# Modeling Particulate Matter Plumes from 2007 California Wildland Fires Using a Coupled Emissions-Transport System

Benjamin W. Koziol[1], R. Chris Owen[1], Michael G. Billmire[1], Tyler A. Erickson[1], Nancy H. F. French[1], Tatiana V. Loboda[2]

[1]Michigan Tech Reseach Institute, Ann Arbor, MI, [2]University of Maryland-College Park

**Poster Contact:**
Benjamin W. Koziol
bkoziol@mtu.edu

## Summary

Transport of particulate matter (PM) emissions from 2007 wildland fires in San Diego County were modeled using the HYbrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT model). Fire PM sources (2.5 and 10) were estimated using a statistical, empirically-based fuel consumption and emission model (CONSUME) parameterized using weather data and fuel loadings from the Fuel Characteristics Classification System (FCCS). PM concentrations estimates from this coupled transport system will be used in a larger project assessing acute respiratory health impacts of fire-emitted pollutants in San Diego County.

## Study Area
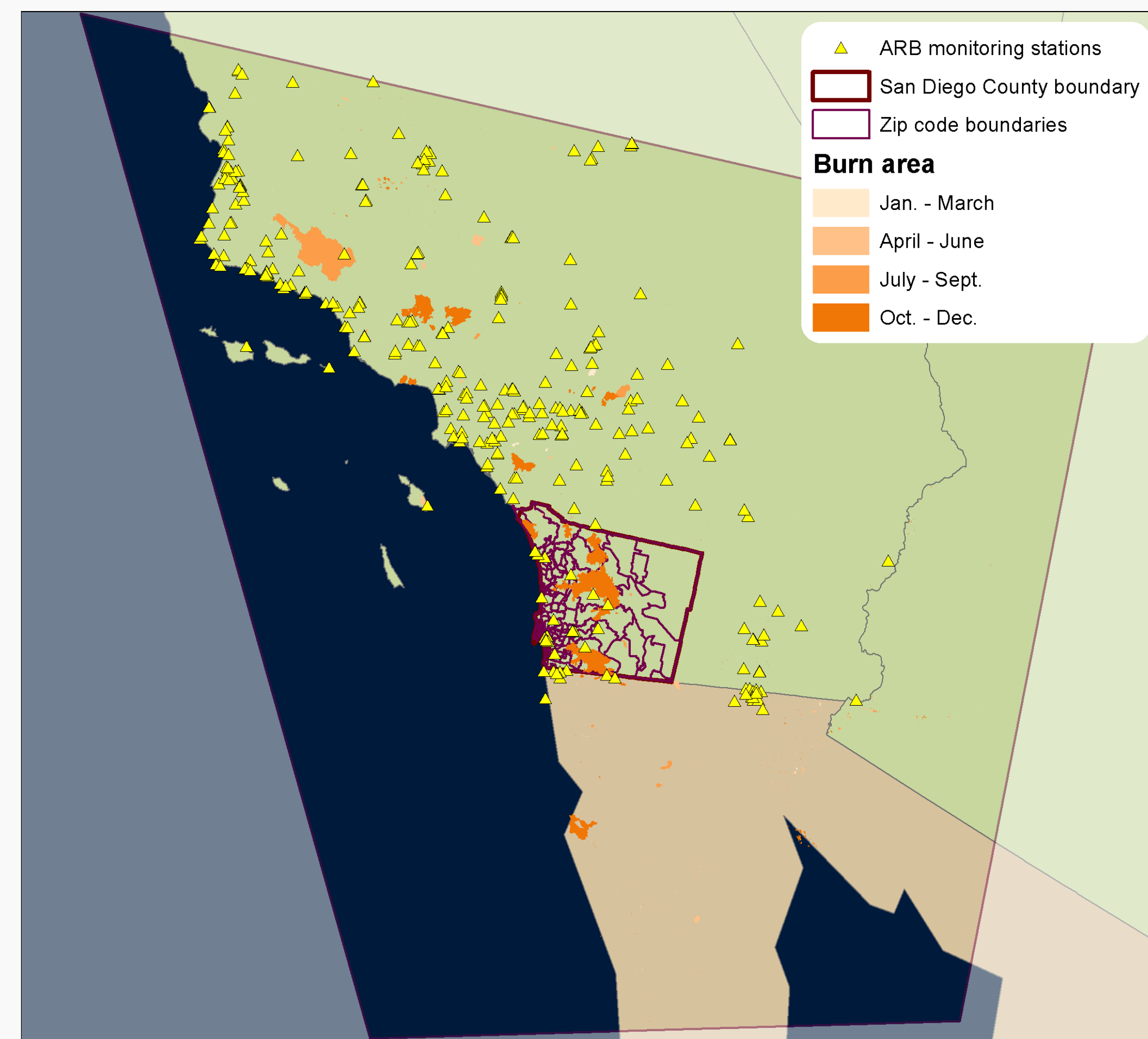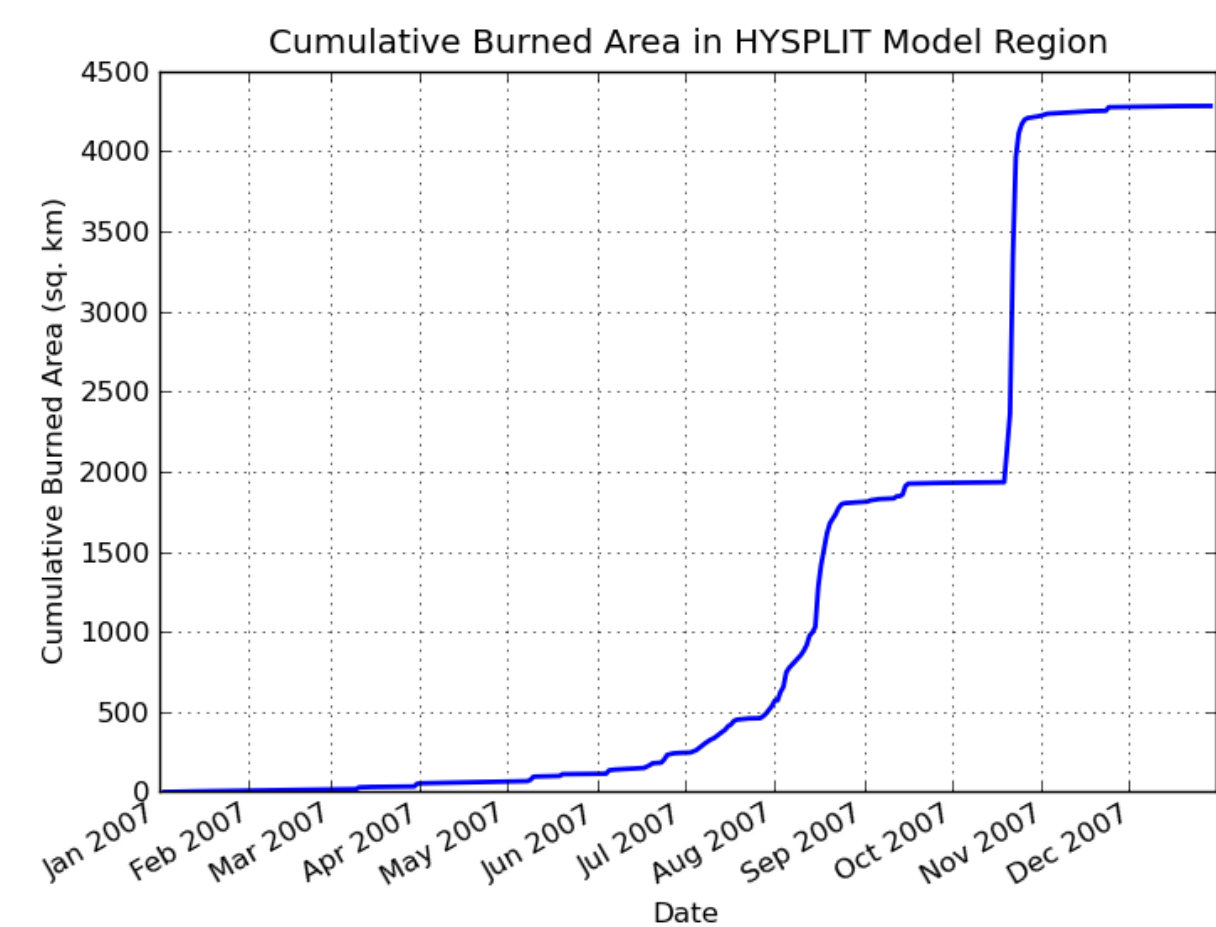


The project study area covers San Diego County, CA. Peak burning in this region occurred in the latter half of October during a period of excessively dry, windy conditions. The shaded polygon represents the HYSPLIT modeling boundaries.

