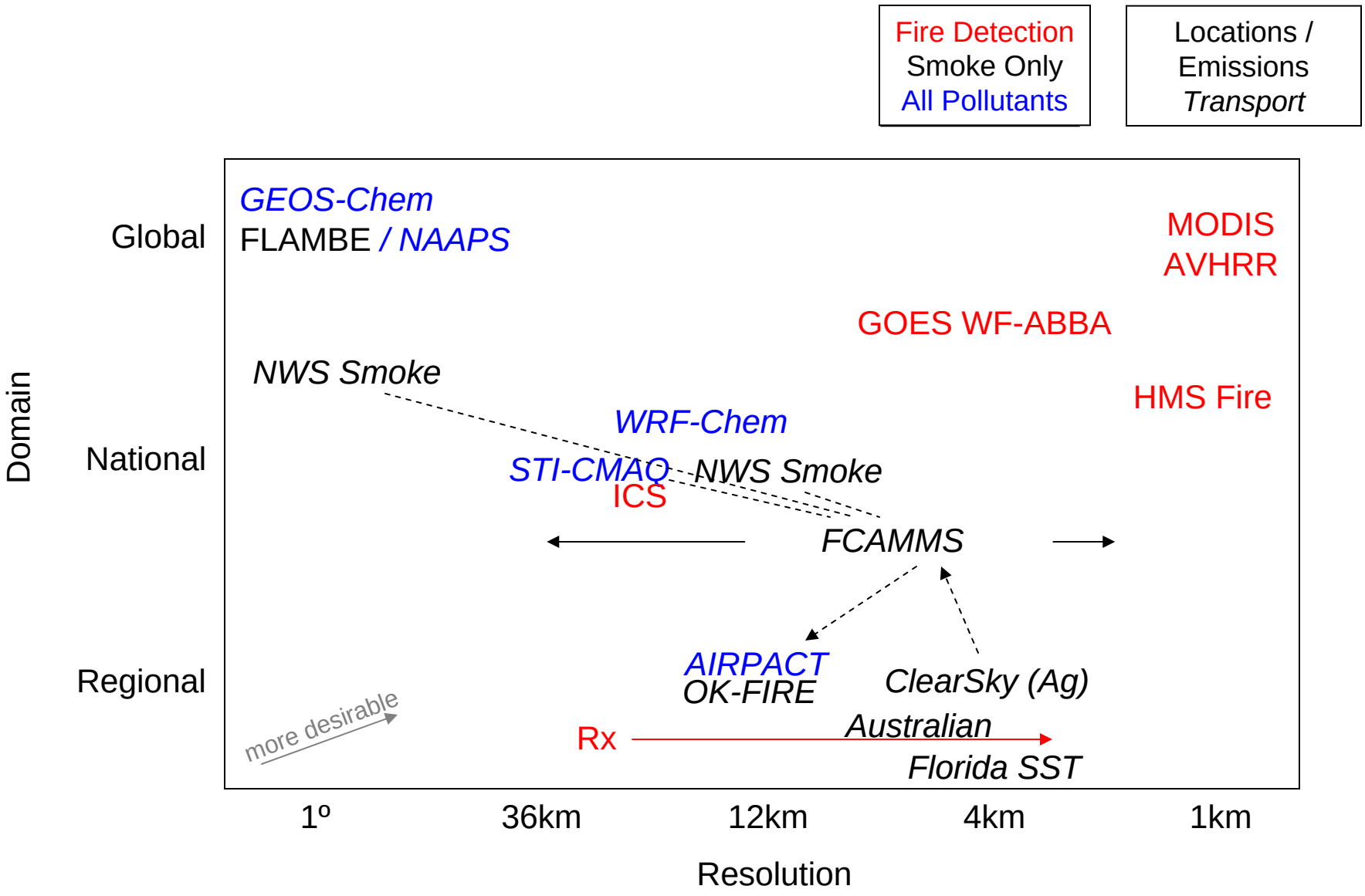




Models can be run locally or remotely (as web-services)

JFSP funded project

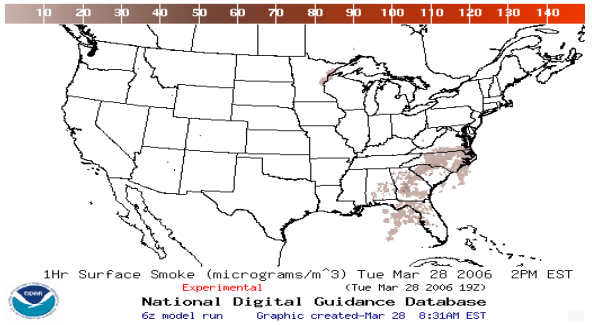
Real-Time Smoke-Related Sys



National Smoke Products

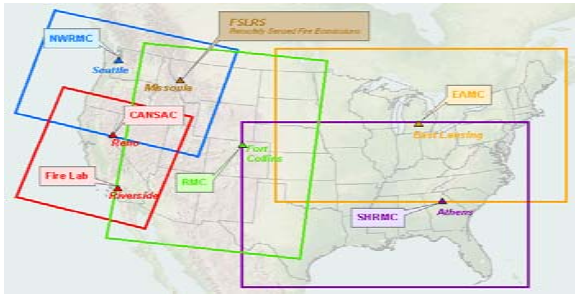
National Weather Service

- smoke only (12-km) & aq (36-km)



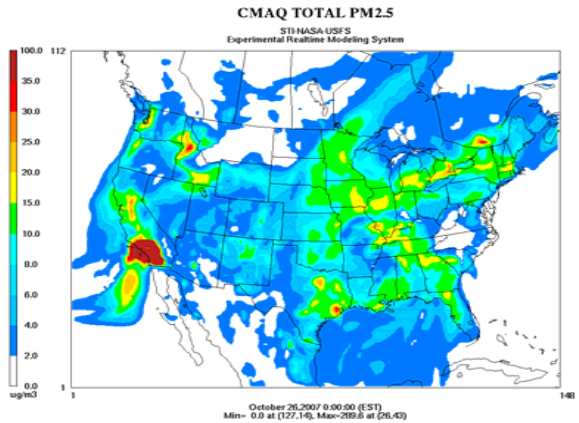
FCAMMS

- smoke only
- regional hi-res (4-km)
- national 12-km 3-day
  (based on NWS NAM)
- national 36-km 7-day
  (based on NWS GFS)



