The Role of Satellite Observations in Assessing Impacts of Wildfire Occurrence on Respiratory Health of Population

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Outline

- Wildfire and human health
- Interdisciplinary work: all pieces of the puzzle
- Role of fire satellite data and information in emissions modeling
- Concluding thoughts

Wildfire and Health:

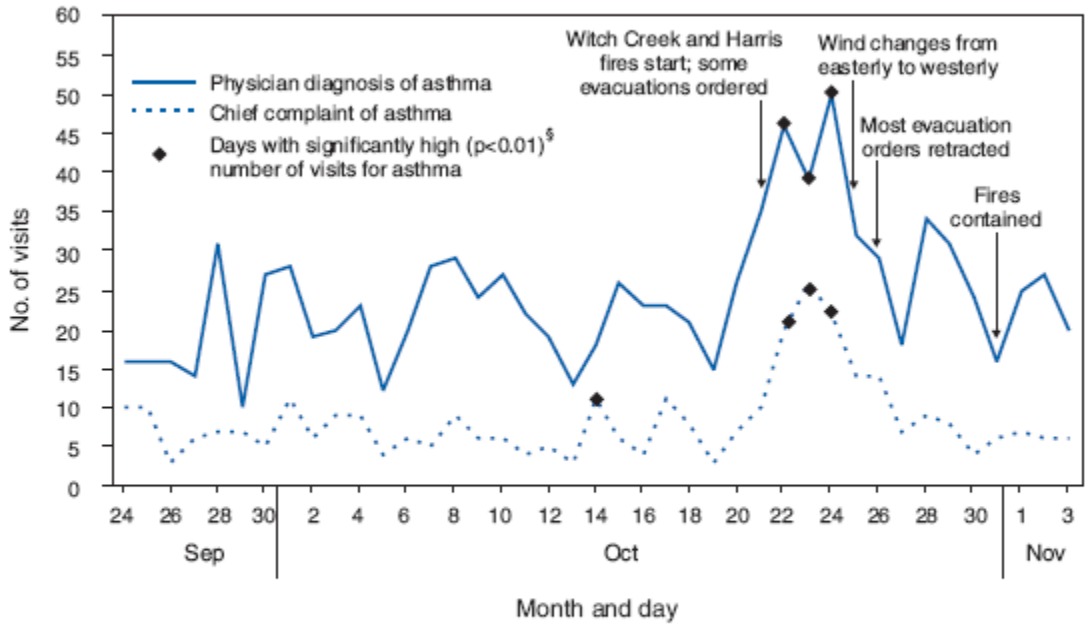
Wildfire PM toxicity

- Wildfire PM contains chemical components that are toxic to the lung and especially to alveolar macrophages.

- Wildfire PM appears to be more toxic to the lung than equal doses of PM collected from ambient air from the same region during a comparable season

2007 Health surveillance reports

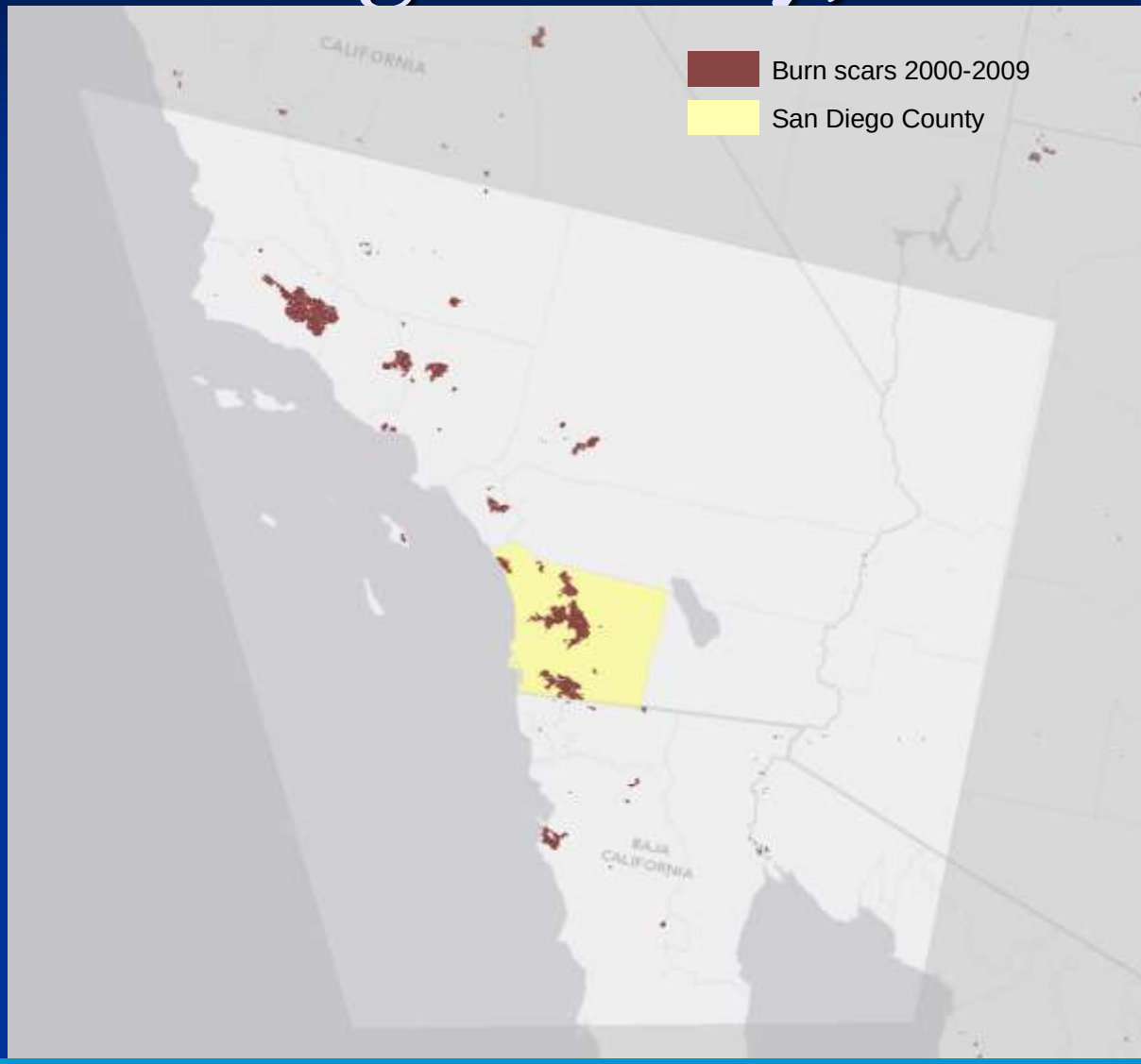
FIGURE 2. Number of emergency department visits, by chief complaint* and diagnosis† of asthma — six hospitals, San Diego, California, September 22–November 17, 2007



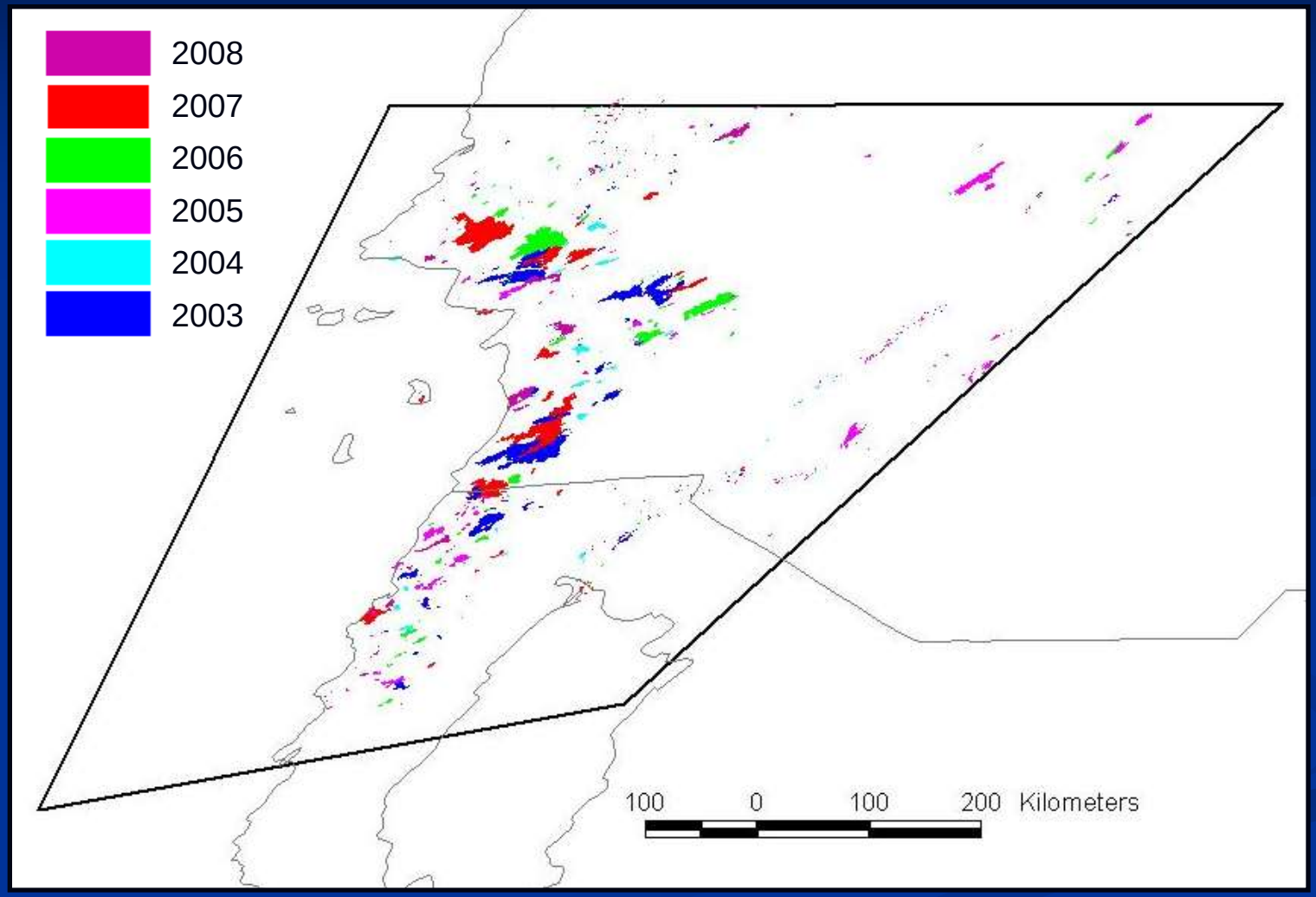
* Free-text chief complaints are parsed for specified keywords and assigned to syndromes and subsyndromes.
† Based on *International Classification of Diseases, Ninth Revision, Clinical Modification* code 493 (asthma).
§ Statistical significance determined using a modification of the Early Aberration Reporting System (EARS) C-2 algorithm.

