2014 Fire NEI Workshop: Emissions Processing – *SmartFire Details*

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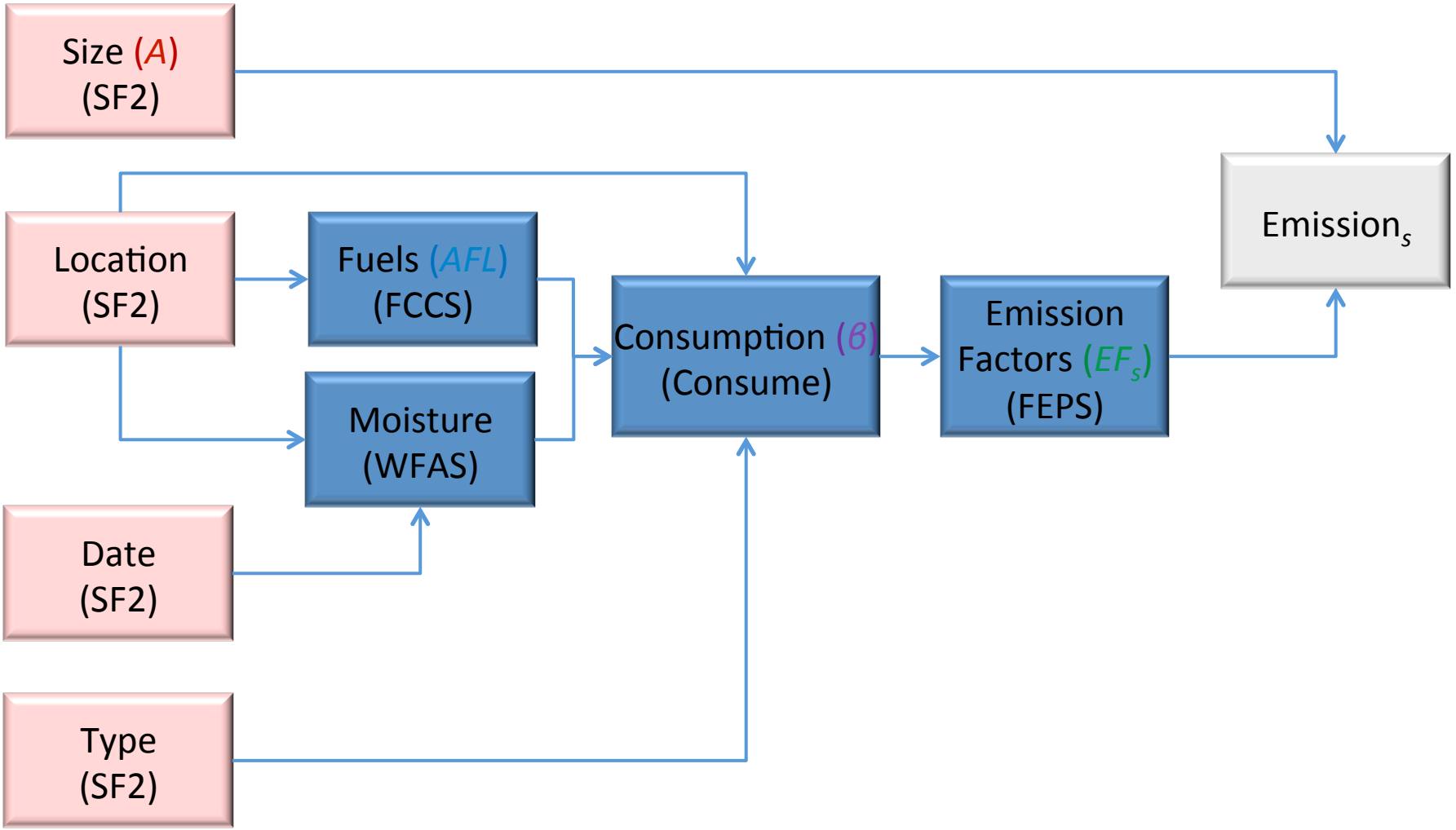
NEI Method – Tying Information Together



Outline

- SmartFire 2 in detail
- How SmartFire 2 was set up for the 2011 inventory
- How SF2 methods are being improved for 2014

SmartFire 2 – What is it?

SmartFire 2 (SF2)

- is a framework for producing fire activity data
- is not a single algorithm
- does not calculate emissions, but provides activity
- is open source (GPL license, code available upon request)
- allows for the merging of multiple data sources into a reconciled set of fire information

The Fire Information Problem

There is no single complete, best fire information data source

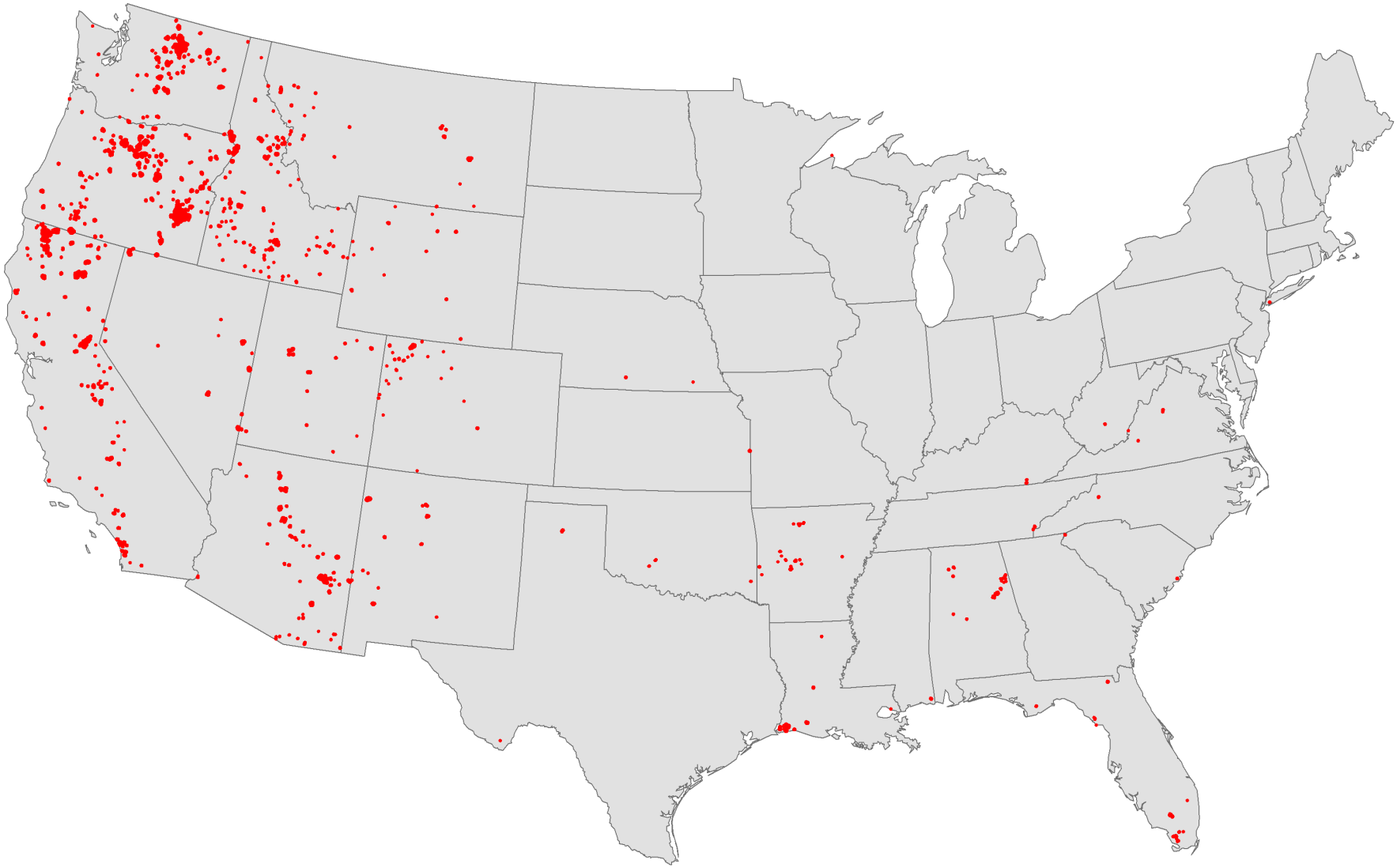
- Coverage is limited (by size, type, jurisdiction) or incomplete (clouds)
- Timeliness varies from near real-time to years later
- Each data source has strengths and weaknesses and information can be redundant

