WEST COAST REGIONAL CARBON SEQUESTRATION PARTNERSHIP:

DEVELOPING A WILDFIRE EMISSION REDUCTION CREDIT ACCOUNTING FRAMEWORK

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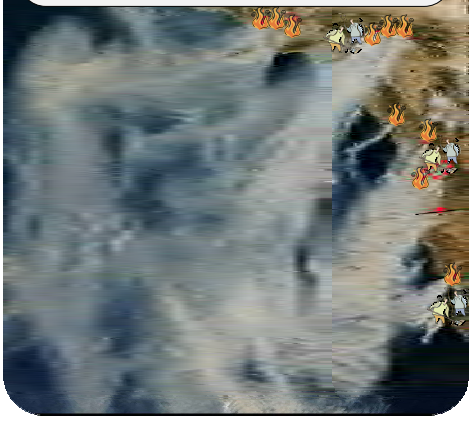
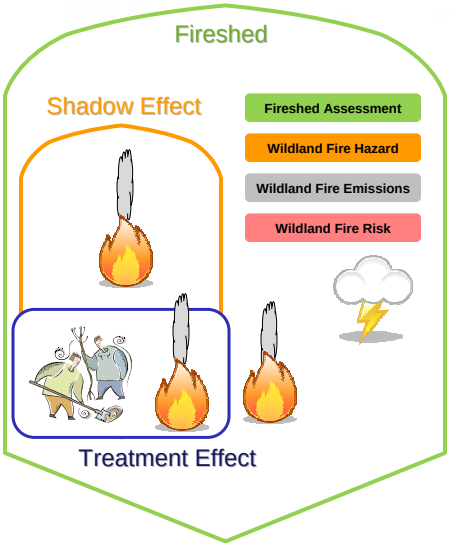
Spatial Informatics Group, LLC
Integrating GIS, Science, Economics & Planning

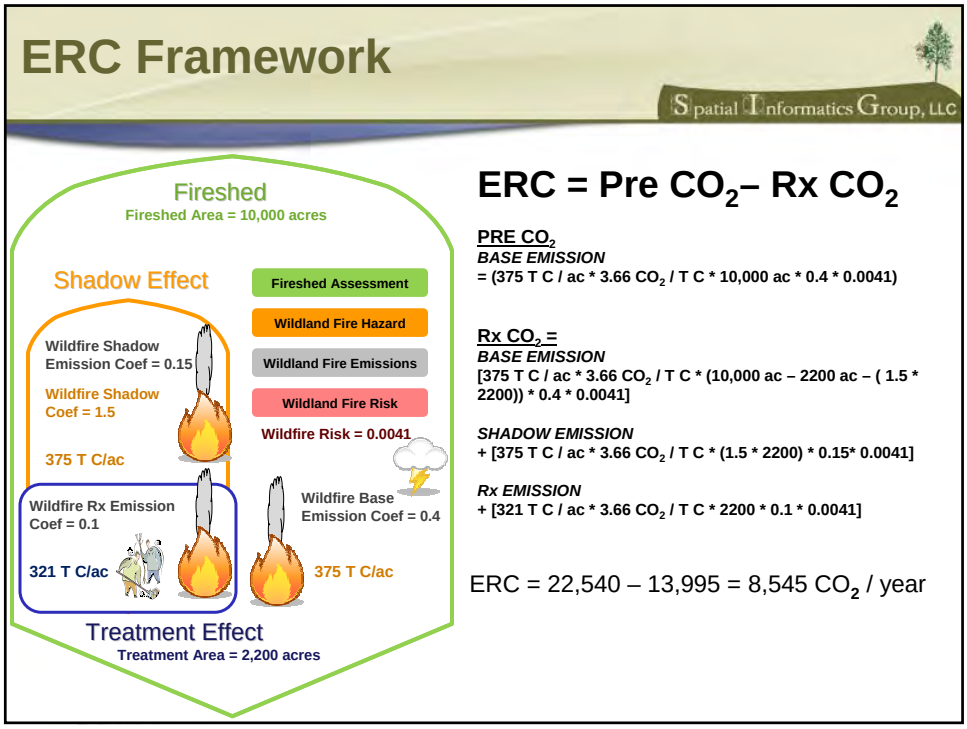
Question...

