Integration of Satellite-Detected and Incident Command-Reported Wildfire Information into BlueSky

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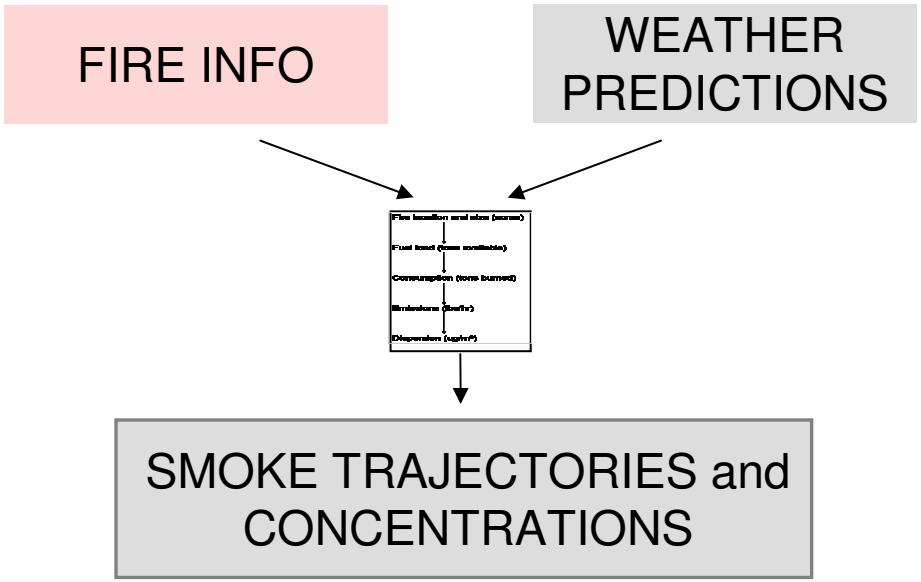
BlueSky

Predicts cumulative smoke impacts from multiple fires (nationally and operationally).



BlueSky's original application was to assist prescribed burners making "go/no go" decisions, but its uses and user base have grown.

Fire location and size (acres)

↓

Fuel load (tons available)

↓

Consumption (tons burned)

↓

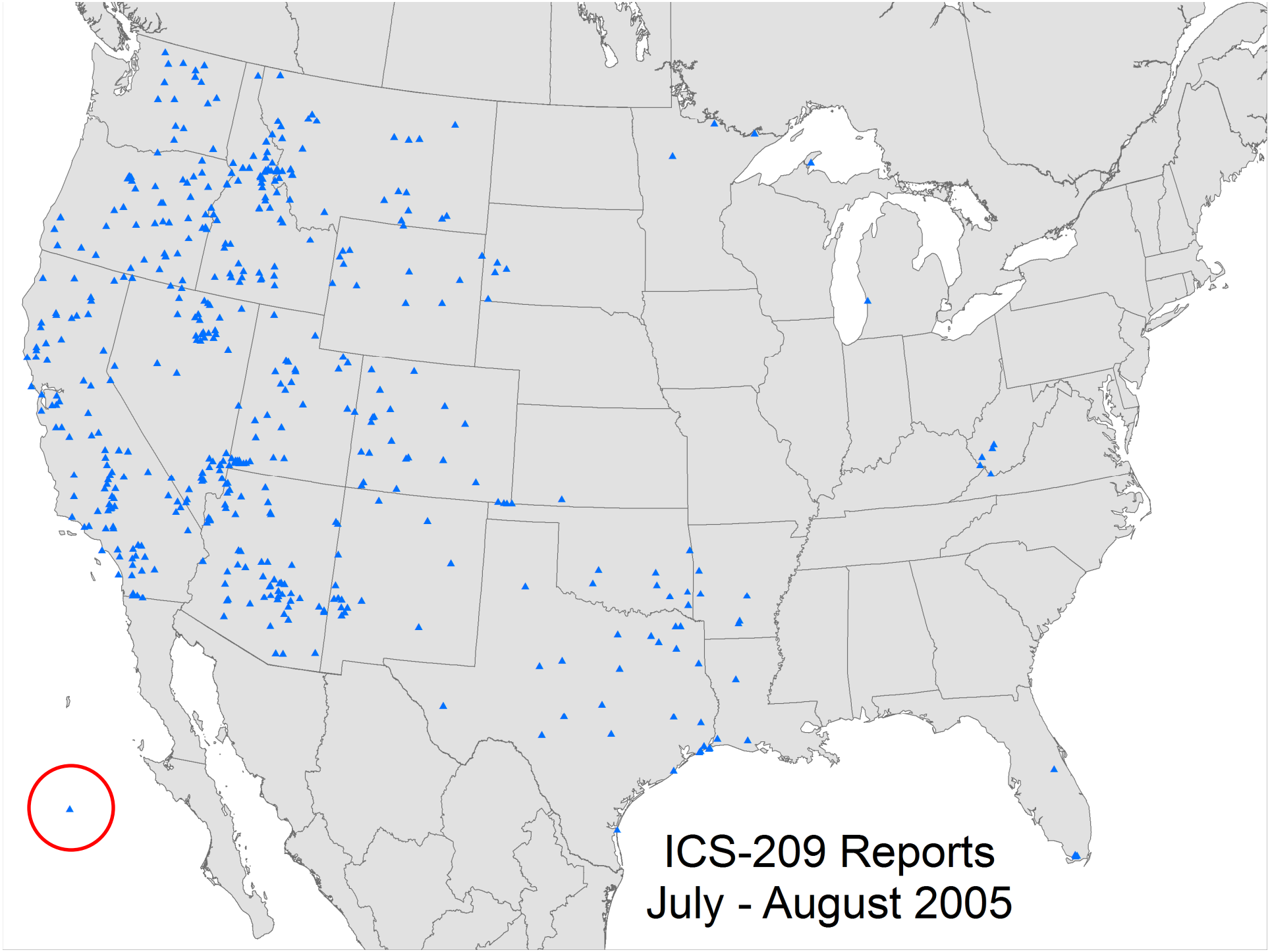
Emissions (lbs/hr)