STI CMAQ

- national emissions inventory + fire
- national 36-km

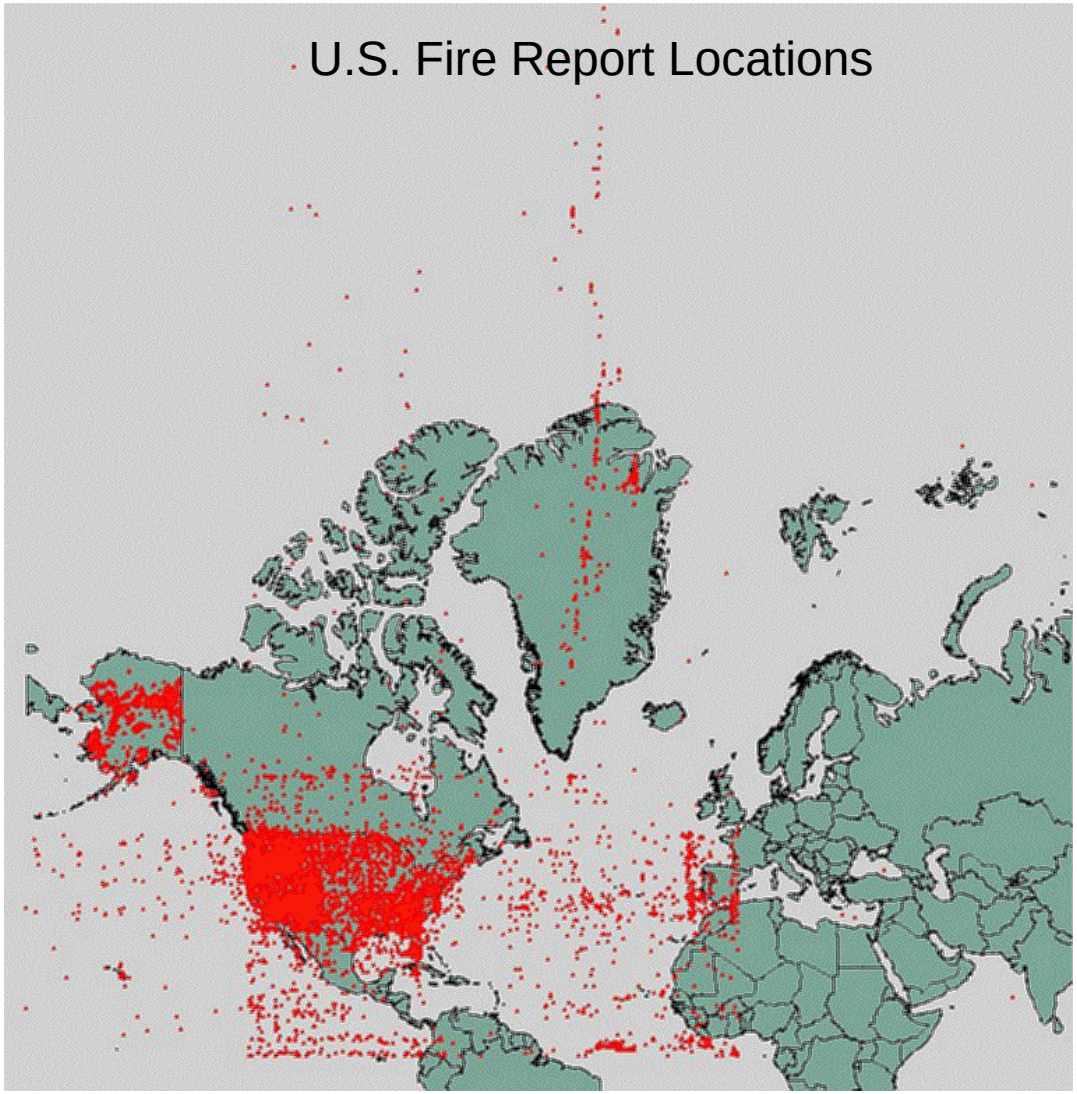


Lessons Learned

Fire information can be of poor quality

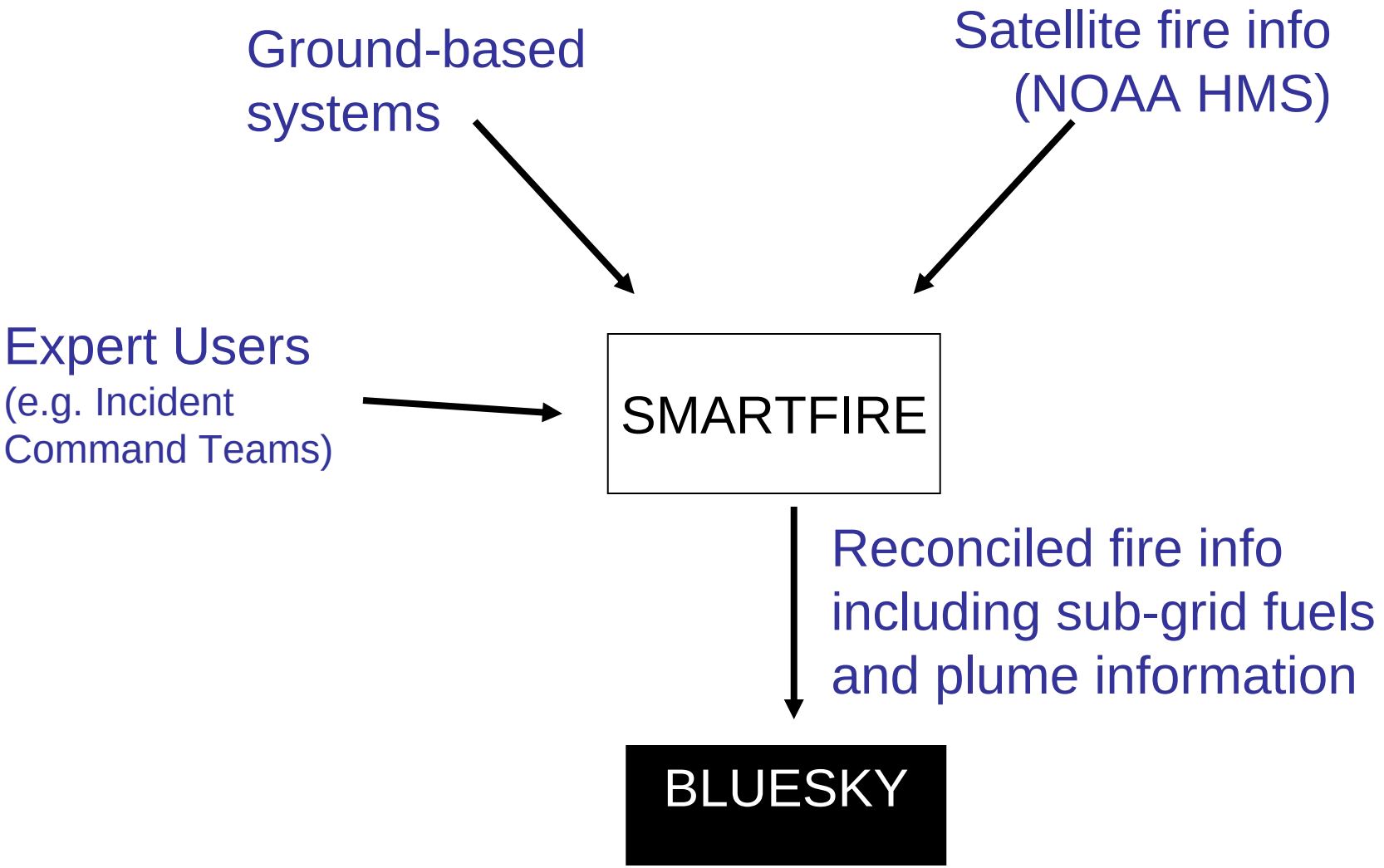
Models differ substantially

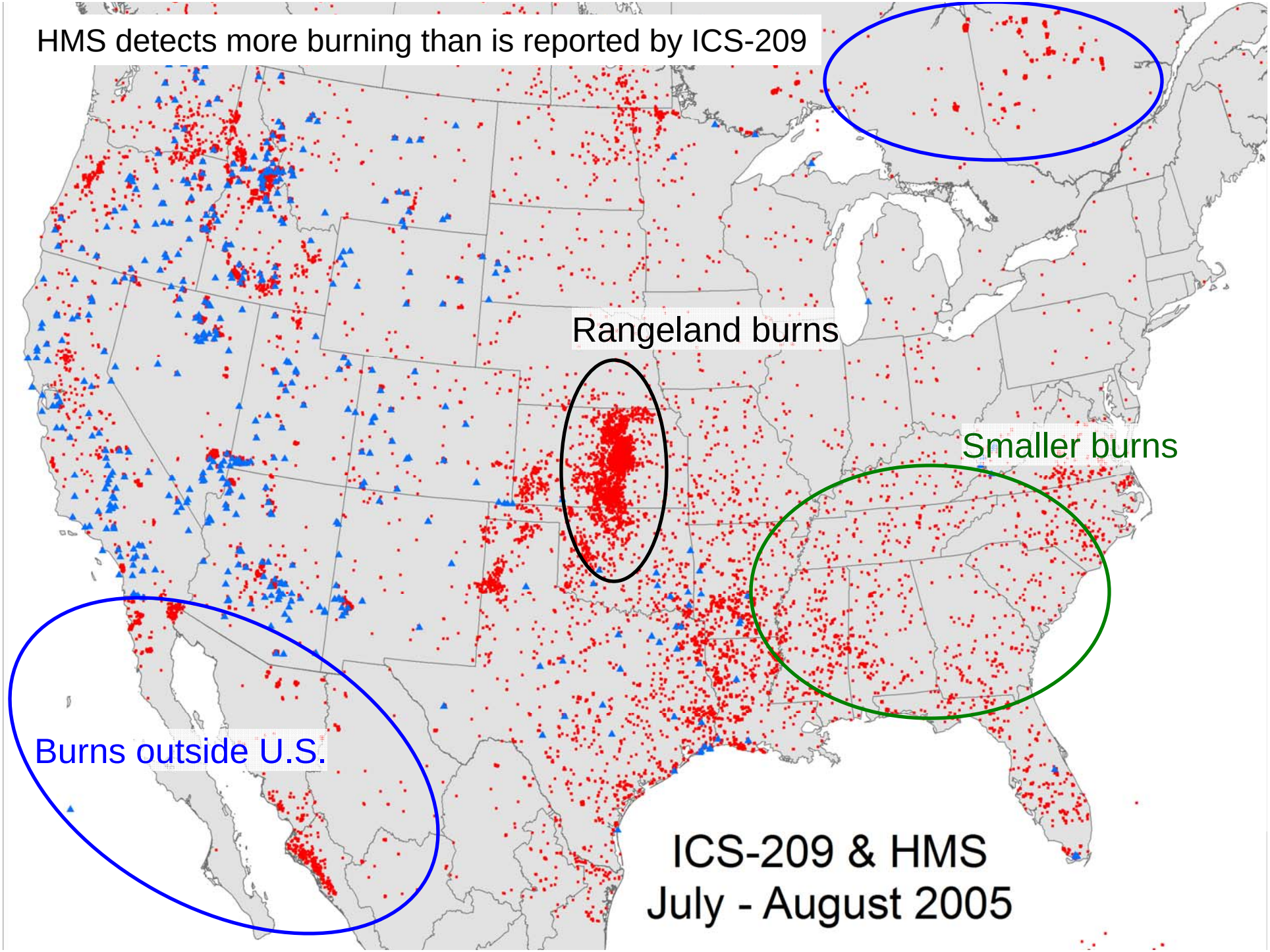
Plume rise needs fixing



Courtesy Tim Brown, DRI

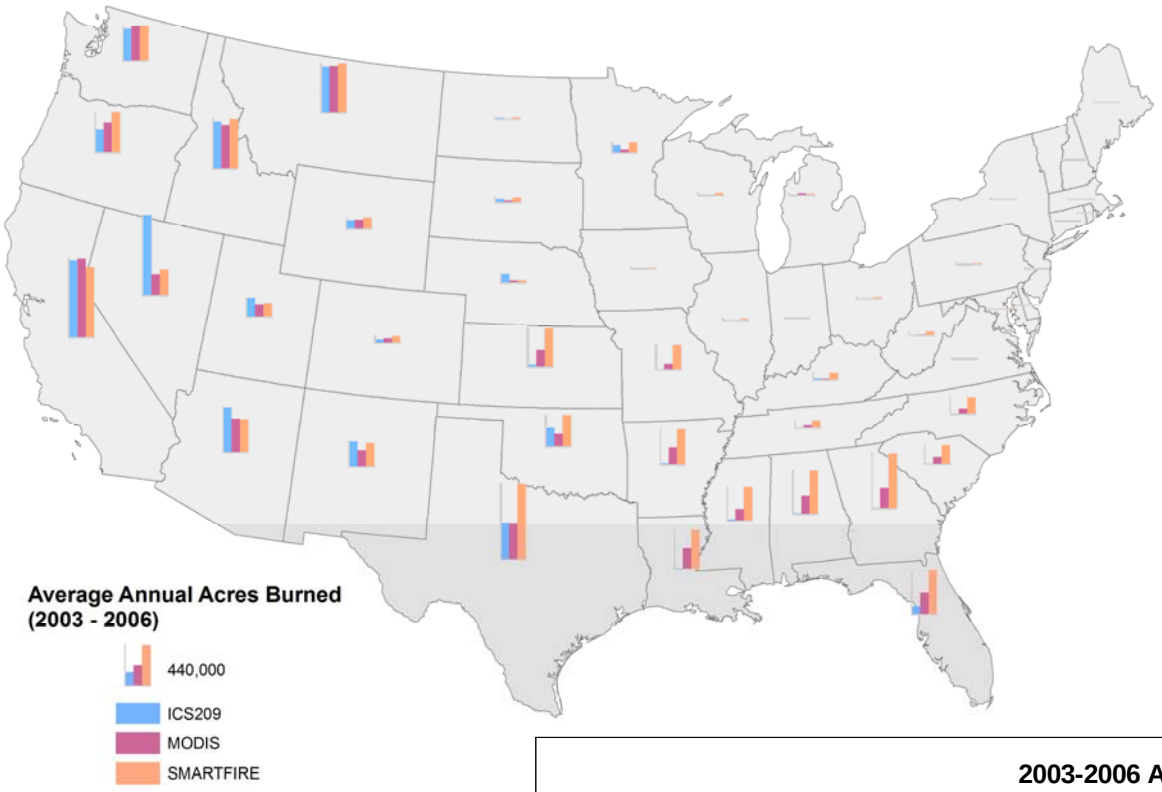
SMARTFIRE: Reconciled fire data

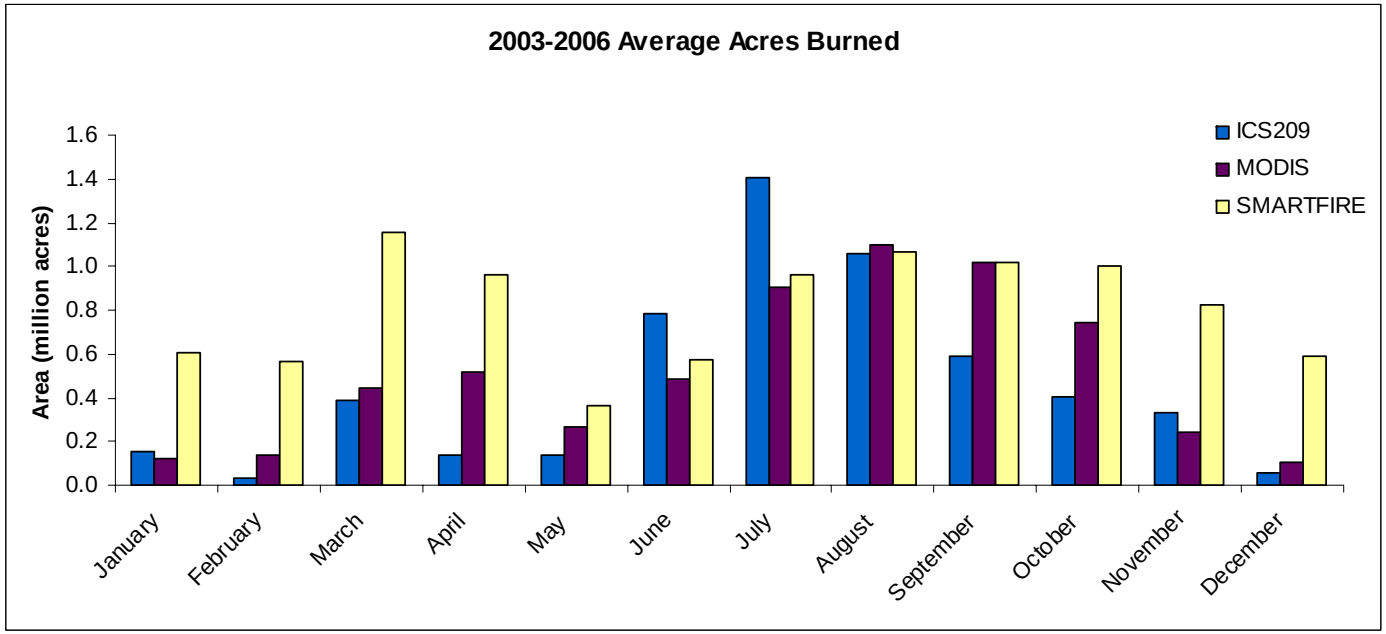



HMS detects more burning than is reported by ICS-209
Rangeland burns
Smaller burns
Burns outside U.S.
ICS-209 & HMS
July - August 2005

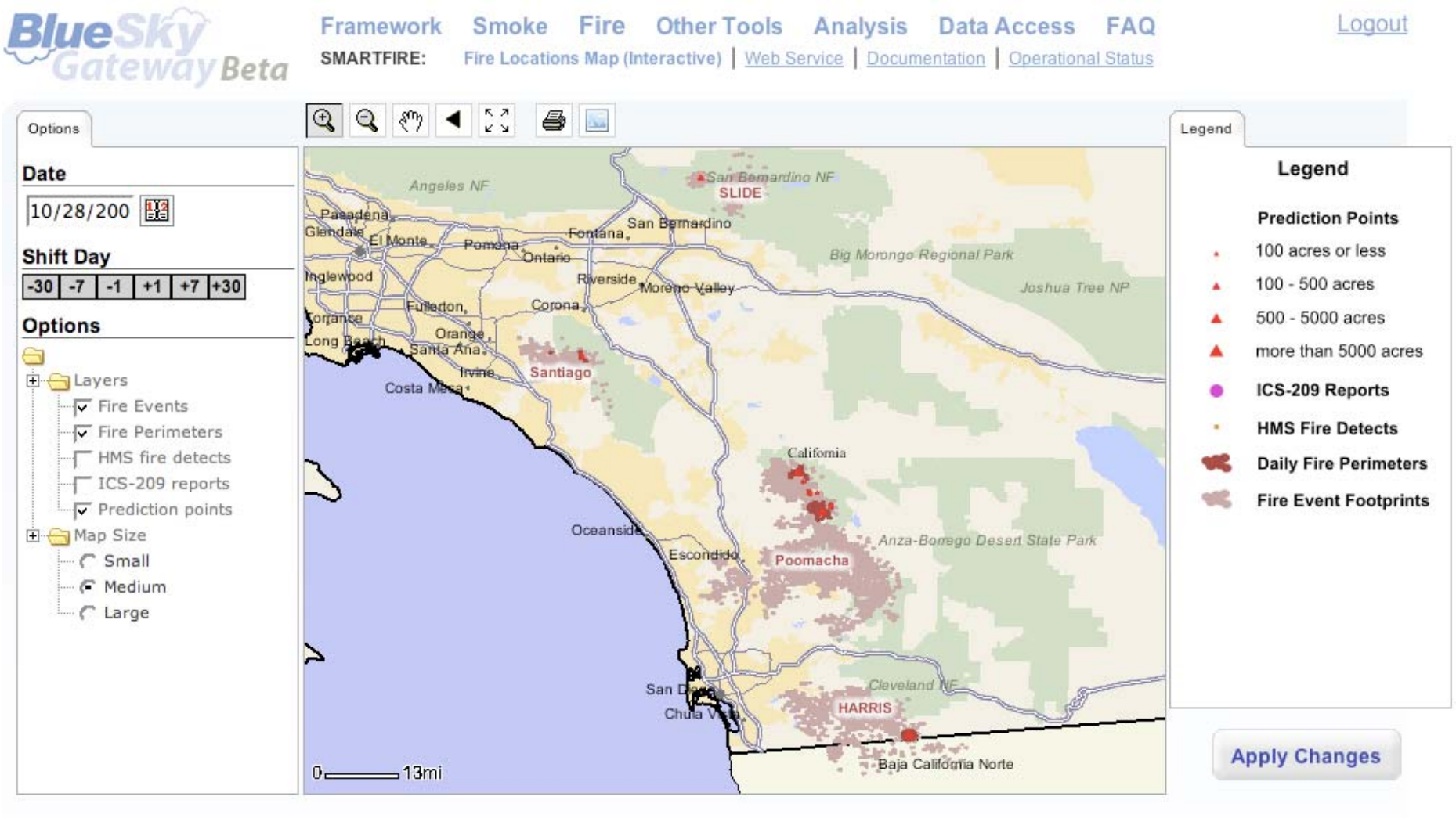