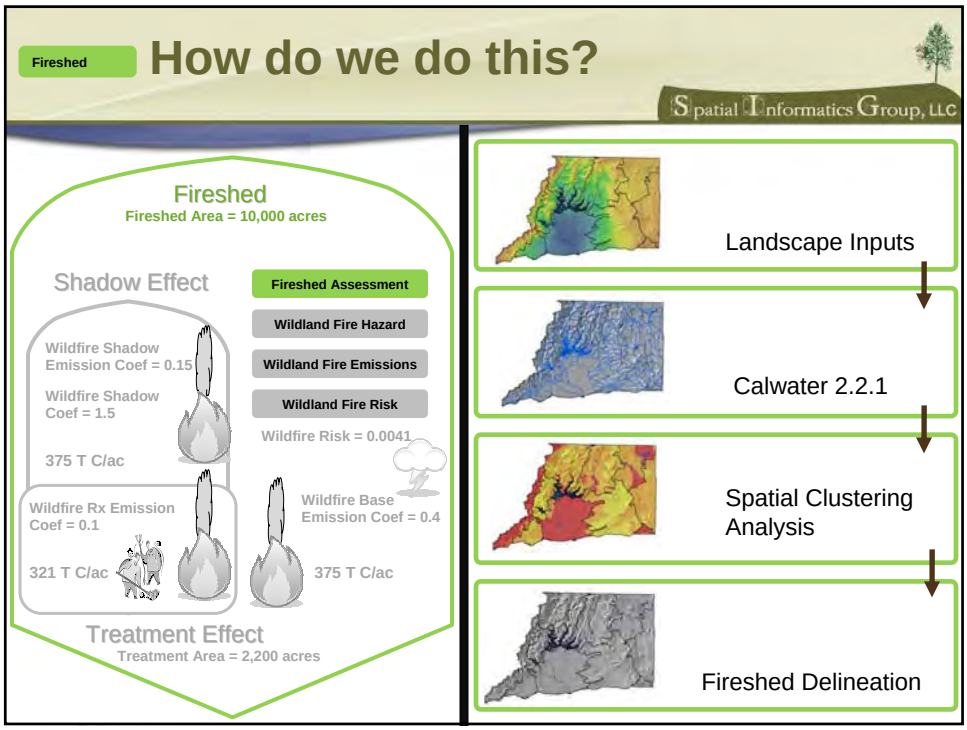
How can wildfire emission reduction credits (ERC) be estimated at the project scale?



ERC = Pre CO_2– Rx CO_2




ERC Framework
Spatial Informatics Group, LLC
Fireshed
Fireshed Area = 10,000 acres
Shadow Effect
Wildfire Shadow Emission Coef = 0.15
Wildfire Shadow Coef = 1.5
375 T C/ac
Wildfire Rx Emission Coef = 0.1
321 T C/ac
Wildfire Base Emission Coef = 0.4
375 T C/ac
Treatment Effect
Treatment Area = 2,200 acres
Fireshed Assessment
Wildland Fire Hazard
Wildland Fire Emissions
Wildland Fire Risk
Wildfire Risk = 0.0041
ERC = Pre CO2– Rx CO2
PRE CO2
BASE EMISSION
= (375 T C / ac * 3.66 CO2 / T C * 10,000 ac * 0.4 * 0.0041)
Rx CO2 =
BASE EMISSION
[375 T C / ac * 3.66 CO2 / T C * (10,000 ac – 2200 ac – (1.5 * 2200)) * 0.4 * 0.0041]
SHADOW EMISSION
+ [375 T C / ac * 3.66 CO2 / T C * (1.5 * 2200) * 0.15* 0.0041]
Rx EMISSION
+ [321 T C / ac * 3.66 CO2 / T C * 2200 * 0.1 * 0.0041]
ERC = 22,540 – 13,995 = 8,545 CO2 / year


Fireshed
How do we do this?
Spatial Informatics Group, LLC
Fireshed
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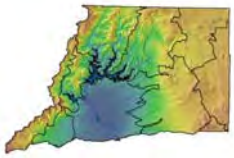
Wildland Fire Hazard
Wildland Fire Emissions
Wildland Fire Risk
Wildfire Risk = 0.0041
Landscape Inputs
Calwater 2.2.1
Spatial Clustering Analysis
Fireshed Delineation

