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Introduction

Air Quality forecasting systems are important for predicting pollutants regulated by National Ambient Air Quality Standards (NAAQS). NAAQS pollutants, include CO, NO₂, PM_{2.5}, PM₁₀, O₃, and SO₂, are considered deleterious to public health and air quality. When a wildfire occurs, plume rise models are needed in the air quality forecast systems to predict the surface concentrations of these pollutants. Inaccuracies in the plume rise model lead to forecasting errors.

Modeled plume heights are based on Briggs Plume Rise equations, which were originally created in the 1960's, to predict plume rise and dispersion for tall industrial smoke stacks. Errors arise because wildfires have very different characteristics.

Objective

The objective of this project is to find causes for error in the Western Regional Air Partnership (WRAP) and Fire Emission Production Simulator (FEPS) plume rise models, by comparing observed and modeled plume heights, and investigating the relationships between model error and various geographical features.

Geographical Features:

- Slope •Elevation •Aspect •Vegetation •Canopy

Method

- Obtained wildfire plume height data from both WRAP and FEPS models from 2005 to 2007.
- Obtained the wildfire elevations with Google Earth .
- Matched WRAP & FEPS wildfire data to MISR wildfire data, based on date and location.
- Checked matches using ArcMap software

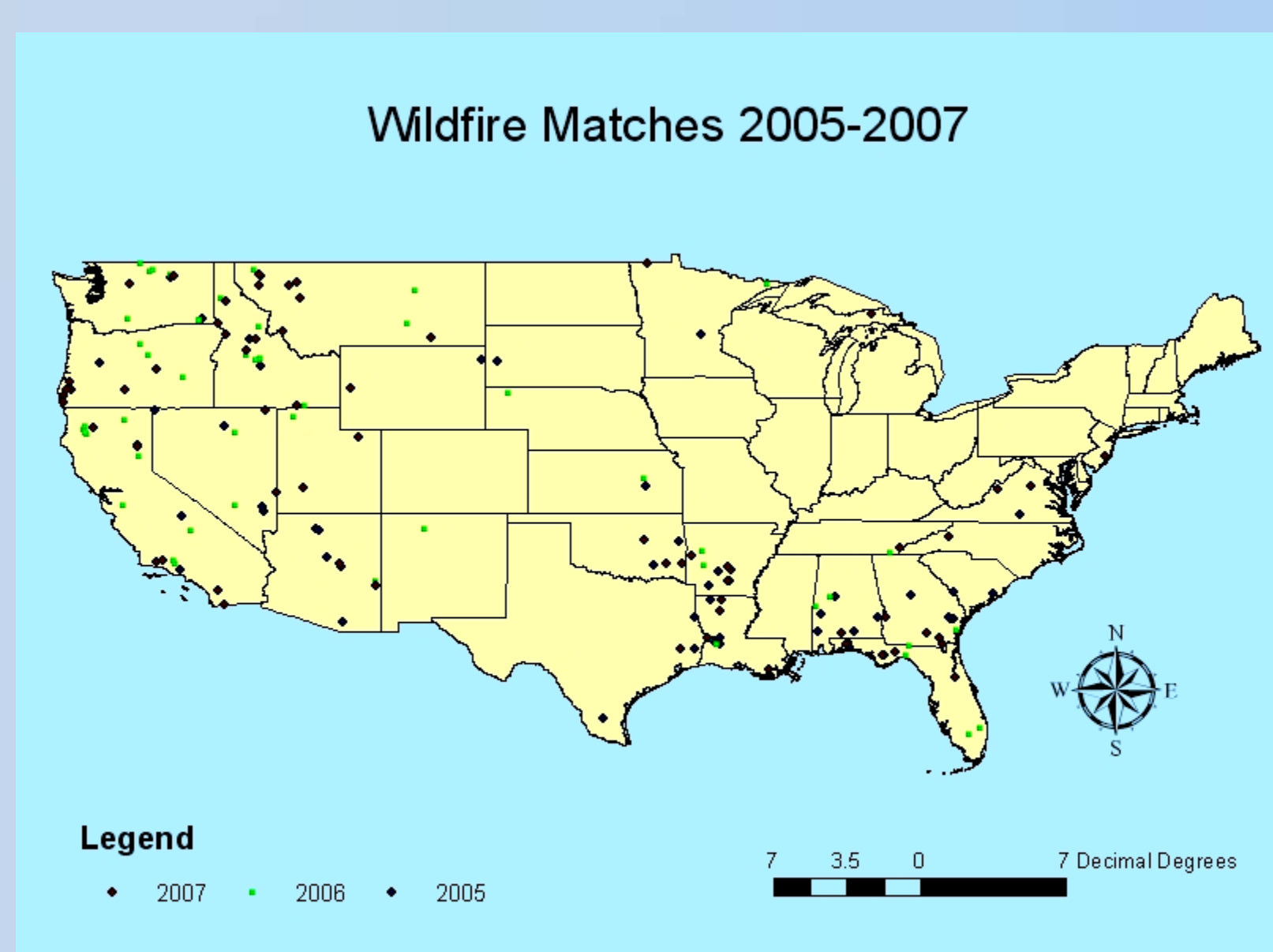


Figure 1: A map of the 163 wildfire matches' locations

- In ArcMap, used USGS Landfire data to assign geographic features to WRAP & FEPS matches.
 - Landfire data provided on 30 meter grid
 - MISR data: 275 meter grid
- Graphed error in plume rise vs. each geographical feature.
- Error in plume rise was shown using: Modeled-MISR plume heights, Modeled/MISR plume heights, & Modeled and Miser plume heights shown together.

Results

The Landfire data is provide in 30m by 30m grid. The MISR data is provided in a larger 275m by 275m grid. When a MISR fire is located it can be anywhere in the grid 275m by 275m, meaning there could be multiple geographical values for that fire. If these values vary greatly they can add to error in our analysis.



Figure 2: A 300m by approximate 300m rectangle showing Landfire slope data.

Past research showed that there may be a correlation between slope and plume height error.² However when more points were analyzed the linear correlation showed very low R² values. These results were also true for aspect.