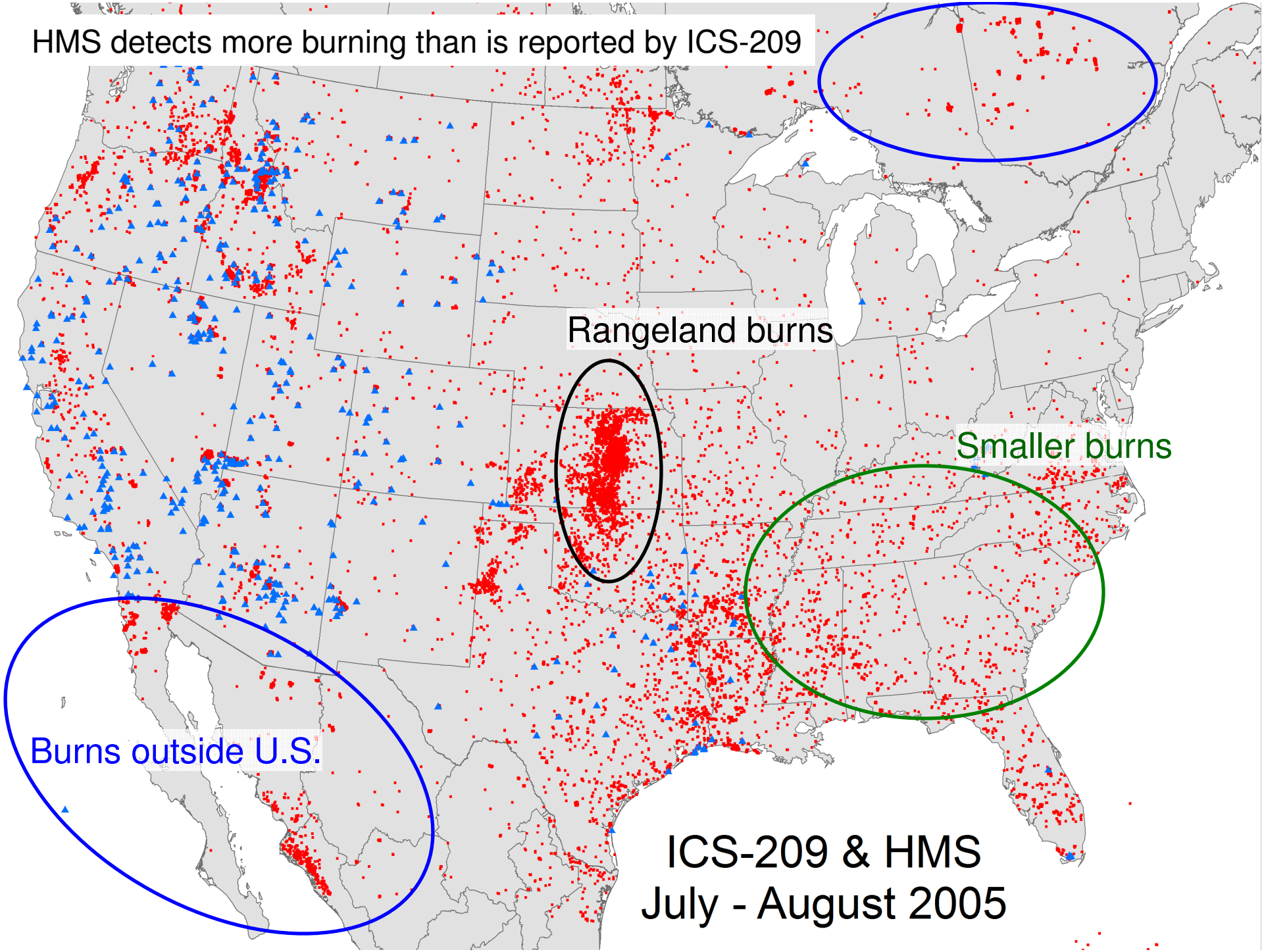
↓

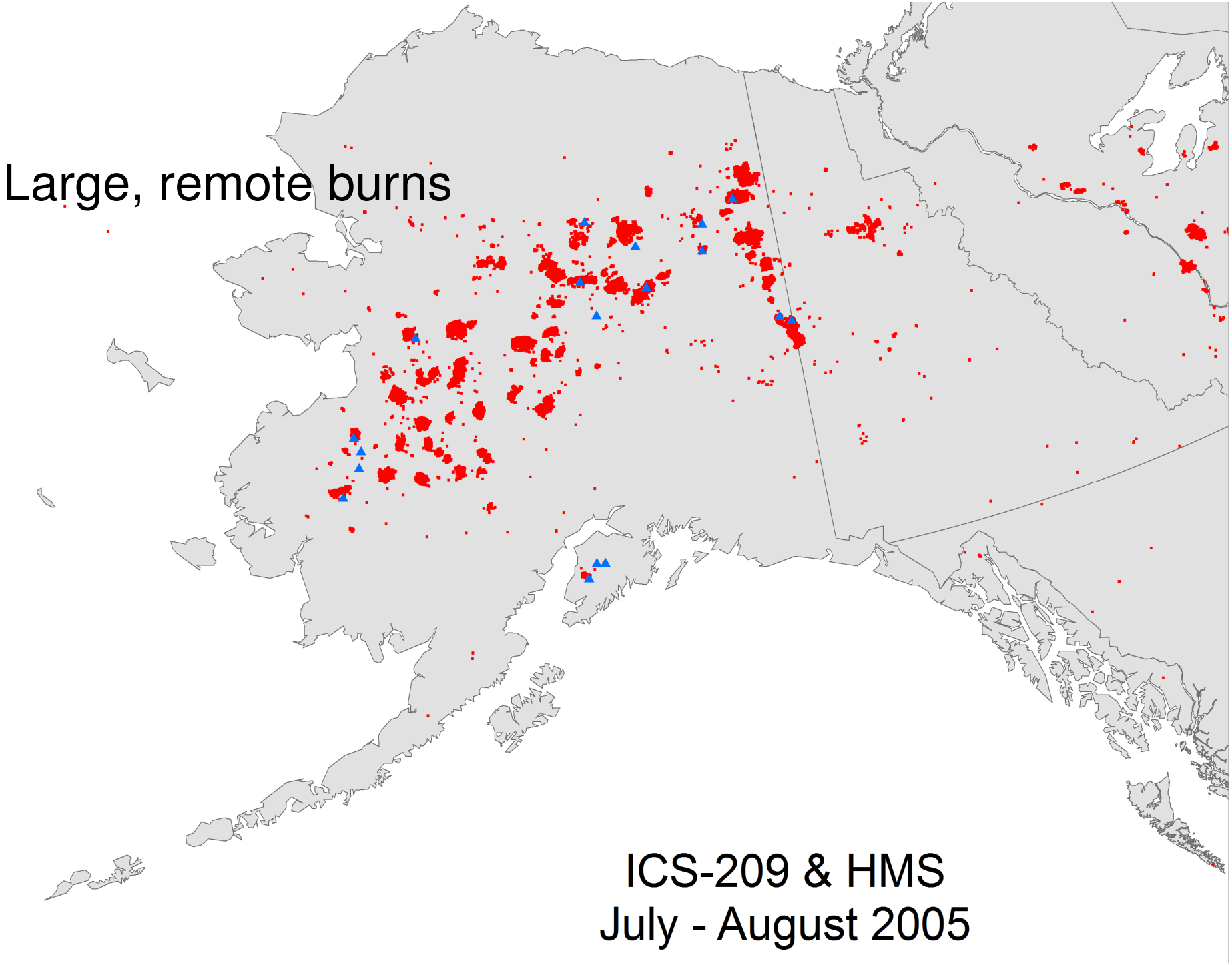
Dispersion (μg/m^3)

Fire Information

- Currently, wildfire location and size inputs are provided by Incident Command Summary reports (ICS-209).
- ICS-209 report data have limitations.
- Satellite fire detections from the NOAA Hazard Mapping System (HMS) may address these limitations.
  1. Better coverage
  2. Better spatial resolution
  3. Daily information