## Spatial Datasets
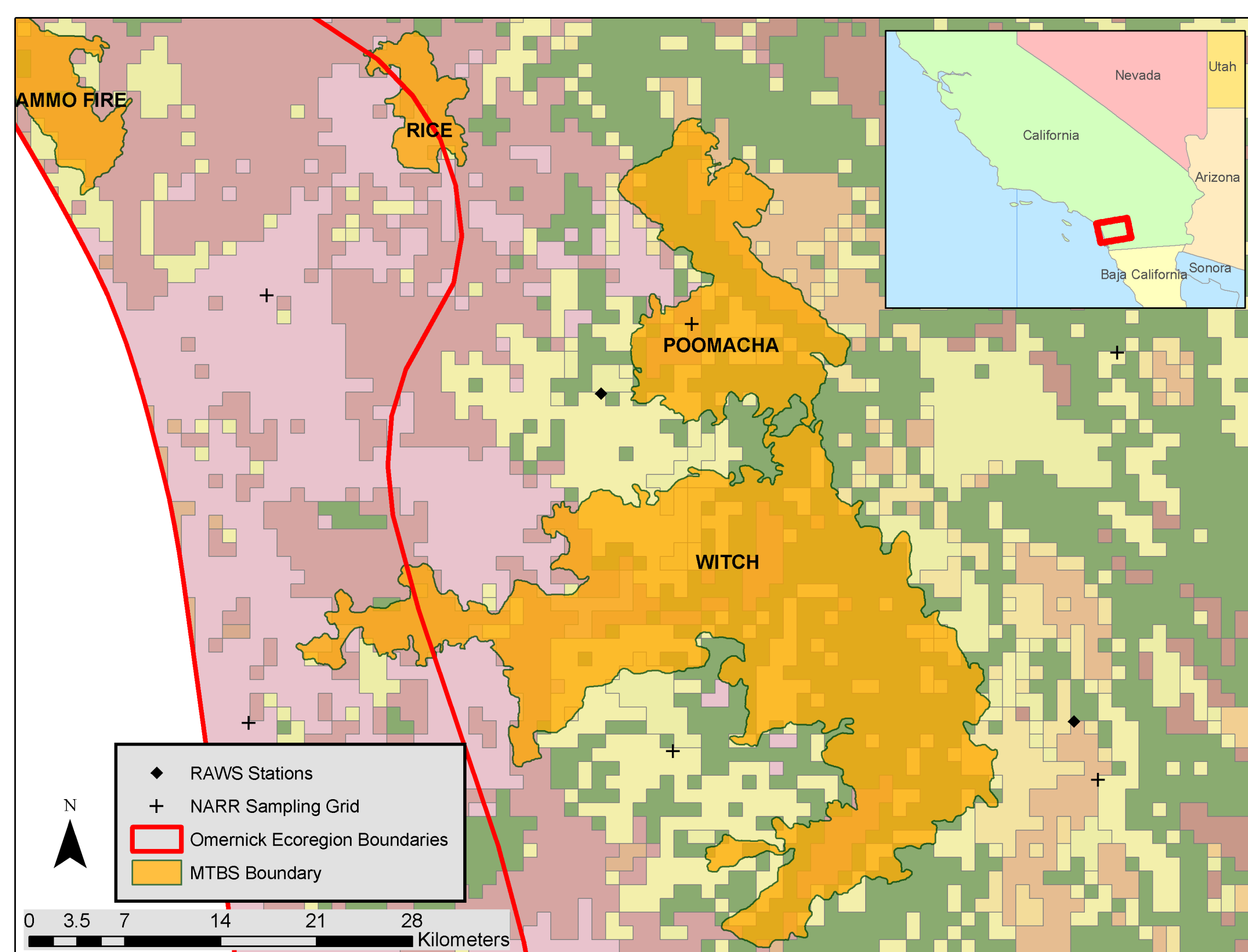


This graphic (left) depicts the configuration of various spatial datasets used in the emissions calculation. The CONSUME model (FERA 2010) is an empirically-derived statistical model of fuel consumption and emission speciation. The grid-like vector layer underlying the image to the left is a CONSUME input describing fuel loadings. CONSUME requires, as inputs, FCCS (Fuel Characteristics Classification System) (FERA 2010) fuel beds, fuel moisture, and select fire behavior parameters. Vectorized temporal burn perimeters were derived from geostatistical interpolation of fire progression remote sensing images and local physiographic indicators (not shown).