Example Source: GeoMac Perimeters

Wildfire perimeters developed by GIS teams during wildfire incidents

- Coverage: mostly large wildfires
- Timeliness: currently available
- Strengths: accurate size and shape
- Weaknesses: limited timing information

2014 GeoMac Perimeters

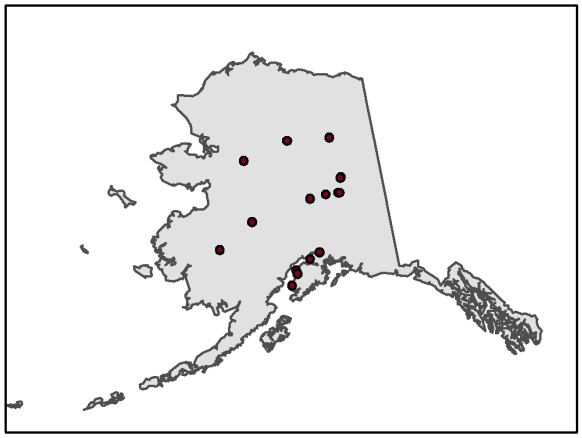


Example Source: ICS-209 Reports

Compilation of daily situation reports from incident command teams

- Coverage: predominantly wildfires
- Timeliness: available for the 2014 NEI
- Strengths: identification of fire type and name, reasonable size and daily growth
- Weaknesses: no shape information, location is start only, error prone

2008 ICS-209 Reports

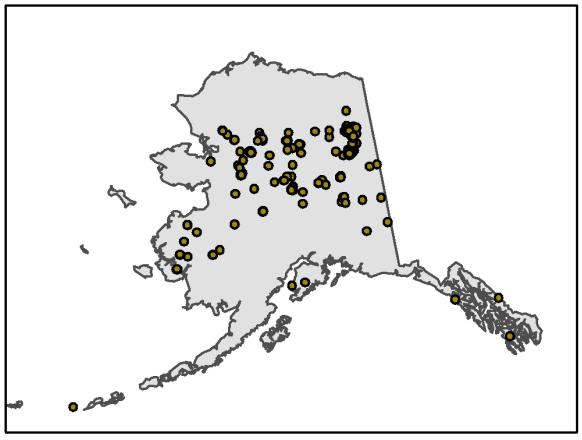


Example Source: HMS fire detects

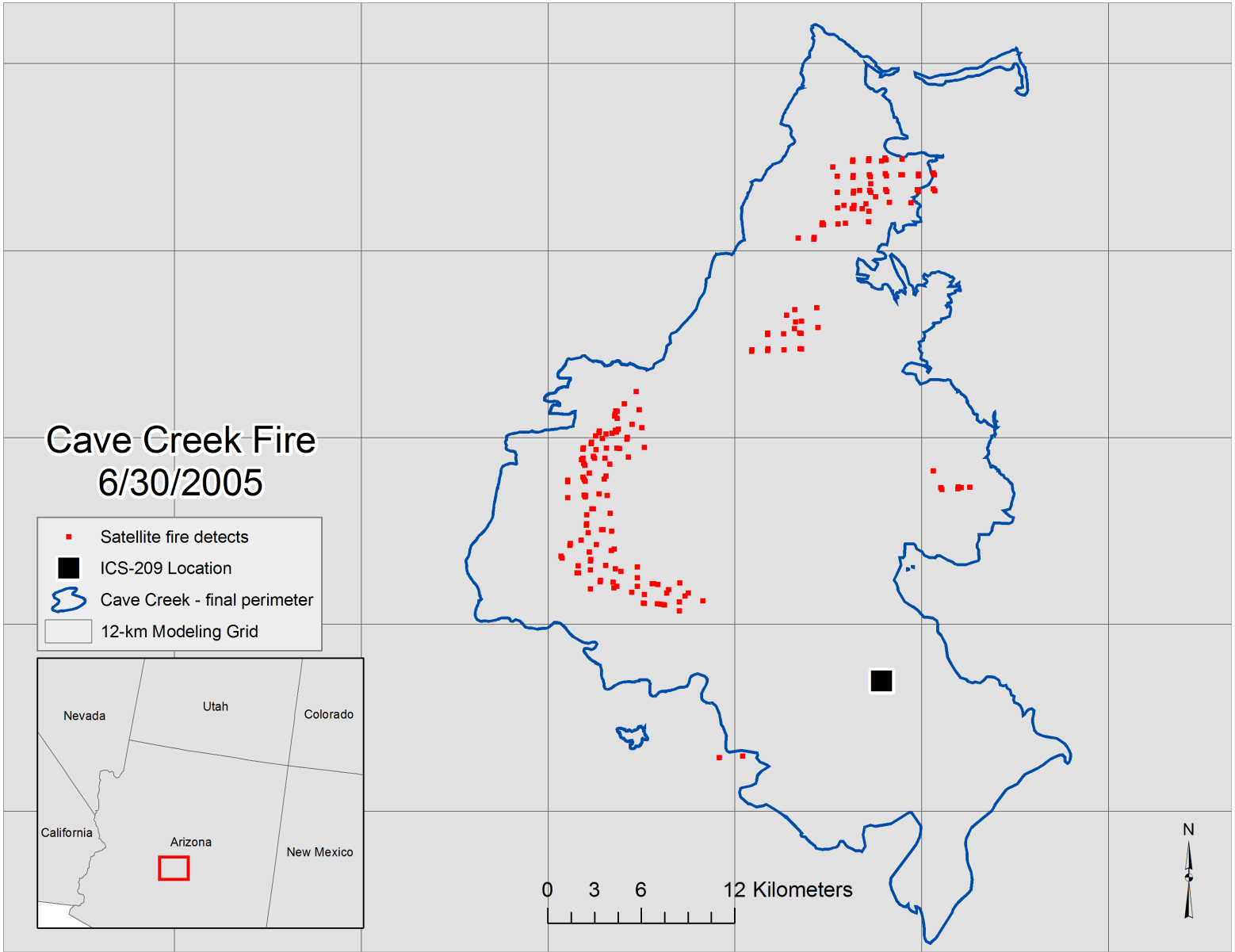
Compilation of satellite detected fires plus human quality control