Fireshed

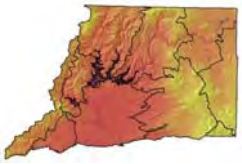
Inputs

Spatial Informatics Group, LLC

Wind Velocity

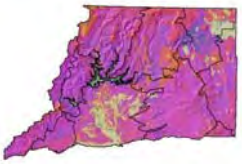


Humidity

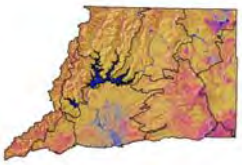


Temperature

FRI Departure



Precipitation



Mean Fire Return Interval

Fireshed

Spatial Clustering

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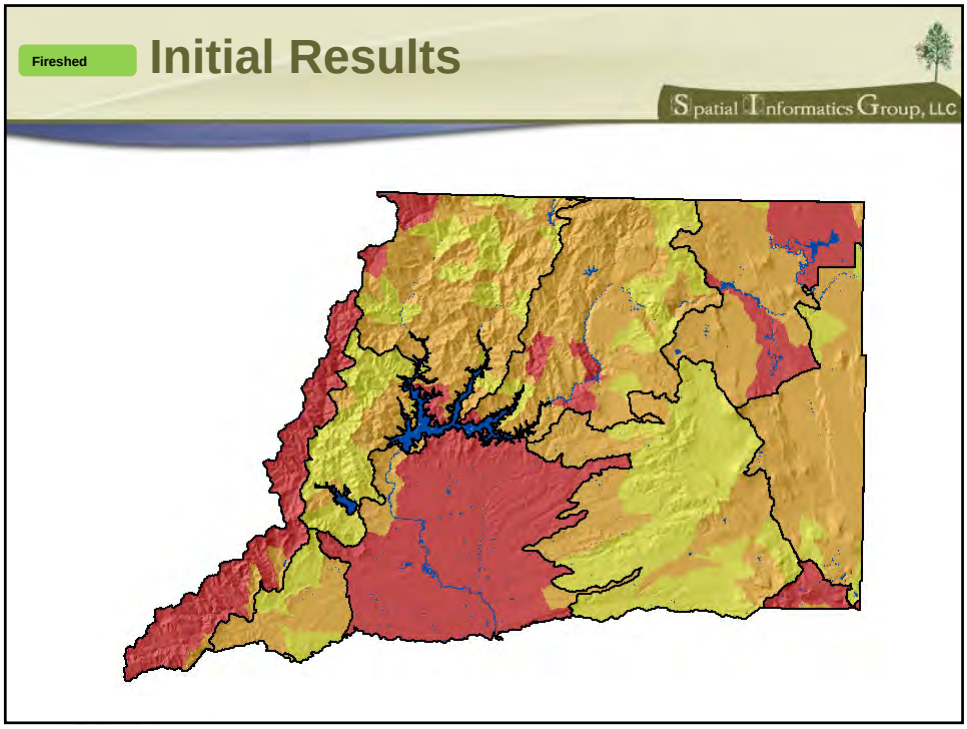
(Getis-Ord Gi*)


Fireshed
Initial Results
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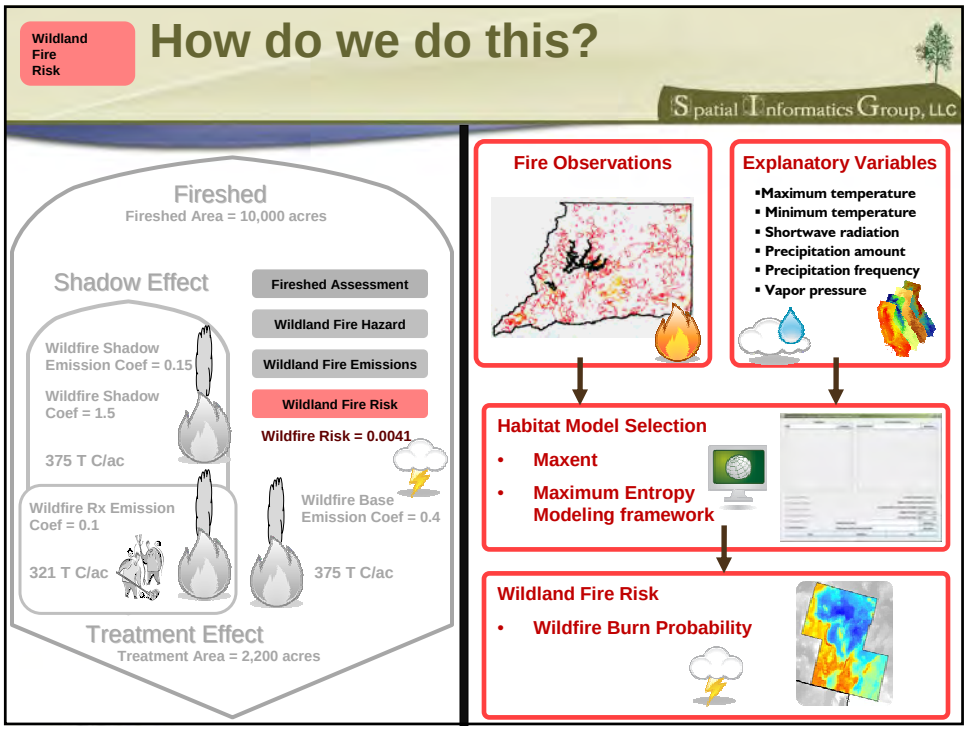
Wildland Fire Risk
How do we do this?
Spatial Informatics Group, LLC
Fireshed
Fireshed Area = 10,000 acres
Shadow Effect
Wildfire Shadow Emission Coef = 0.15
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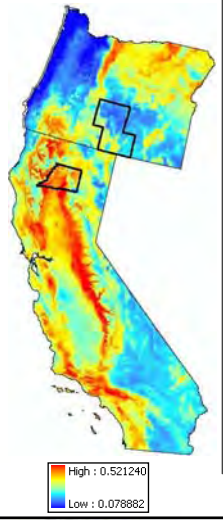
375 T C/ac
Treatment Effect
Treatment Area = 2,200 acres
Fireshed Assessment
Wildland Fire Hazard
Wildland Fire Emissions
Wildland Fire Risk
Wildfire Risk = 0.0041
Fire Observations
Explanatory Variables
▪Maximum temperature
▪ Minimum temperature
▪ Shortwave radiation
▪ Precipitation amount
▪ Precipitation frequency
▪ Vapor pressure
Habitat Model Selection
• Maxent
• Maximum Entropy Modeling framework
Wildland Fire Risk
• Wildfire Burn Probability