The NARR (North America Regional Reanalysis) and RAWS (Remote Automated Weather Station) points show locations of moisture samples. Using block kriging interpolation, these samples were aggregated at the ecoregion level.

## Emission Mass Sensitivity

Table displays PM emission quantities under different spatial data combinations and model parameters. "Shrub Blackened Percent" is a CONSUME parameter describing the amount of shrub-like fuel consumed in a fire. Chaparral dominates the fuel profile in our study region making this parameter influential on emission mass predictions. Results shown here use a SBP level of 70.

| PM Diameter | Shrub Blck Pct | FCCS 1km (kt) | FCCS 30m (kt) |
|---|---|---|---|
| 2.5 | 50 | 61.88 | 58.59 |
| | 70 | 70.77 | 66.08 |
| | 90 | 75.71 | 70.24 |
| 10 | 50 | 73.40 | 69.18 |
| | 70 | 84.19 | 78.34 |
| | 90 | 90.17 | 83.44 |

## HYSPLIT Modeling



The transport and dispersion of fire PM was modeled using the dispersion mode of the HYSPLIT trajectory model. In these simulations, PM was assumed to be a purely passive tracer, without any reaction or deposition parameters applied during the simulation. PM was modeled for three days after emission. Simulations were driven with meteorological data from the NAM (Eta) Data Assimilation System (EDAS) with a 40km horizontal resolution, 26 vertical levels and output every 3 hours. Particle-only and hybrid puff-particle simulations were tested to optimize model performance (based off comparisons with surface measurements) and computational resources. Unless otherwise noted, the results presented here are from a Gaussian-horizontal and Top-Hat vertical puff simulation (initd=1).
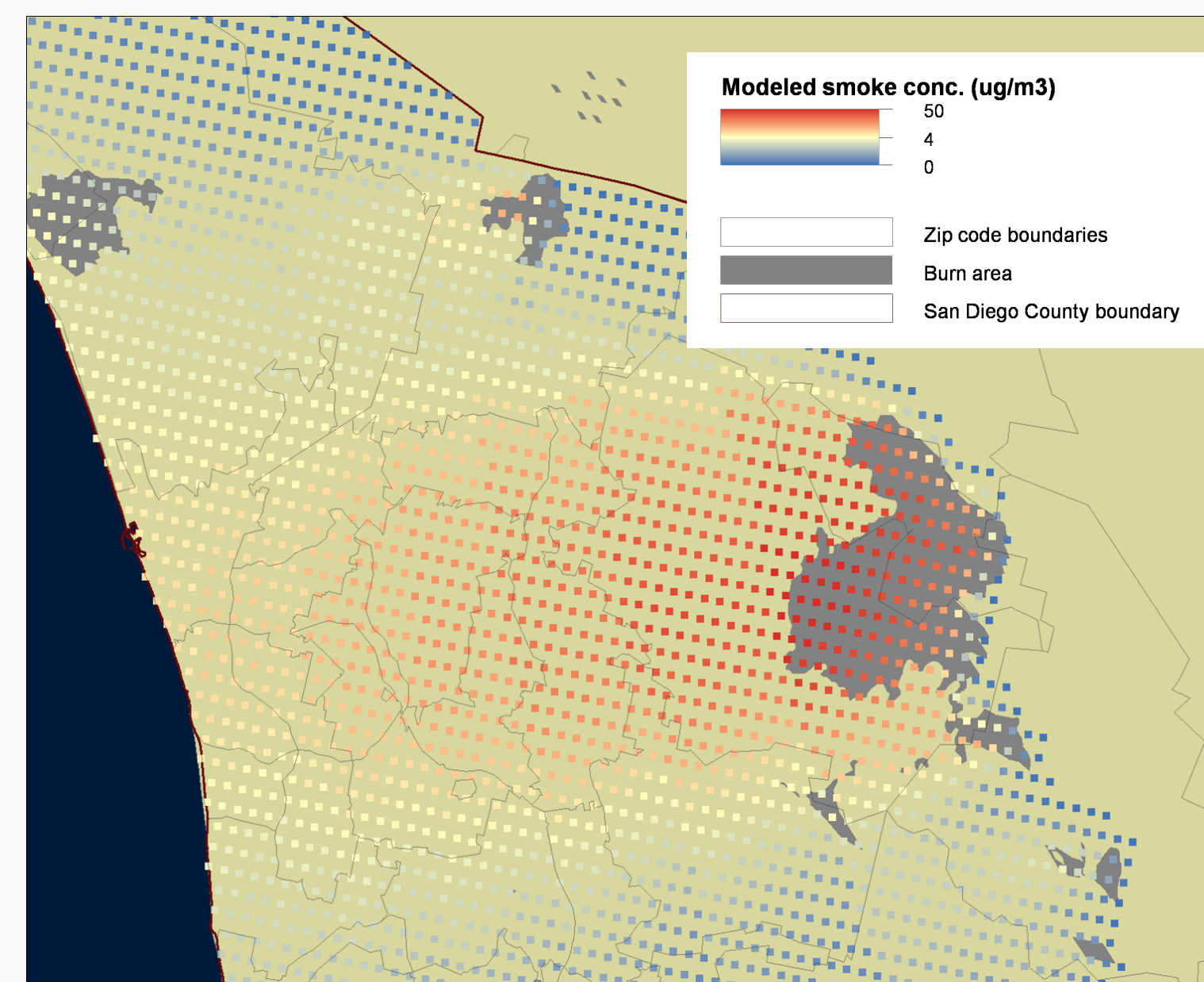
## 2007 Emissions Summary
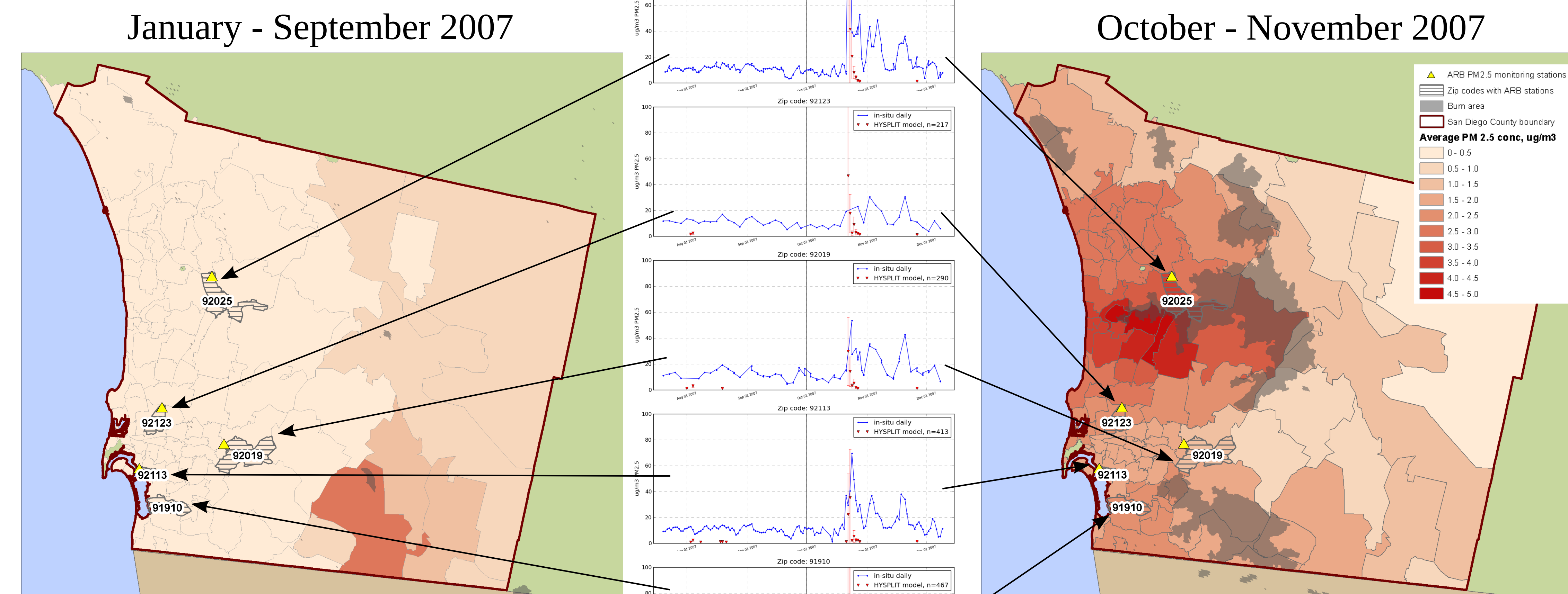


Average PM 2.5 concentrations are reported by zipcode (the summary unit for health data) during low and high fire periods in San Diego County. Line plots compare measurements at ARB monitoring stations with modeled concentrations.

Sources & Relevant Citations
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