- Coverage: detection rate decreases with fire size, no detection under thick clouds
- Timeliness: available in near real-time
- Strengths: many fires covered, daily information
- Weaknesses: fire size and type must be inferred

2008
HMS Fire Detects



Three-Source Example



SmartFire 2 – What is it?

- Three key concepts
  - **Fire** as a unit of information
  - **Association** of fires from multiple data sources
  - **Reconciliation** of the attributes of associated fires

Fire

A fire in the SF2 database has the following attributes:

- Location (latitude and longitude)
- Shape (perimeter)
- Size (total area burned)
- Type (WF, Rx, Ag)
- Start and end dates
- Growth (fraction of area burned for each day)
- Name

SF2 assigns this information for every data source

WF = wildfire, Rx = prescribed, Ag = agricultural

Creating Fires – Example: MTBS*

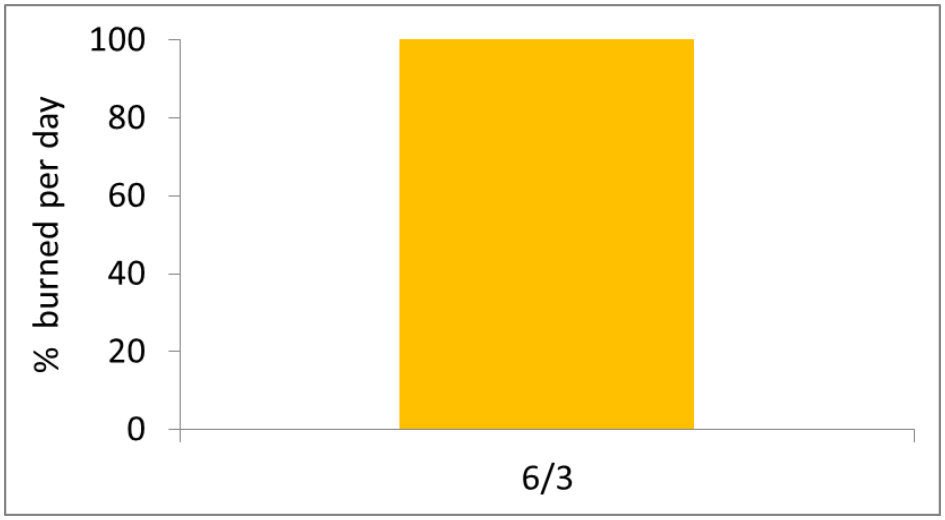
MTBS perimeters are polygons providing a final burn outline

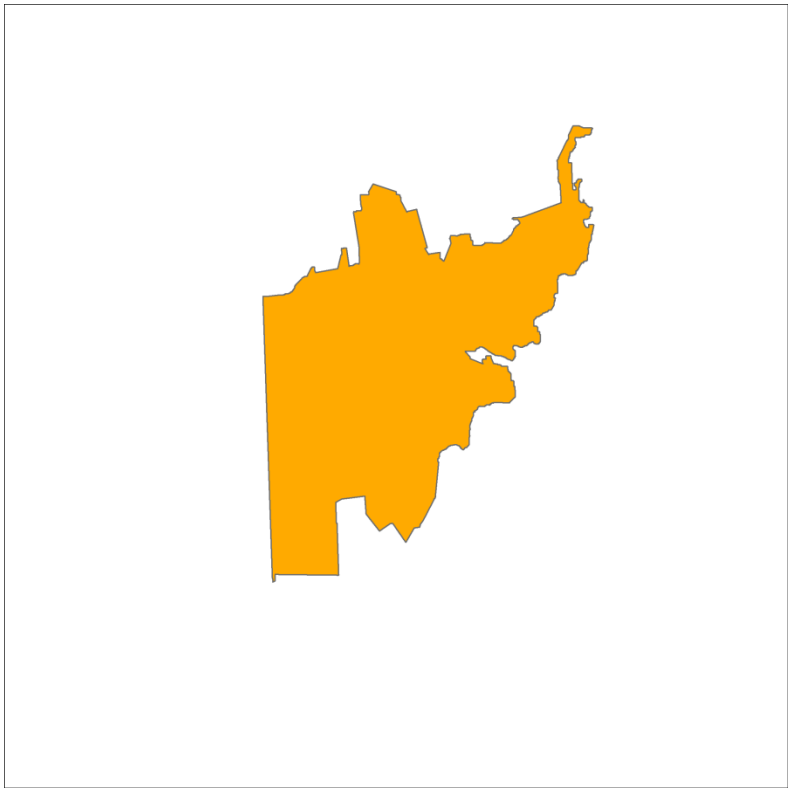
- Location, shape, and size come directly from the polygon
- Assign name and type based on the name field
  - If name includes “unknown” or “Rx”: Rx
  - Else: WF
- Assign start date based on start date field
- Assign end date = start date
- Assign all growth to start date

* MTBS not available for 2014 – GeoMac data are similar and will be substituted

Creating Fires – Example: MTBS

- Name: EVANS ROAD
- Size: 41,561 acres
- Type: WF
- Dates: 6/3/08-6/3/08
- Growth curve:





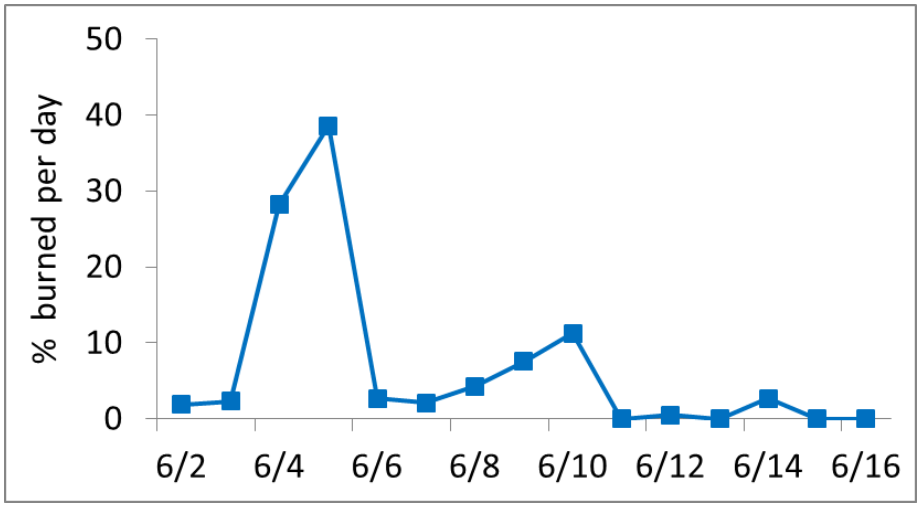
Creating Fires – Example: ICS-209

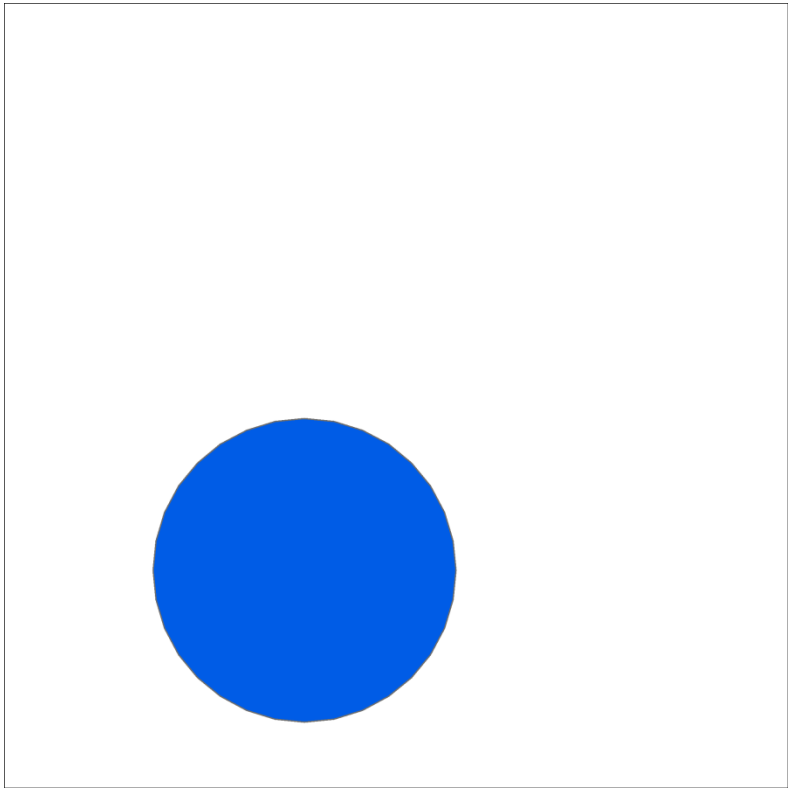
ICS-209 raw data records are daily snapshots of activity for a fire or complex of fires

- Collect all records with the same fire ID field
- Assign location from latitude and longitude fields (ignition point)
- Assign size from area field of last report
- Assign name, type, and start date from fields
- Assign end date from contained date (if available) or last report date (for large fires) or start date
- Shape is circle centered on location with area = size
- Growth is based on area difference between daily reports

Creating Fires – Example: ICS-209

- Name: Evans Road
- Size: 40,704 acres
- Type: WF
- Dates: 6/1/08 - 9/24/08
- Growth curve:





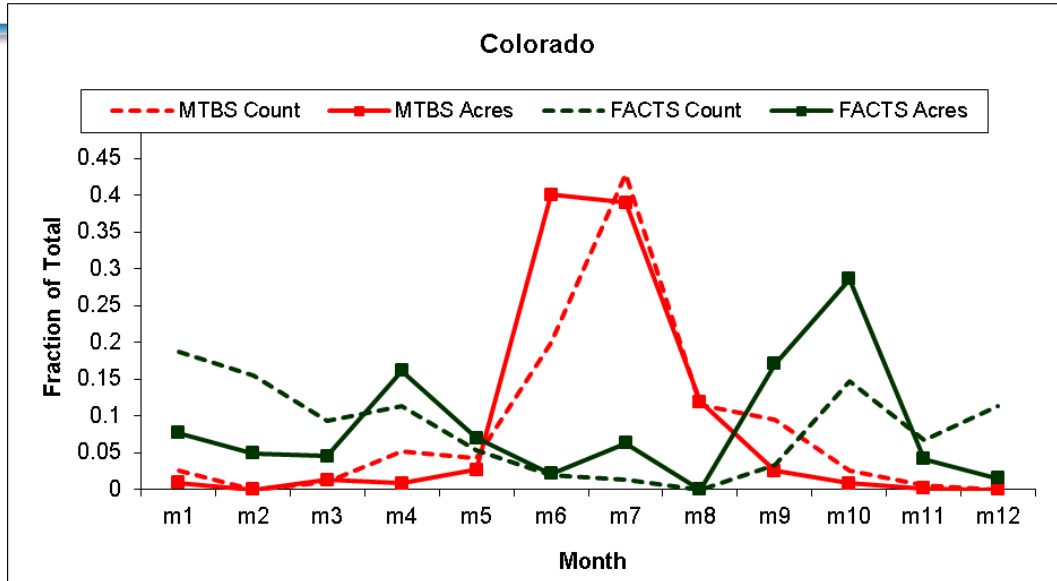
Creating Fires – Example: HMS

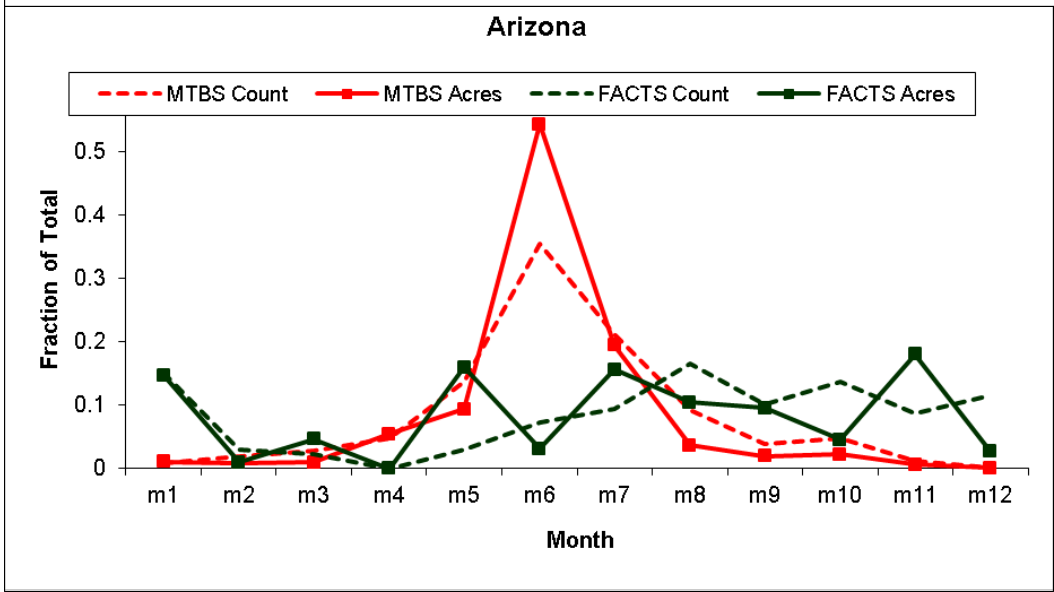
HMS raw data are a collection of points that represent the daily detection of actively burning locations