Ginsberg M, Johnson J et al (2008). Monitoring Health Effects of Wildfires Using the BioSense System – San Diego County, California, October 2007. CDC MMWR 57(27), 741-747.

Study area: San Diego county, CA



Fire occurrence between 2003 and 2008



Wildland fire impacts large areas

Station Fire August 30, 2009 in Acton, California. (Justin Sullivan/Getty Images)

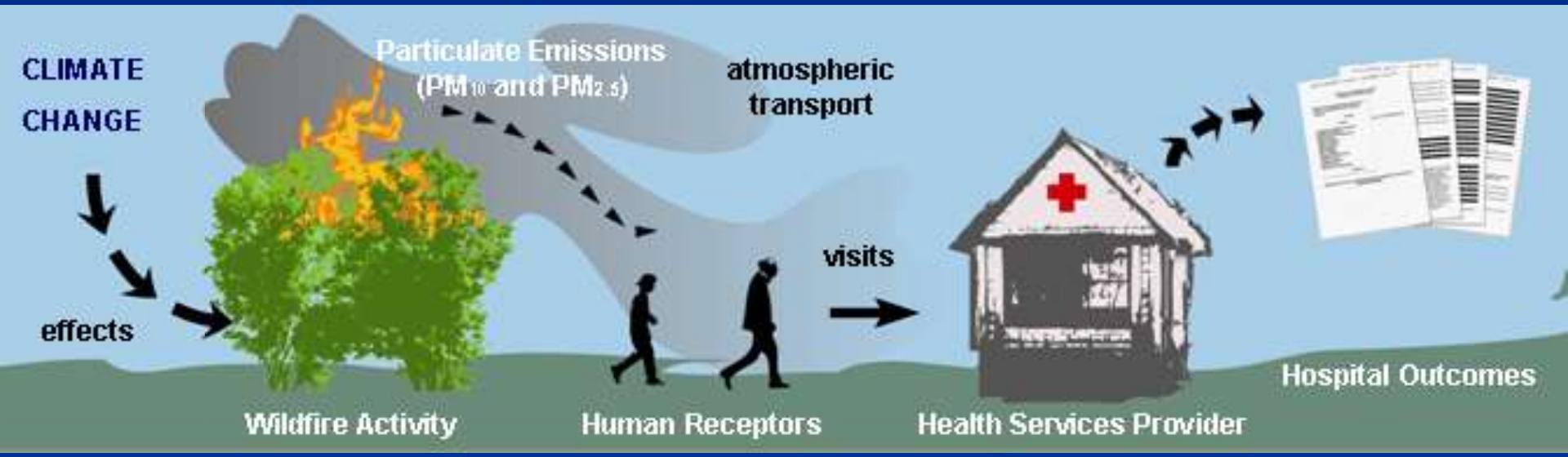
Smoke plumes and air quality

2007 fires on MODIS image

Wildland fire: impact on air quality

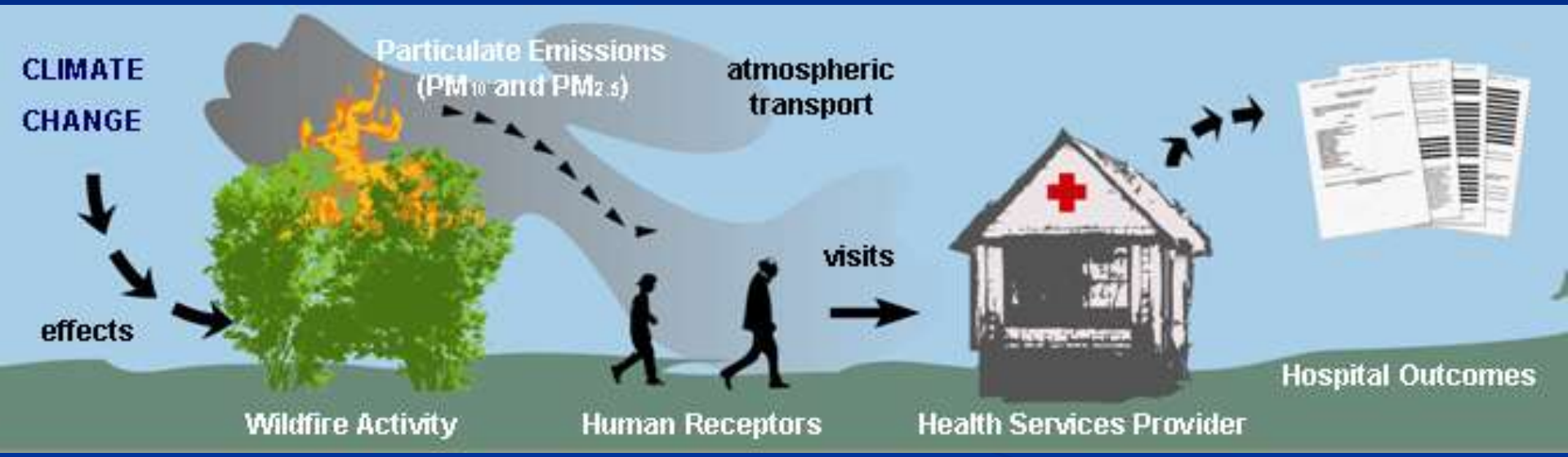
A pyrocumulus cloud over Downtown Los Angeles (Michael Castillo)

