

Modeling the Contribution of Wildfire Emissions to Ambient PM_{2.5} & Black Carbon

Serena Chung¹, Rodrigo Gonzalez-Abraham²
Farren Herron-Thorpe³,
Brian Lamb¹, Sim Larkin⁴, Tara Strand⁵

¹Laboratory for Atmospheric Research, Washington State University

²Molina Center for Strategic Studies in Energy and Environment

³Washington Department of Ecology

⁴U.S. Forest Service Pacific Northwest Research Station

⁵Scion Research

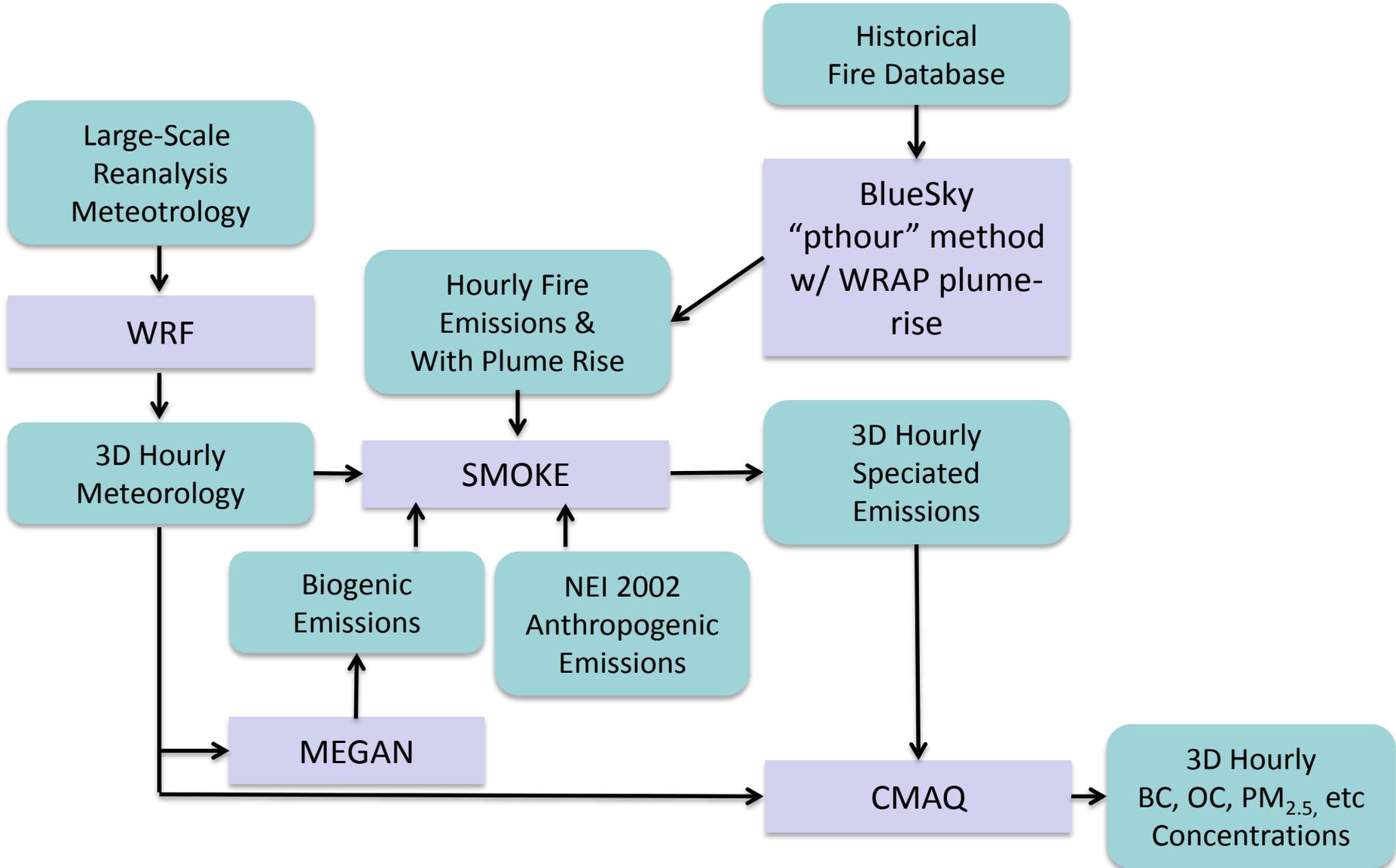
NW-AIRQUEST Annual Meeting

June 19, 2014

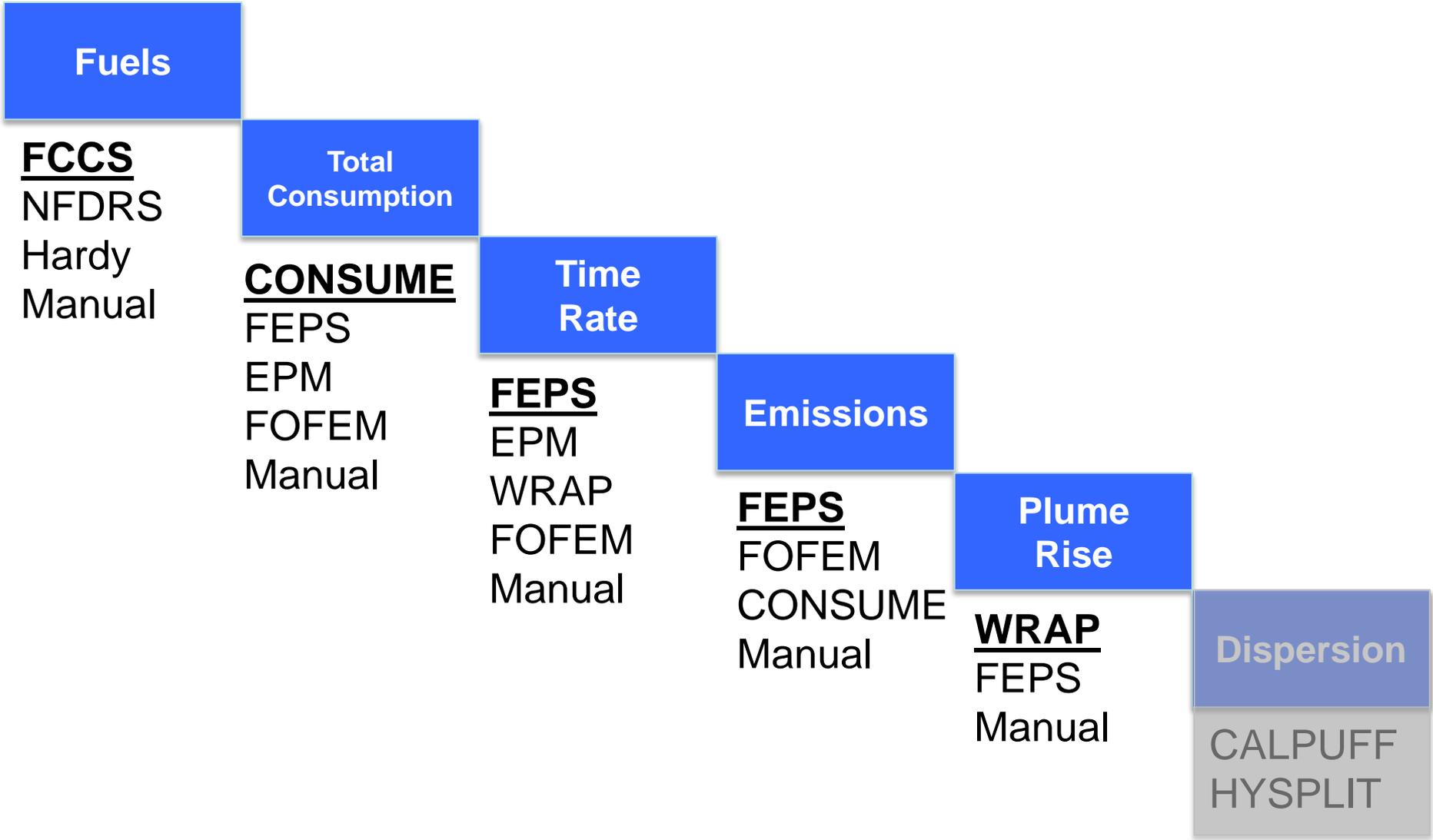
Introduction

- Funded by the Joint Fire Sciences Program
- Objectives:
 - Quantify the contributions for fires to ambient
 - BC
 - PM_{2.5}
 - Evaluate inter-annual variability
- Approach:
 - Modeling: WRF-BlueSky-CMAQ Modeling
 - 36-km CONUS, Jun-Jul-Aug, 1996-2005
 - Observations: IMPROVE Network