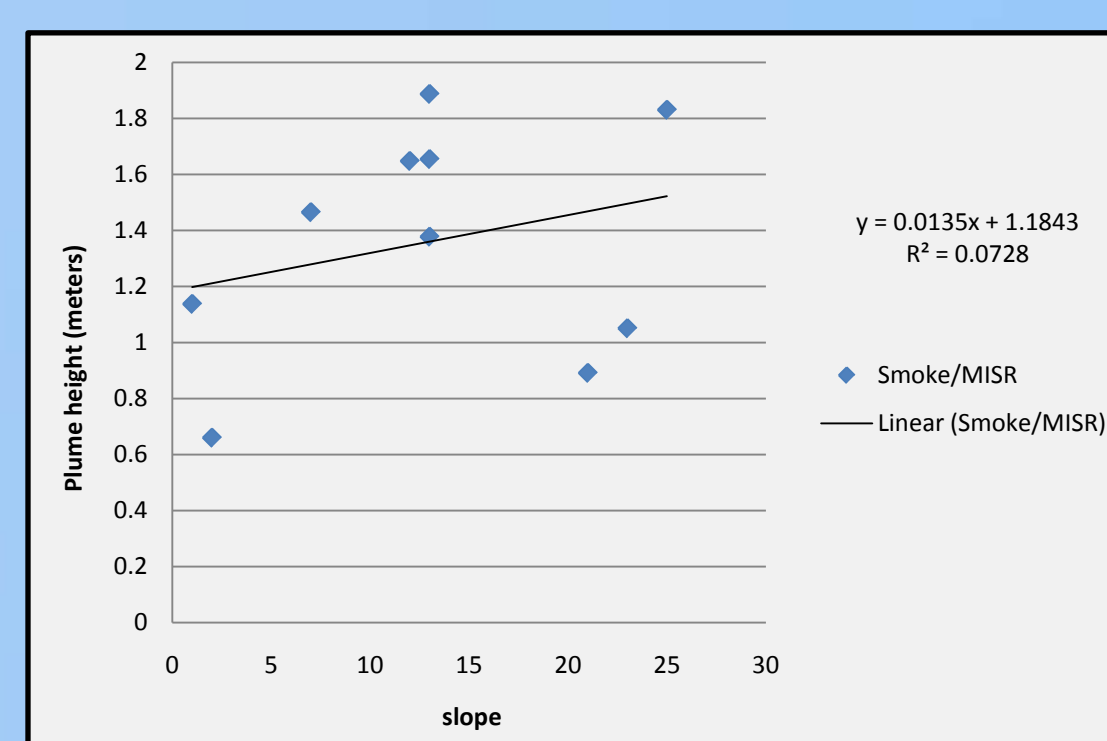


Chart 1: Past research data showing Smoke/MISR plume height vs. slope

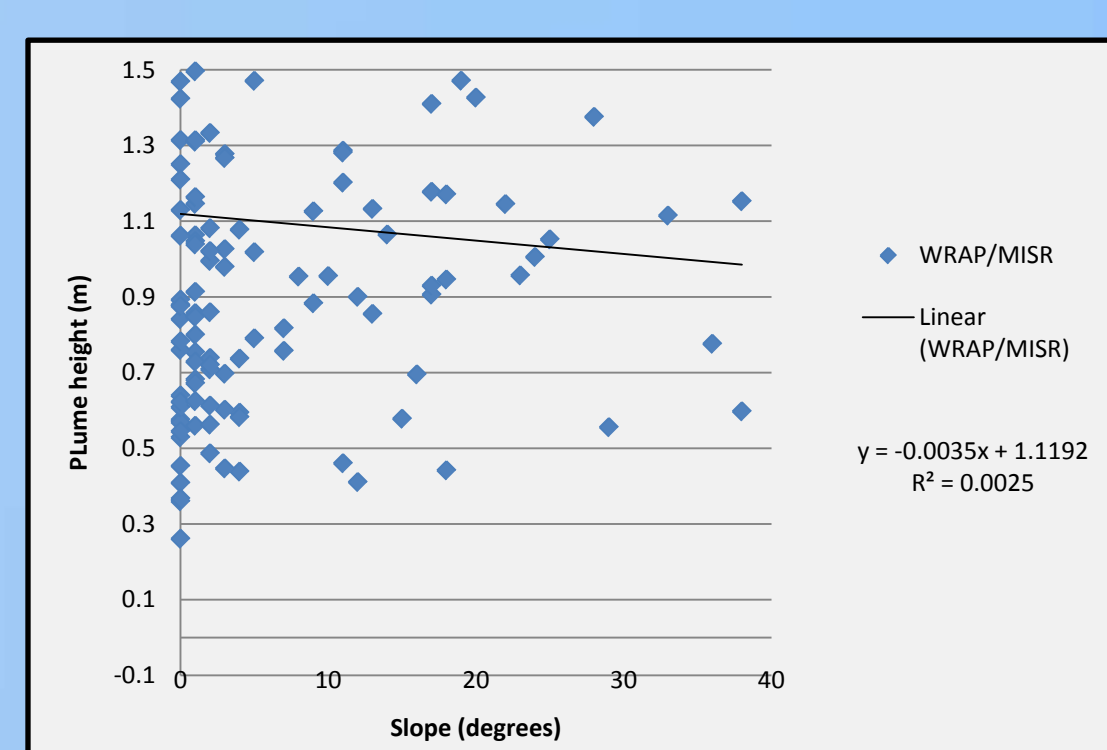


Chart 2: WRAP/ MISR plume height changes graphed against slope

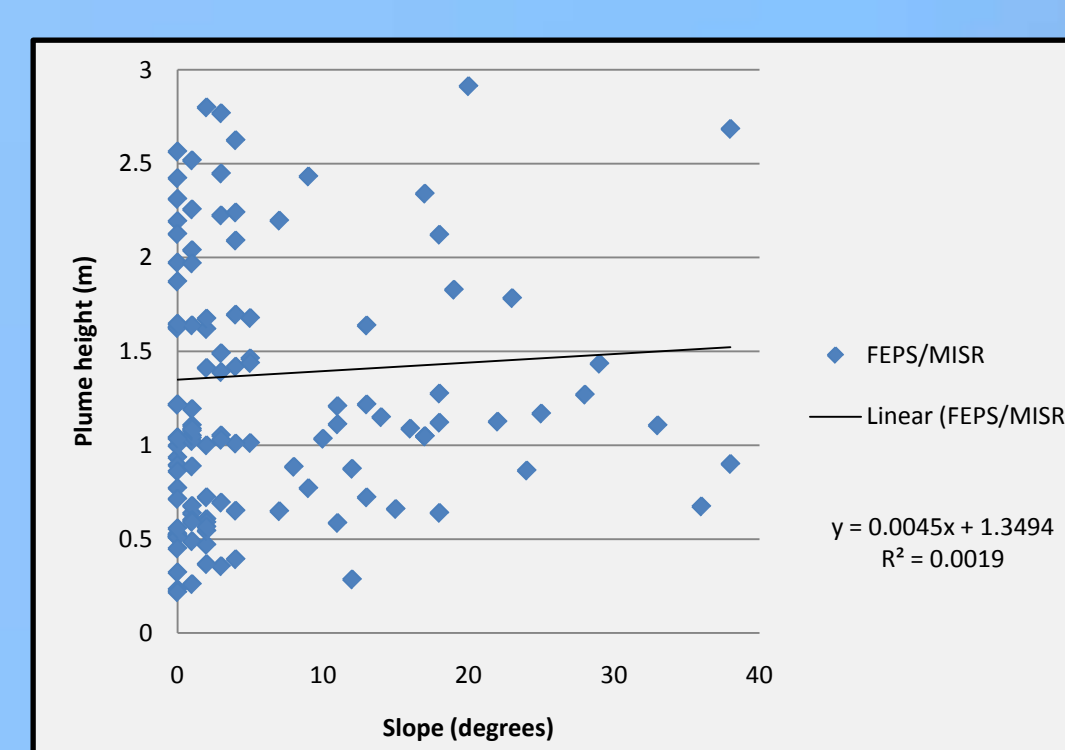


Chart 3: FEPS/ MISR plume height changes graphed against slope

In both the WRAP & FEPS models elevation is assumed to be equal to 0. To correct for this elevation was added to the plume heights. Our data showed that error in plume height did increase with increase elevation.