Fire occurrence – Emissions - Health

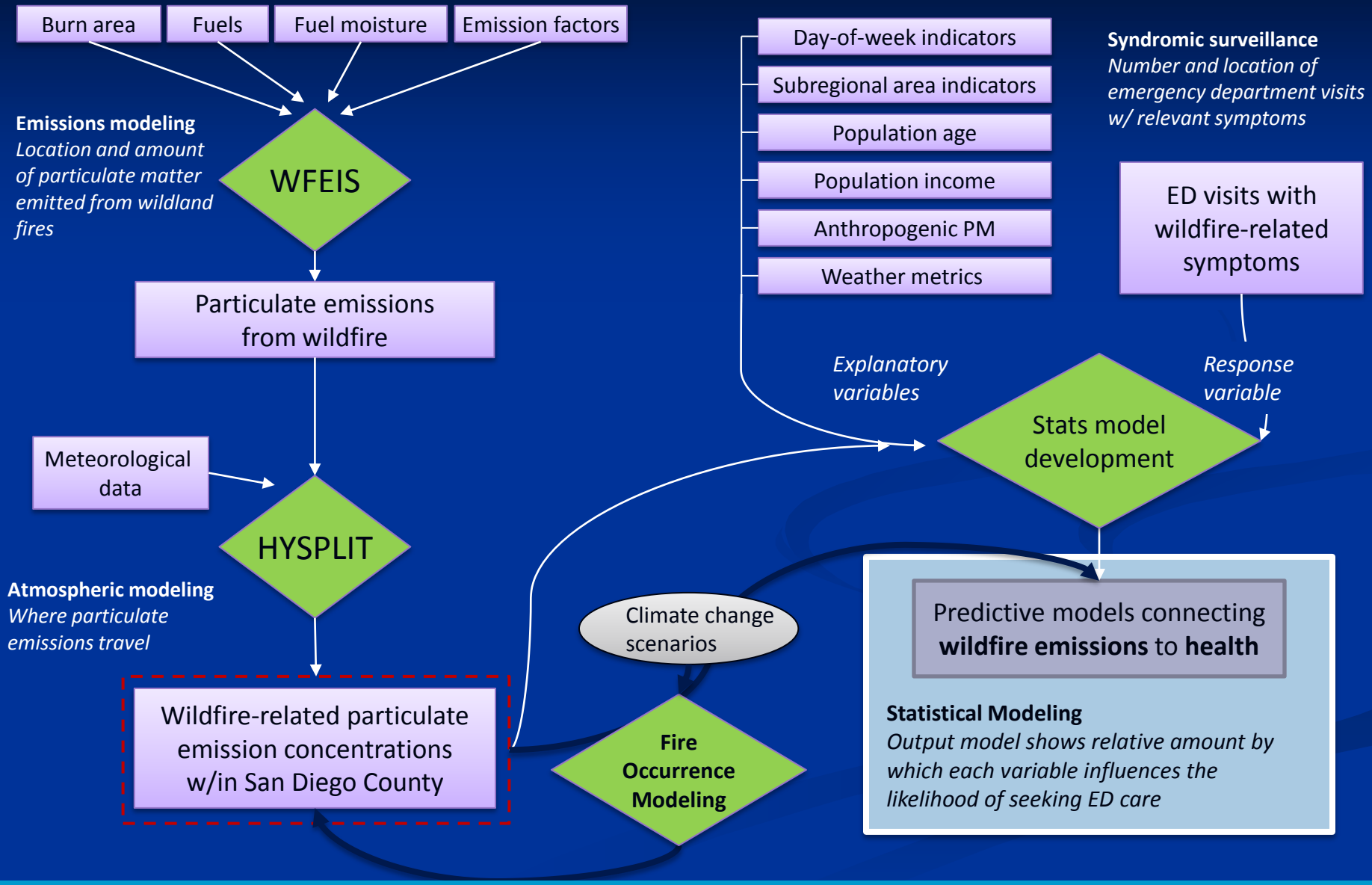


Doing Interdisciplinary Research: collecting all pieces of the puzzle

Fire occurrence – Emissions - Health

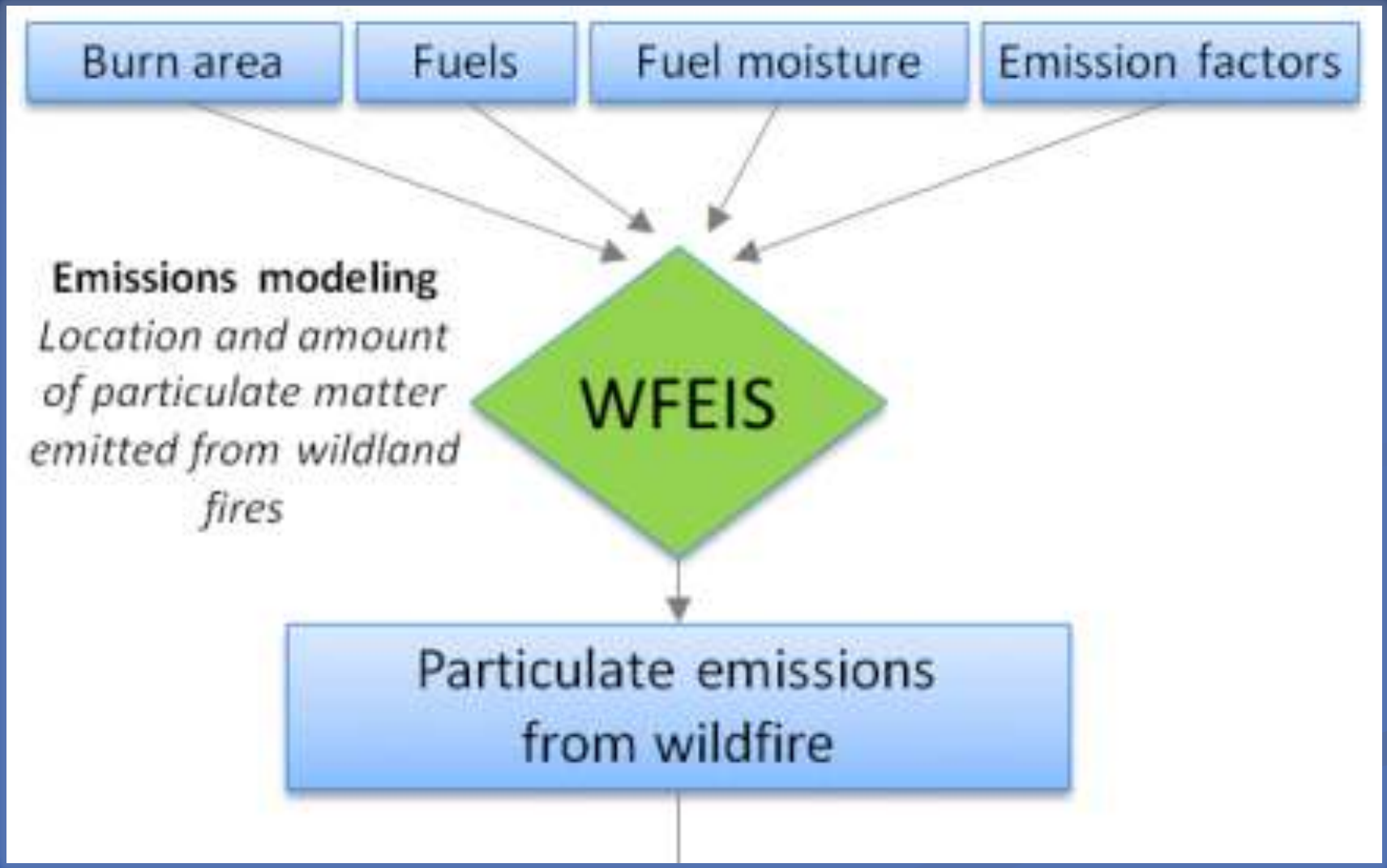


Work and data flow

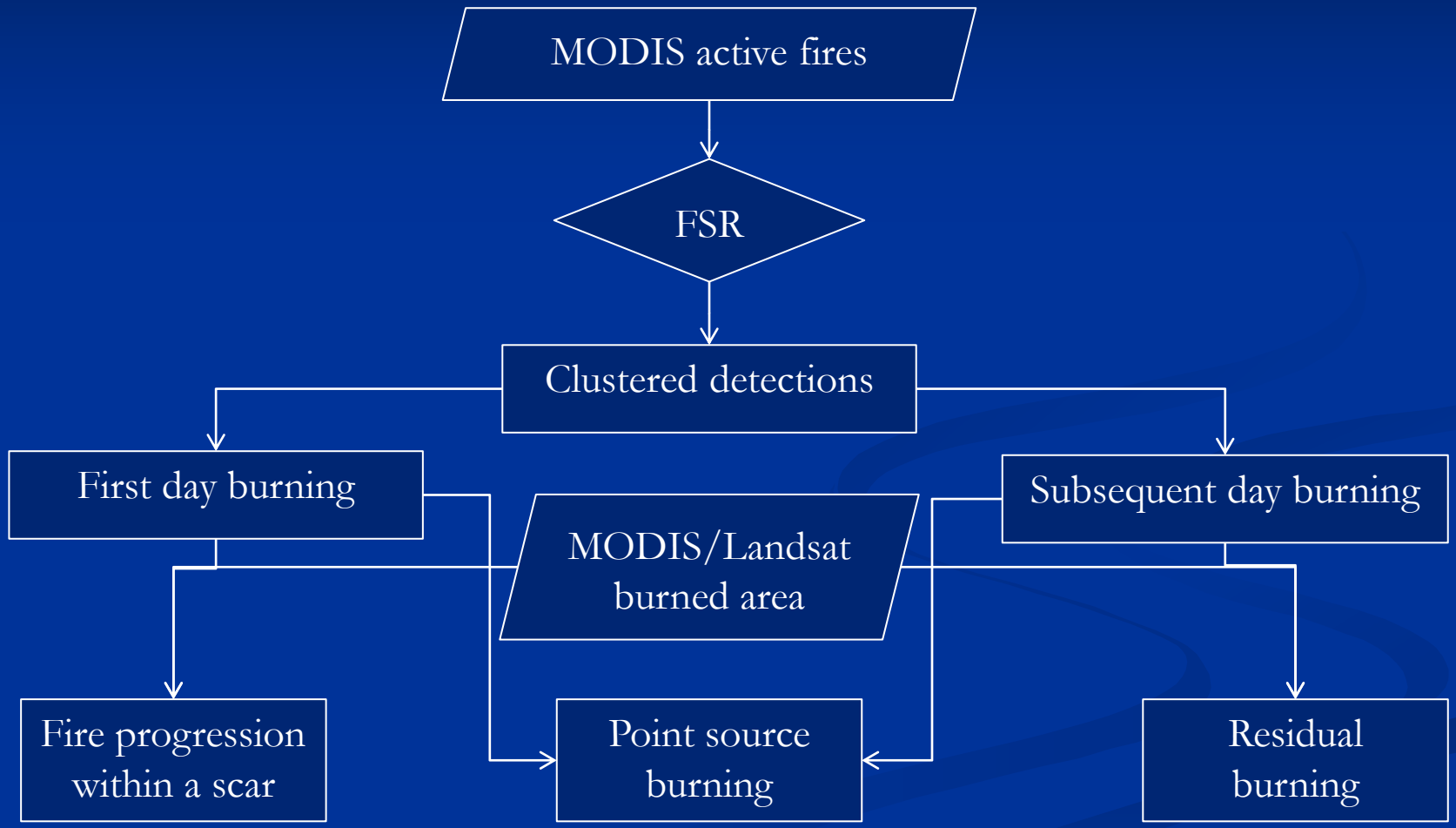


Role of Satellite Fire Data

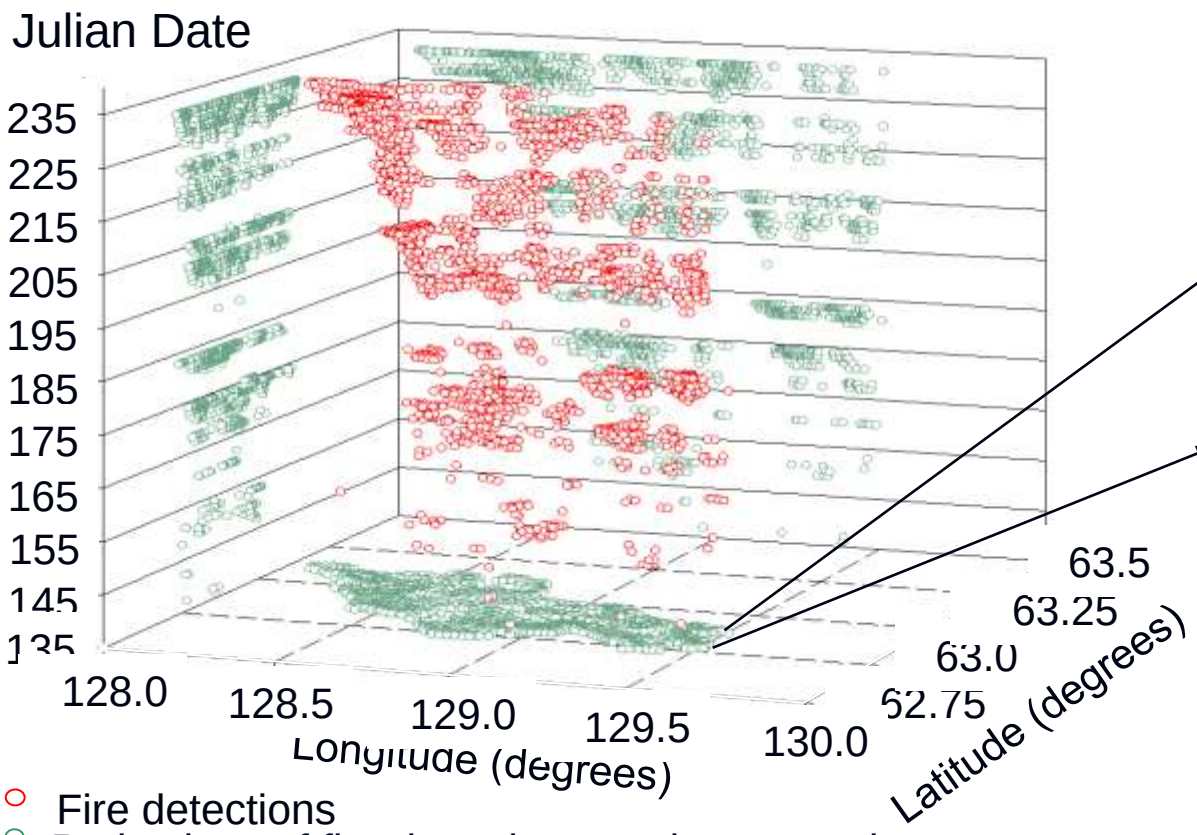
Quantifying wildfire emissions



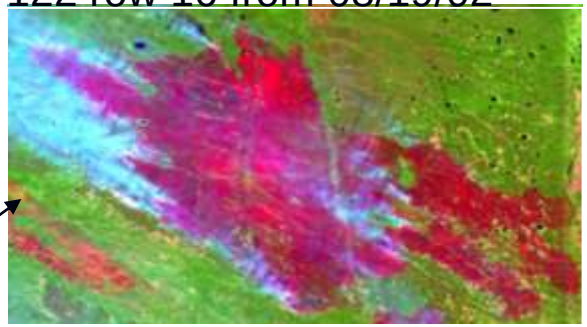
Decomposing fire events using MODIS data products