Modeling Framework

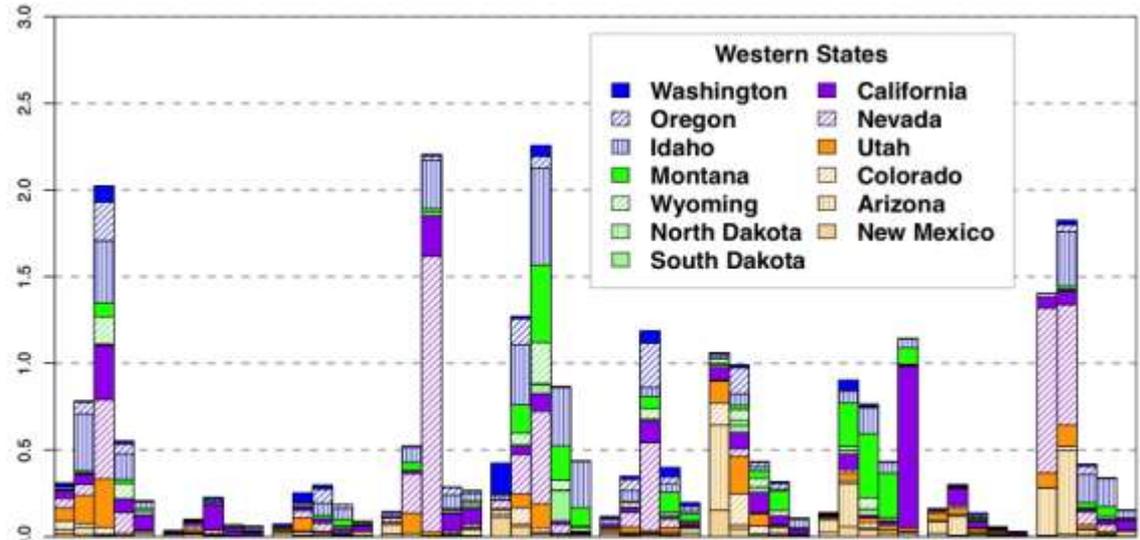


BlueSky Framework Options



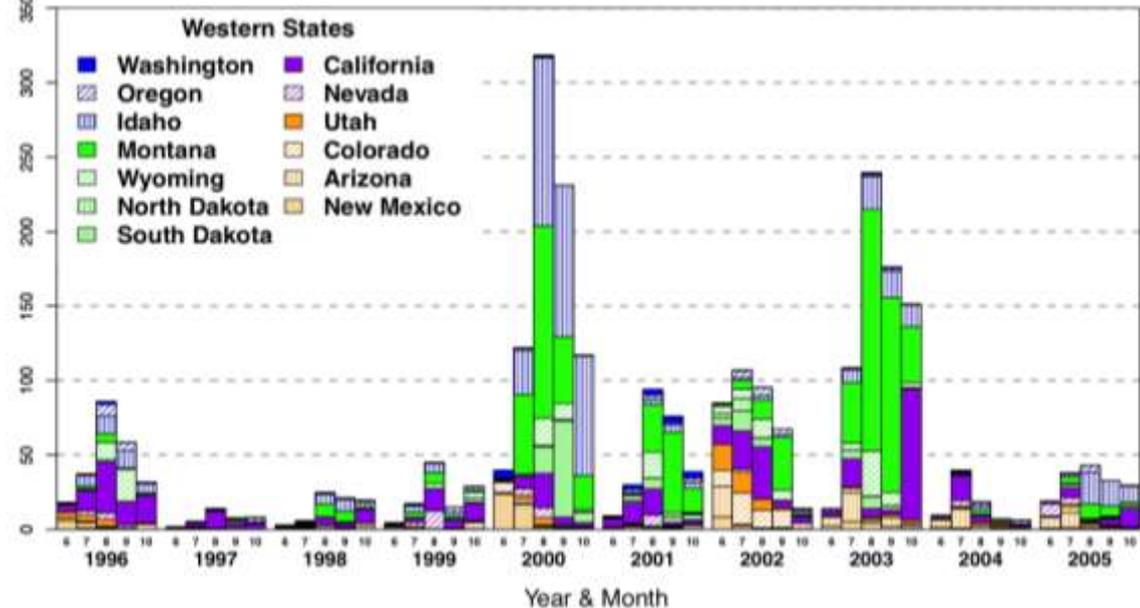
Area Burned & Modeled PM_{2.5} Emissions

Monthly
Acres-Days Burned x 10⁻⁶
(<http://capita.wustl.edu/fsan/FedFireHist.htm>)



Monthly
PM_{2.5} Emission (Gg)
from BlueSky

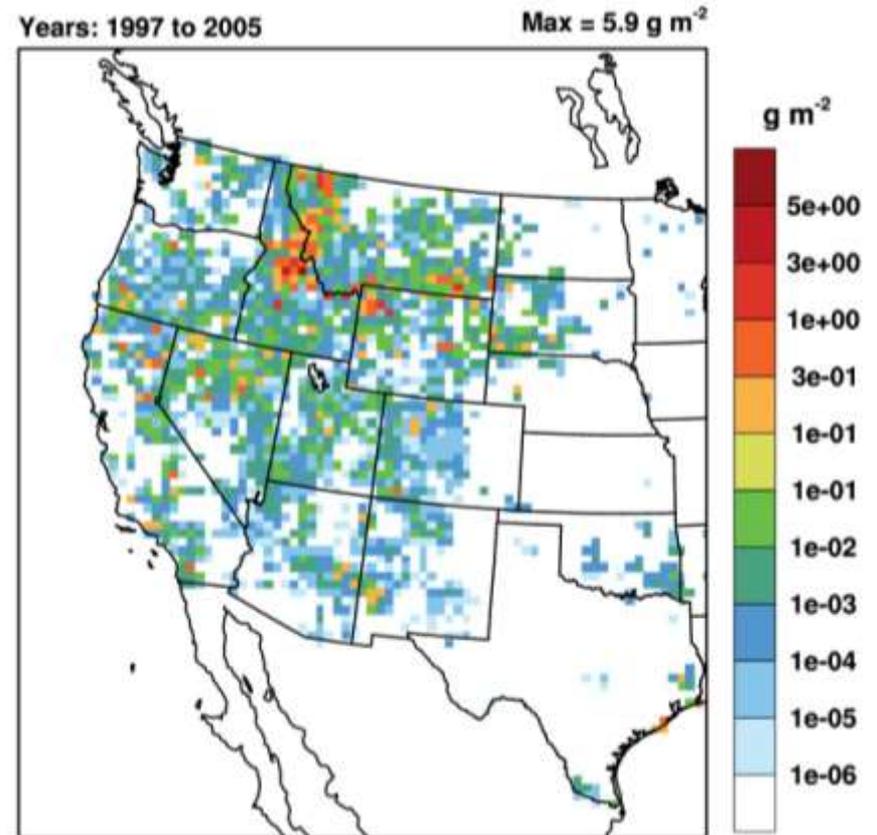
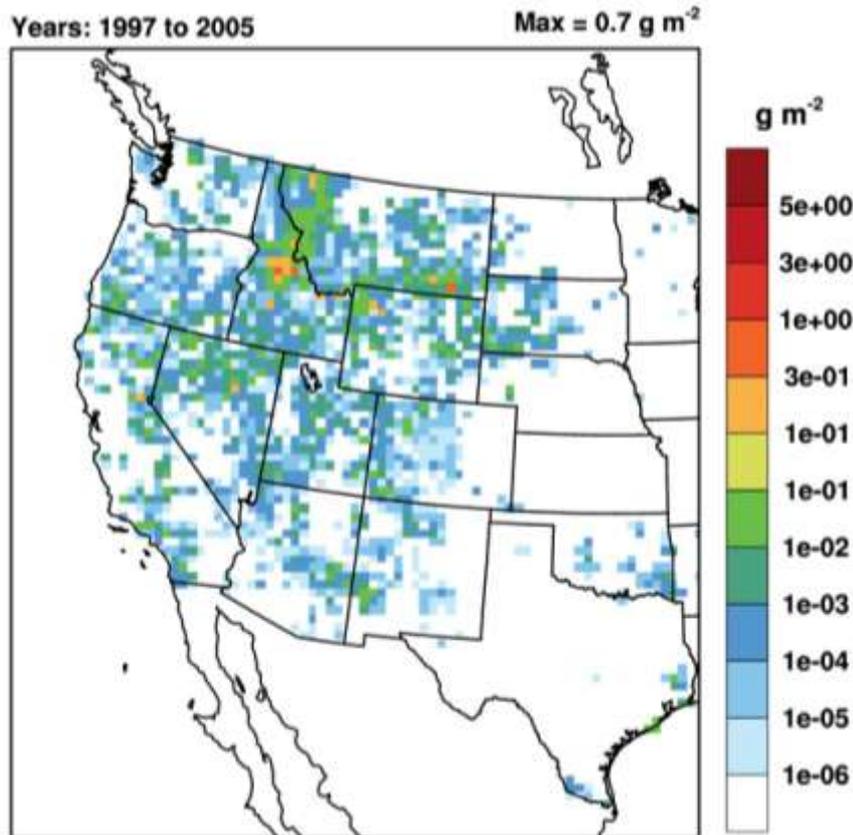
(16% and 77% of PM_{2.5} emissions were assumed to be BC and organic aerosol, respectively.)