- Group all points that are close in time and space and draw circular buffers to create location, shape, start date, end date, and daily fraction of growth
- Assign placeholder name
- Assign type based on climatology analysis
- Assign size based on number of detects and vegetation type

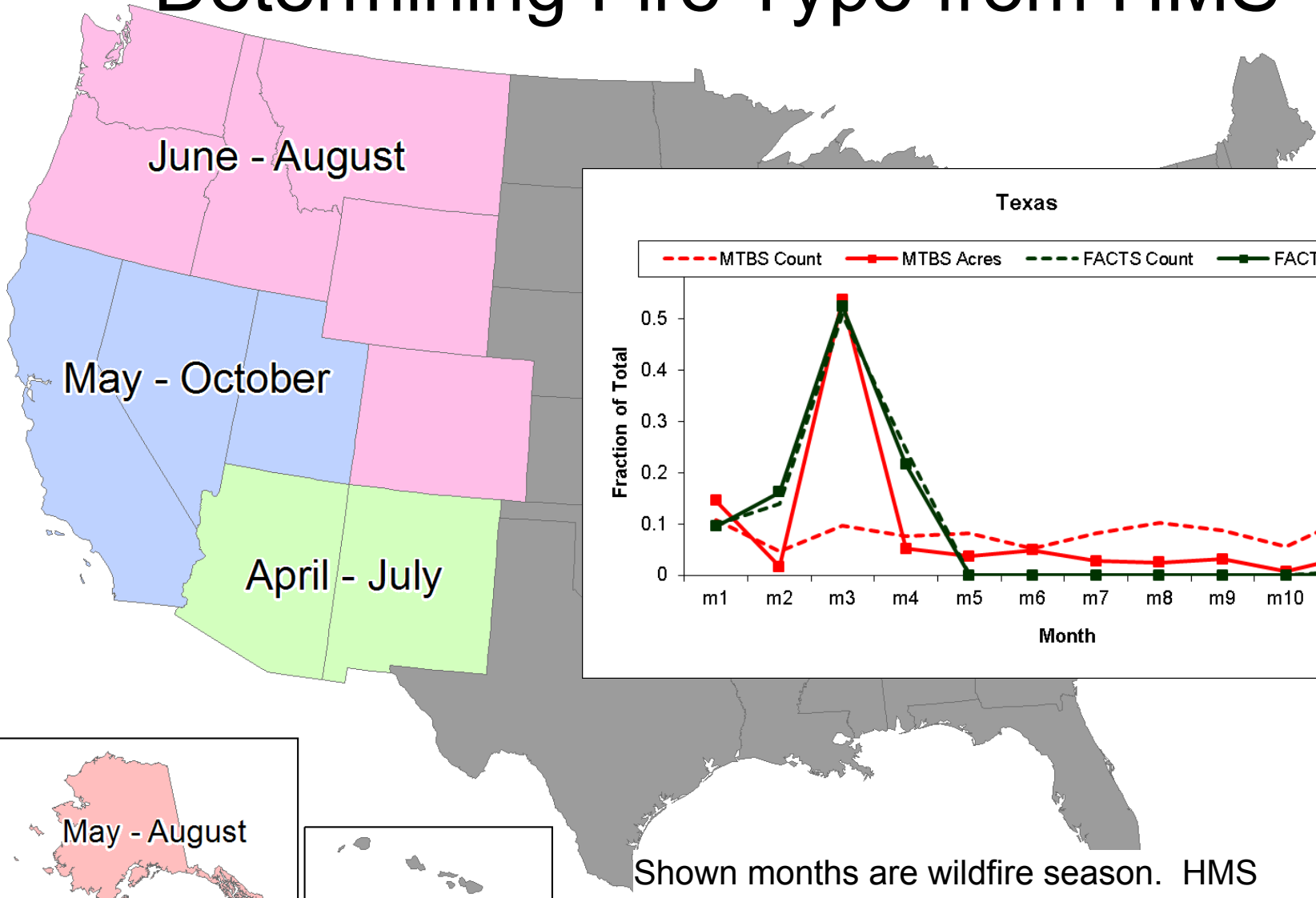
Fire Type Climatology – Basis

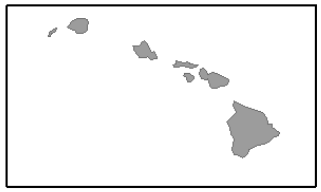
- State-by-state analysis of two databases
  - FACTS (Forest Service ACtivity Tracking System)
    - FY ‘08 and ’09
    - Rx burns
  - MTBS
    - 1984 – 2006
    - Mostly WF
- Some states had separable seasons





Determining Fire Type from HMS





Shown months are wildfire season. HMS only fires falling within these locations/ months are classified as WF. All others are classified as Rx.