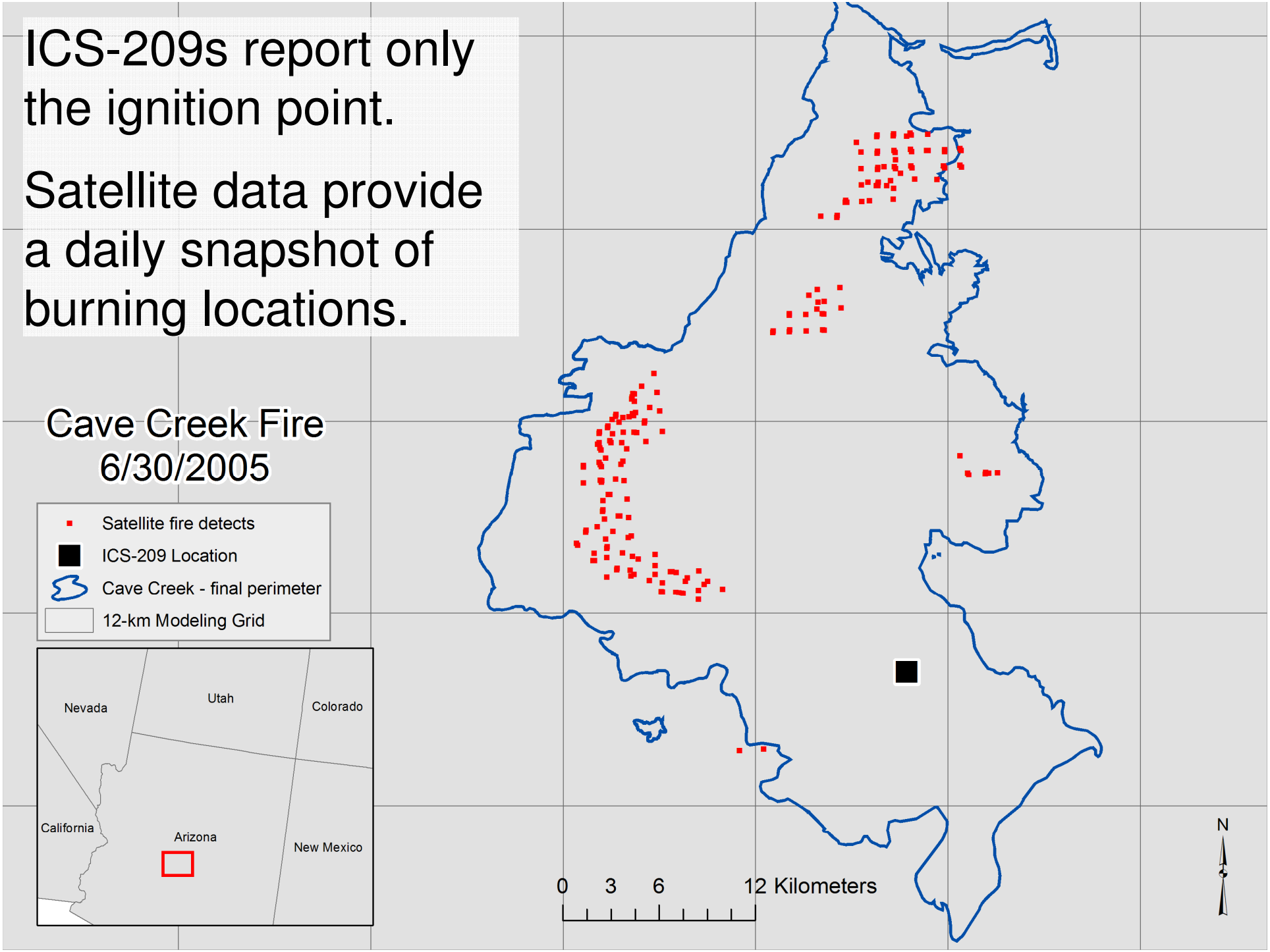

ICS-209 Reports
July - August 2005


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

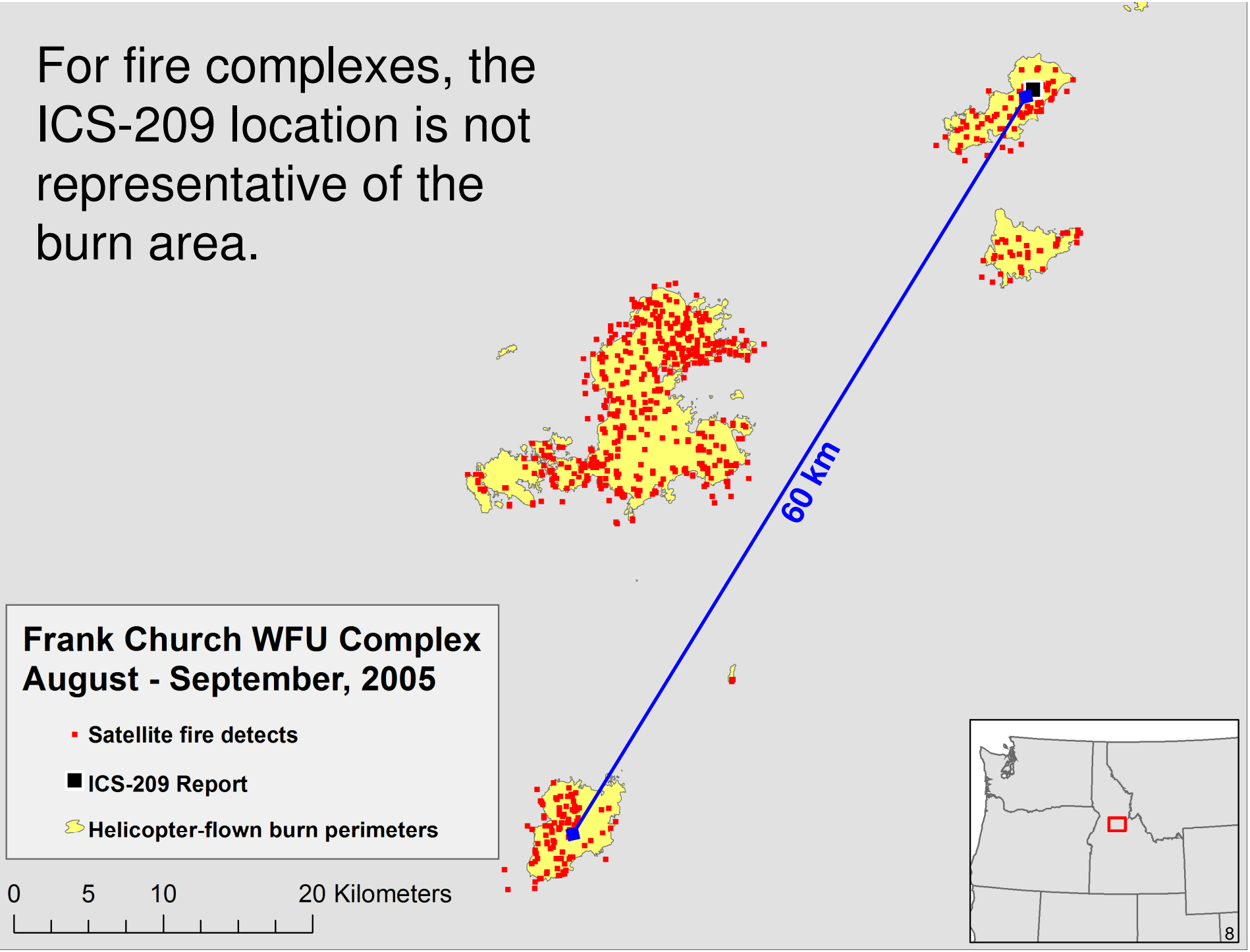

Large, remote burns
ICS-209 & HMS
July - August 2005

ICS-209s report only the ignition point.

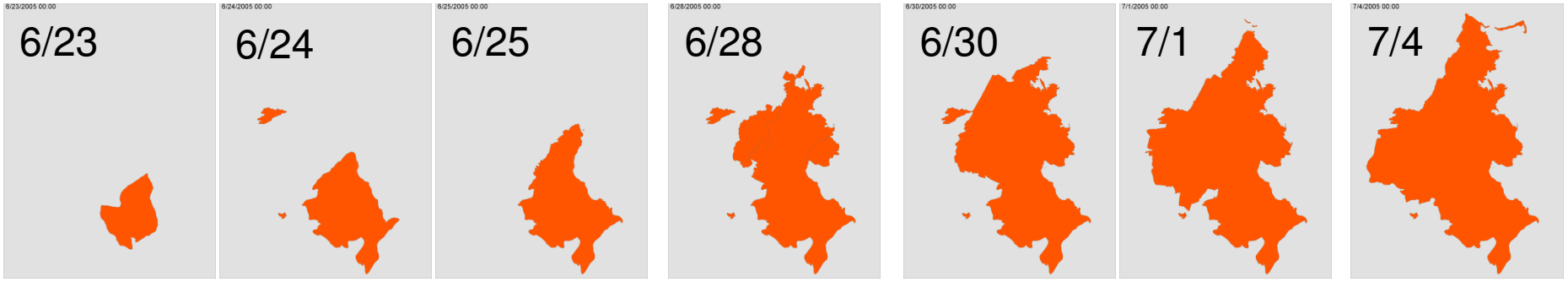
Satellite data provide a daily snapshot of burning locations.



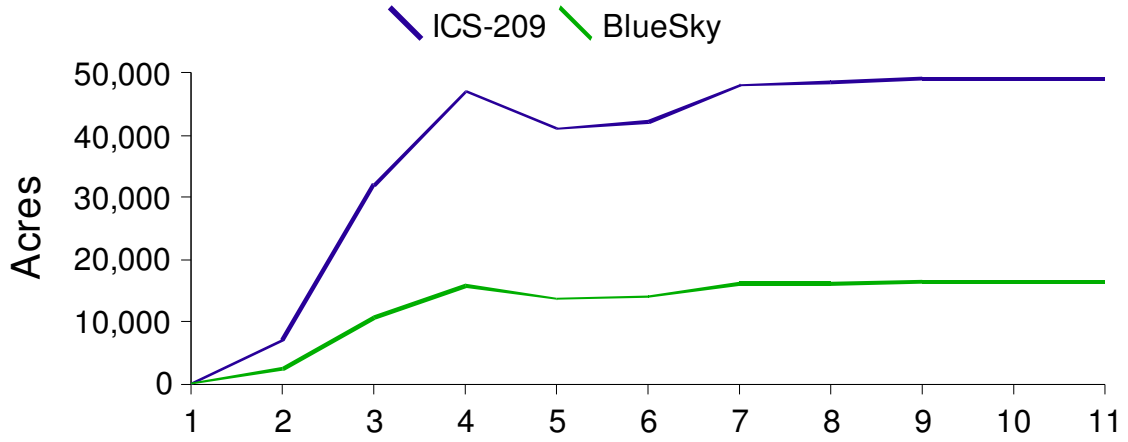
For fire complexes, the ICS-209 location is not representative of the burn area.



- ICS-209 reports provide an area that represents the cumulative area burned up to the report date.
- Reports are not always available for every day.
- Thus, the daily burned area information is not readily available.



Currently, BlueSky uses 1/3 of the *cumulative* area reported in ICS-209s as its estimate of daily area burned.

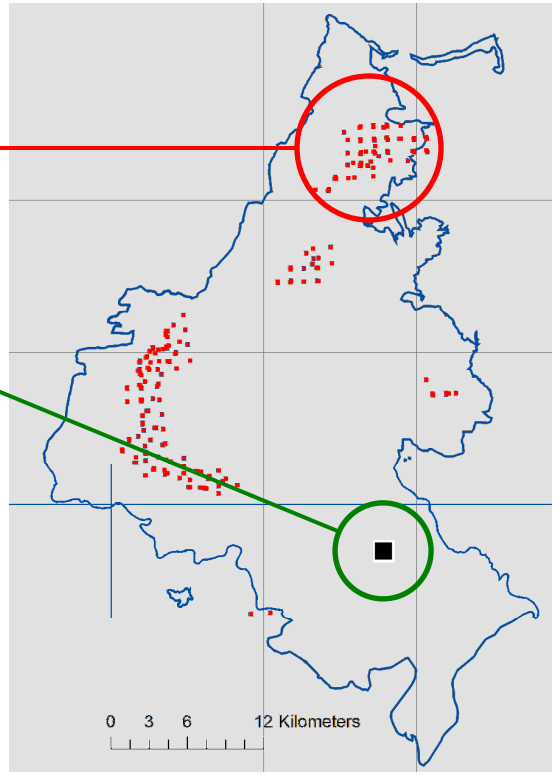


Reconciliation

- Satellite data make up for some ICS-209 weaknesses.
- But, we do not want to abandon ICS-209 data.
  - Satellites miss fires too!
    - Too small, low intensity, or short lived
    - Clouds
  - ICS-209 contains useful metadata.
    - Fuels
    - Growth potential
    - Name
- Goal: Use both HMS data and ICS-209 data as inputs to BlueSky.
- Problem: Cannot simply use both. Large fires are routinely reported by both data sets.
- Solution: Develop an algorithm to reconcile the two data sets into a single record of daily fire activity.

Challenges to Reconciliation

- Fires move: algorithm must know that this fire is the same as this fire.
- In addition to location, BlueSky needs area burned input. Area burned (over 24 hours) must be inferred from 1-km pixels that the satellite determined to be "actively burning" when it flew over.