Fire Emissions: August of 1997-2005

August-Total Fire BC Emissions
Averaged over 1997-2005

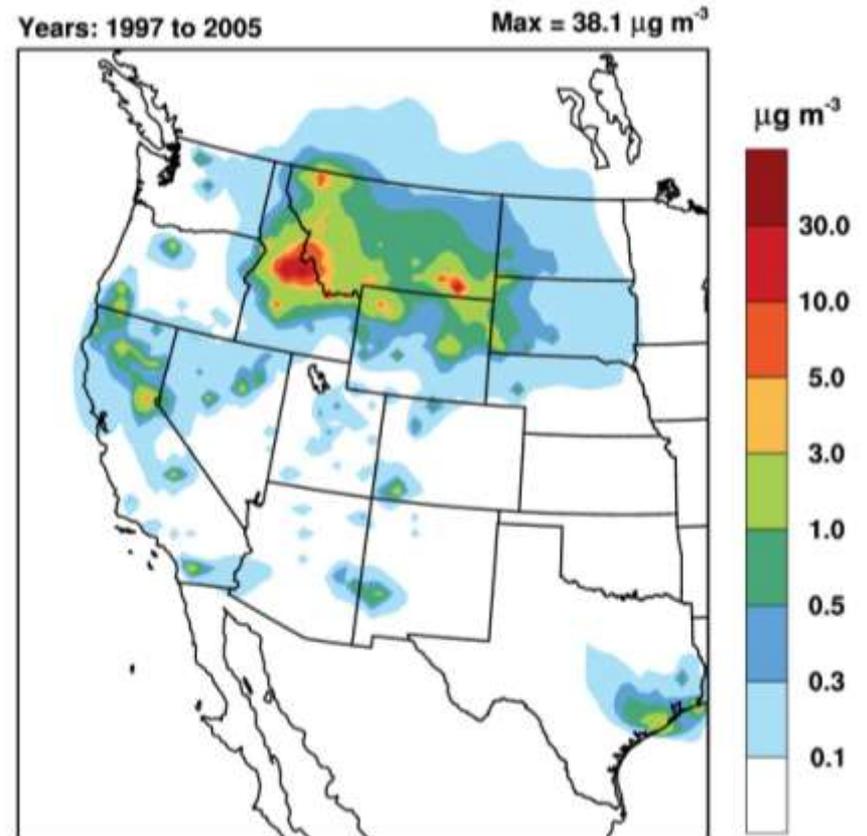
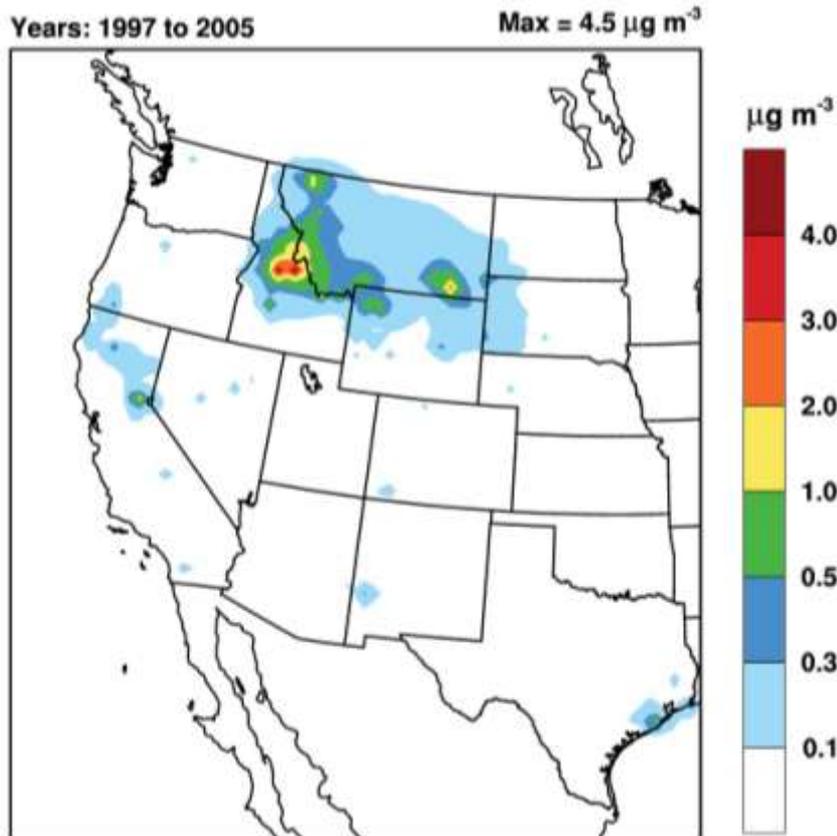
August-Total Fire BC Emissions
Maximum during 1997-2005



Modeled BC Concentrations: August of 1997-2005

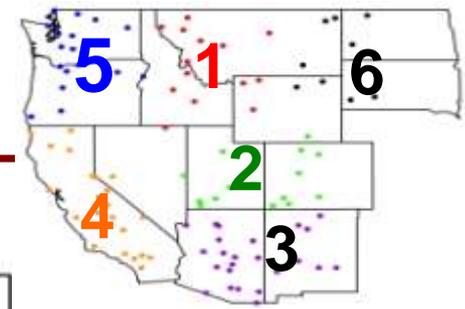
August-Mean BC Concentrations
from Fires
Averaged over 1997-2005

August-Mean BC Concentrations
from Fires
Maximum during 1997-2005

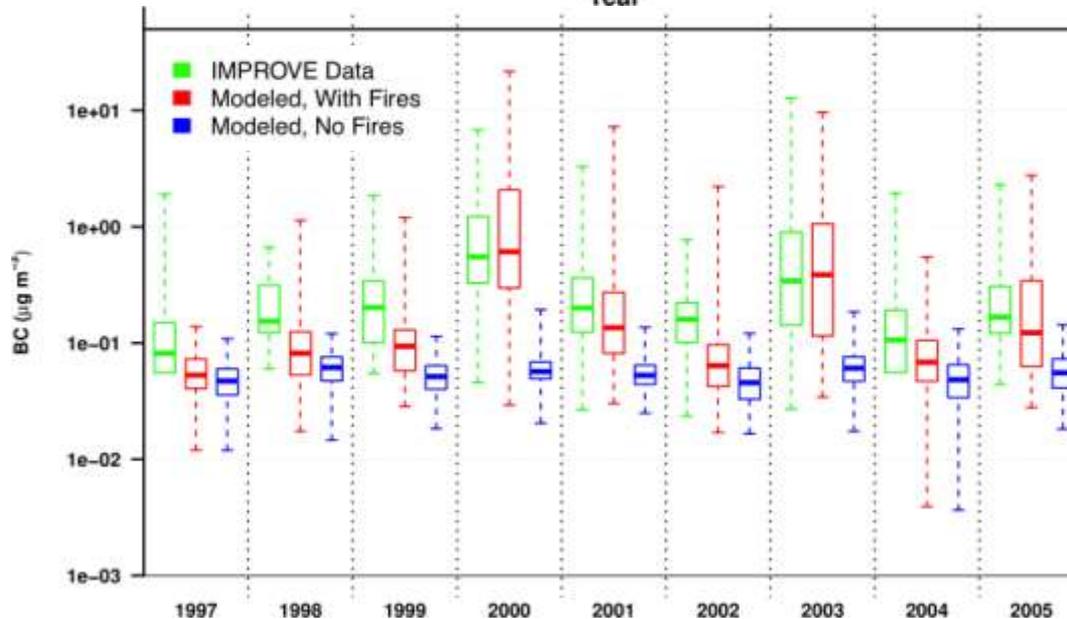
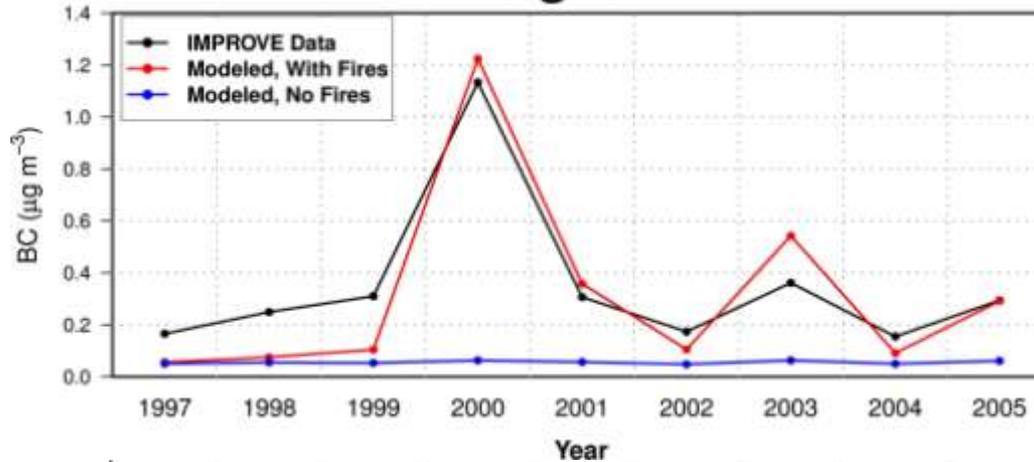