NEI / SMARTFIRE

comparisons based on 2000-2003
NOAA HMS's use of GOES
picks up smaller burns in the SE





SMARTFIRE: Data viewer



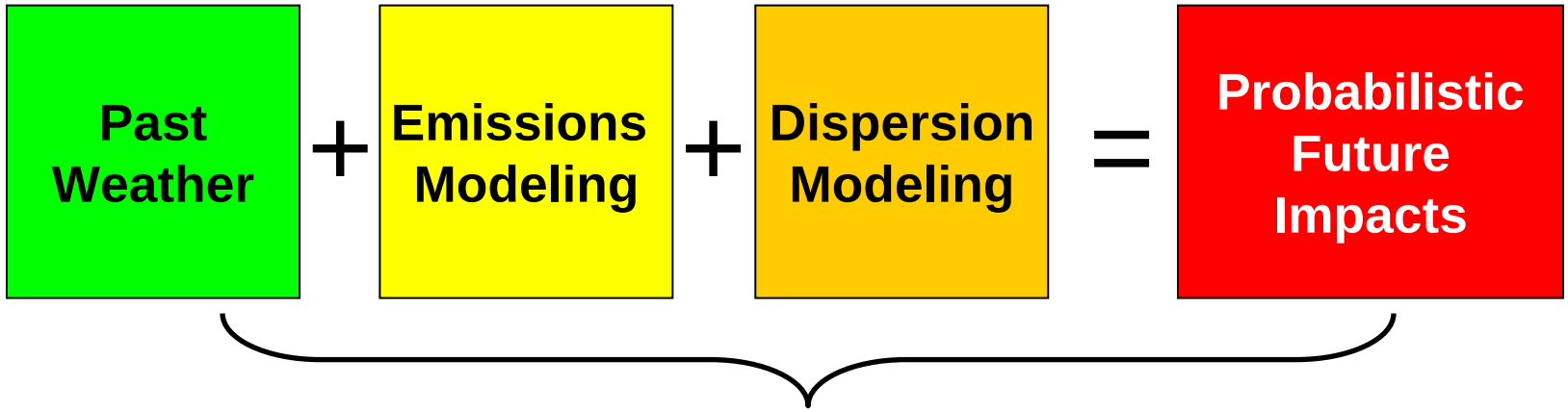
AQUIPT: Longer-range planning

air quality impacts planning tool

Example: planning fire this August

Can't say what impacts **will be**

But can use **history as a guide**



Web Interface

Example: Fire this August

air quality impacts planning tool

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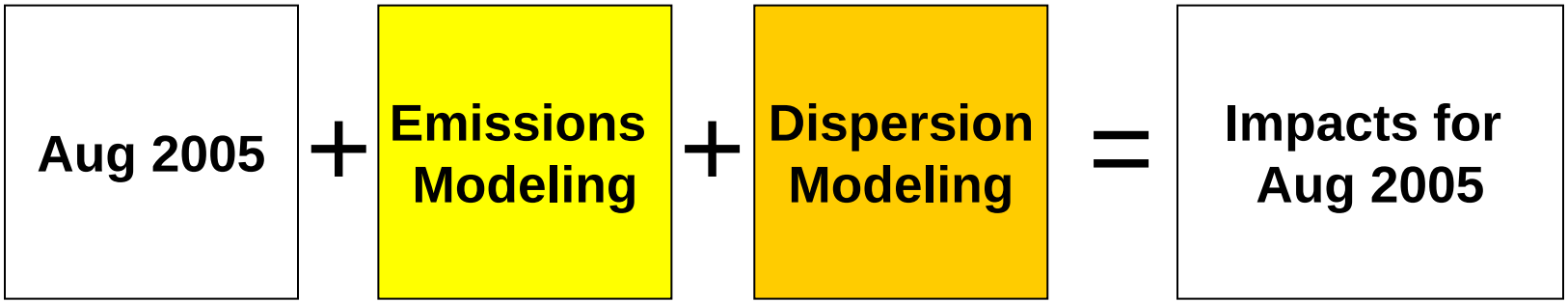

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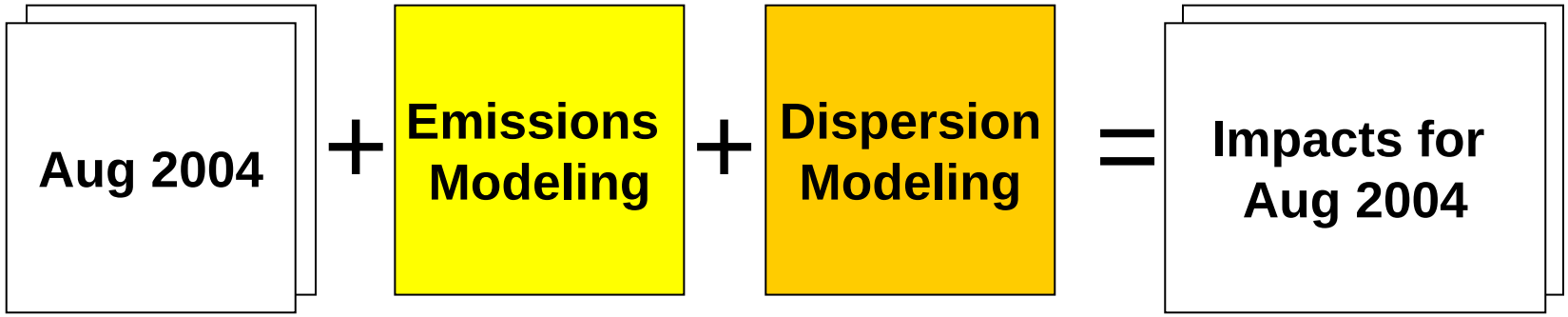