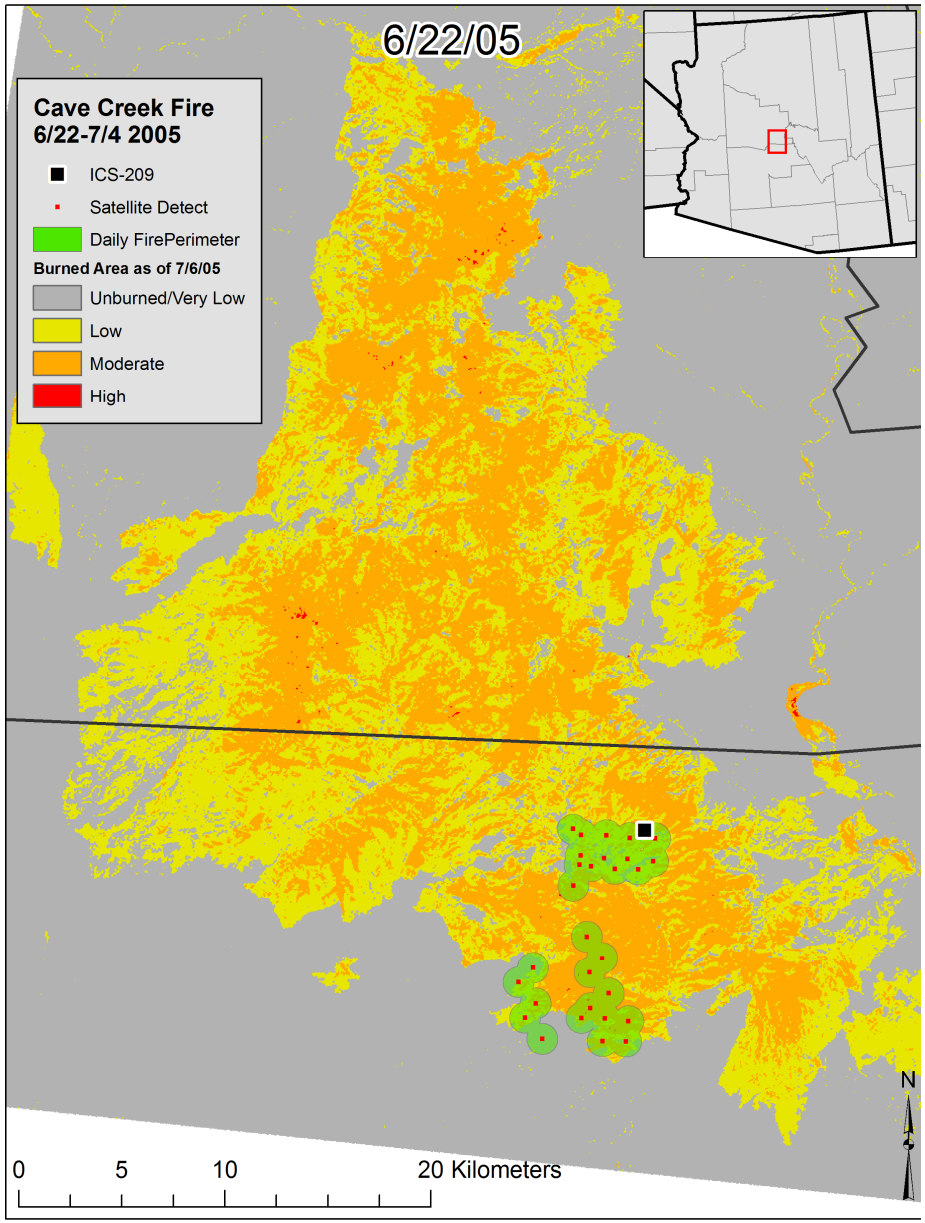


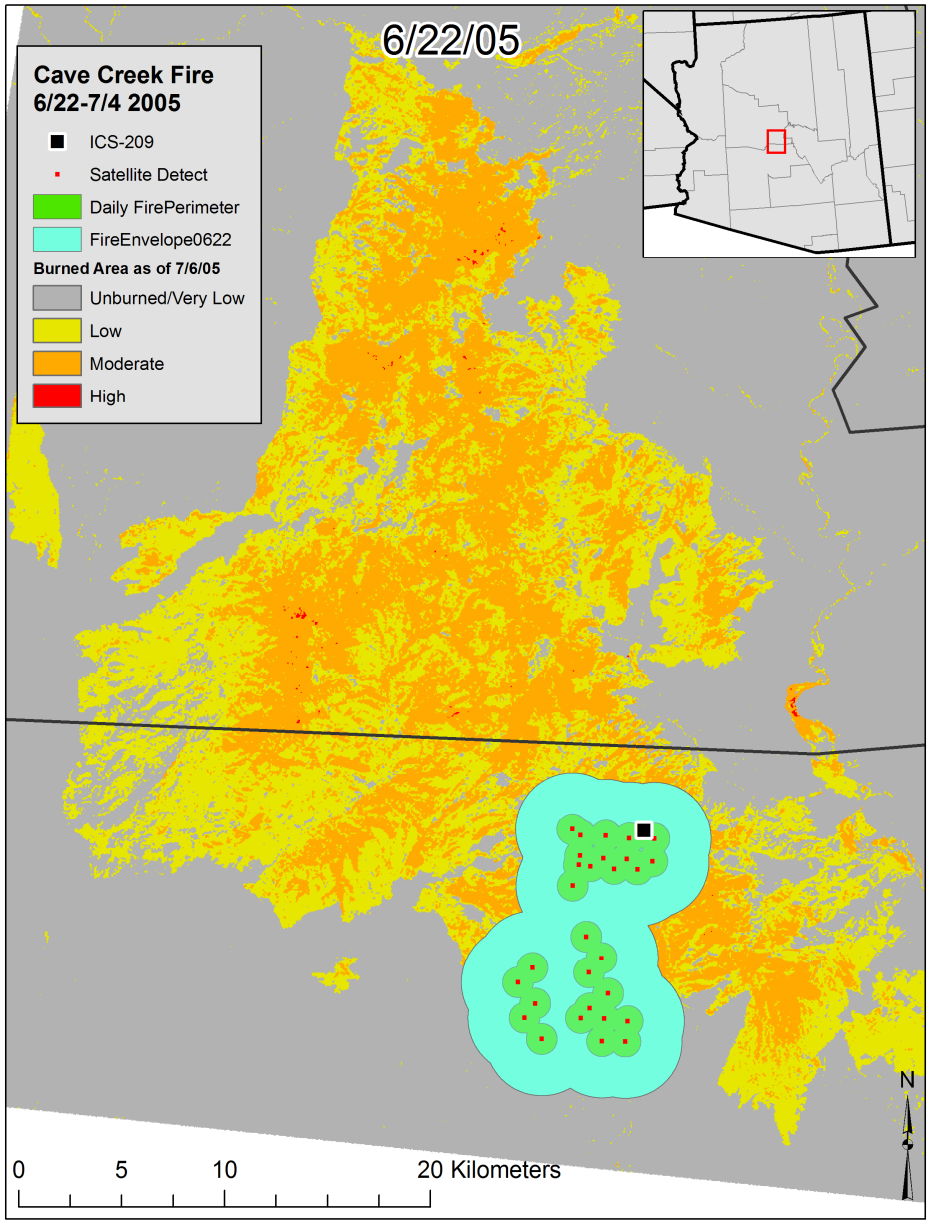
Based on an initial correlation analysis from several large wildfires in the West, area burned is currently estimated as about 1.75 km^2 (400 acres) per pixel. This number is neither correct nor final.

SMARTFIRE

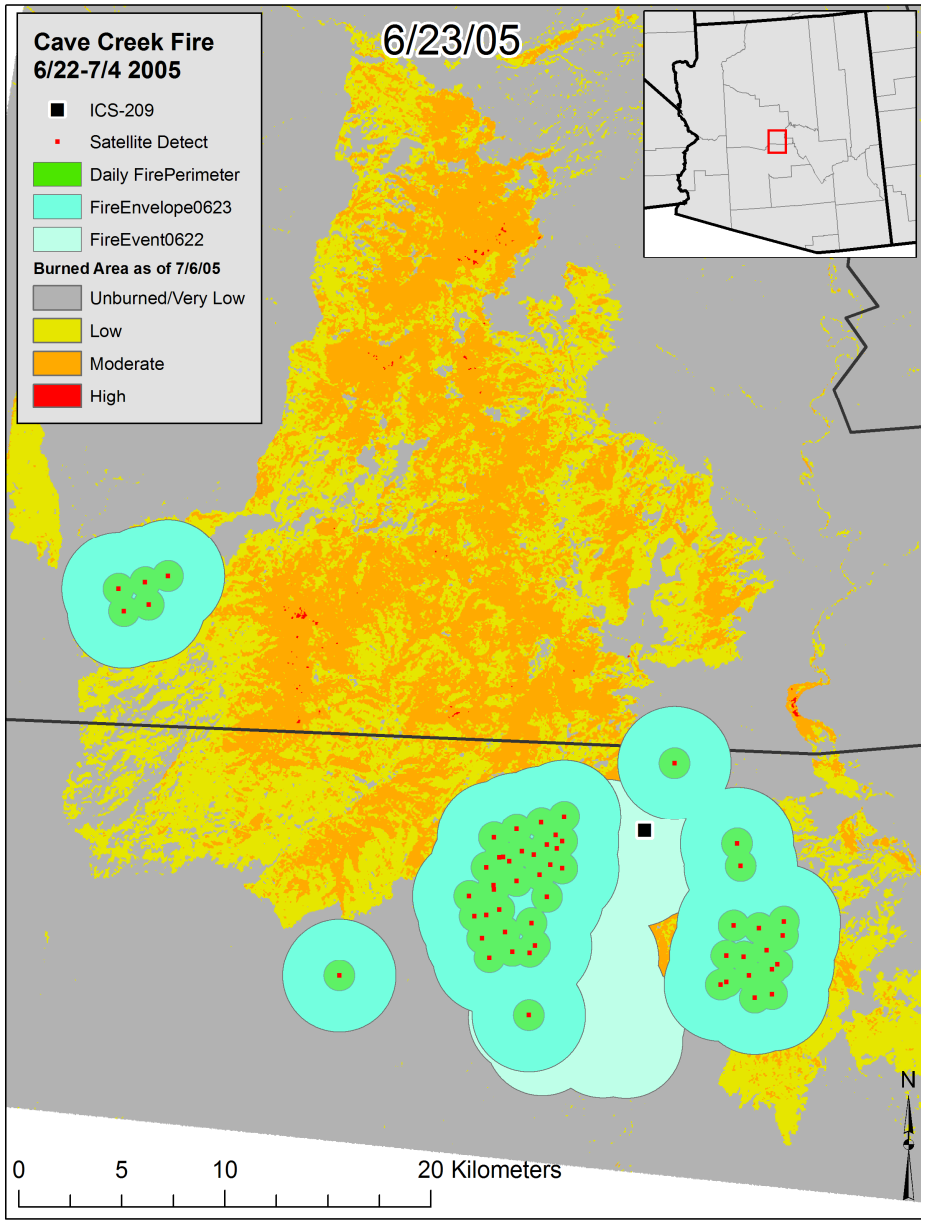
- SMARTFIRE provides daily burn area data to BlueSky on a national scale.
- SMARTFIRE is a computational system for the operational reconciliation of fire information (e.g., ICS-209-reported, satellite-detected, and user-defined wildfires).
- SMARTFIRE compiles a database of fire progression information that can be mined to improve next-day burn predictions. The current prediction uses persistence.