Modeled vs Observed BC Concentrations

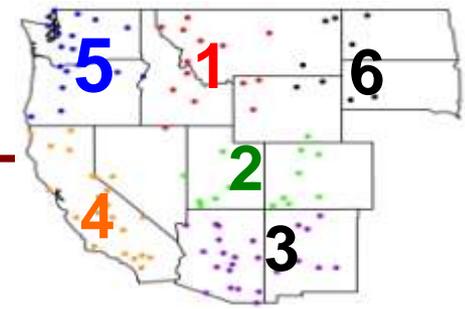
August of 1997-2005



Region 1

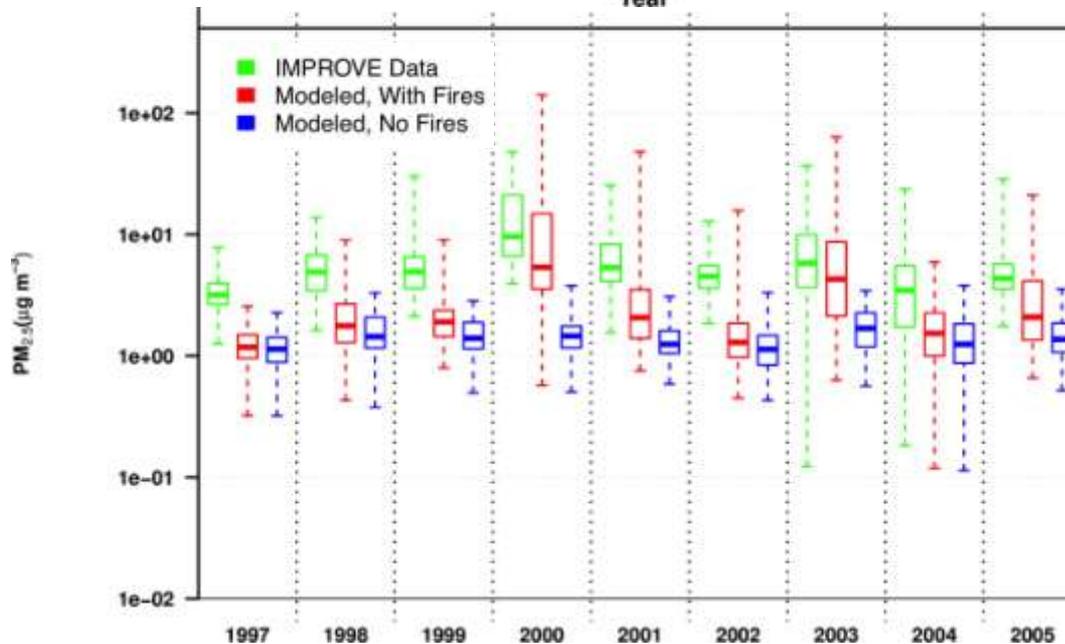
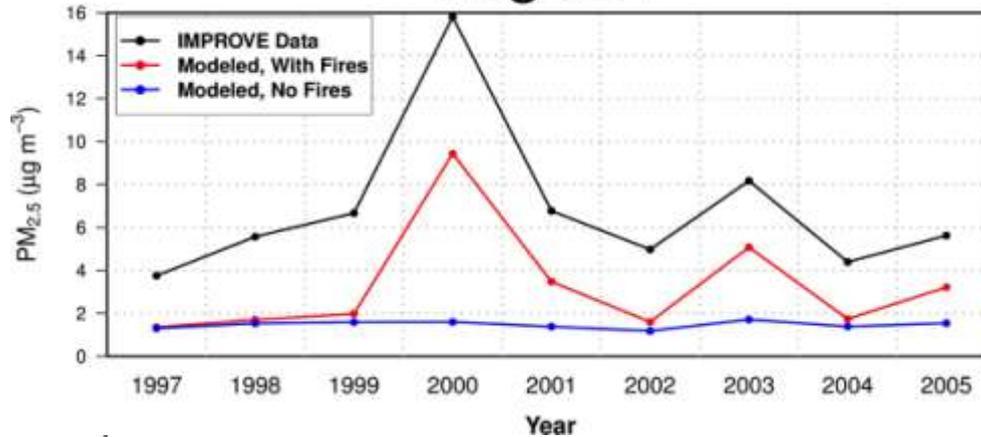


Modeled vs Observed PM_{2.5} Concentrations



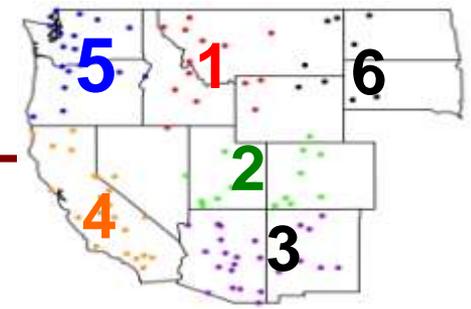
August of 1997-2005

Region 1

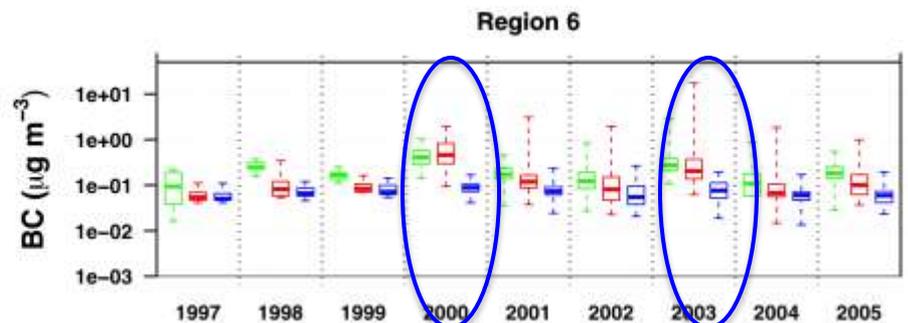
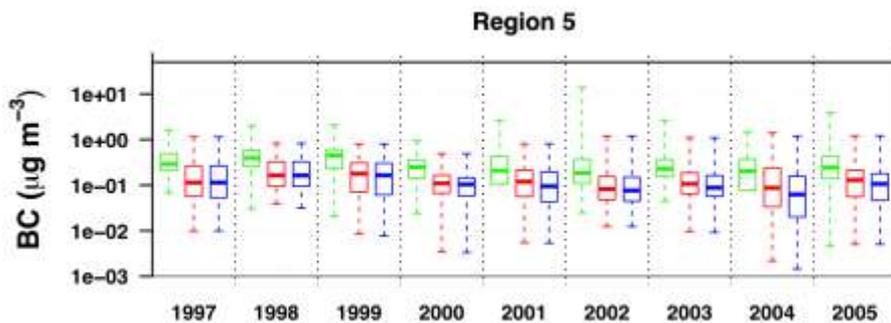
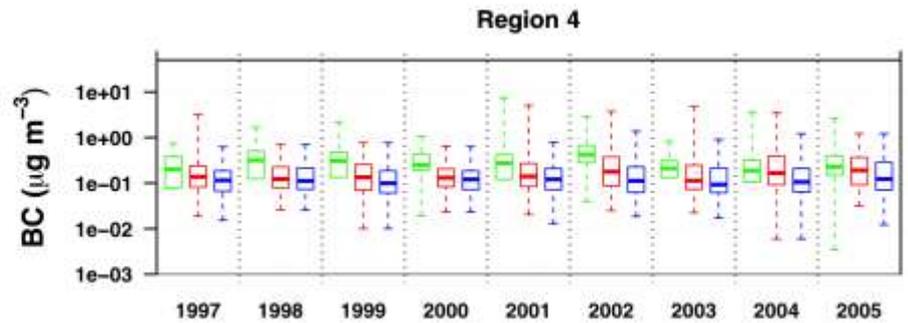
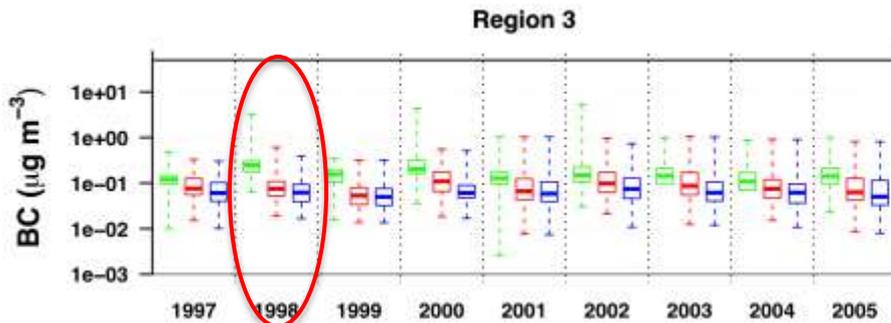
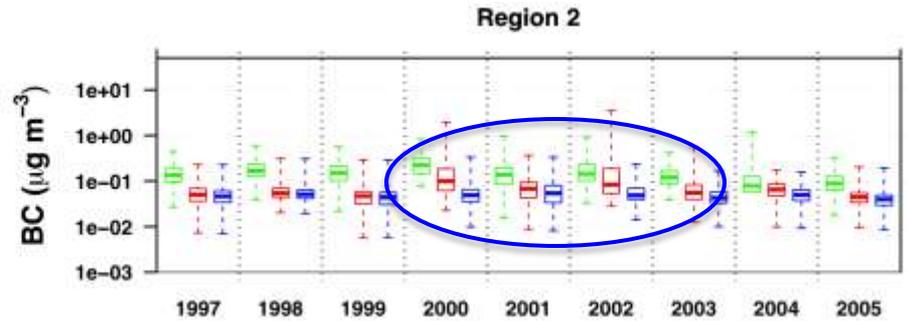
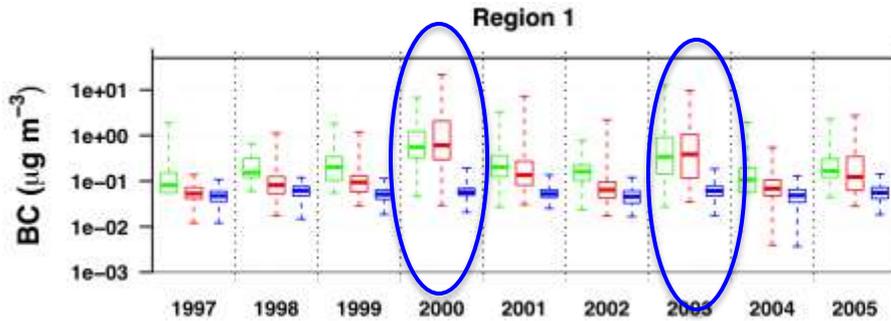