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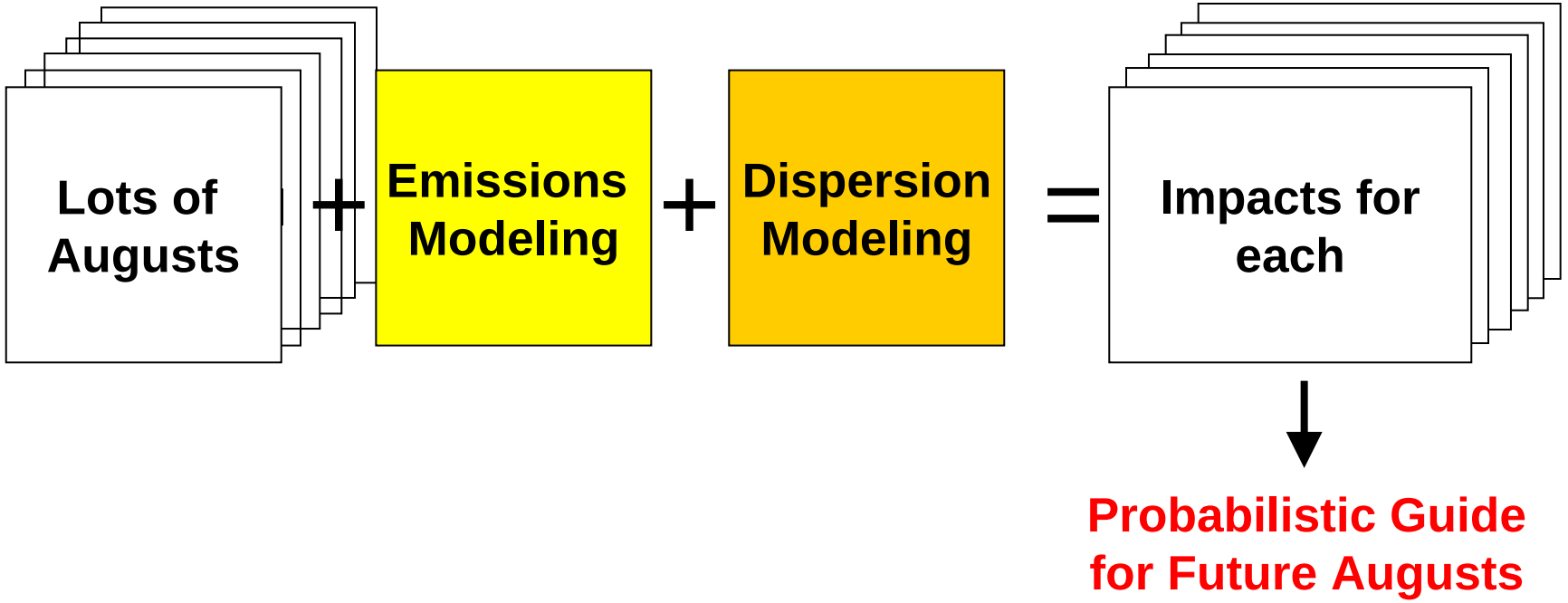
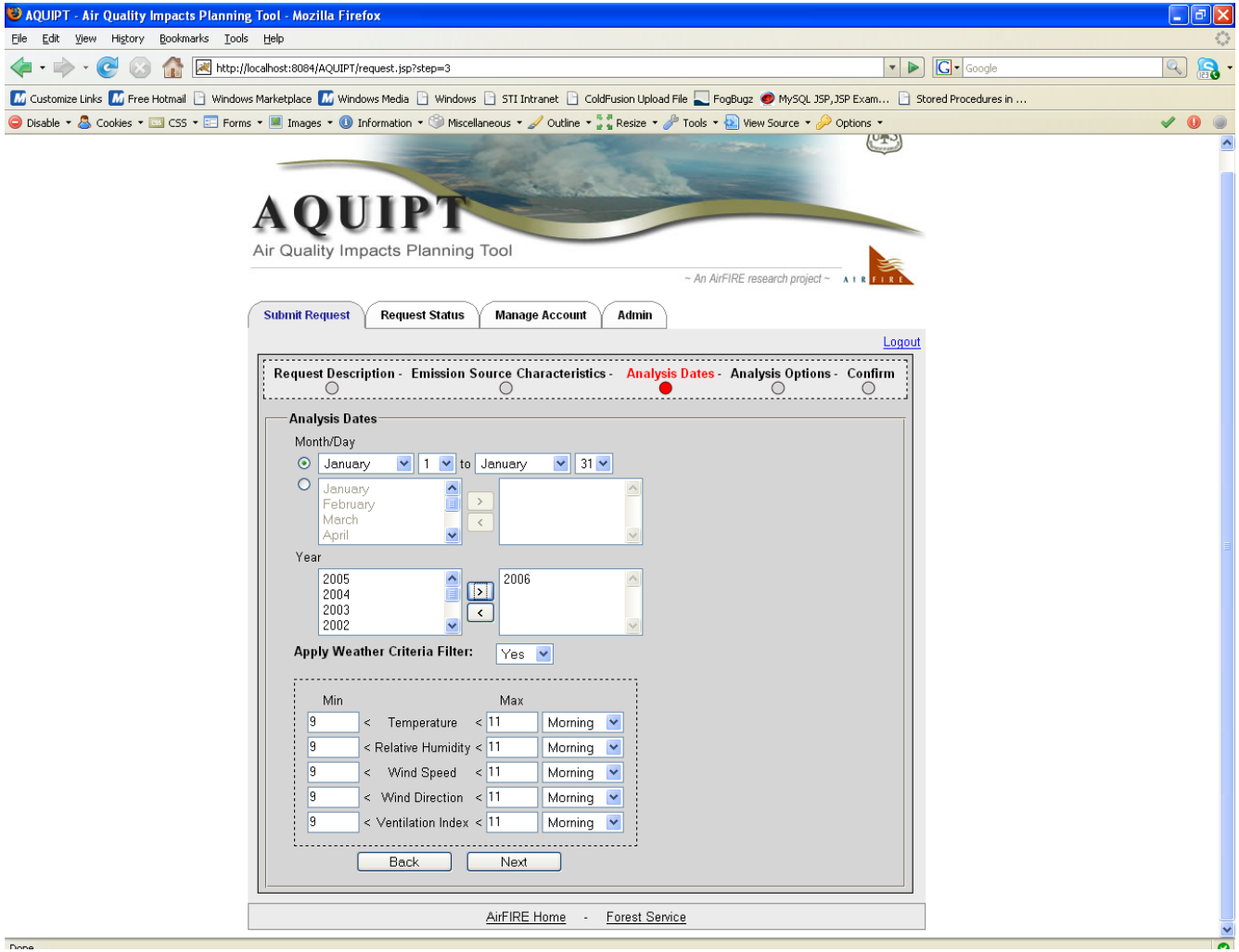


AQUIPT: Accessible through web

air quality impacts planning tool



AIRFIRE
ATMOSPHERE & FIRE INTERACTIONS RESEARCH & ENGINEERING

AQUIPT: Summary

Provide basic source info, it does the rest

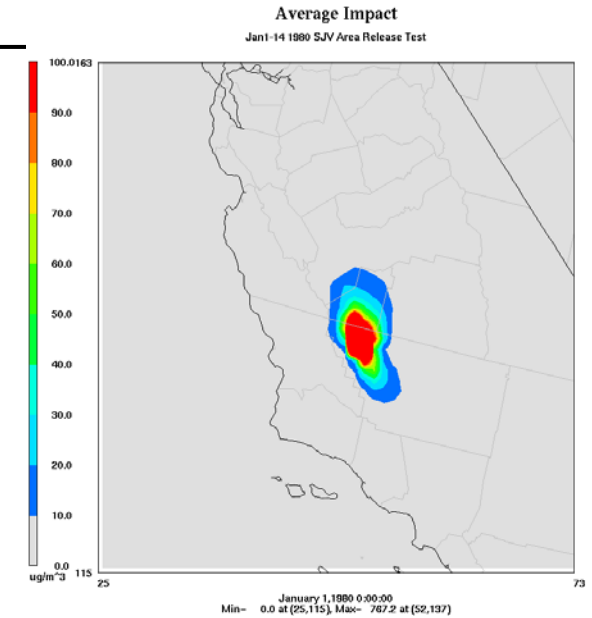
Not just fire

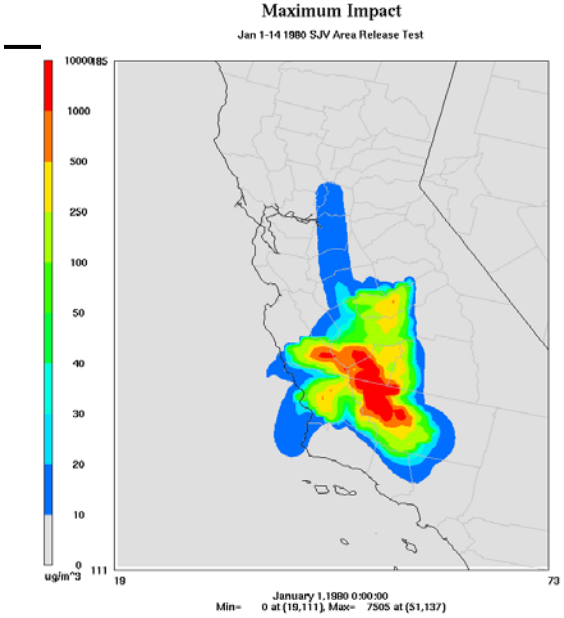
Uses 1979-2006 climatology

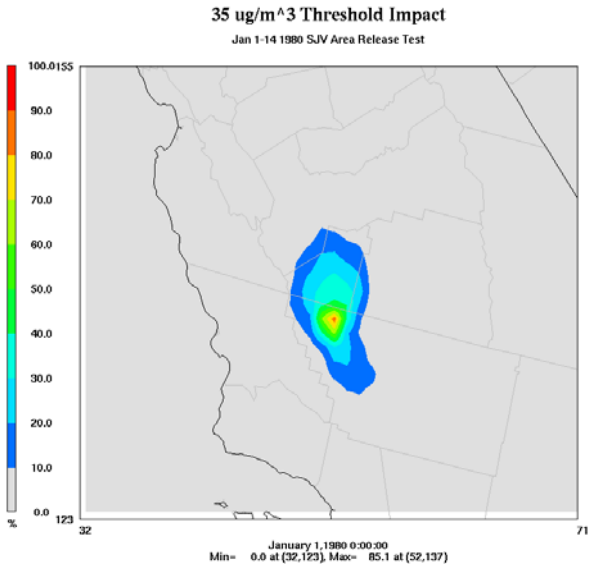
Provides statistical answer to “what would have happened?