Determining Default Fire Type – Next Steps

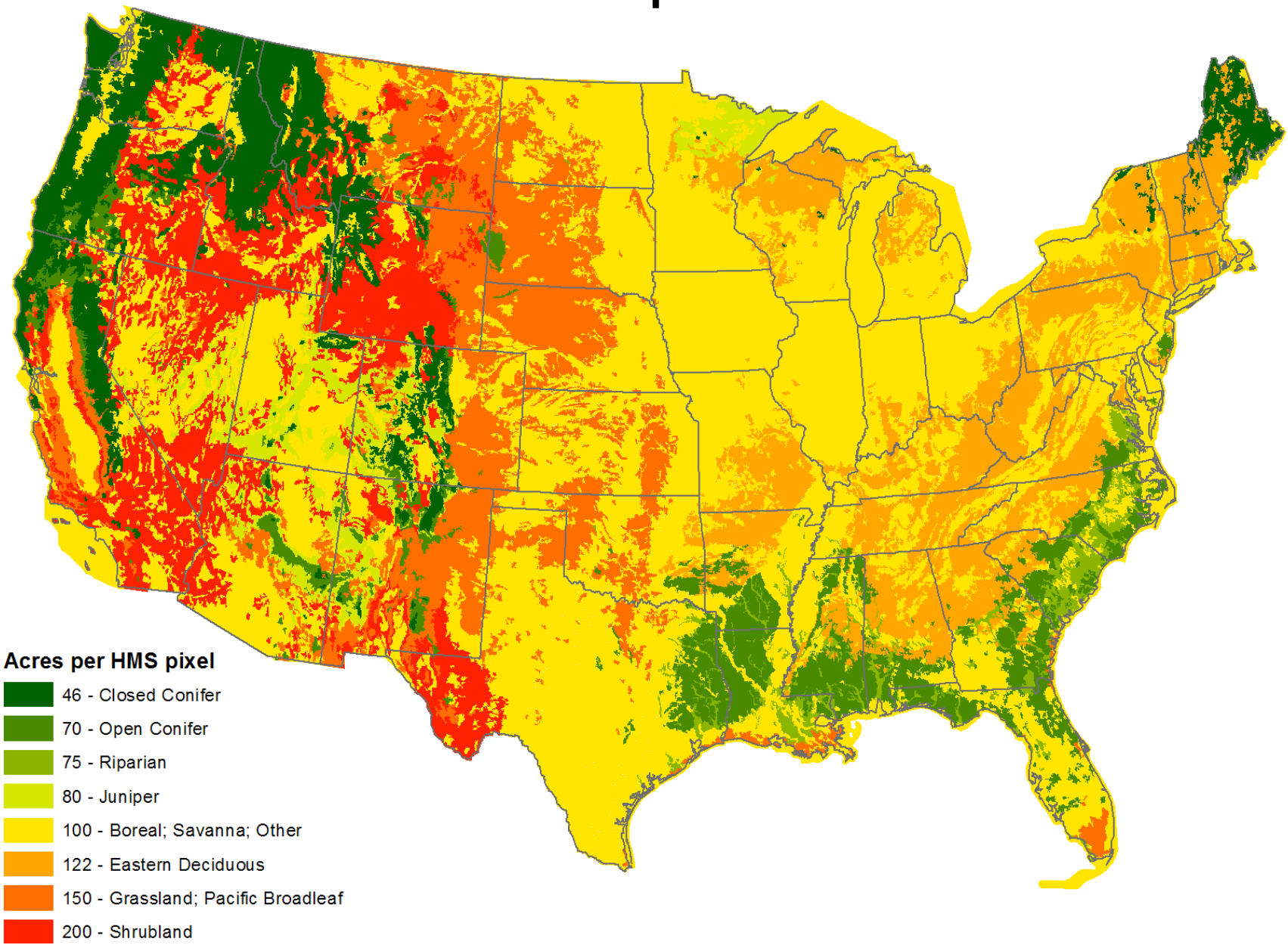
- Goal: refine our default fire type assumptions for data sources that do not provide type information
- Examine additional data sets over a longer time span
  - NASF fire occurrence
  - FACTS/NFPORS Rx burns
- Develop fire prescription conditions map
  - If a location is too dry, prescribed burns will not be lit
- The addition of local activity data to the inventory reduces the need for making these guesses in the first place

National Fire Operations and Reporting System (NFPORS)
Forest Service Activity Tracking Support (FACTS)

Determining Fire Size from HMS Detects

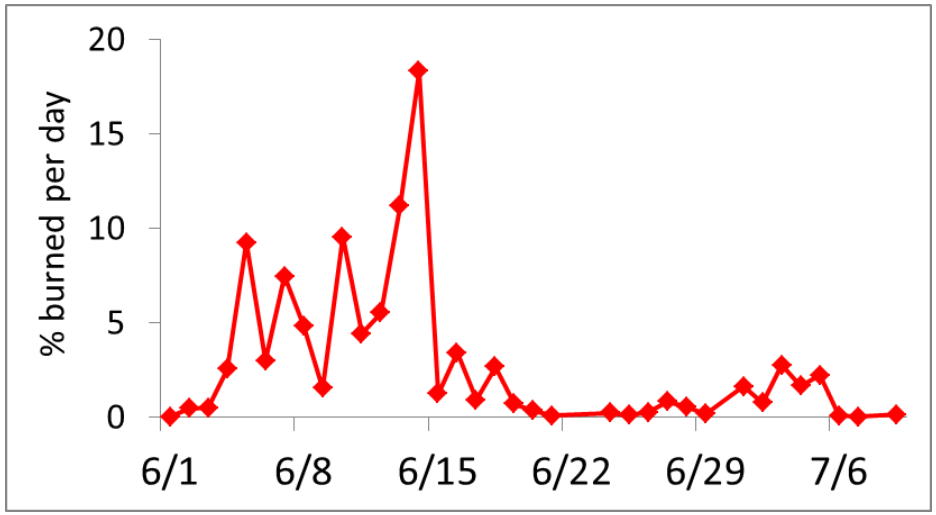
- Satellite detection varies by land cover
  - Grassland fires are fast and short-lived resulting in few detects per area burned
  - Forest fires often smolder longer resulting in more detects per area burned
- Assessed 2008 MTBS fires in 12 vegetation classes to determine characteristic acres per detect