Modeled vs Observed BC Concentrations

August of 1997-2005

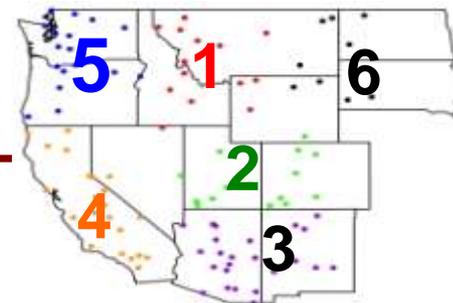


- IMPROVE Data
- Modeled, With Fires
- Modeled, No Fires

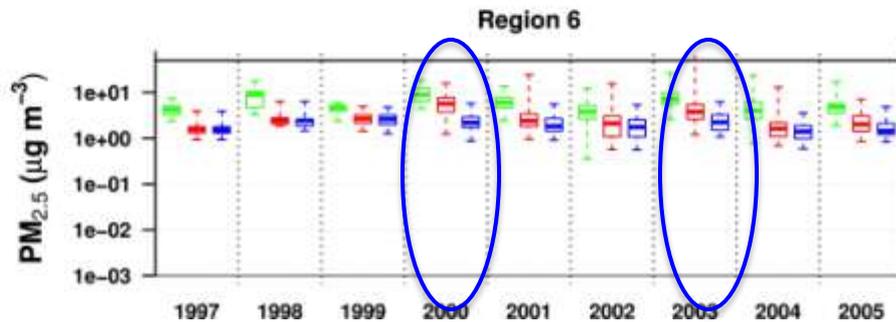
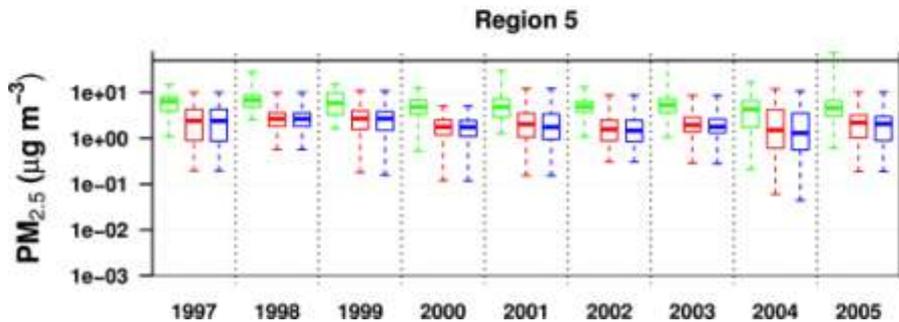
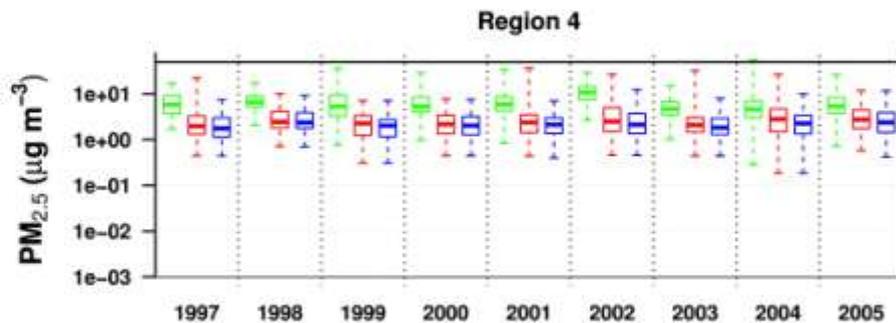
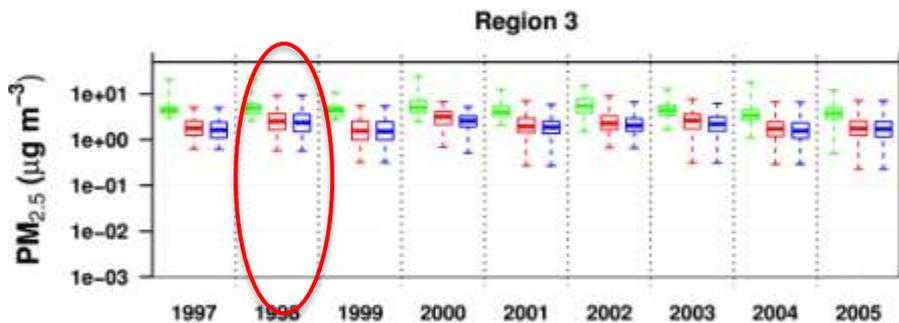
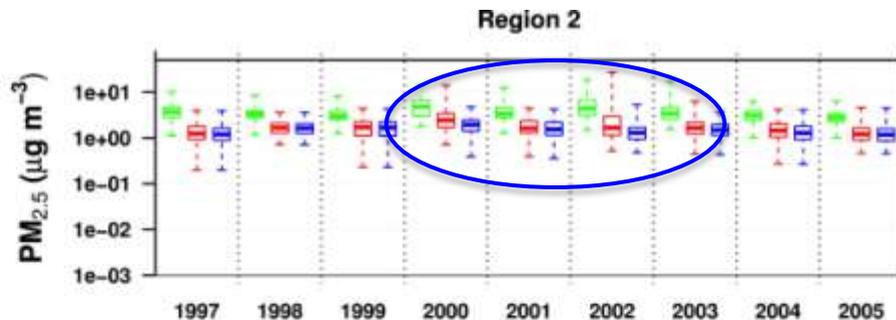
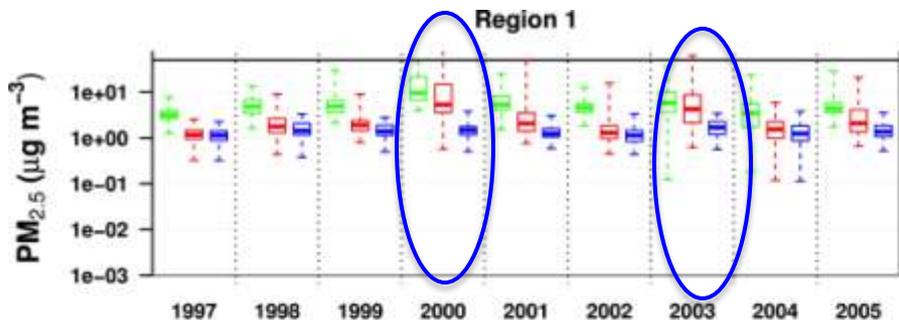