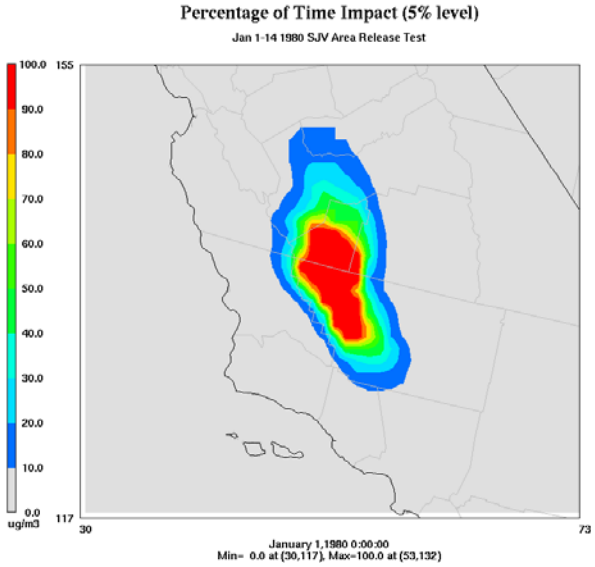
24-hr turnaround

Working on better graphics







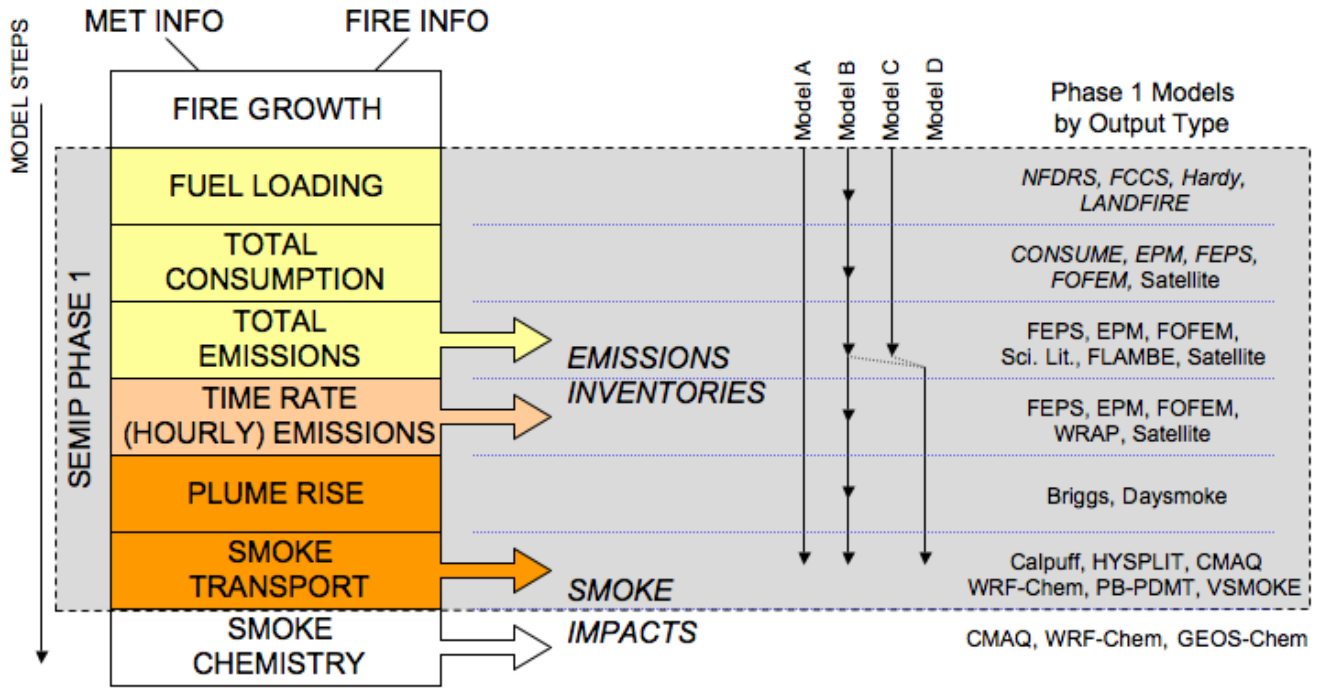


Smoke and Emissions Model Inter-comparison Project (SEMIP)

Just funded

Large-scale, Inclusive

Based on other "MIPs"



getBlueSky.org portal

Model Evaluation & Field Observations

- field observations (available in real-time, USFS)
- New! Large-scale model inter-comparison project (SEMIP)

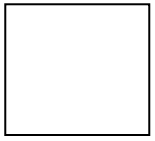
Real-Time Smoke & AQ Forecasts

- embedded in operational NWS Smoke Forecasts
- experimental predictions:
  - regional high-resolution CALPUFF (USFS)
  - regional Northwest ony CMAQ (WSU)
  - New! national CMAQ (STI)
  - New! Canada: British Columbia and Alberta (UBC)
  - New! real-time scenario game-playing (soon, USFS)
  - more being added

Longer-Range Planning Tools

- New! probable impacts based on climatology (AQUIPT)
- New! National Emissions Inventory (NEI) assessments

+

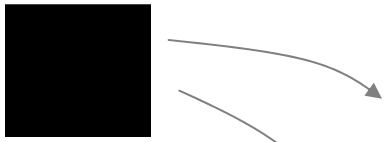


Fire Info

- New! SMARTFIRE reconciled fire info

AIR FIRE
ATMOSPHERE & FIRE INTERACTIONS RESEARCH & ENGINEERING
STI

Next Steps



Linking Regional and National Forecasts

- High res local w/cross-boundary transport.
- Incident response super-res (300m) ?

Model Evaluation

- Model Inter-comparison Project
- Continuing field observations

Plume Rise Studies

- Multiple Cores is Largest Problem

Uncertainty Guides

- Ensembles and scenarios as proxy

Game-Playing (What-if?)

- Expose uncertainty / what-if in real-time

+

Fire Information Improvements

- Linking Rx, Ag fire w/SMARTFIRE

Thank you

Funding from National Fire Plan, **USDA CSREES NRI**, USFS, Joint Fire Science Program, EPA, DOI, and NASA ROSES DSS.

Our many collaborators and partners, including Ray Knighton. Susan O'Neill.

BlueSky Meeting: May 20-22, Boise.