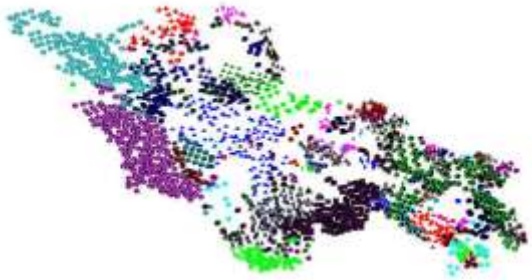


Information from active fires



Landsat ETM+ image path 122 row 16 from 08/19/02

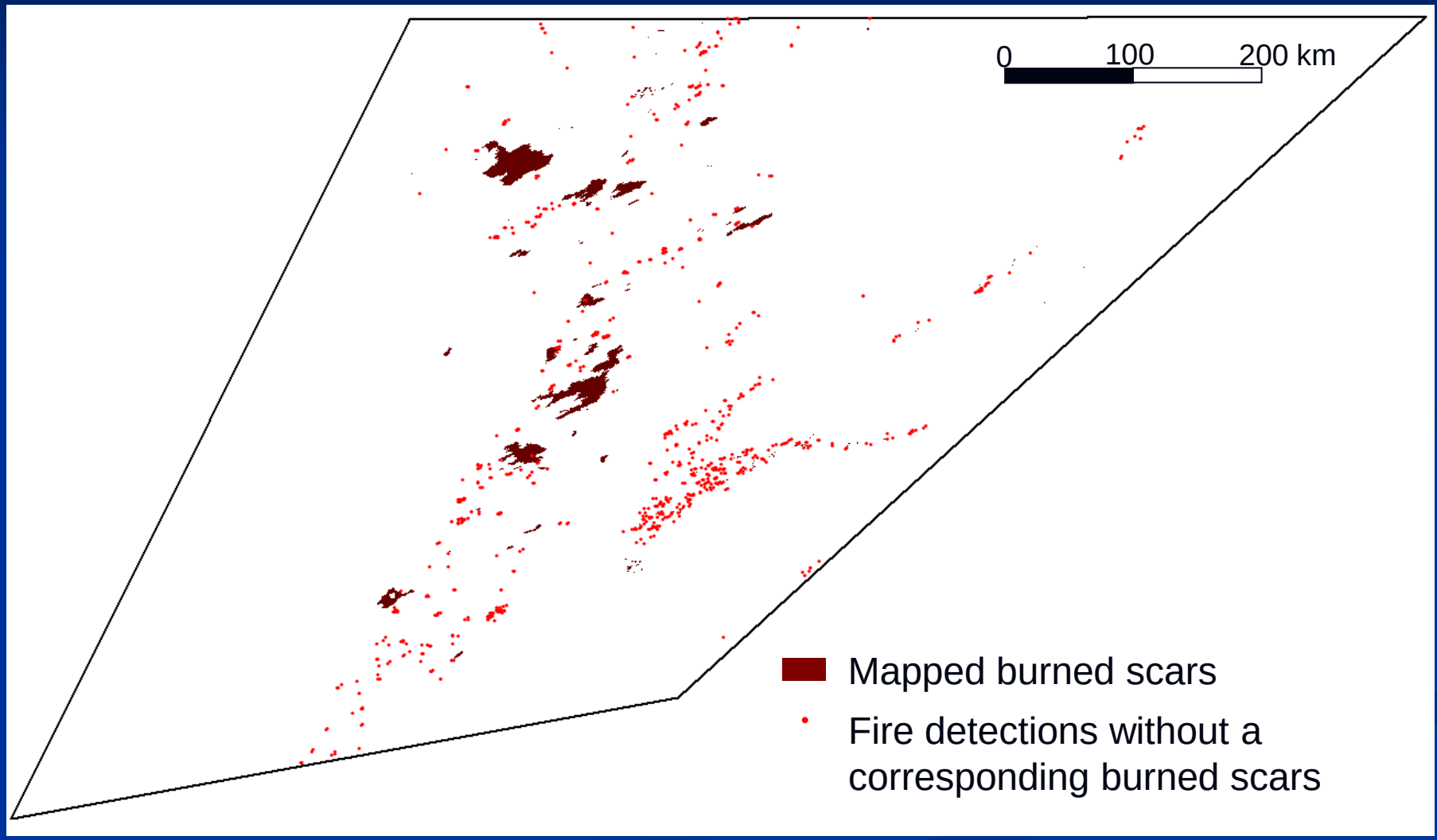




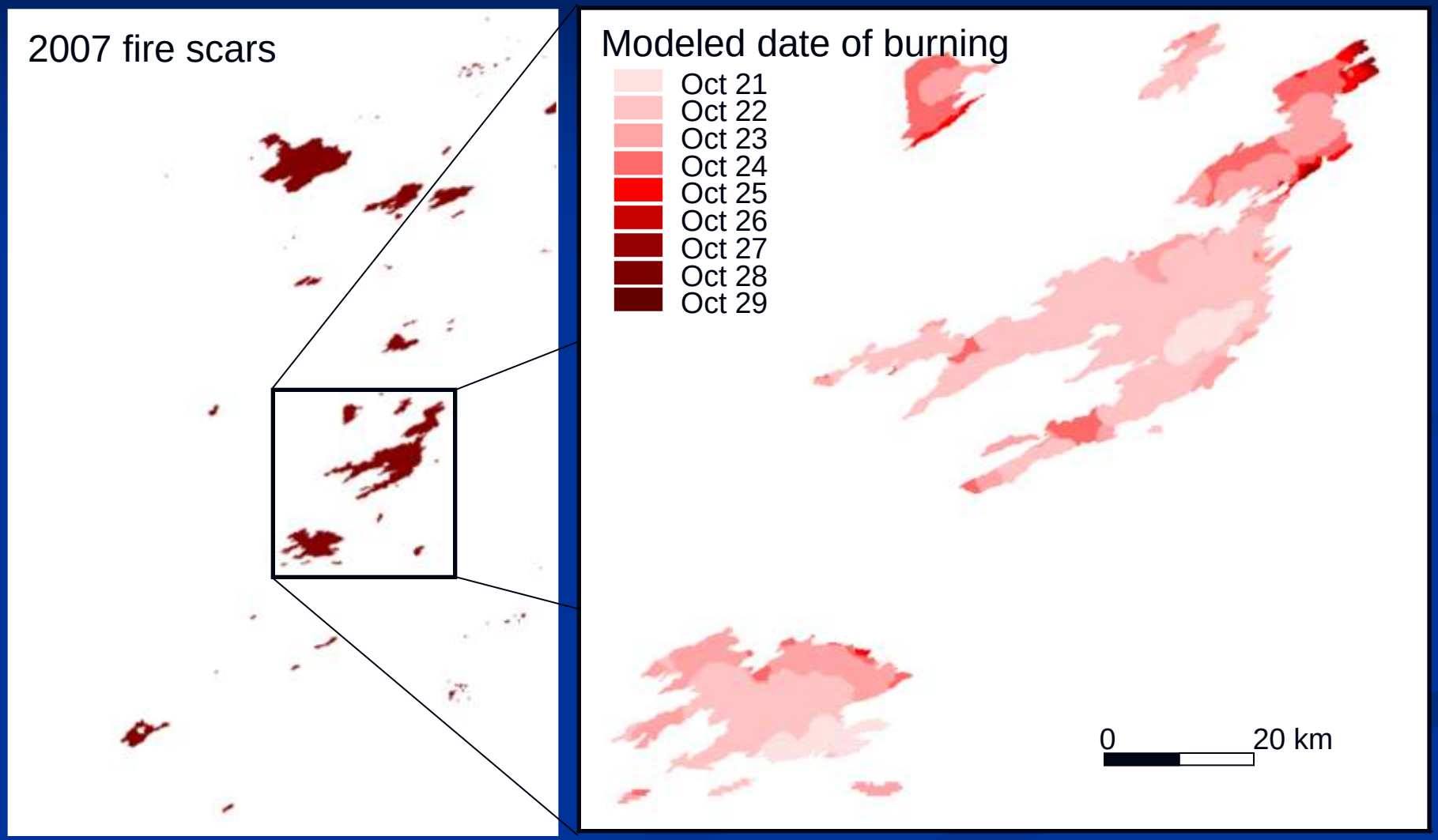
MODIS active fire detections clustered by the FSR algorithm