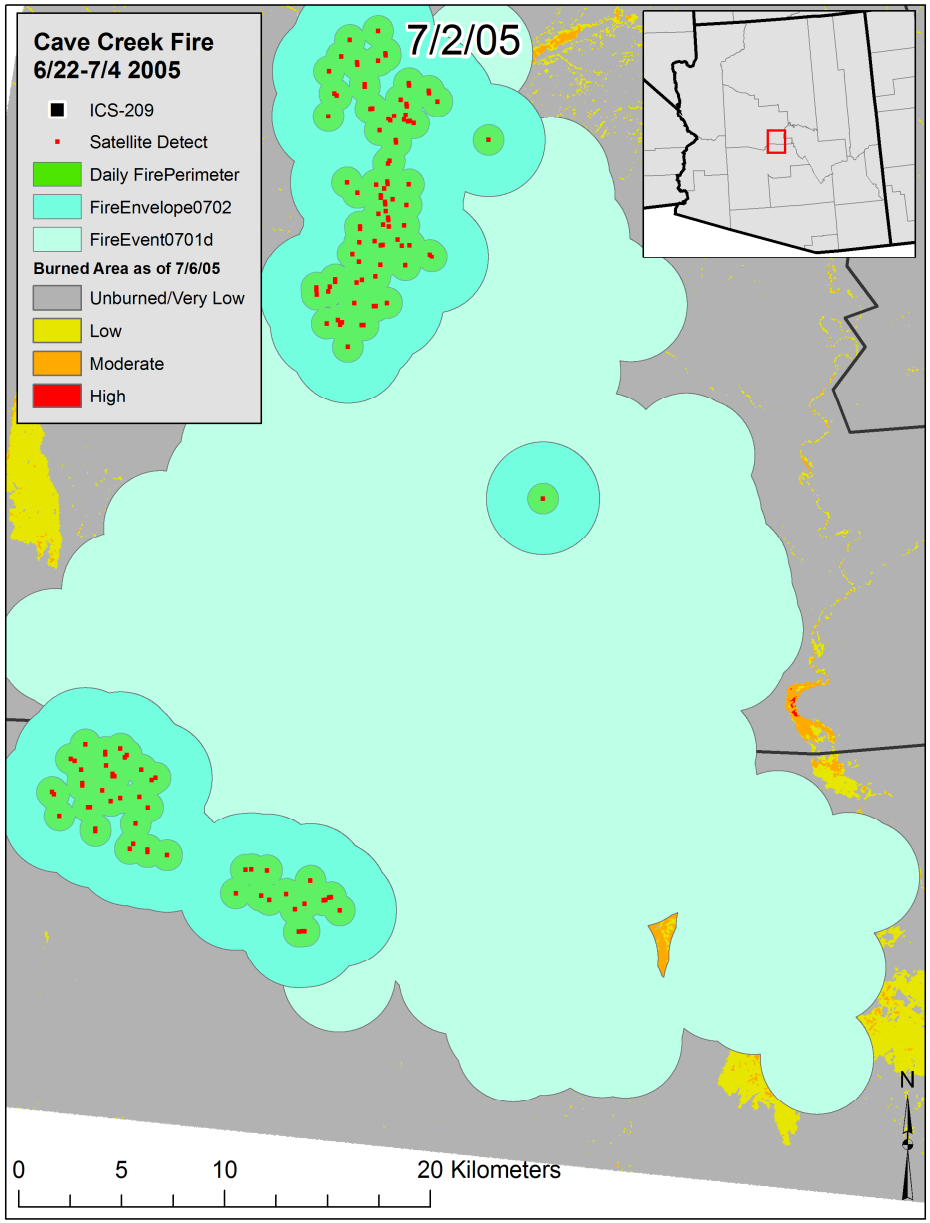
SMARTFIRE Fire Event Development (1 of 2)

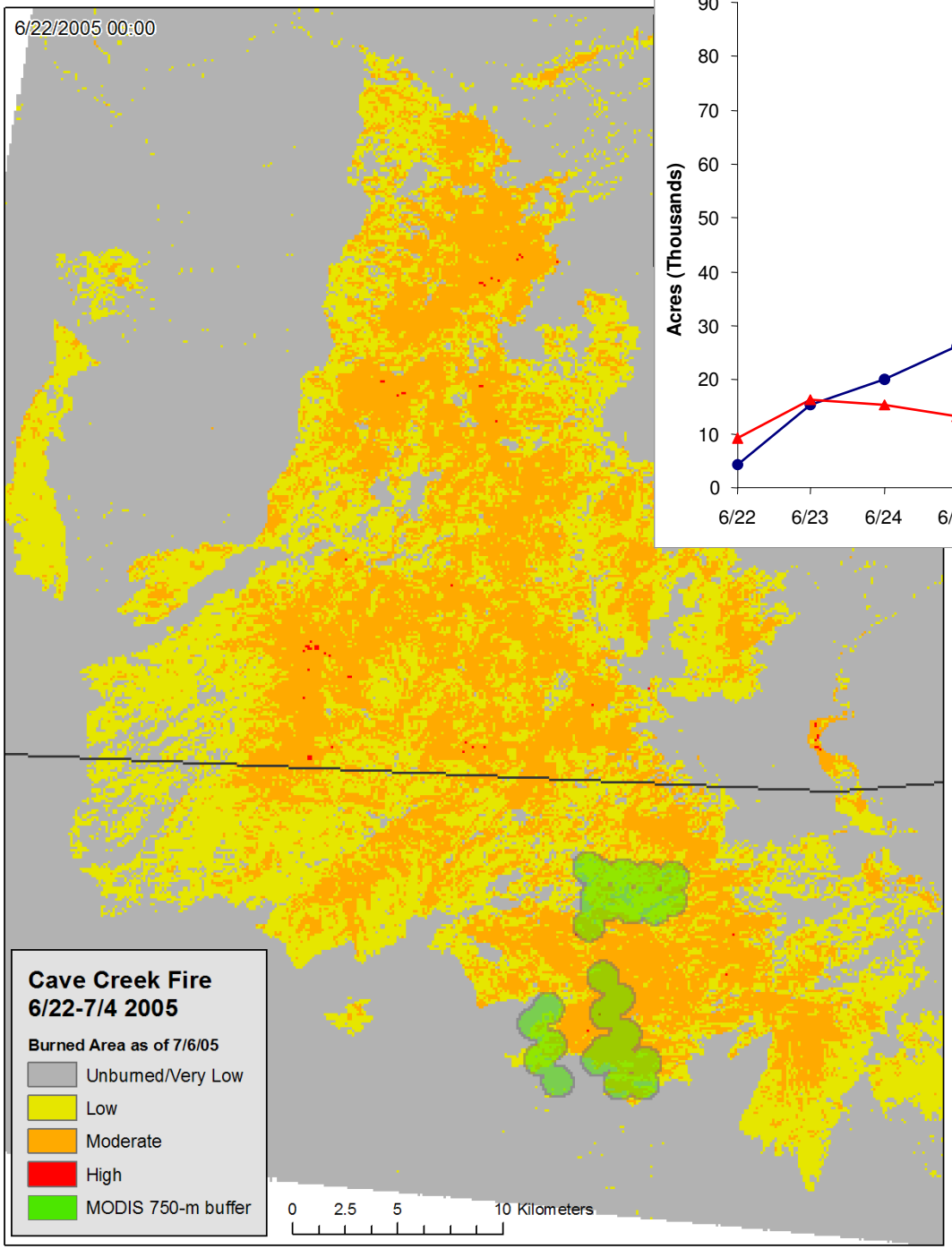


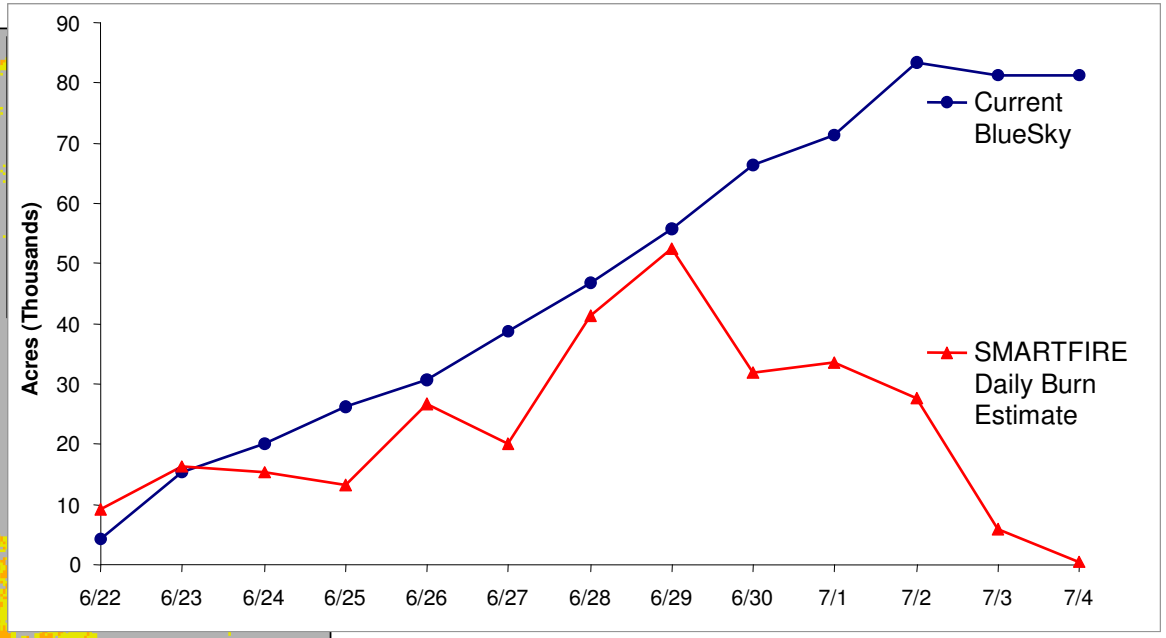


SMARTFIRE Fire Event Development (2 of 2)