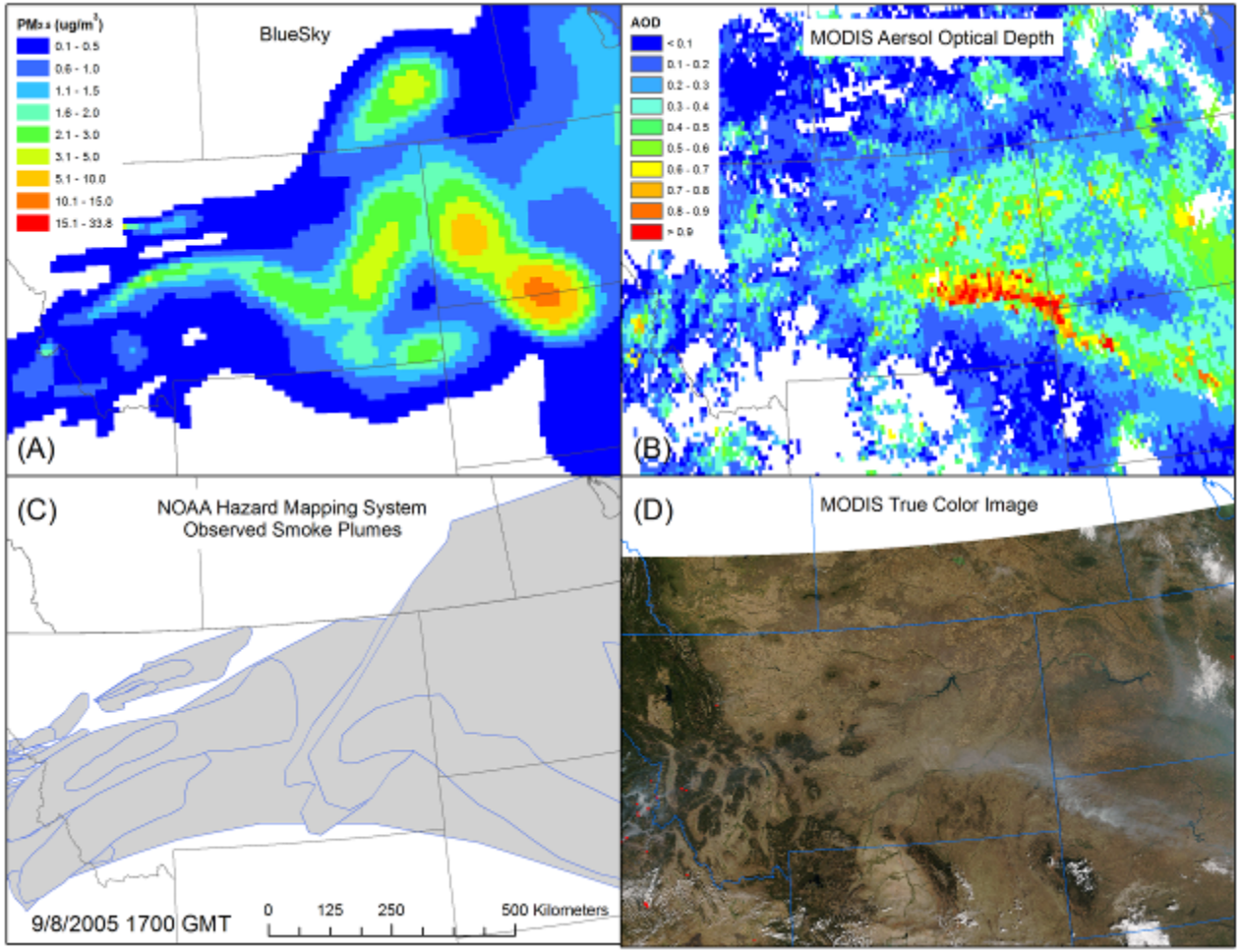
http://getBlueSky.org

Sim Larkin
206-732-7849
larkin@fs.fed.us

Tara Strand
206-732-7867
tstrand@fs.fed.us

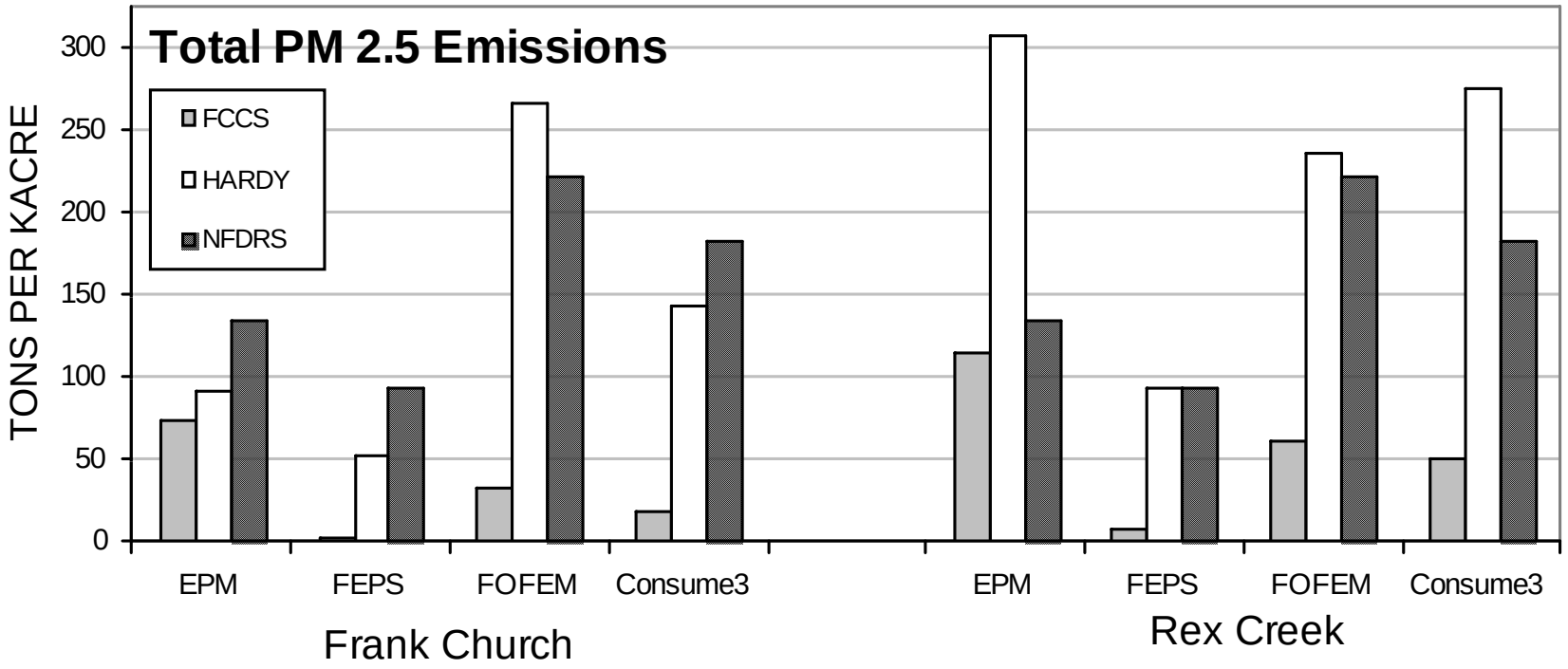
The big picture: not so bad

Bluesky models long-range transport very well,
but historically has generally under-predicted.



Which model is best?

Emissions based on using different combinations of fuel loading maps and fuel consumption models



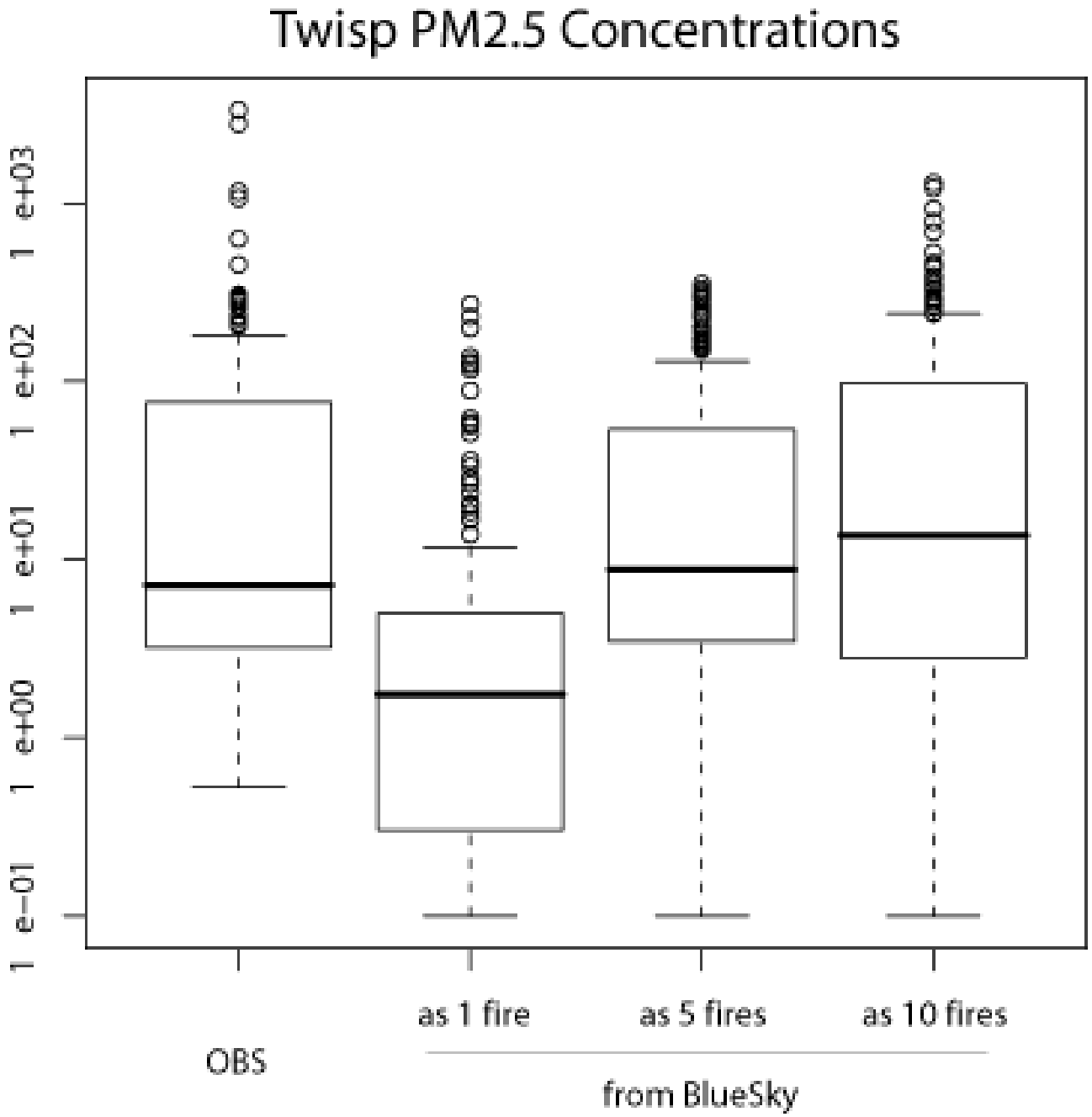
Larkin et al 2008

Plume Rise

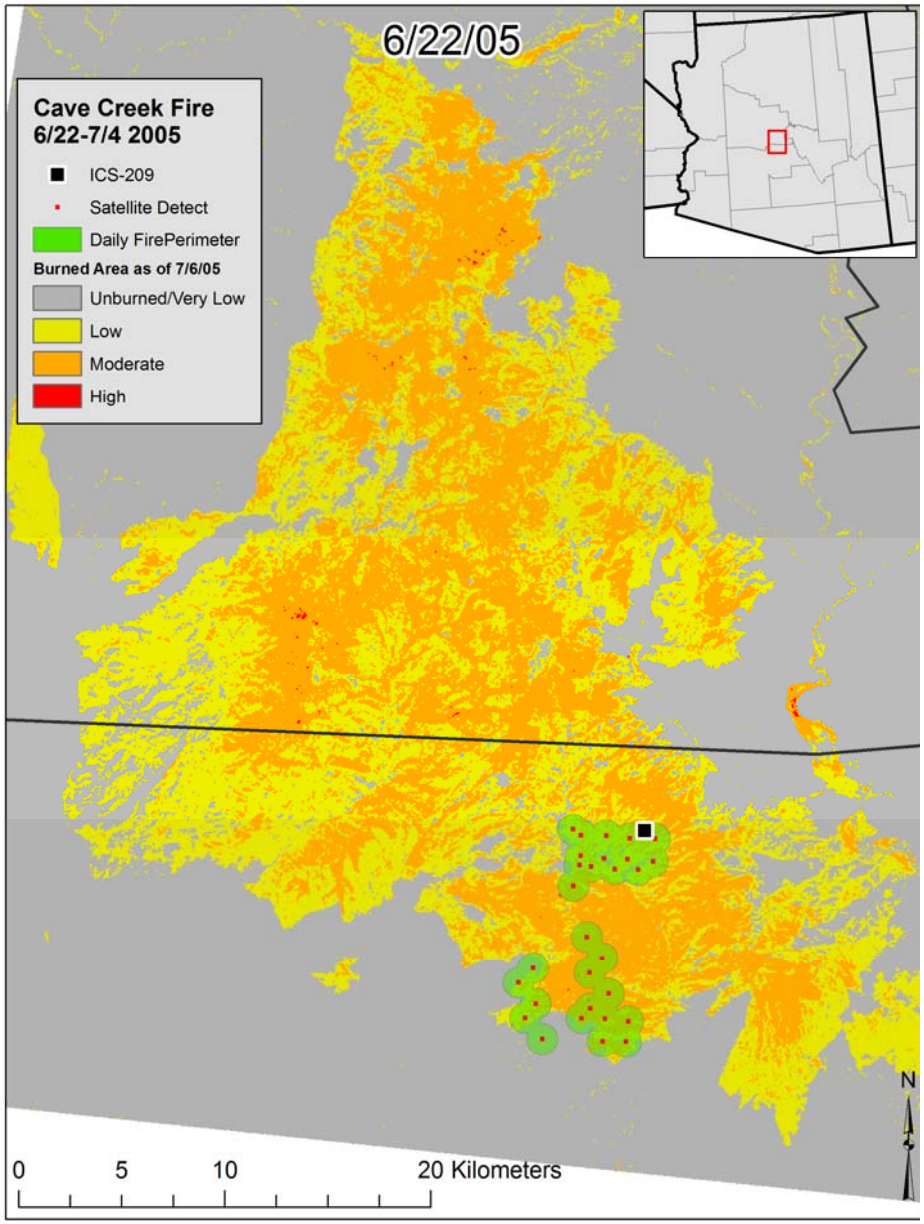
- Fires are currently modeled as single plumes, lofting smoke unrealistically high and lowering ground impacts