Wildland Fire Risk

Results

Spatial Informatics Group, LLC

Fire Probability - Average



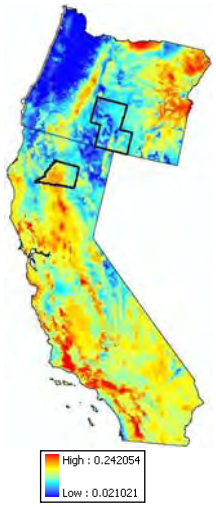
Model sensitivity to a variety of factors explored:

- Training data region, extent
- Temporal window
- Predictor variable selection
- Fuel masking

➢ Models most sensitive to training data (i.e., fire history data) region and extent

➢Some regions more sensitive than others

Fire Probability – Standard Deviation



Wildland Fire Risk

Results Fire Return Interval (years)

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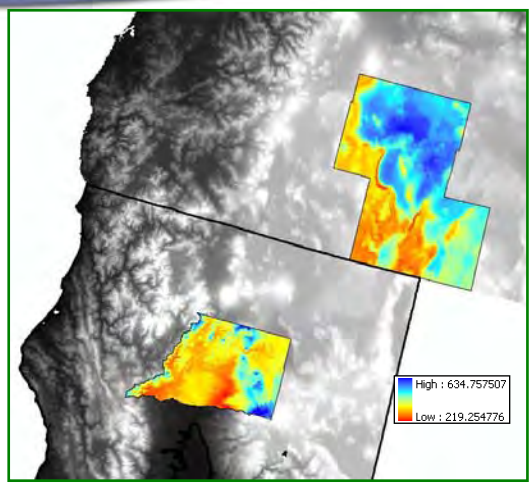

*** conversion of Maxent's "probability" to fire return interval dependent on determination of appropriate regional annual burn rate (this varies with location, time window, and whether non-fuel areas are masked out)

Wildland Fire Risk

Fire Risk Next Steps

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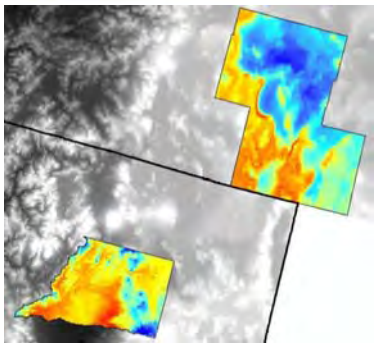
Calibration

- Locate more complete testing data (current Oregon datasets are "sparse data" with spatial biases)
- Include proxy variables for ignition components and fire spread-rates
- Model comparison and averaging
- Determine optimum training variables with covariance matrices and sensitivity analysis



Validation

- Quantify uncertainty in predictions
- Compare fit of models based on clamping grids (estimation of no-analogue environmental conditions), omission/commission errors on training and testing data