Modeled vs Observed PM_{2.5} Concentrations

August of 1997-2005

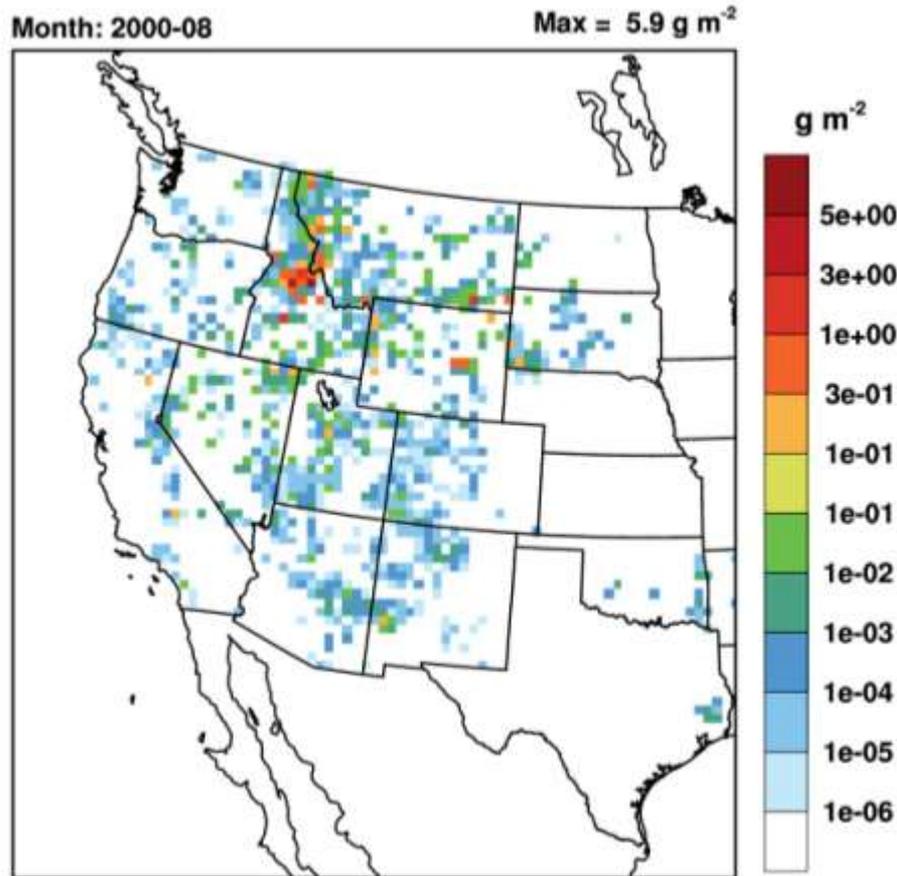


- IMPROVE Data
- Modeled, With Fires
- Modeled, No Fires

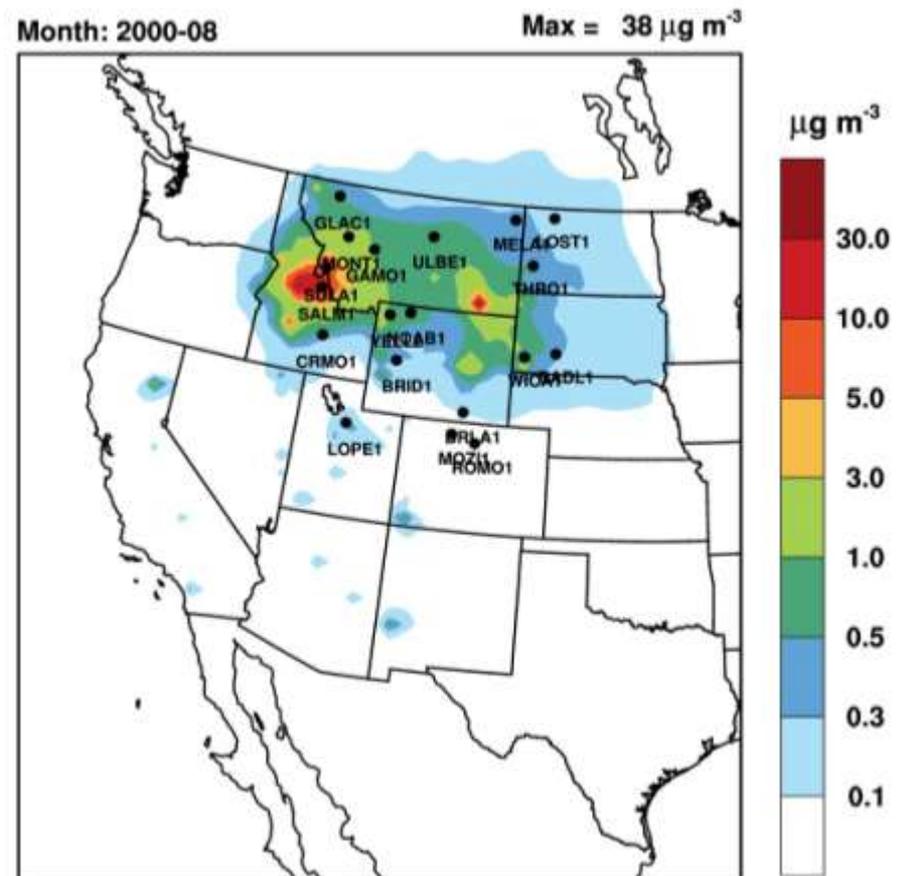


August 2000 Results

Fire BC Emission
(total for the month)

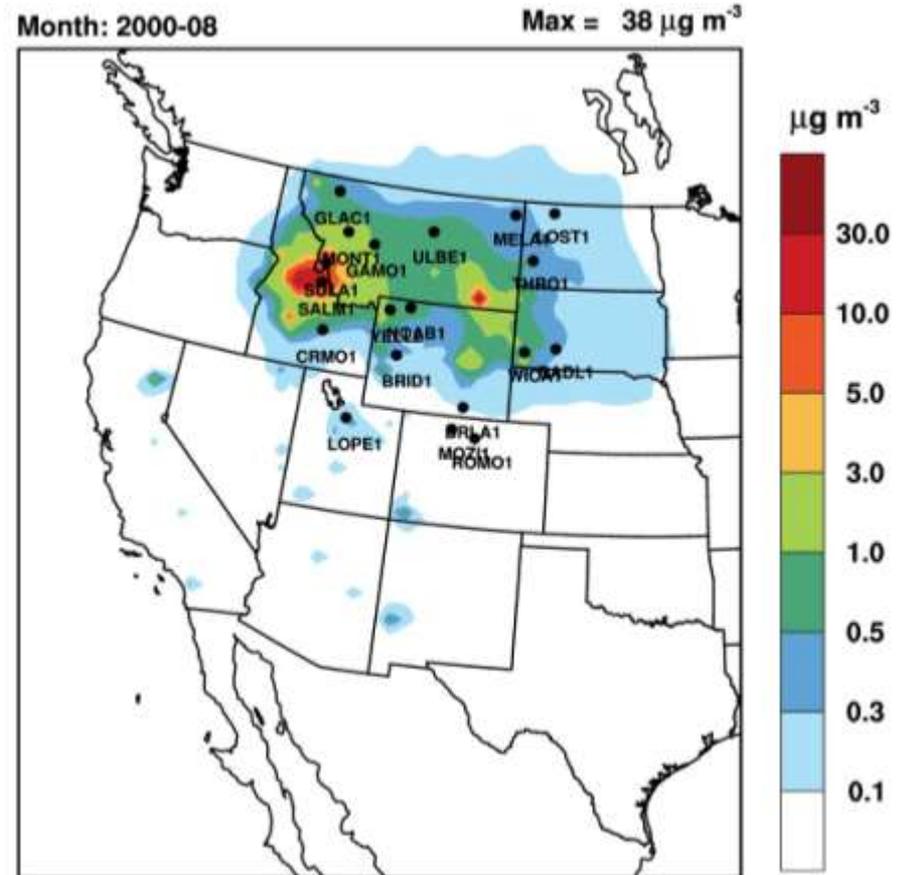
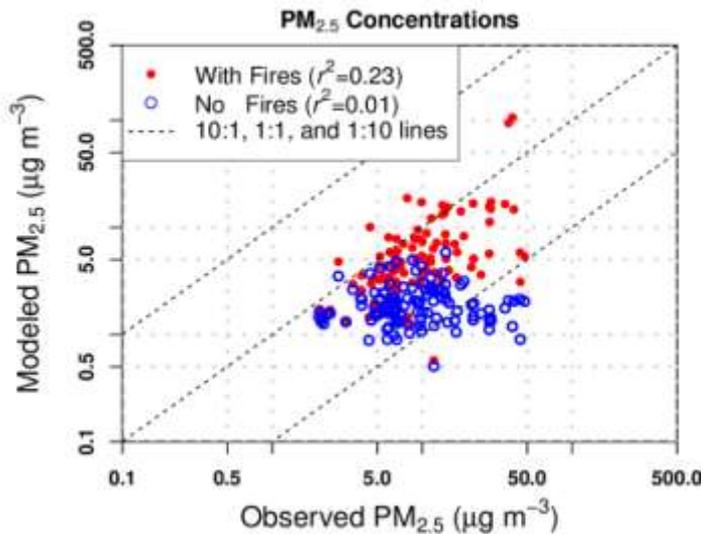
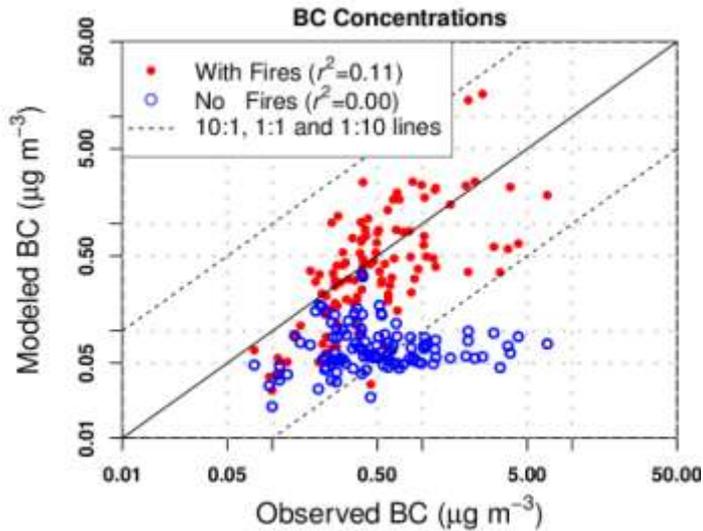


Fire Contribution to
BC Concentration
(averaged over the month)