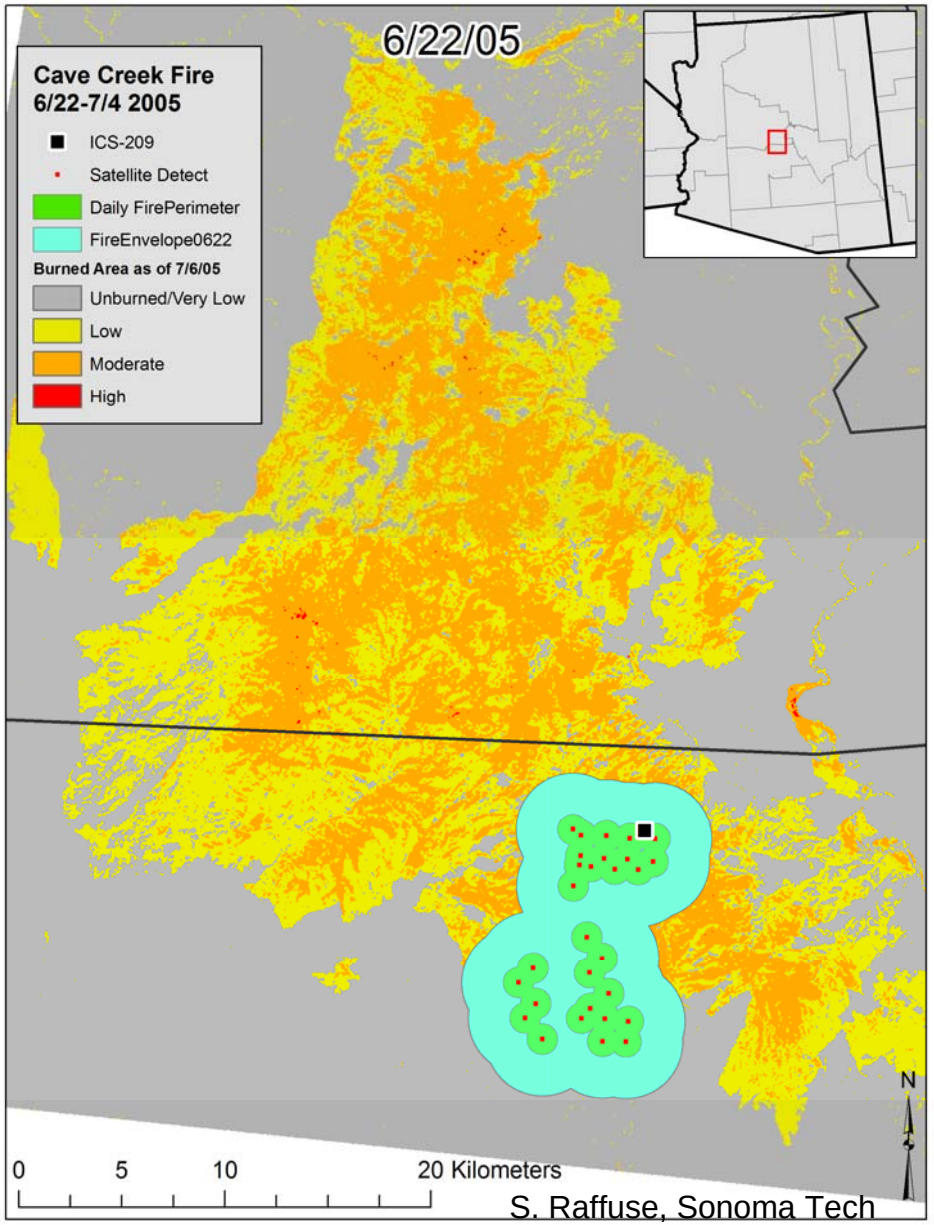
- In reality, fires are made of many burning areas lofting smoke to various heights

Multiple plumes make it look better



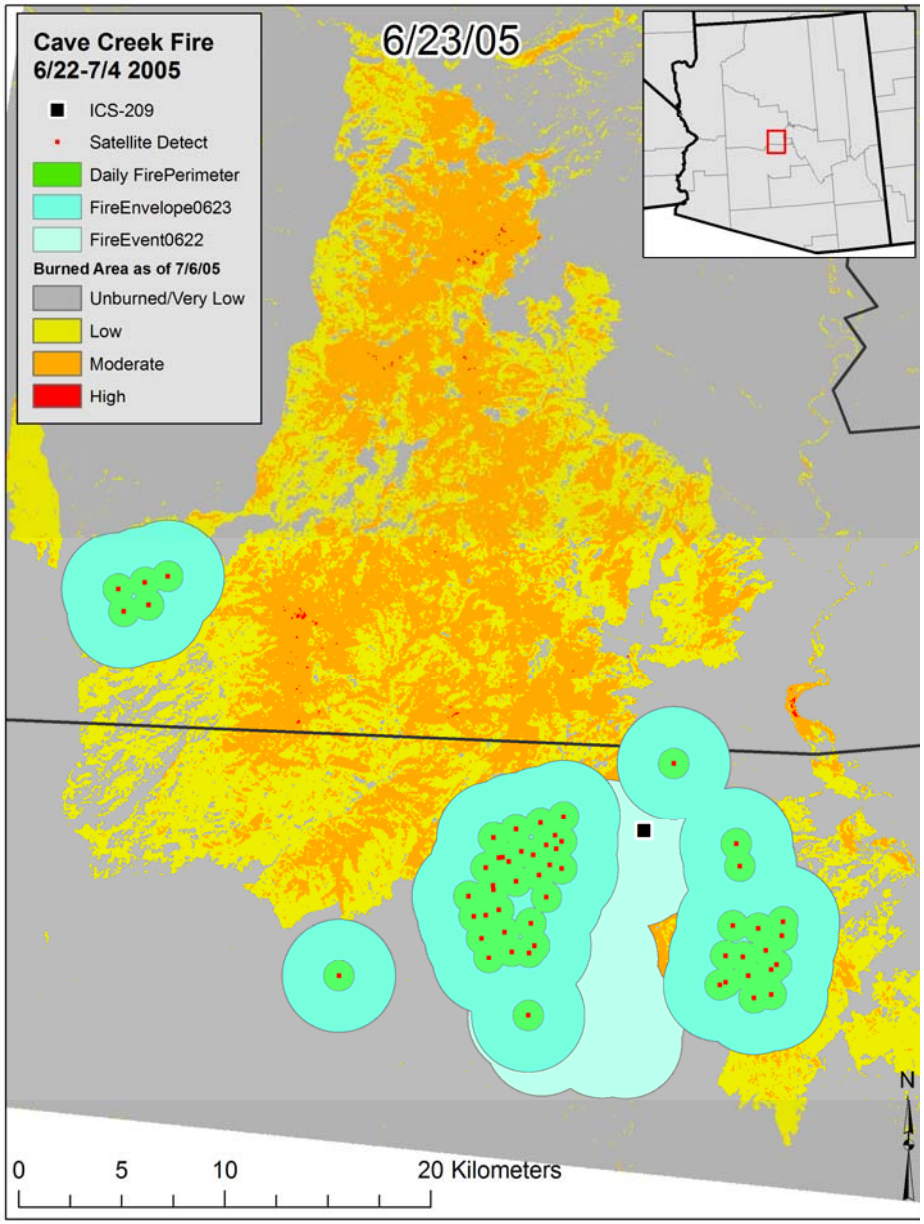
SMARTFIRE FireEvent Development (1 of 2)

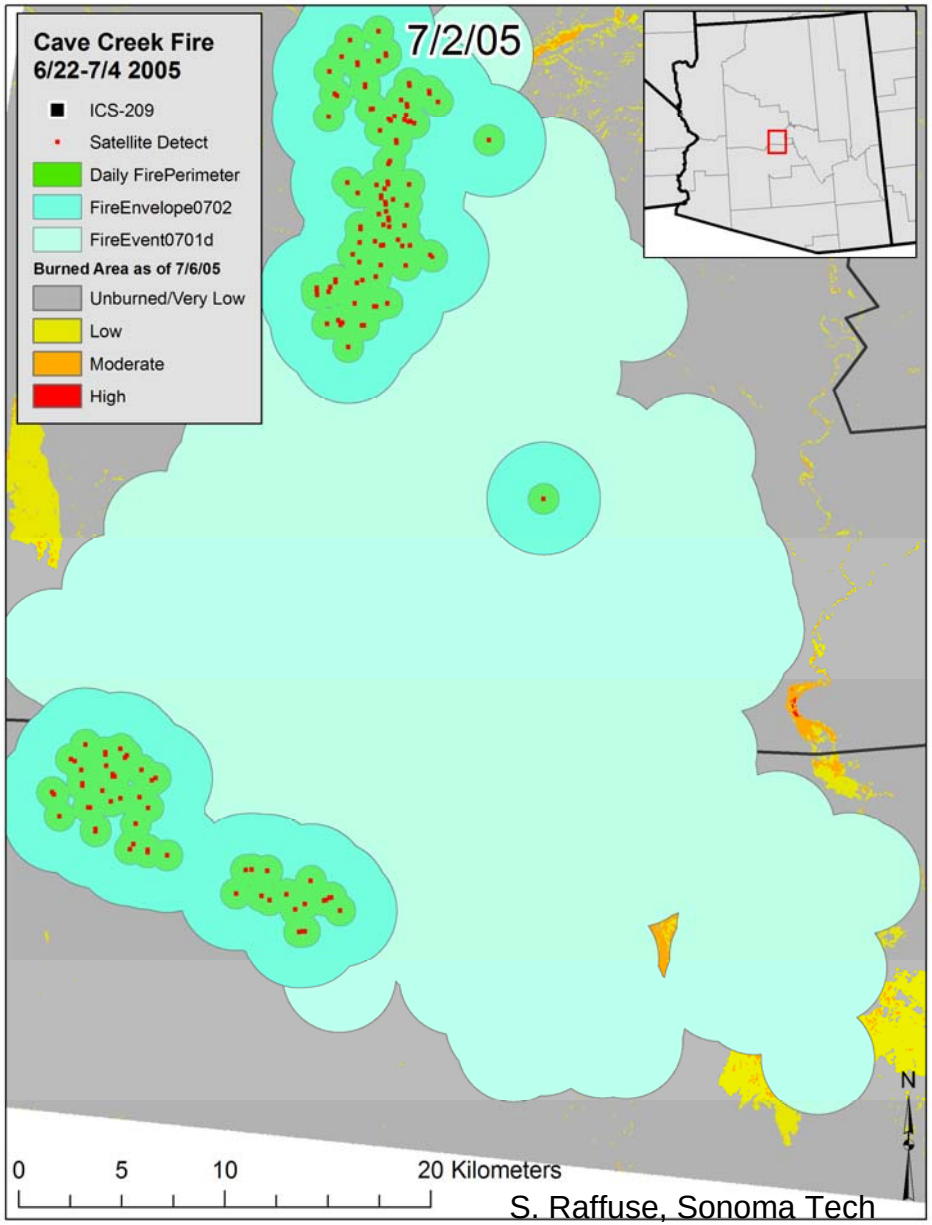




S. Raffuse, Sonoma Tech

SMARTFIRE FireEvent Development (2 of 2)