- Fire detections
- Projections of fire detections on the respective axes

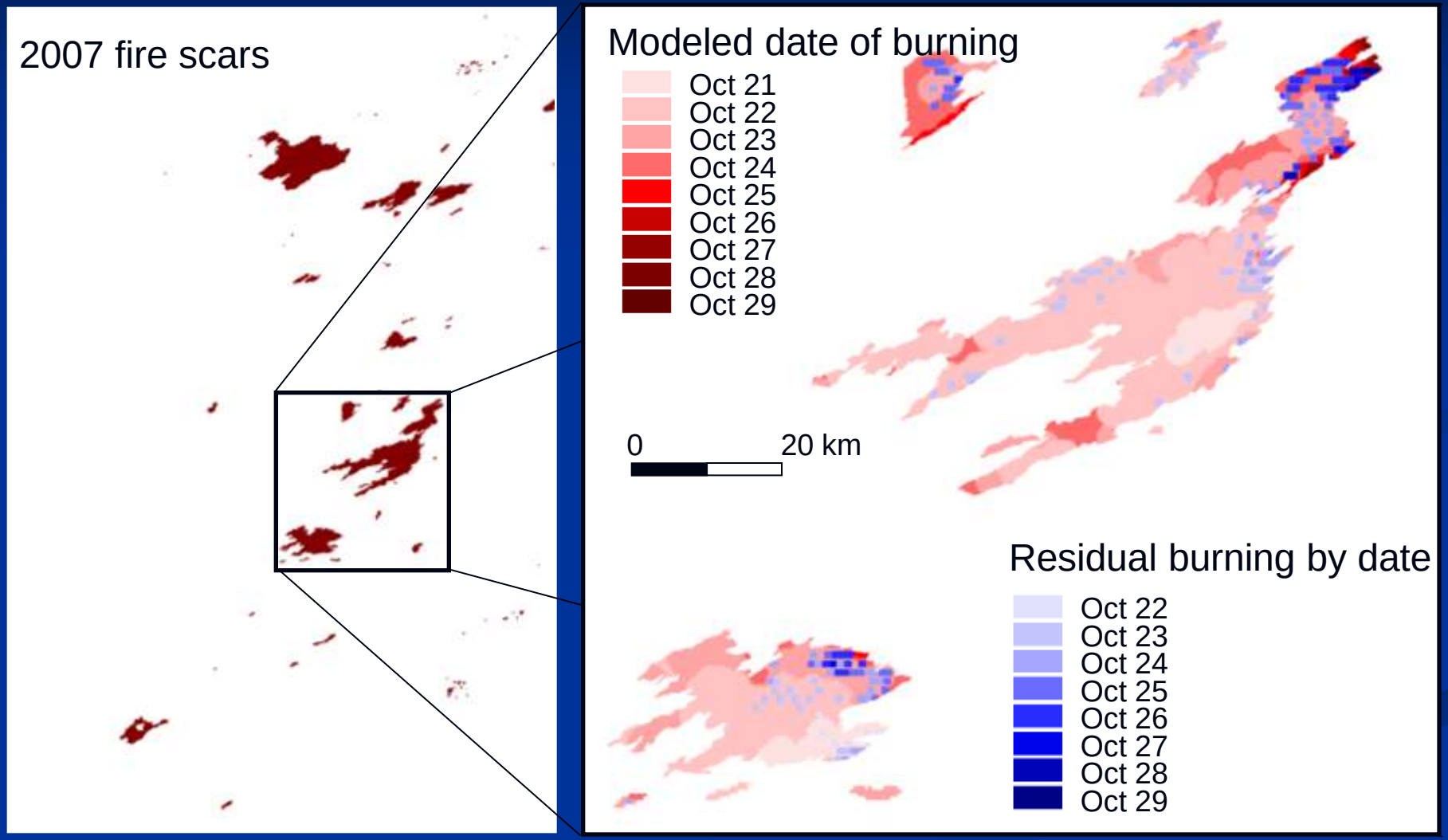
Characterizing burning process: point source burning



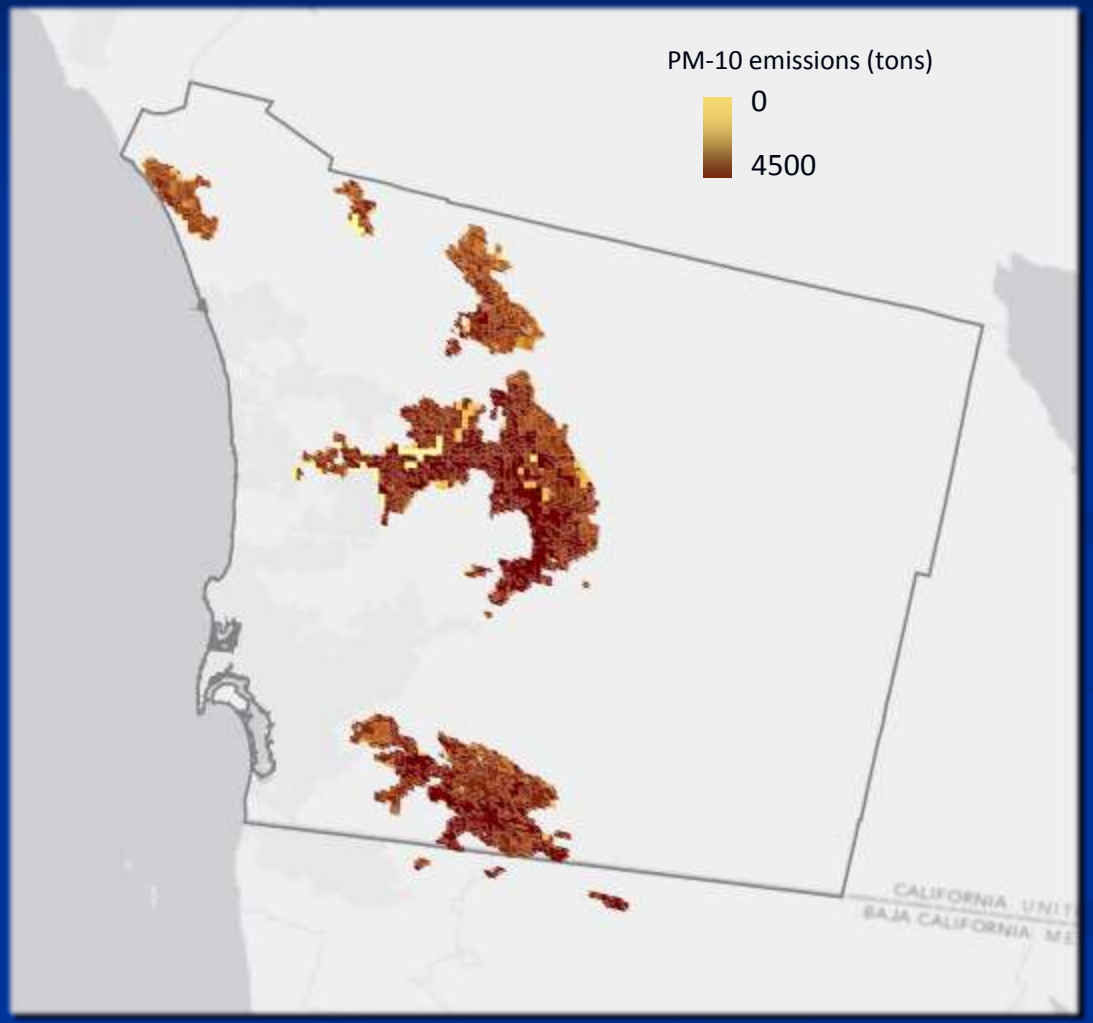
Characterizing burning process: fire progression in scars