6/22/2005 00:00
Cave Creek Fire
6/22-7/4 2005
Burned Area as of 7/6/05
Unburned/Very Low
Low
Moderate
High
MODIS 750-m buffer
0 2.5 5 10 Kilometers


Acres (Thousands)
90
80
70
60
50
40
30
20
10
0
6/22
6/23
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6/28
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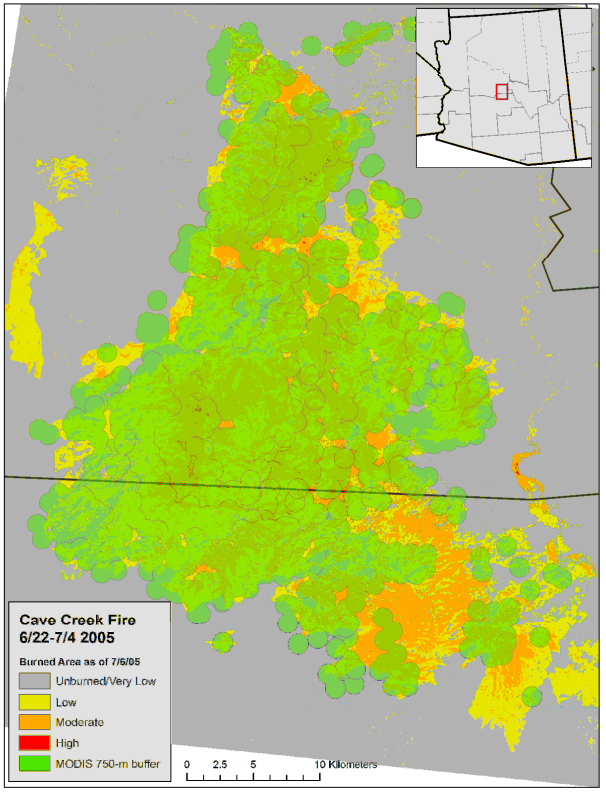
6/30
7/1
7/2
7/3
7/4
Current BlueSky
SMARTFIRE Daily Burn Estimate


Cave Creek Fire
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Burned Area as of 7/6/05
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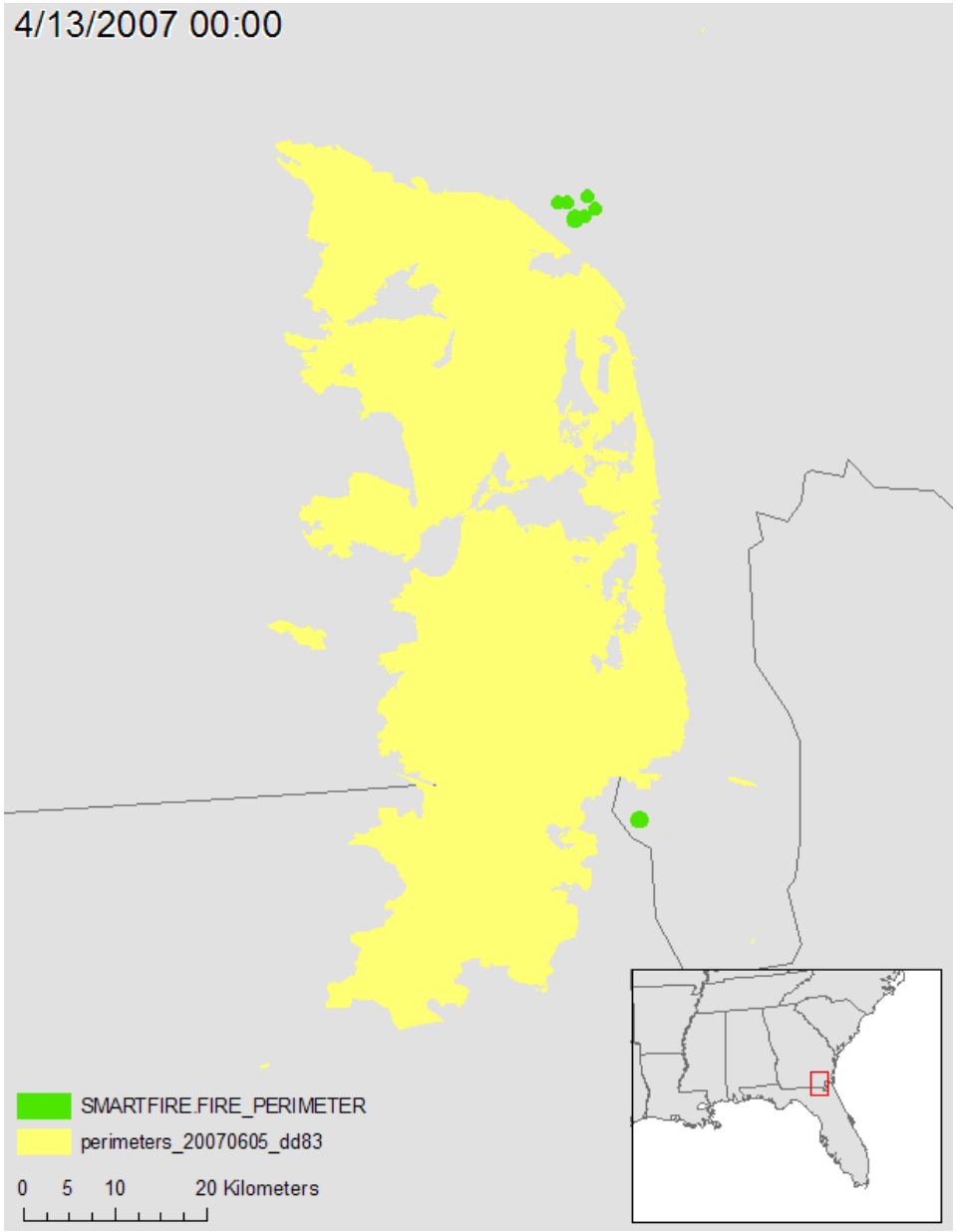
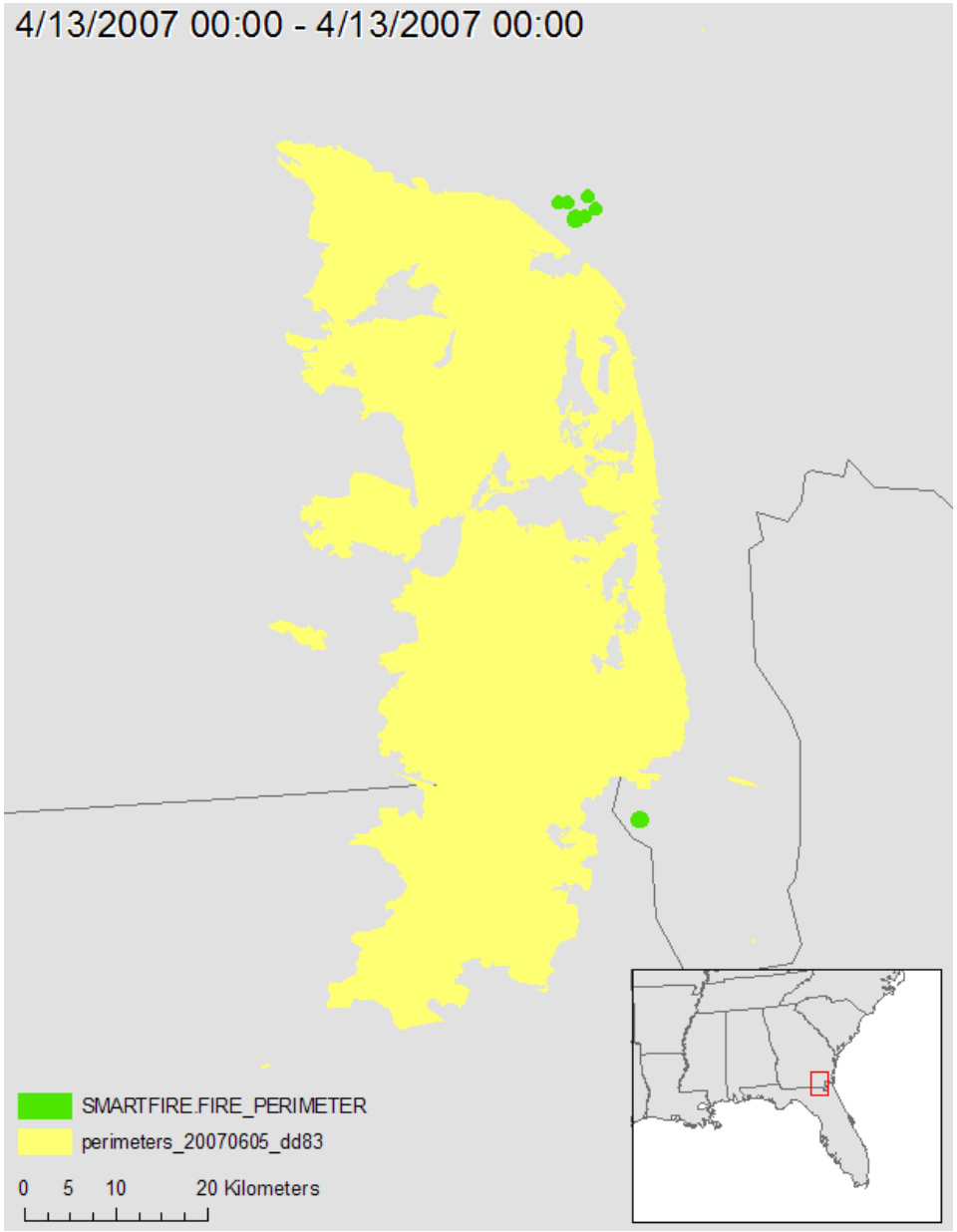
Georgia/Florida Wildfires