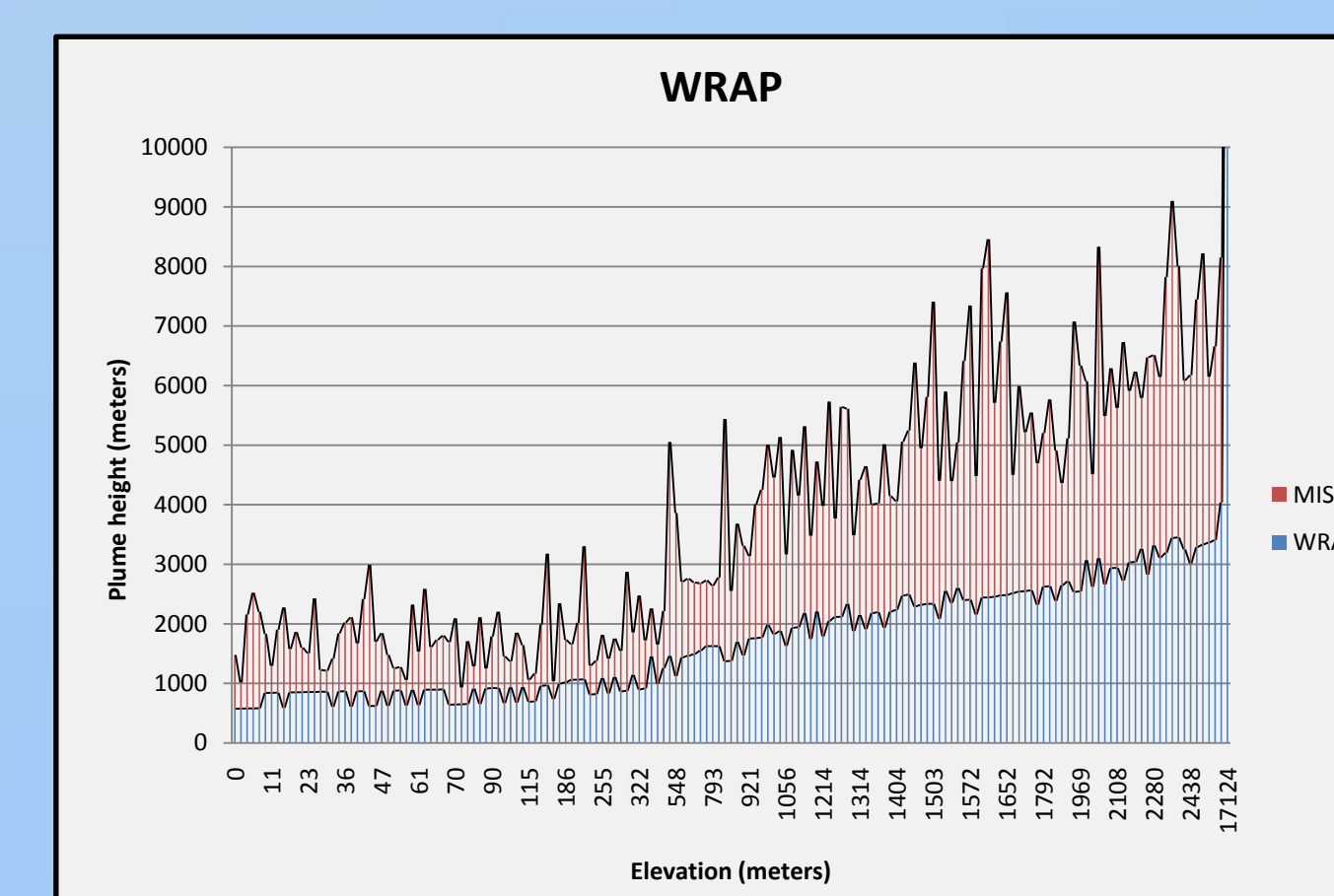


Chart 4: MISR & WRAP plume height vs. Elevation

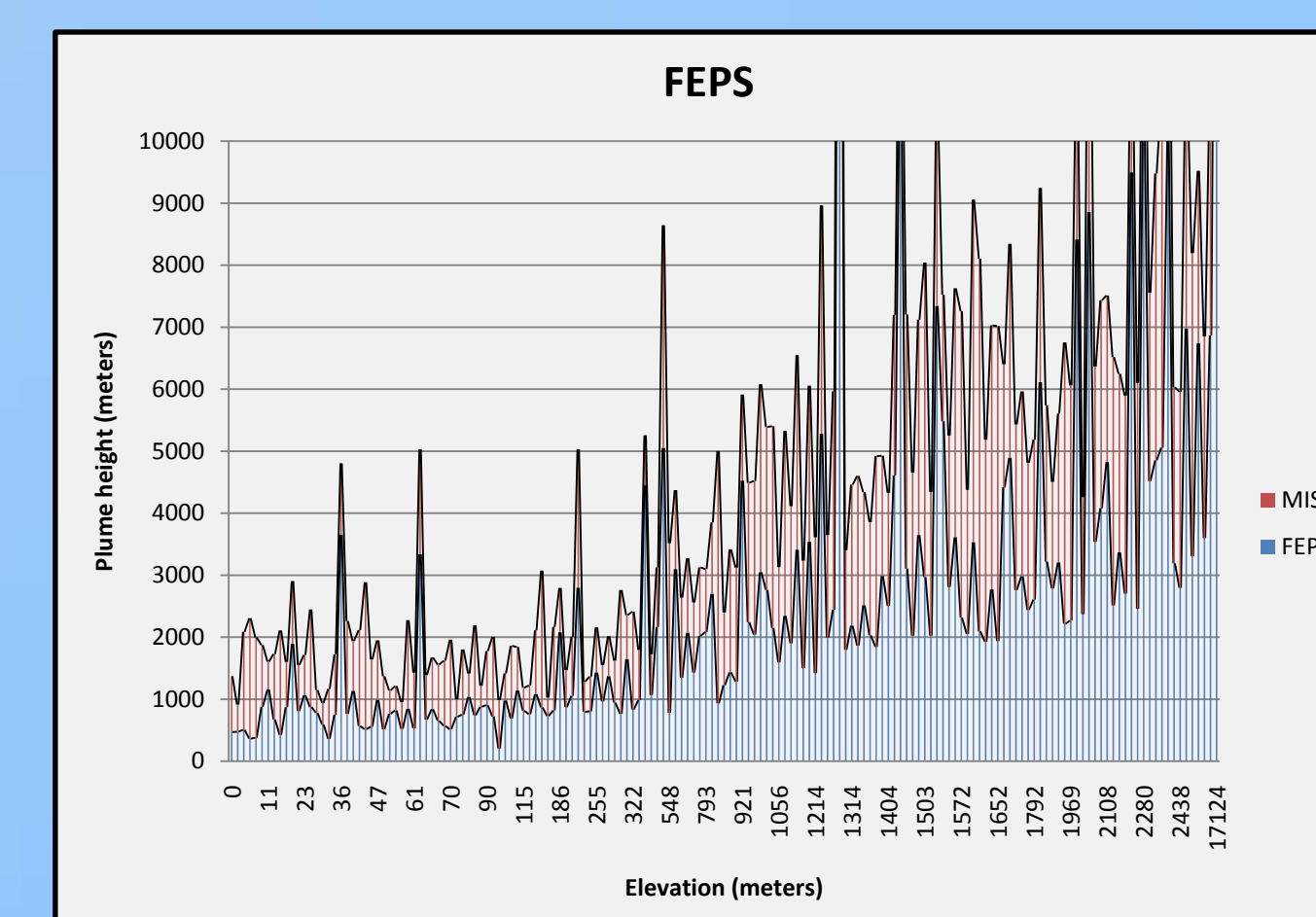


Chart 4: MISR & FEPS plume height vs. Elevation

The canopy data we found had been normalized and made it difficult to find variations between multiple points. The vegetation data provided different vegetation for most points. This made it hard to determine which type of vegetation would lead to an error in plume height.

Future Work

- Using vegetation and canopy data we will look further into the fuel loading for the wildfires, because both can be sources of fuel for wildfires.
- Make changes to the models to limit error.

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Reference

1. Raffuse, S. An Evaluation of Modeled Plume Rise With Satellite Data. 8th CMAS Conference, Oct 2009
2. Christian, K. Evaluation of the characterization of smoke plumes within the AIRPACT model. Summer 2009