Characterizing burning process: residual burning



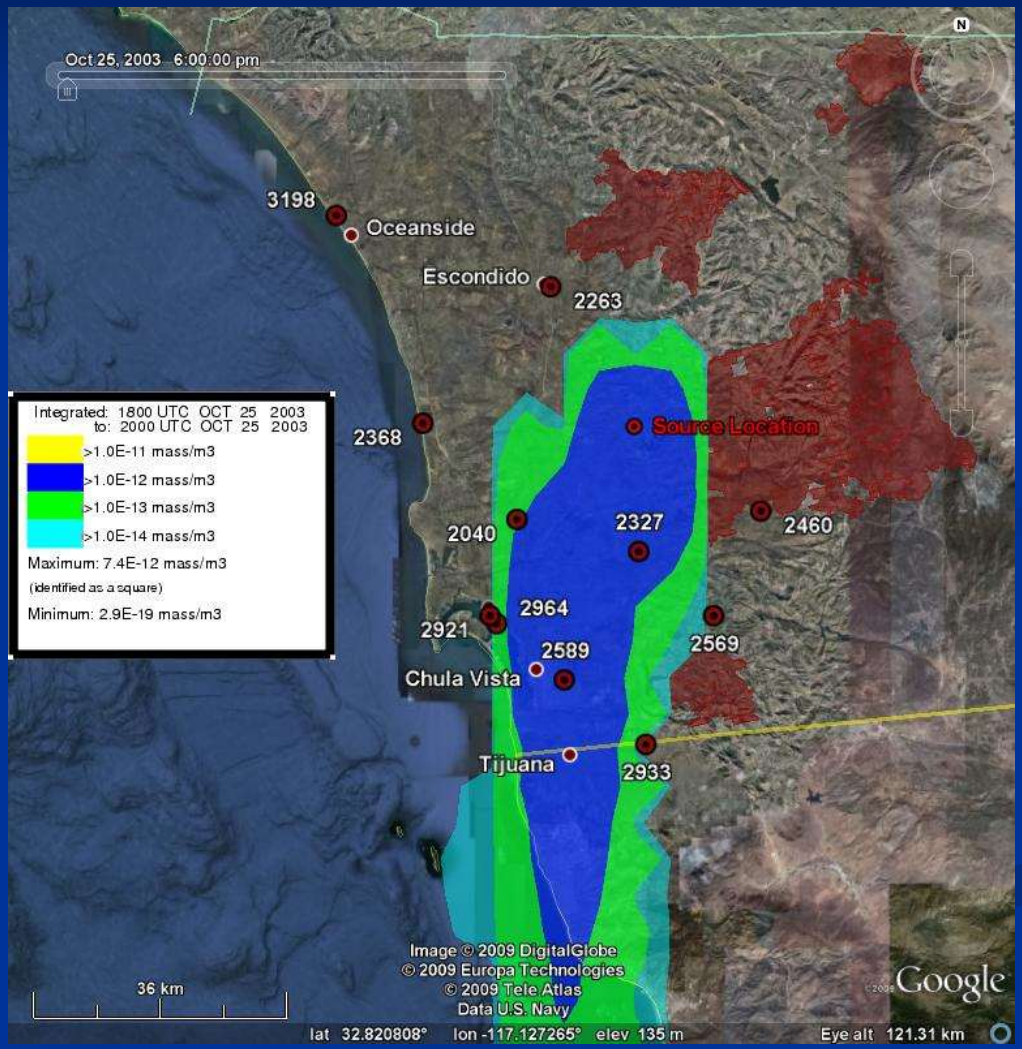
Spatially and temporally explicit emissions estimates (WFEIS)



Sample WFEIS output, showing PM-10 emissions from burn scars from October to November 2007 in San Diego County

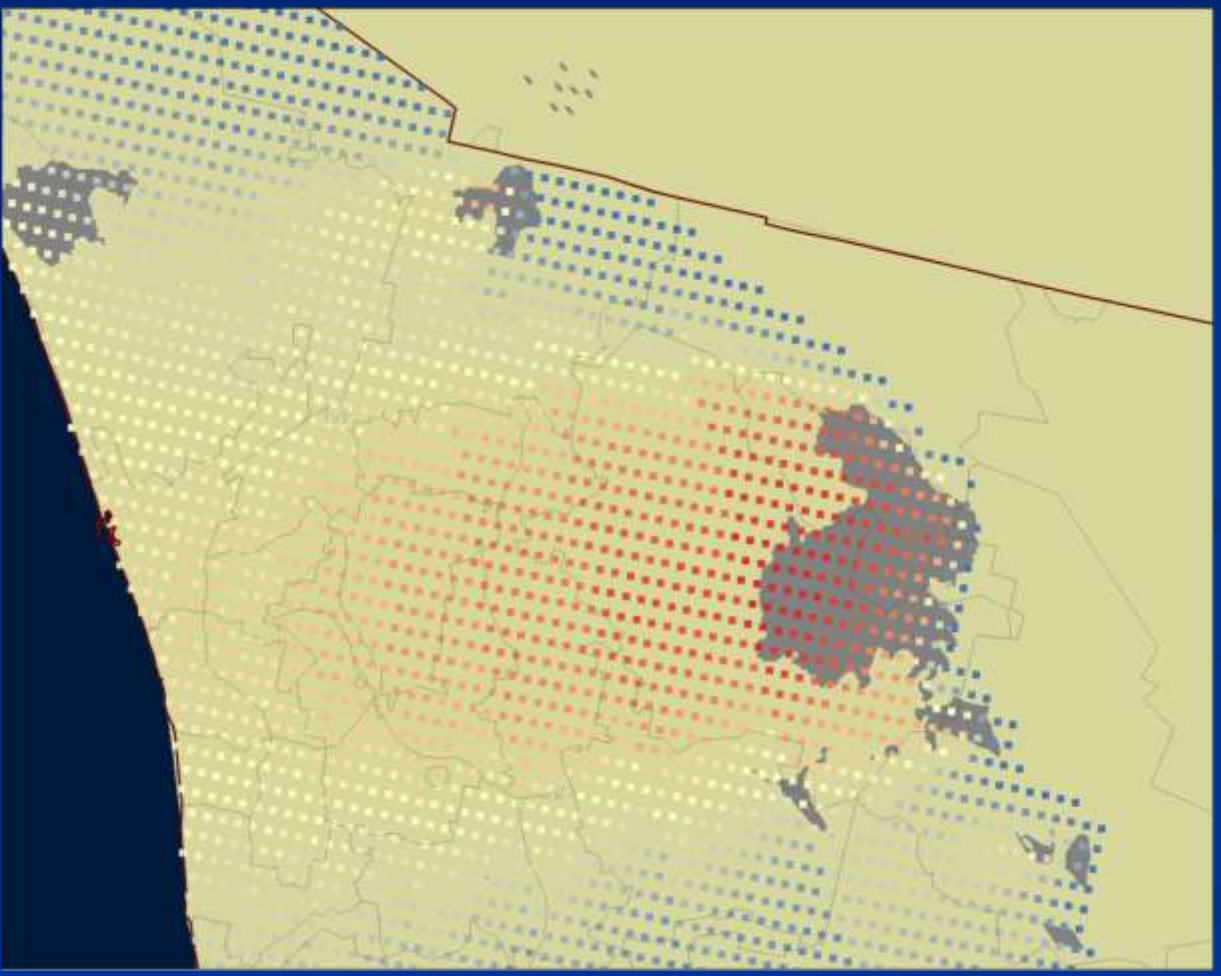
Atmospheric transport & dispersion modeling

- Example particulate concentrations estimated by HYSPLIT



- Red areas are fires in October 2003
- Modeled smoke plume is shown in blues & greens
- Red circles show locations of air quality stations