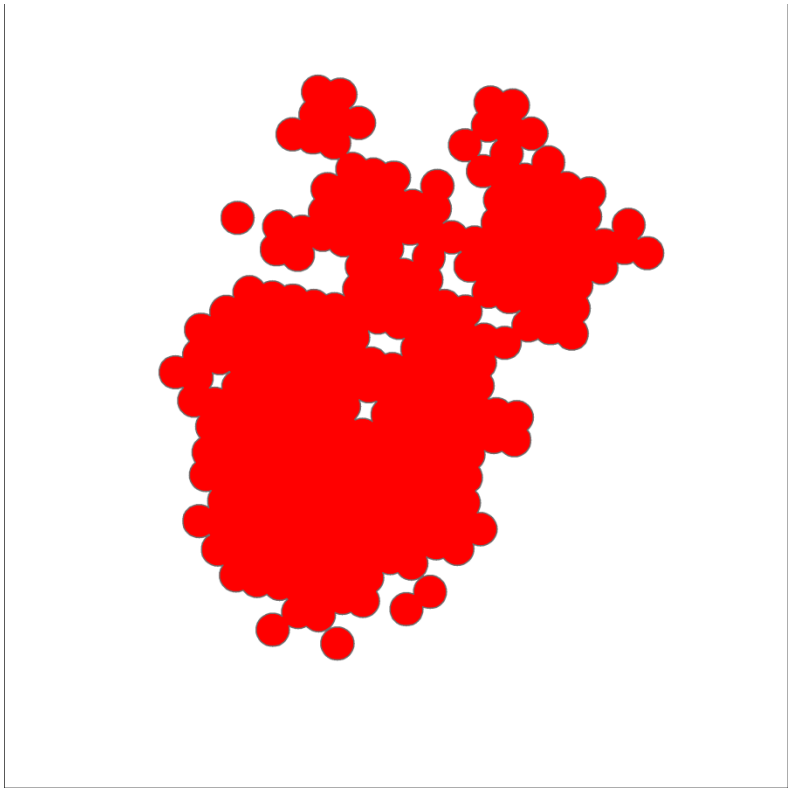
Acres per HMS Detect



Creating Fires – Example: HMS

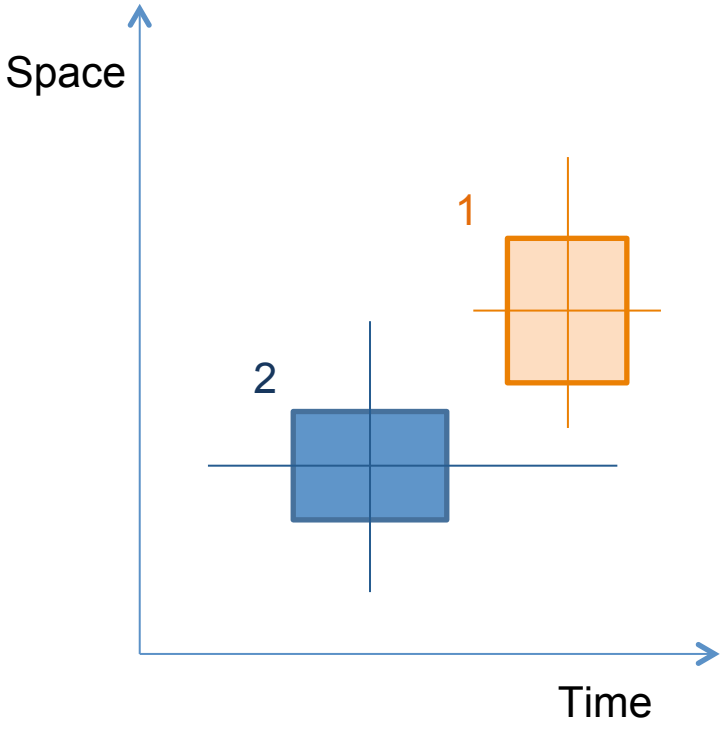
- Name: Unknown Fire
- Size: 141,960 acres
- Type: Rx
- Dates: 6/1/08 - 7/9/08
- Growth curve:





Association Details – Abstract

- Goal of association is to avoid double-counting
- Hypothetical fire from data sources **1** (e.g., ICS-209) and **2** (e.g., MTBS)
- Boxes depict spatial footprint and time range
- Lines depict uncertainties
- Though they do not overlap in time and space, they will be associated as one fire because they overlap within the uncertainty range



Association Details – Uncertainties Used

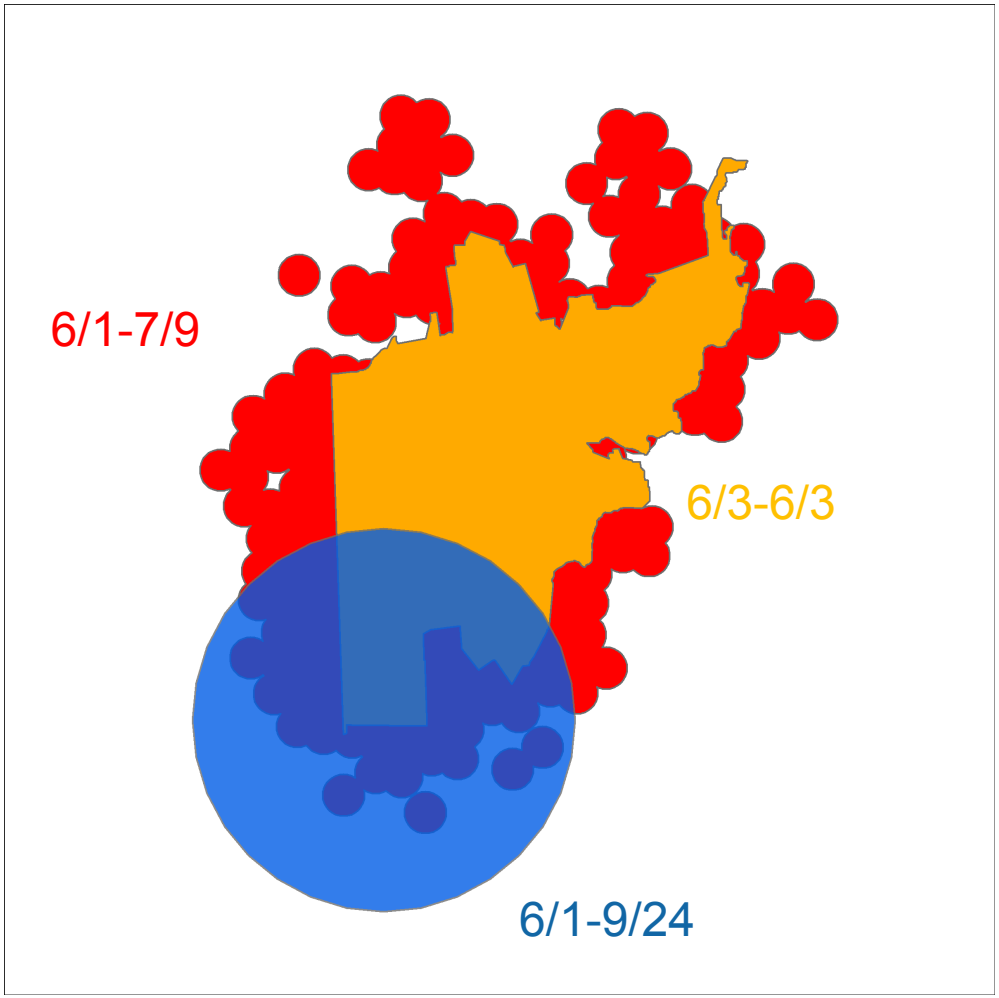
Spatiotemporal uncertainty values used for the 2008 NEI

Data Source	Spatial Uncertainty (km)	Start Uncertainty (days)	End Uncertainty (days)
MTBS	0.5	1	30
ICS-209	5	1	4
HMS	4	2	3

These values were chosen based on expert judgment and should be refined with further study for future inventories.
Unless data sets are perfect, some double-counting is unavoidable and manual QC should be applied, especially for large fires.

Association – Evans Road Example

- Fires from multiple data sources that are nearby in time and space are associated.
- SF2 now knows the examples are three views of the same fire.



Reconciliation – Merging the Data

- We now have 3 sizes, 3 start dates, 3 names, etc. for this fire. Reconciliation gets us back to 1 size, start, date, name, etc.
- The method for reconciliation uses a ranking for each element (size, date, etc.) for each data source.