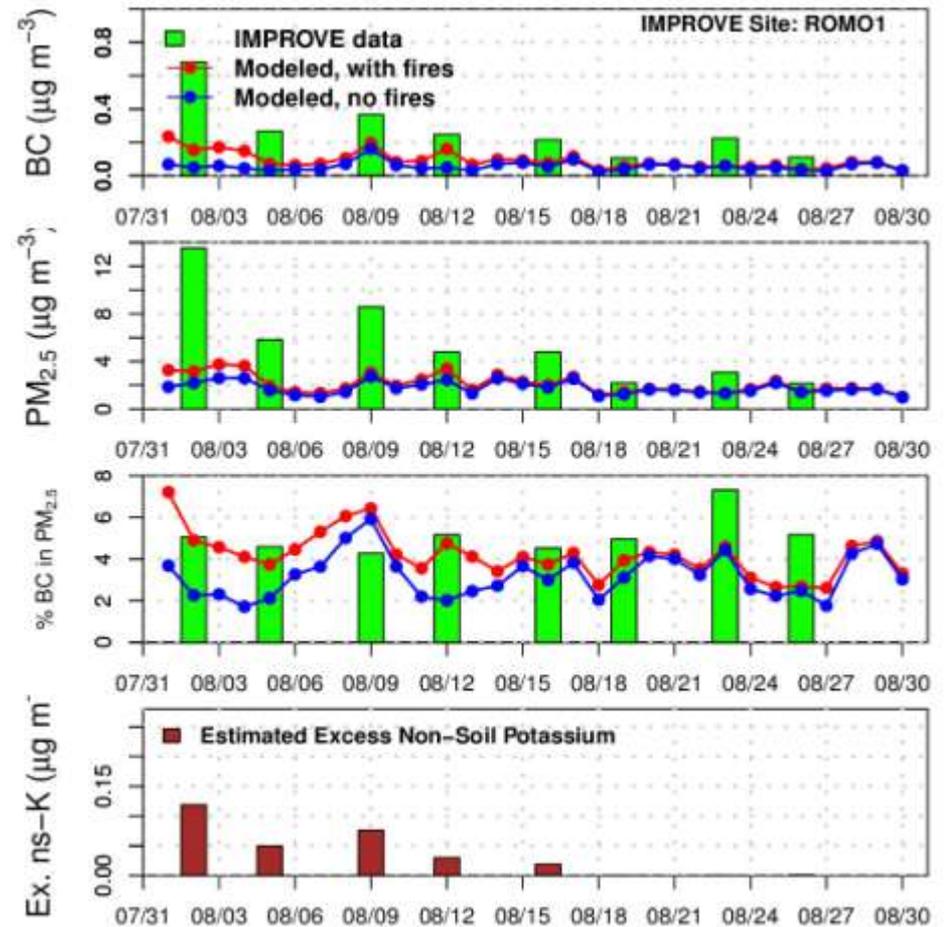
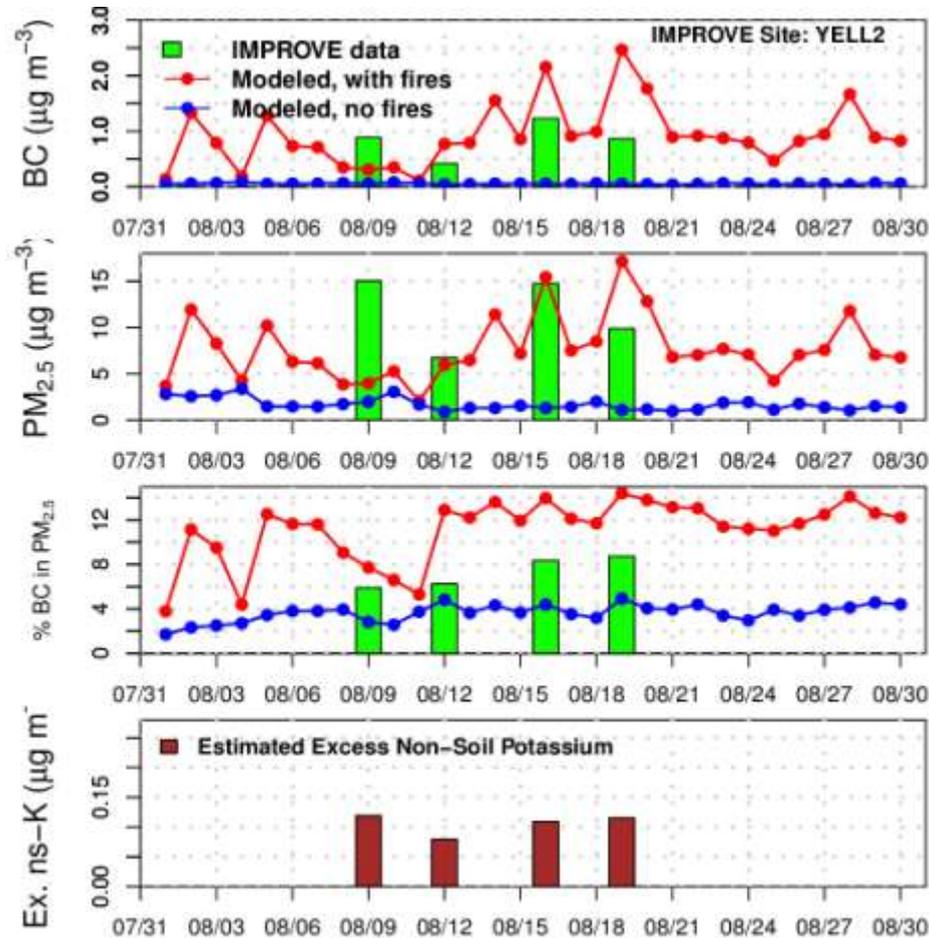
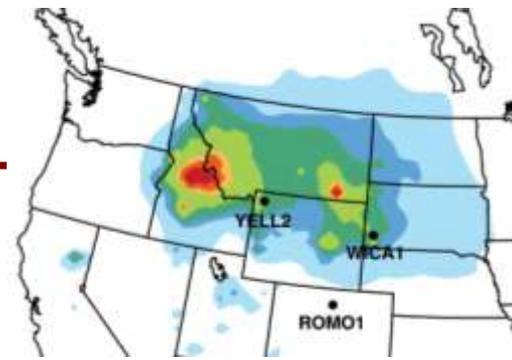


Model vs Observed BC & PM_{2.5} for August 2000

Fire Contribution to BC Concentration (averaged over the month)

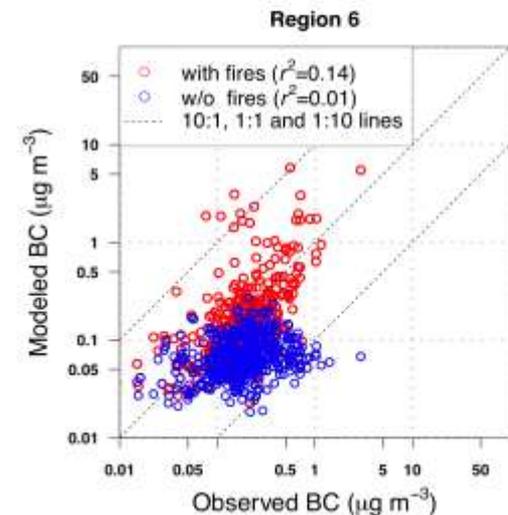
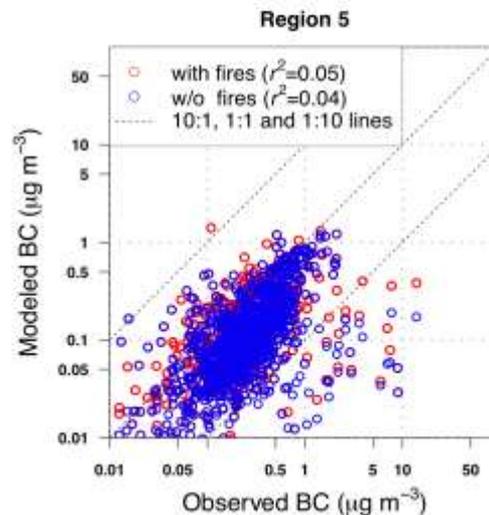
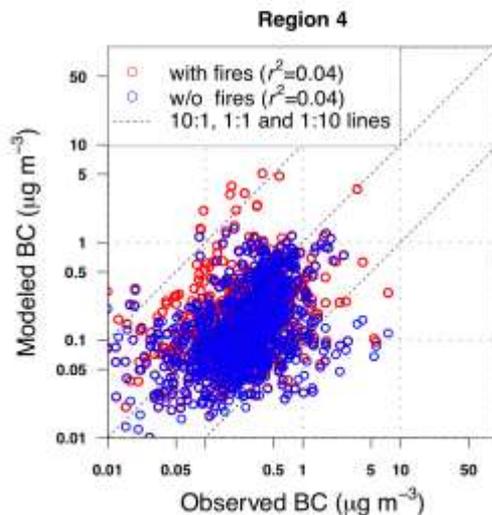
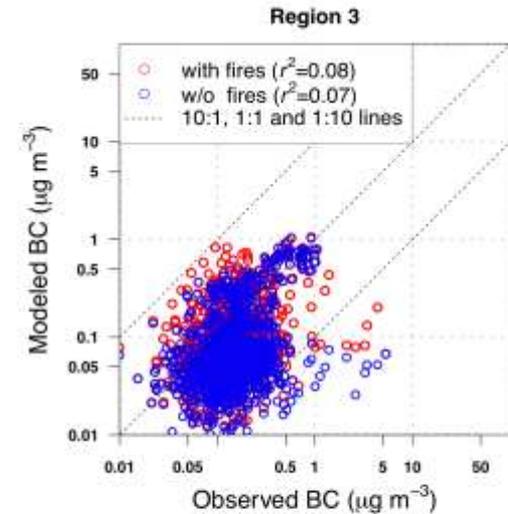
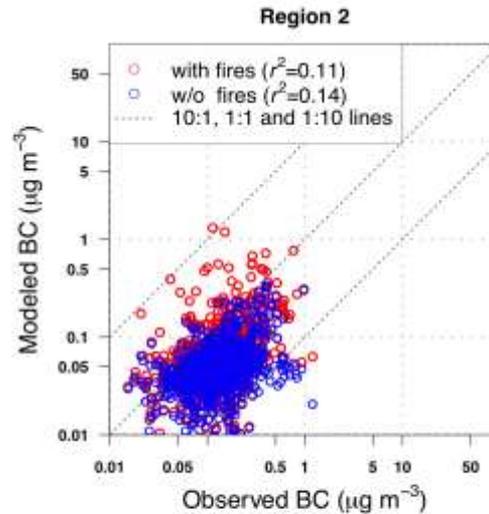
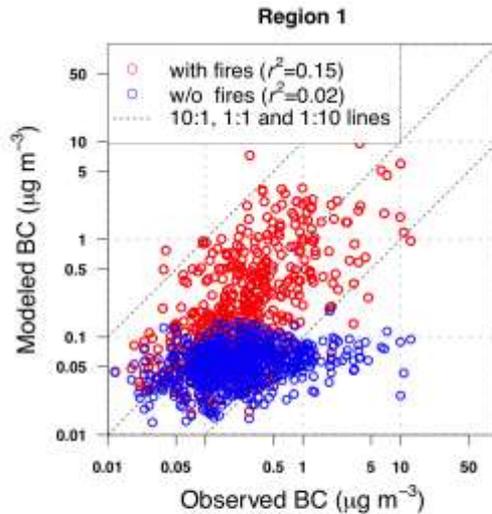
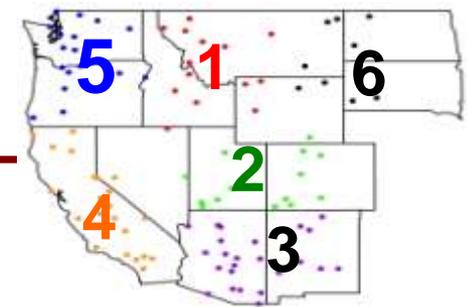