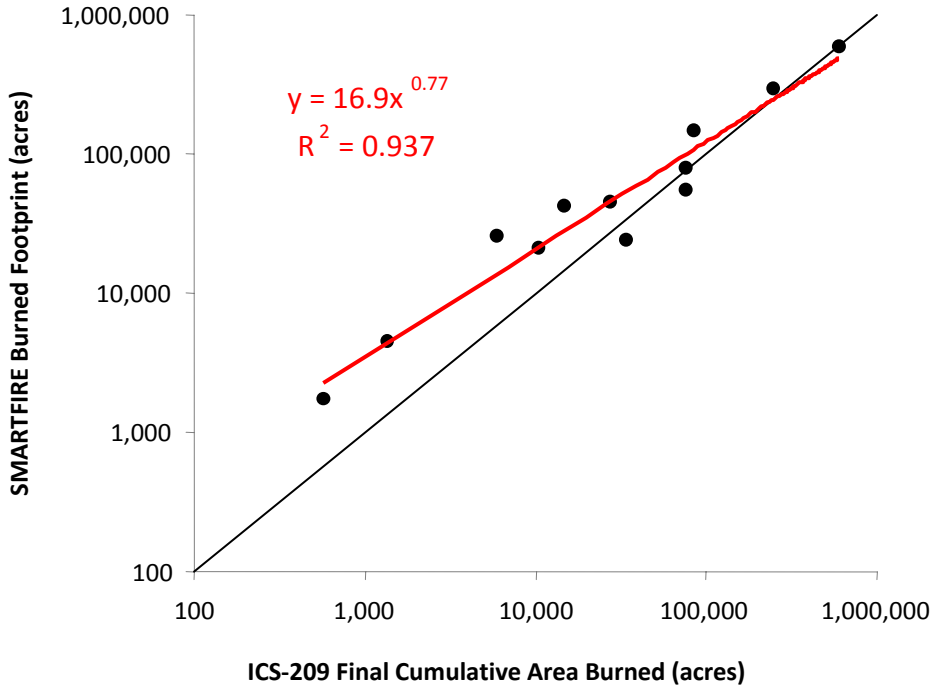
S. Raffuse, Sonoma Tech

Wildfire Area Burned Estimates

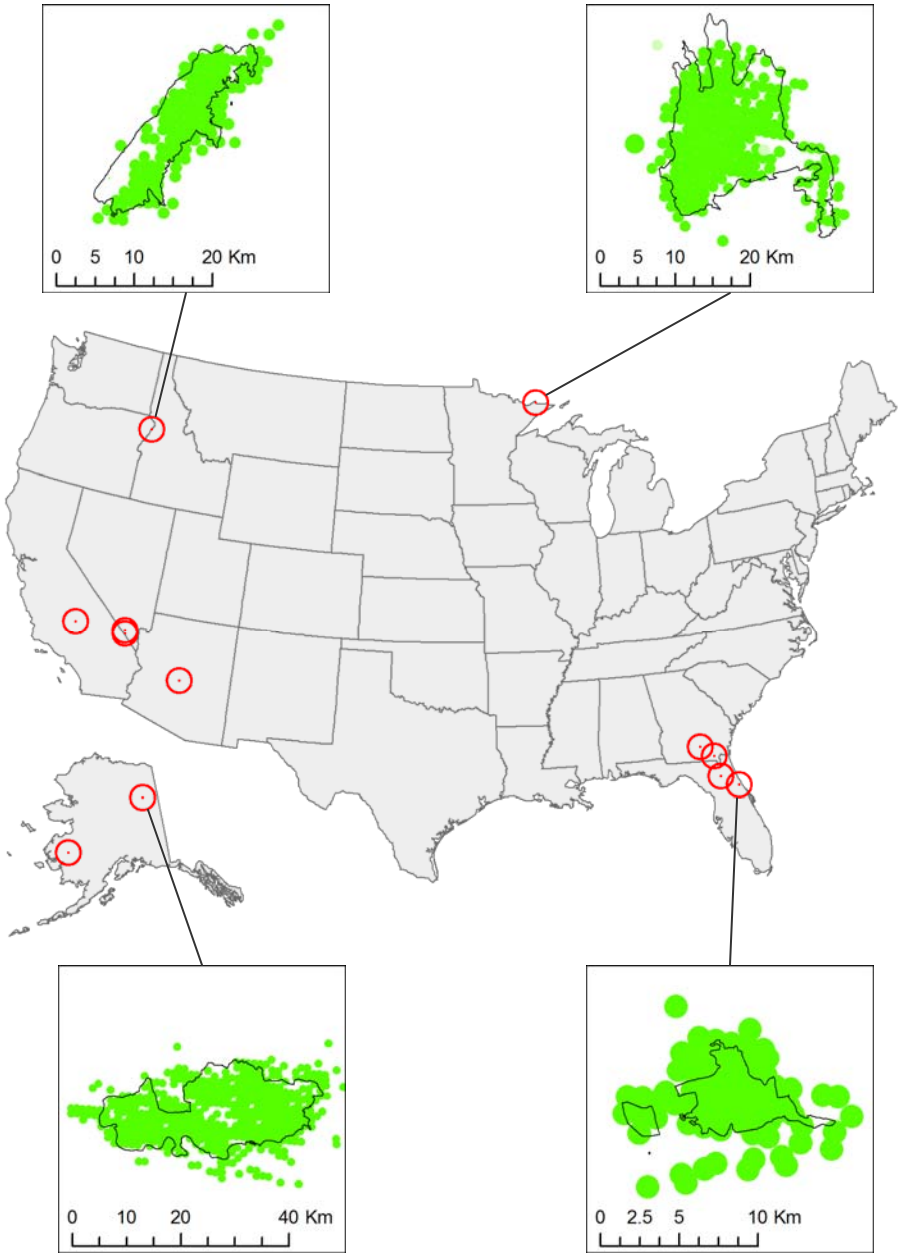
For the largest fires examined, SMARTFIRE final footprints match very well with final ICS-209 area estimates.

SMARTFIRE tends to overestimate area burned for smaller wildfires.

This relationship appears independent of ecosystem or fuel type.



Wildfire Test Locations



Smaller Fires

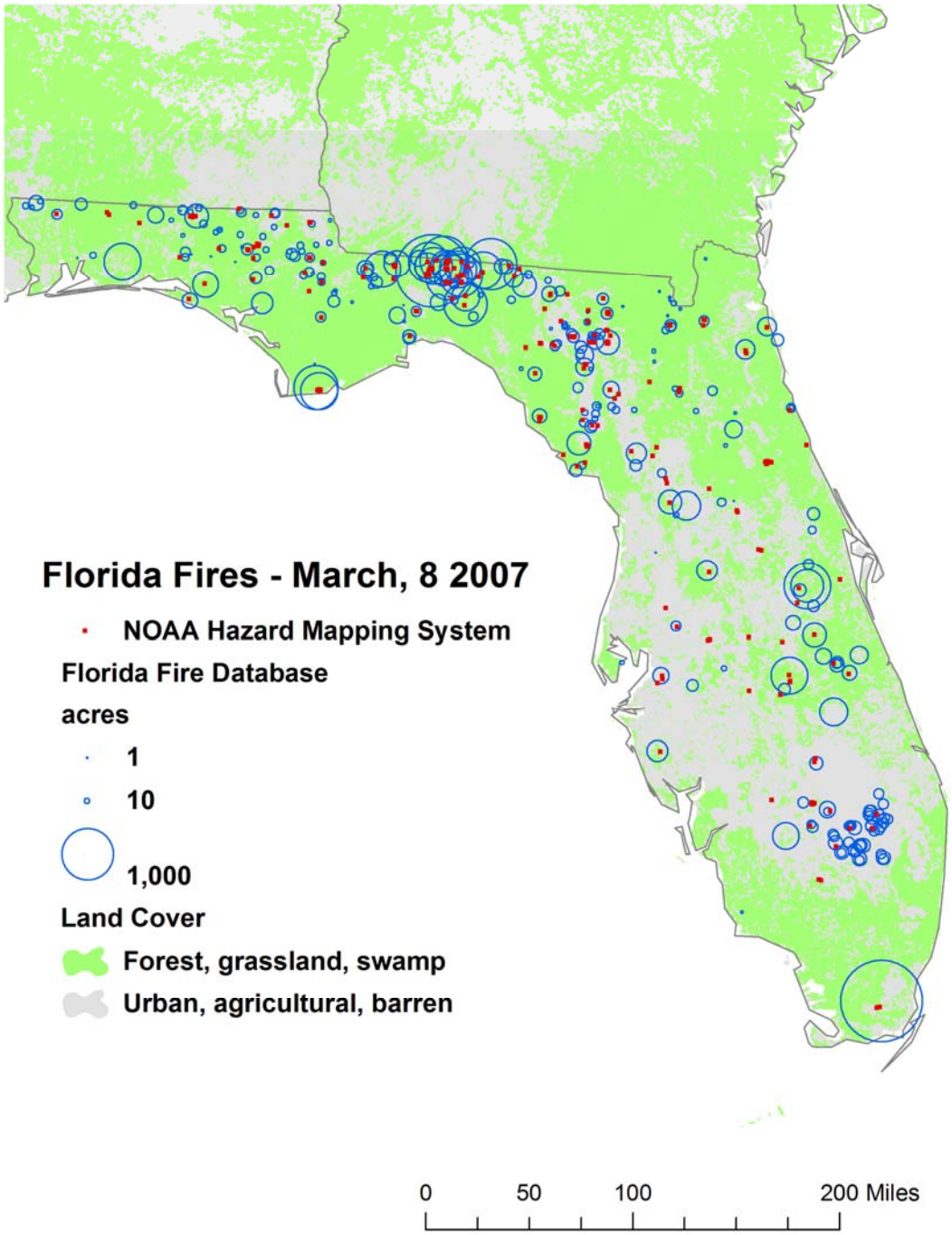
ICS-209 report information is not available for many small fires.

- Agricultural burns
- Prescribed fires
- Rangeland fires
- Small wildfires

For these fires, available data sets will be used to validate SMARTFIRE.

The large-scale pattern of satellite detects matches fairly well with this single day of fires from a Florida fire database.

Mismatches may be due to satellite false detects, satellite non-detects, or database errors.



Southern California Fires

- asked by USDA for data
- supplemented other sources (e.g. NWS)
- SMARTFIRE (HMS&ICS) fire info
- CMAQ and CALPUFF model outputs (+NWS HYSPLIT)
- Used:
  - internally by USFS fire resource managers;
  - in Smog Stories and press releases by USDA & AirNow;
  - on White House conf call