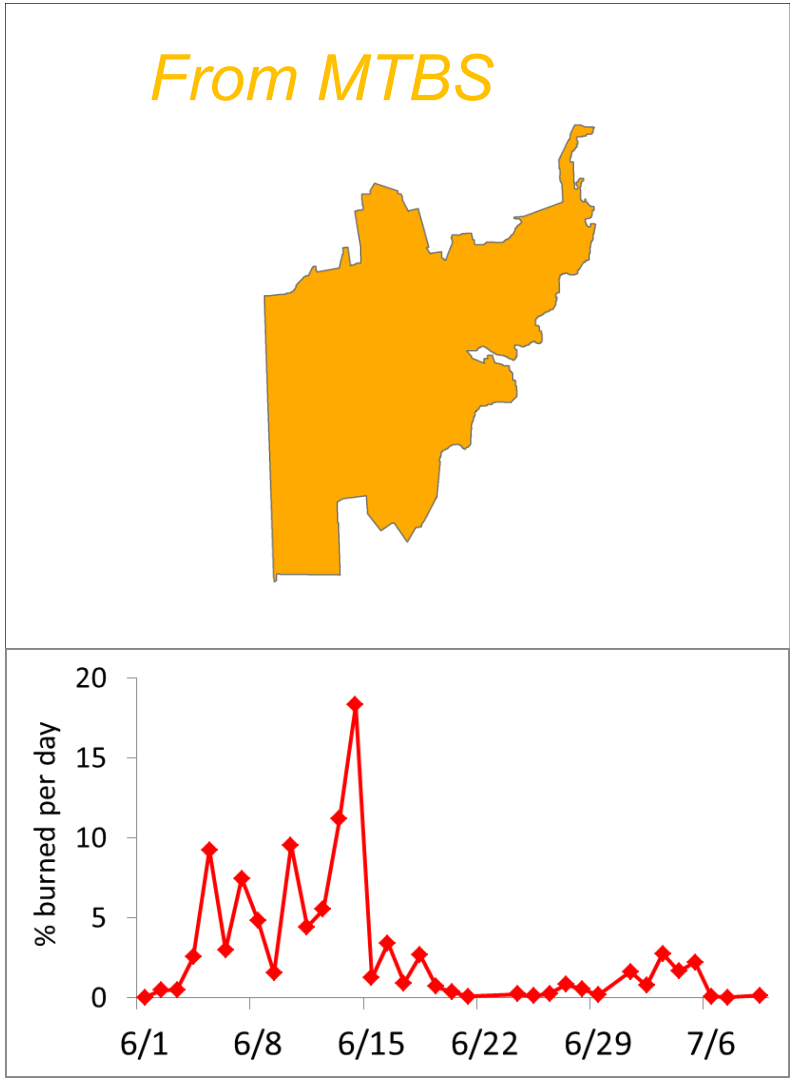
Example Reconciliation Table

Data Element	First Choice	Second Choice	Third Choice
Location/shape	MTBS	HMS	ICS-209*
Final size	MTBS	ICS-209	HMS*
Daily activity	HMS	ICS-209	MTBS*
Fire type (WF/Rx)	ICS-209	MTBS	HMS*
Name	ICS-209	MTBS*	HMS*
Start date	First reported		
End date	HMS	ICS-209	MTBS*

* These values must be inferred

Reconciliation Example – Evans Road

- Name: Evans Road
  - *From ICS-209*
- Size: 41,561 acres
  - *From MTBS*
- Type: WF
  - *From ICS-209*
- Dates: 6/1/08-7/9/08
  - *First reported, HMS*
- Growth curve:
  - *From HMS*

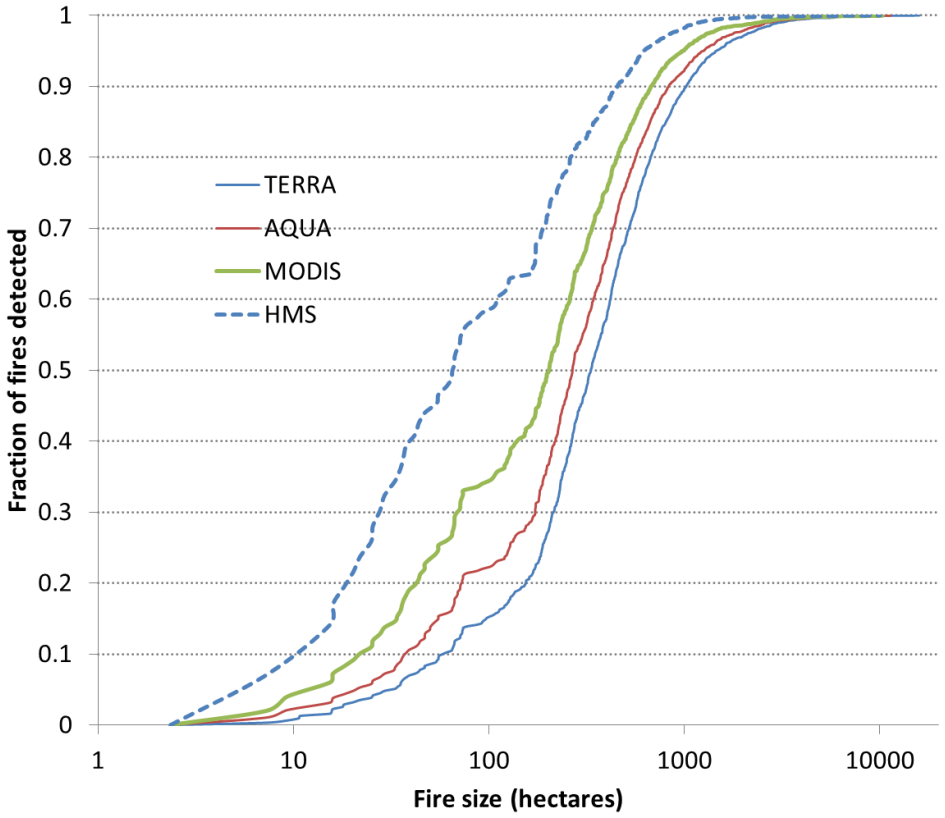


Why We Need Your Data

- There are 60,000 fires in the 2008 NEI.
- Of those, fewer than 2,000 have any information besides HMS satellite detects.
- A typical case:
  - 6/1/08
  - Somewhere in Georgia
  - Size and type of fire must be inferred

Why We Need Your Data

Even HMS data are missing most of the fires < 100 acres in size



Potential for Improvement

Data Element	First Choice	Second Choice	Third Choice	Fourth Choice
Location/shape	Local data	GeoMac	HMS	ICS-209
Final size	Local data	GeoMac	ICS-209	HMS
Daily activity	Local data	HMS	ICS-209	GeoMac
Fire type (WF/ Rx)	Local data	ICS-209	GeoMac	HMS
Name	Local data	ICS-209	GeoMac	HMS
Start date	Local data		First reported	
End date	Local data	HMS	ICS-209	GeoMac