Model vs Observed BC & PM_{2.5} for August 2000



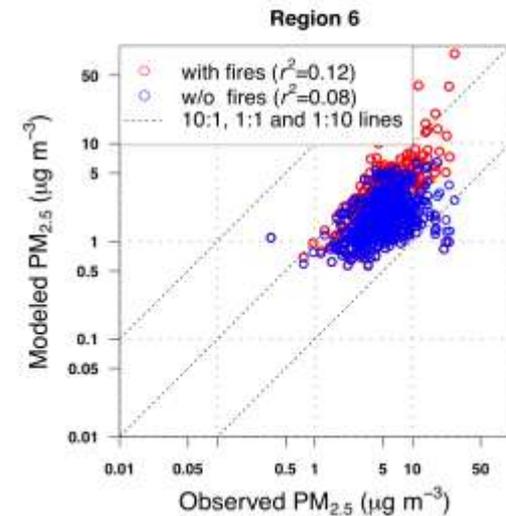
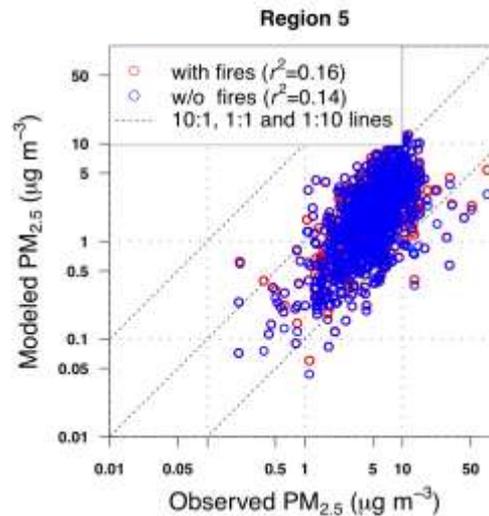
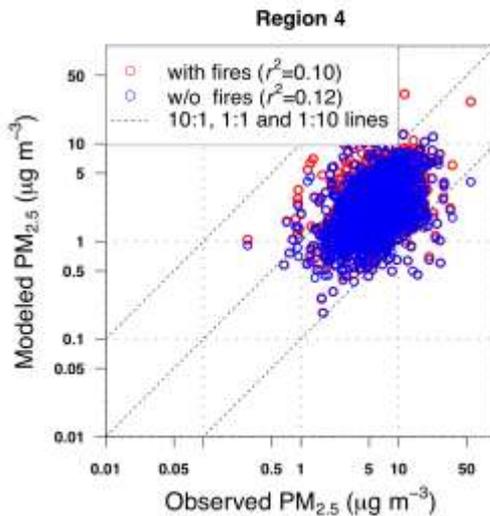
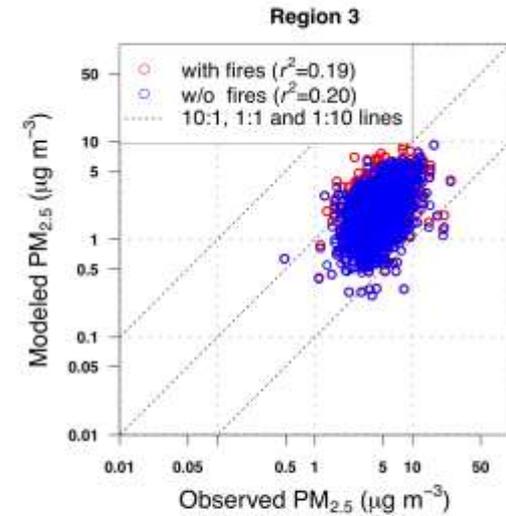
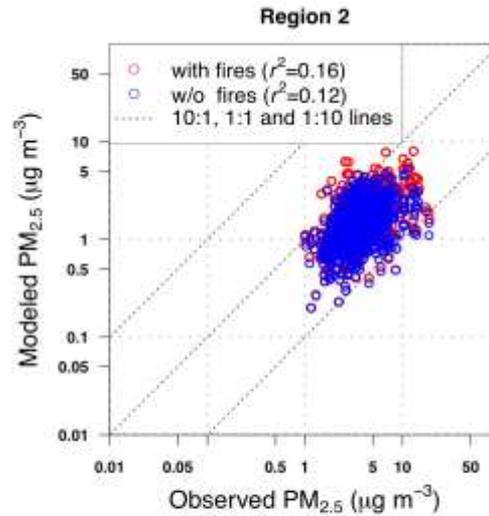
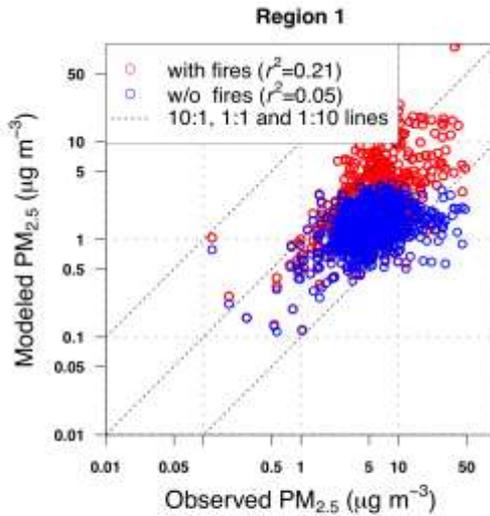
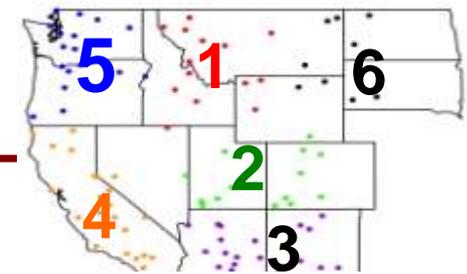
Modeled vs Observed BC Concentrations:

August of 1997-2005



Modeled vs Observed PM_{2.5} Concentrations:

August of 1997-2005



Summary

- For the August 2000 high fire season in central Idaho and western Montana
 - On average, model predictions for BC agree well with IMPROVE data
 - The model tends to underpredict $PM_{2.5}$
 - The model sometimes over predicts BC and $PM_{2.5}$ "close" to the fires, but under predicts further downwind.
 - Possibly because too much smoldering emissions are trapped in the first model in the BlueSky's "pthour" method.
 - Modeled BC to $PM_{2.5}$ ratios tend to be higher than observed
 - 16% and 77% of fire $PM_{2.5}$ emissions were assumed to be BC and organic aerosol, respectively
- For other periods, the model tends to underpredict both $PM_{2.5}$ and BC
- Insufficient secondary organic aerosol (SOA) formation could explain some of the underprediction

Modeled vs Observed BC Concentrations

August of 1997-2005