Daily Area Burned



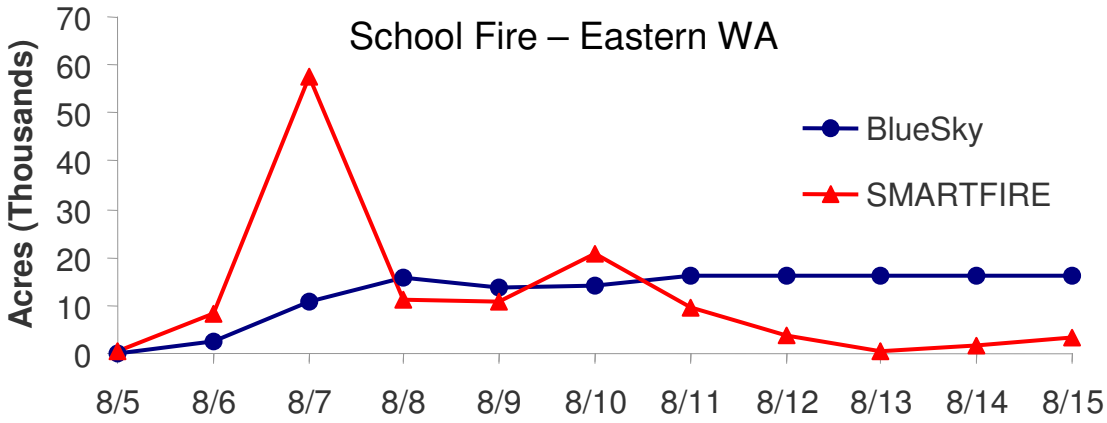
Cumulative Area Burned



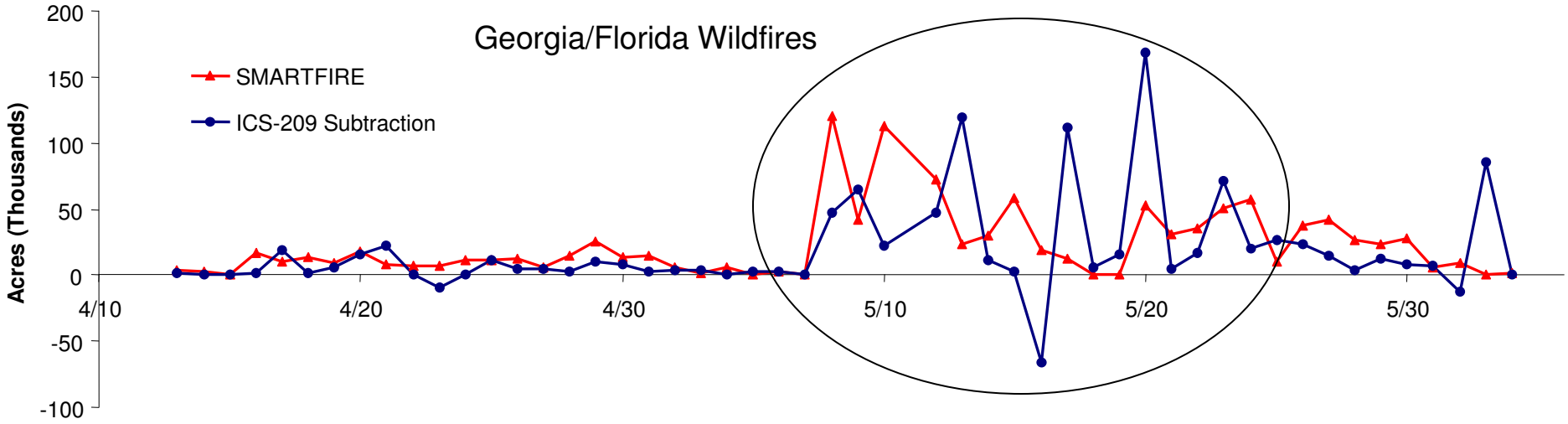
Temporal Improvements

SMARTFIRE captures the initial fire growth followed by a long tail as fire dies.

The previous BlueSky method (1/3 of current ICS-209 area) overestimates burning at the end of the fire.



Subtraction of previous cumulative area burned from ICS-209 does not work because area burned is not updated daily and may even shrink.

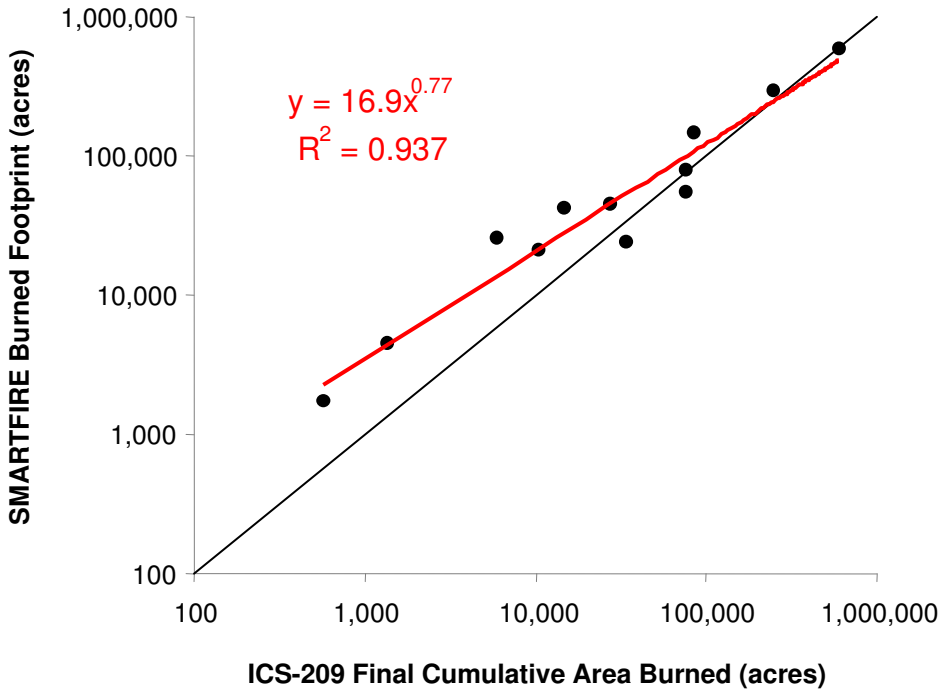


Wildfire Area Burned Estimates

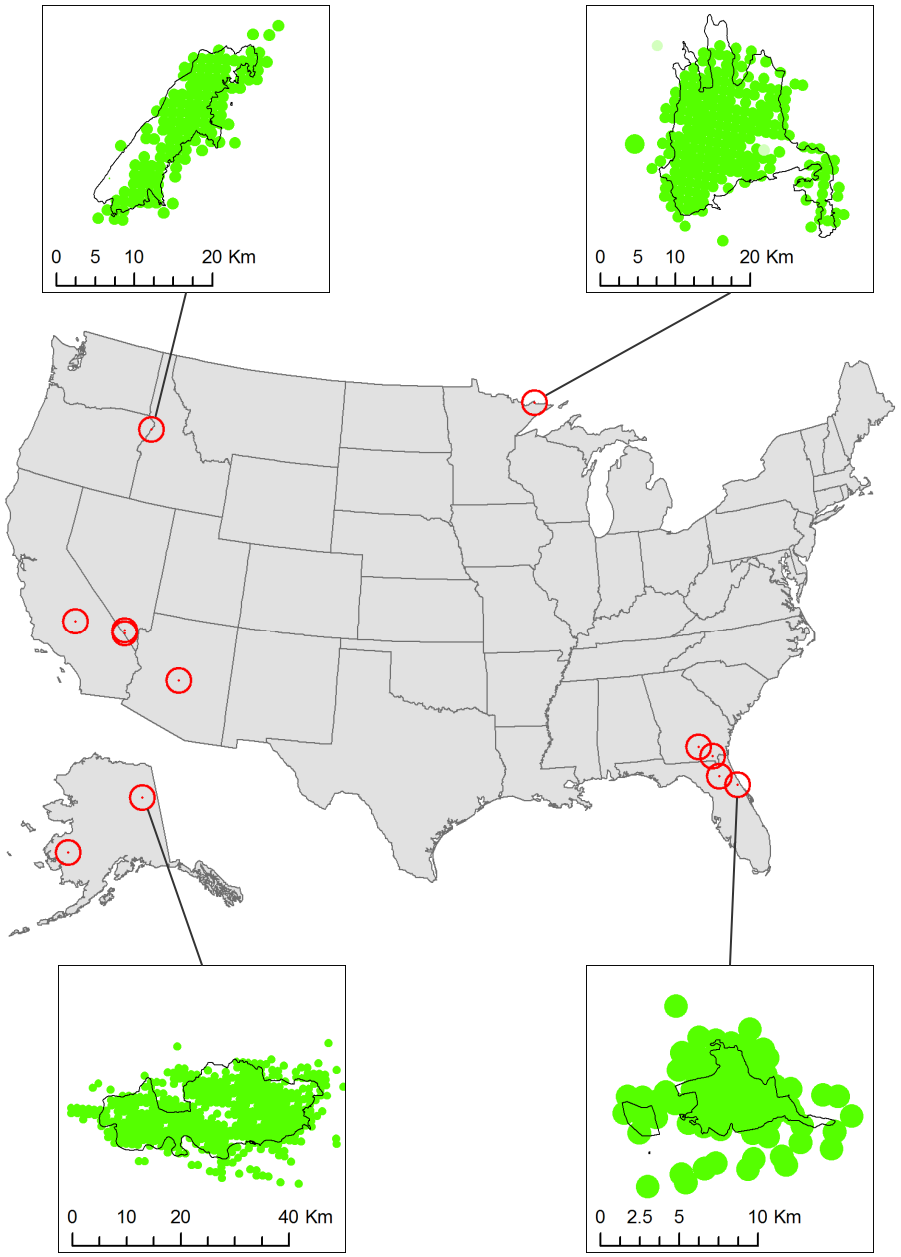
For the largest fires examined, SMARTFIRE final footprints match very well with final ICS-209 area estimates.