Modeling PM concentrations

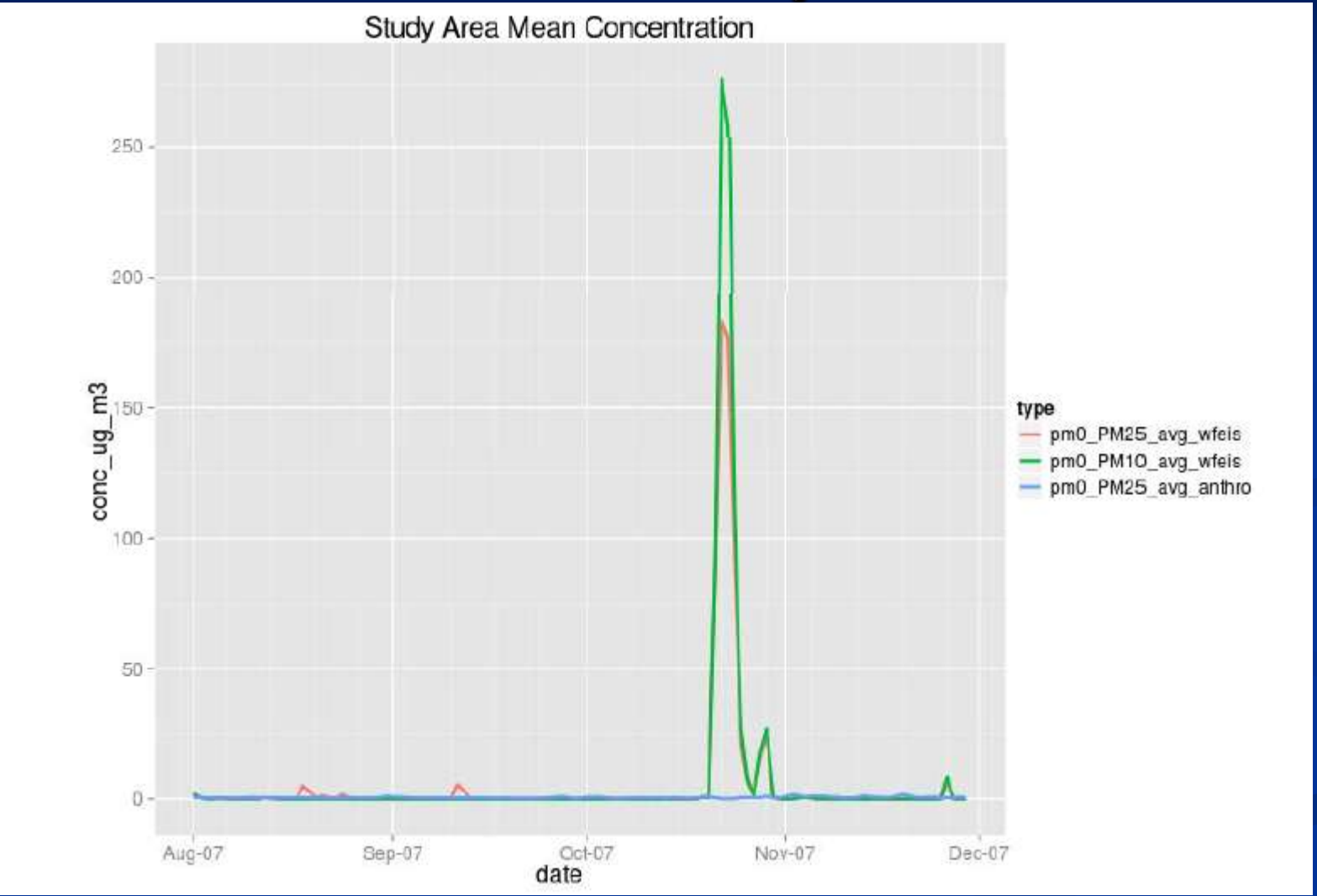


Modeled smoke conc. (µg/m3)

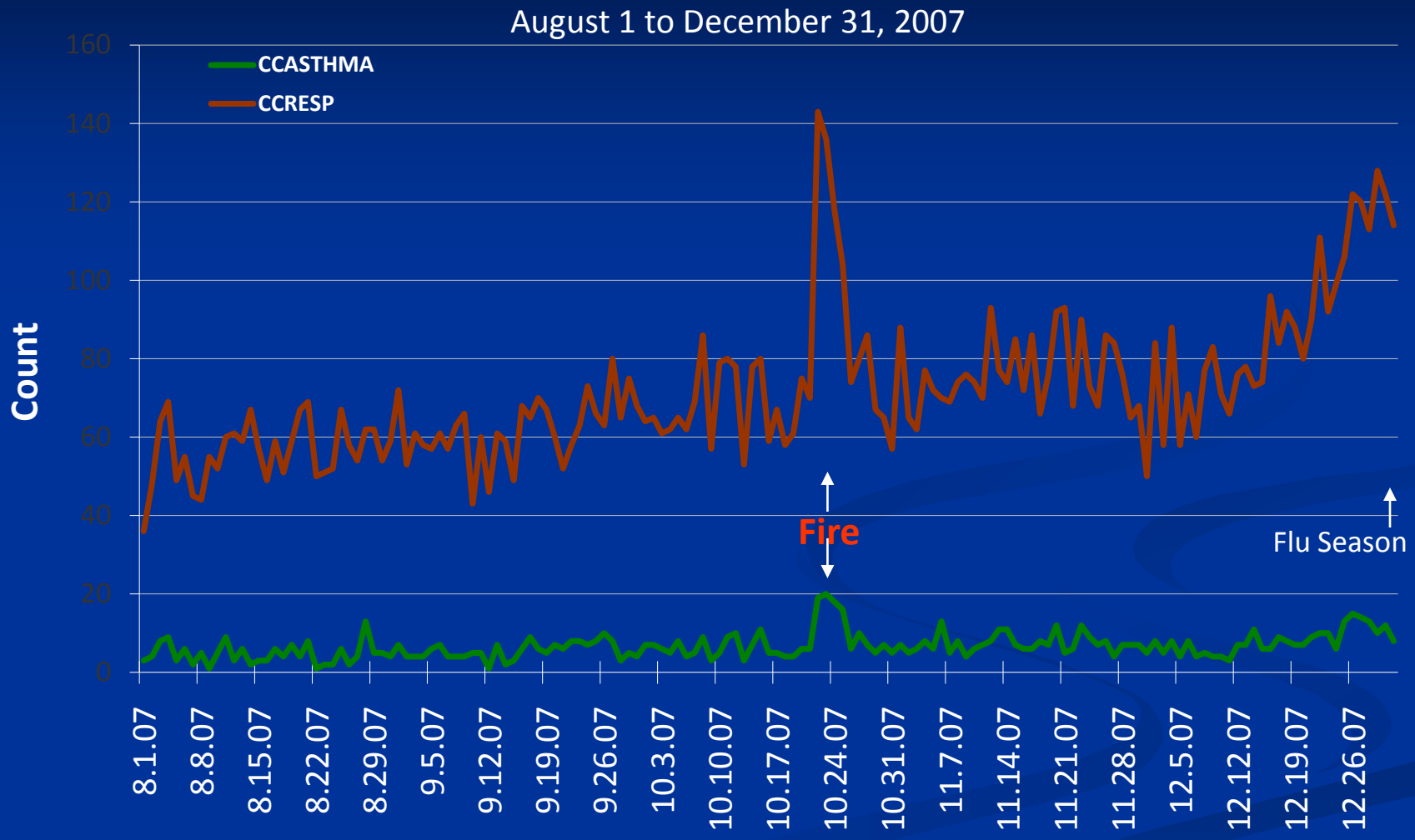
HYSPLIT model was run for 3 days after emission:

- In the dispersion mode
- Traced PM2.5 and PM10 particles
- No deposition allowed

Air Quality Data

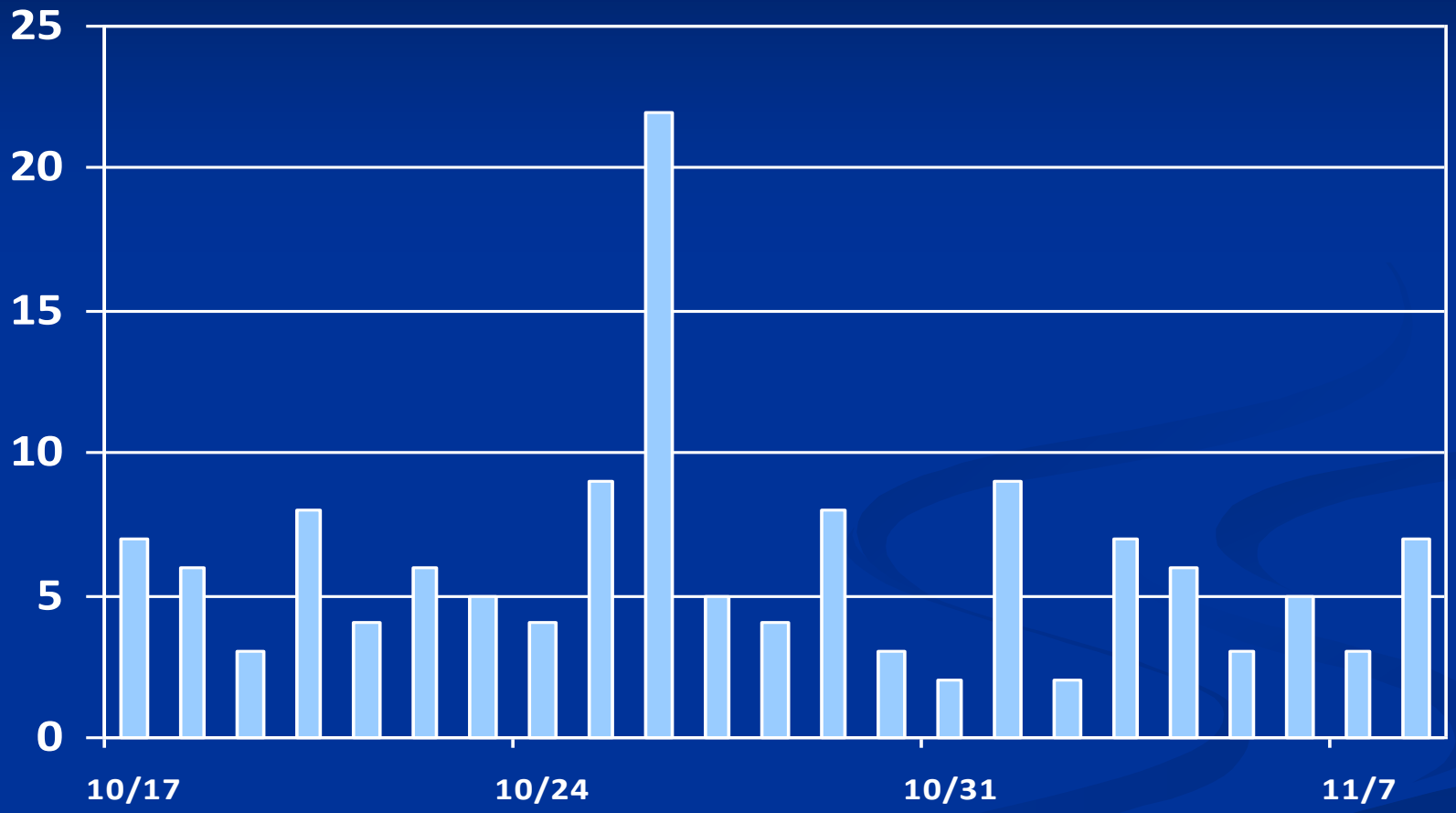


Respiratory Related Encounters at Participating Emergency Departments*

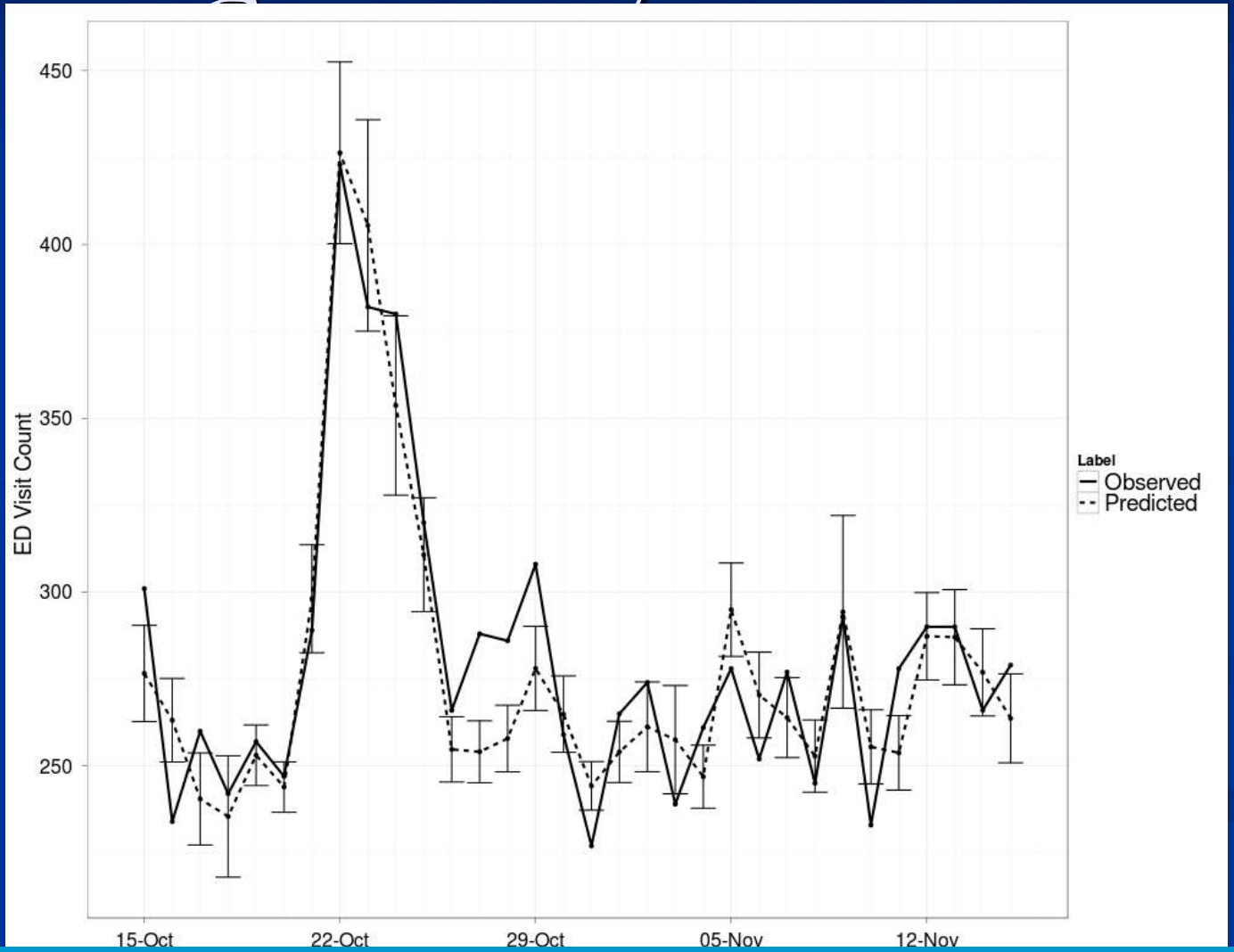


*San Diego Aberration Detection and Incident Characterization (SDADIC)

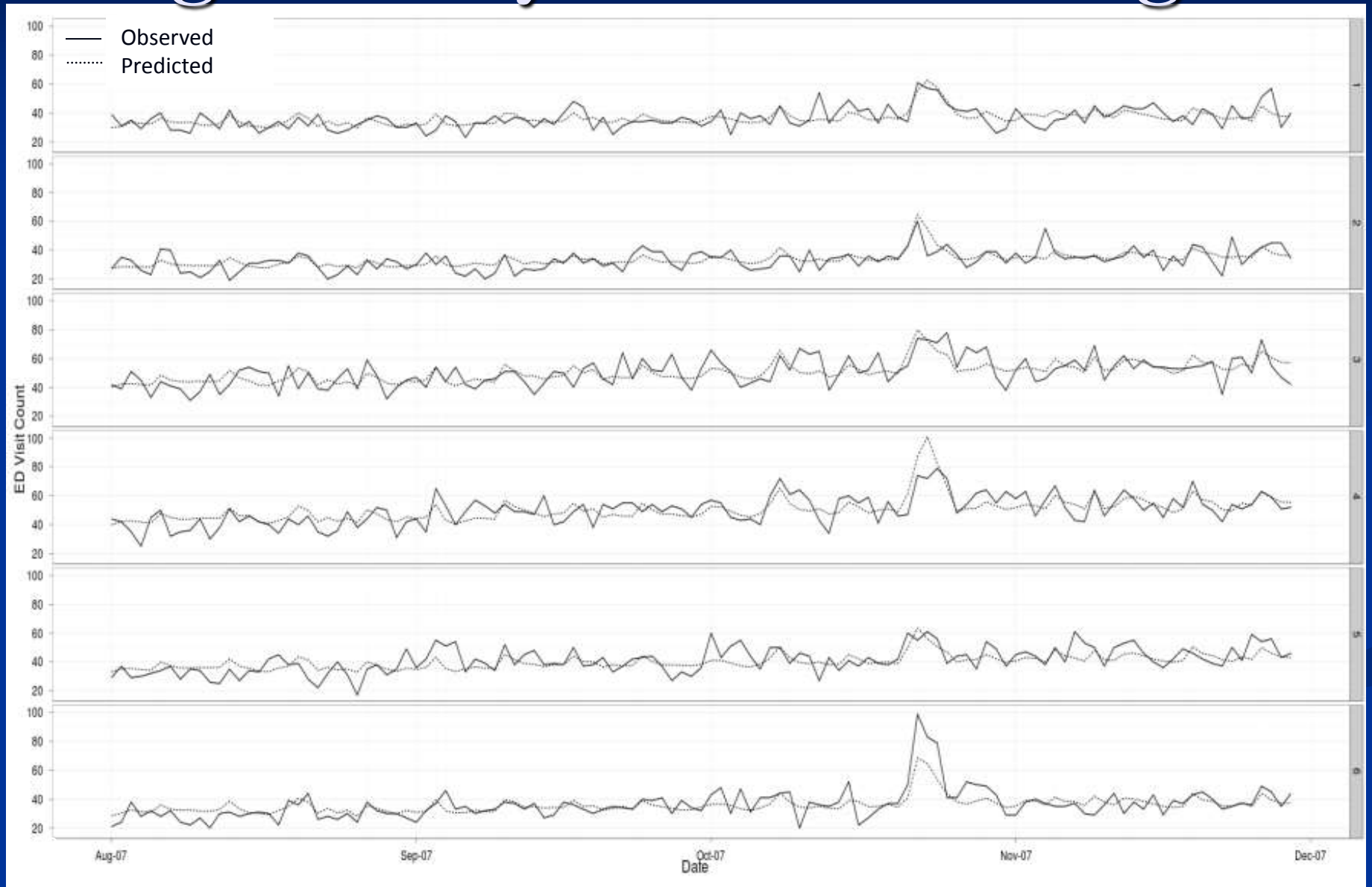
Total Medical Examiner Deaths by Day of Death, 2003 (preliminary data)



Modeling hospital visits in San Diego County for 2007



Modeling hospital visits in San Diego County for 2007: sub regions



Concluding thoughts

- We know:
  - Wildfire releases strong toxins which affect respiratory health
  - Young people (< 24 years) are more sensitive to smoke impacts (in our study)
- New research shows:
  - wildfire impacts cardiovascular health
  - indoor concentrations of wildfire PM is near-equivalent to outdoor concentrations

Concluding thoughts II

- Satellite data provide critical and virtually unavailable from other sources information for tracking fire impacts.
- Studies of environmental impacts on health (present and future) involve multi-disciplinary teams of researchers

Acknowledgements

- NIH grant 1 RC1 ES018612 (2009 – 2011)
- All collaborators and particularly Dr. Nancy French and Benjamin Koziol of the Michigan Technological Research Institute.