SMARTFIRE tends to overestimate area burned for smaller wildfires.

This relationship appears independent of ecosystem or fuel type.



Wildfire Test Locations



Smaller Fires

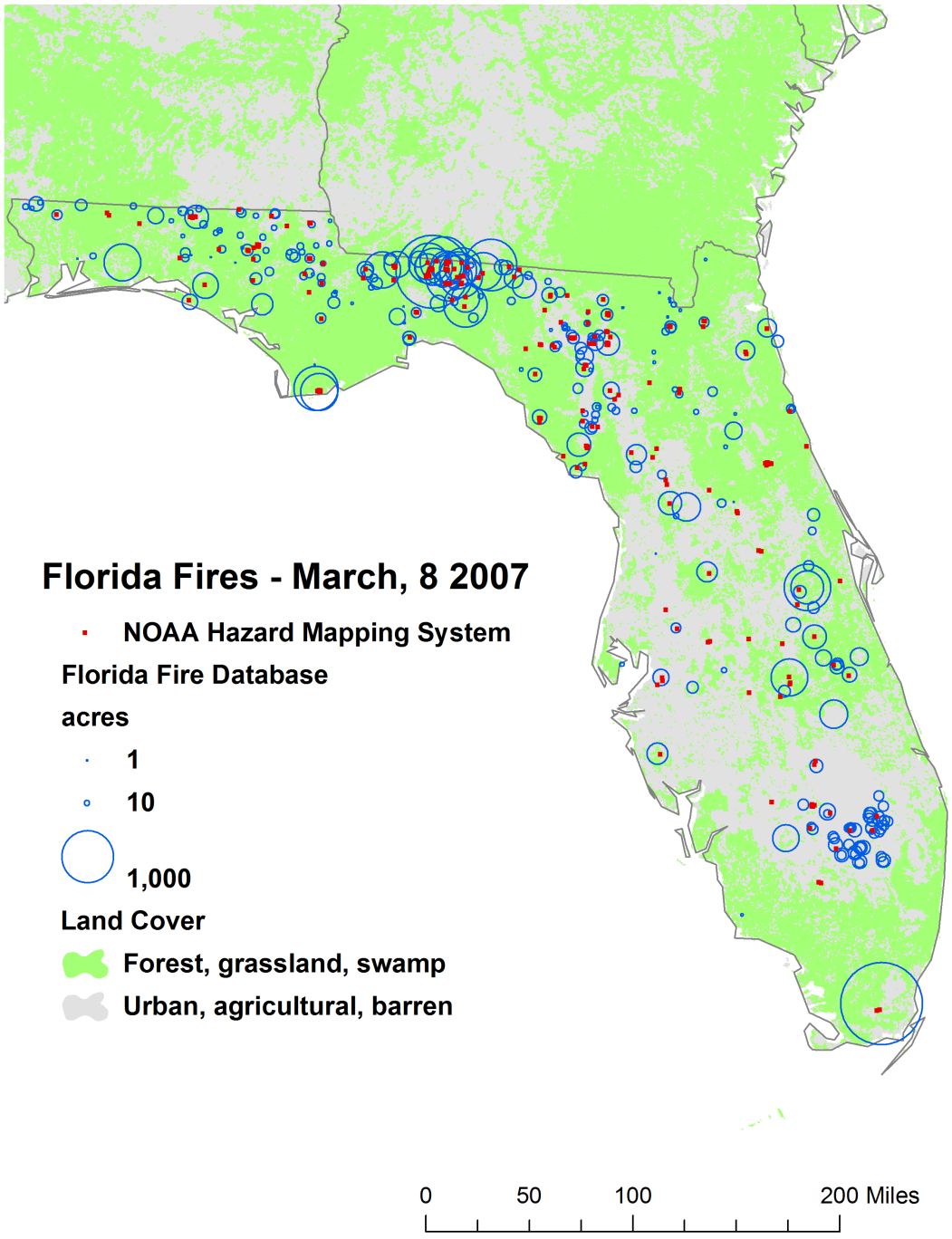
ICS-209 report information is not available for many small fires.

- 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.



Key Findings So Far

- The addition of daily satellite data makes the temporal profile of area burned more realistic.
- For fires that are seen in both data sets, SMARTFIRE avoids double-counting (usually).
- SMARTFIRE's burned footprint for large fires shows good agreement with other data.
- SMARTFIRE overestimates the burned area of small wildfires and has not been validated for smaller prescribed and agricultural burns.
- With the addition of satellite data, many more burn events are identified than the current system includes.
  - Small fires not reported by ICS-209s
  - Canadian and Mexican fires
  - Large fires detected as several sections

Current Status / Next Steps

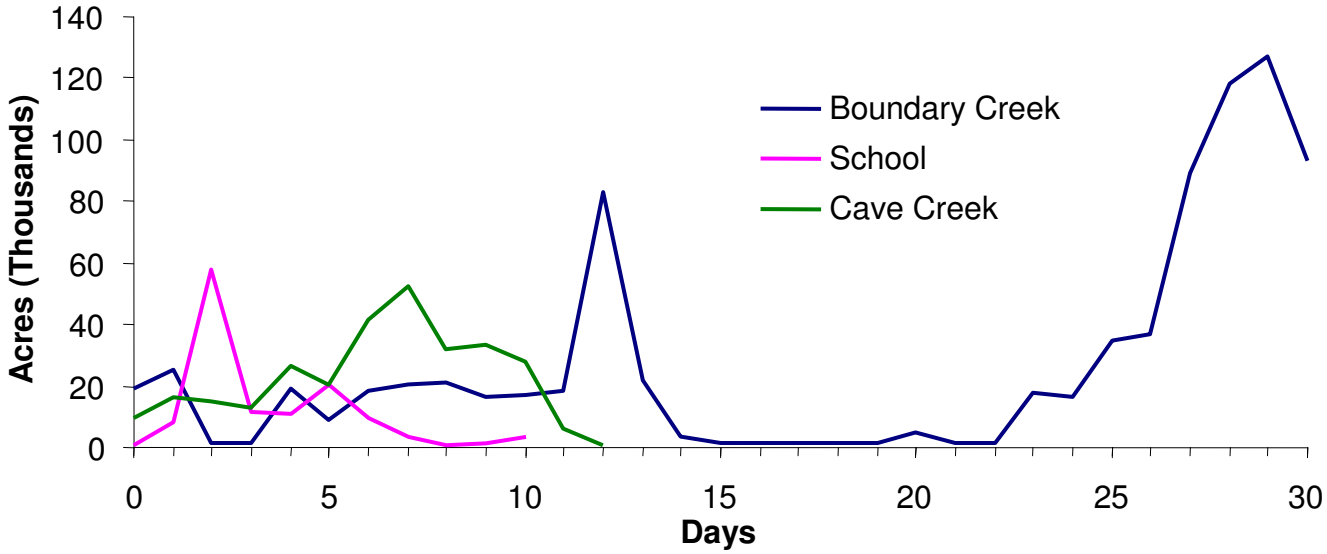
- SMARTFIRE data are being delivered to the Pacific Northwest (PNW) via a web service.
- BlueSky smoke predictions driven by SMARTFIRE on the PNW development server are coming soon.
- Pending further validation, testing, and refinement of algorithm parameters, SMARTFIRE products will be released to the Forest Service regional modeling centers and used in the national, operational 36-km BlueSky model.

Potential Improvements (1 of 2)

- Algorithm refinements targeting smaller fires
- Reconciliation of additional data sets in SMARTFIRE
  - Prescribed burn reporting systems
  - Burn perimeters from GeoMac
  - Manual input and override capability based on ground-based intelligence through a user interface

Potential Improvements (2 of 2)

- Prediction algorithm
  - Current algorithm is persistence.
  - Could this be improved through the study of time series data for many fires in different conditions?



Acknowledgments

- USFS AirFire
  - Sue Ferguson, Susan O'Neil, Sim Larkin, Robert Solomon, many others
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  - Daniel Pryden, Dana Sullivan, Lyle Chinkin, Chris Ovard, others
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- NASA Decision Support

Thank you!

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