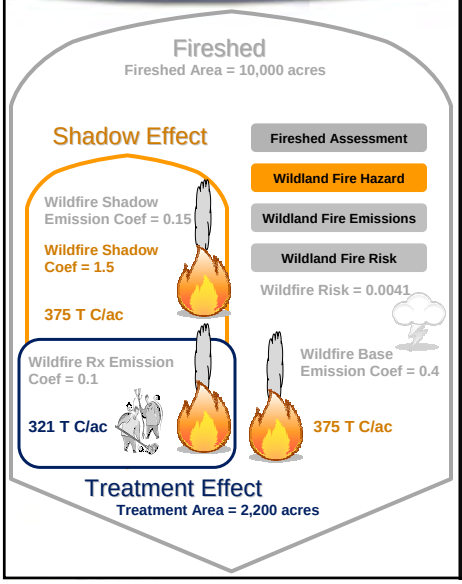
We are also…

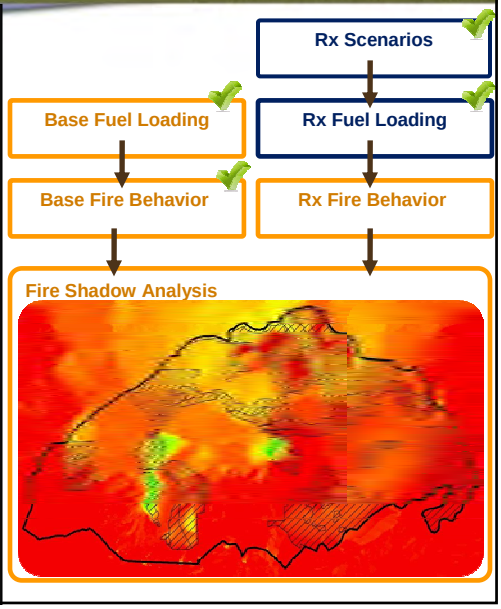
- Investigating statistical hazard functions and "fat-tailed" distributions of risk
- Creating baseline risk maps for fires >300 acres, >1000 acres, and >5000 acres
- Interpreting variation in models

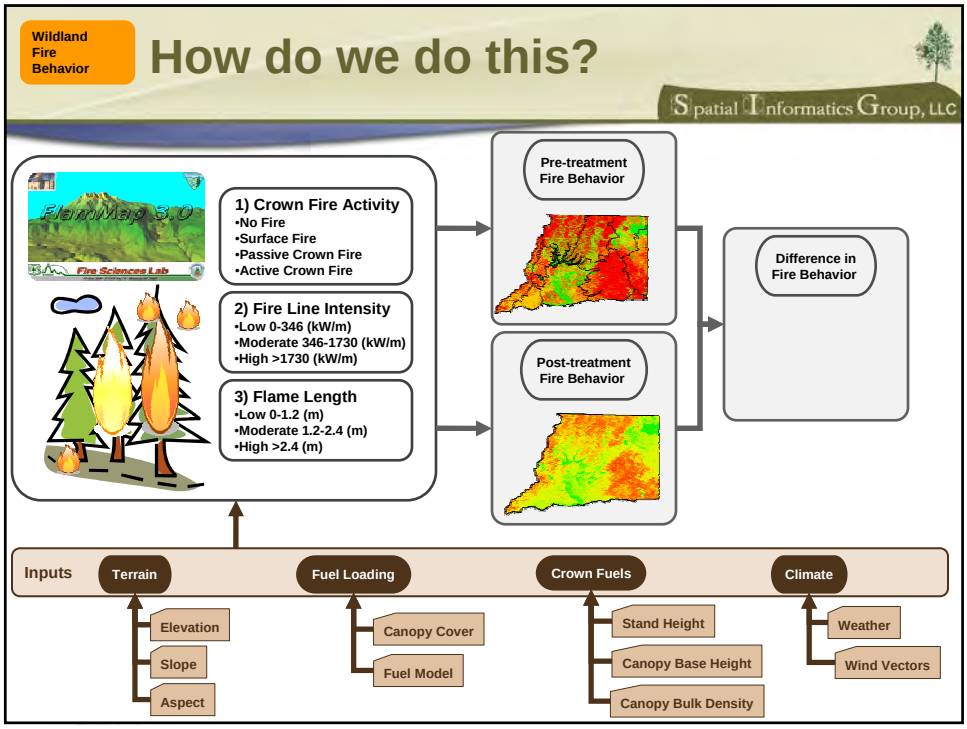
Wildland Fire Behavior

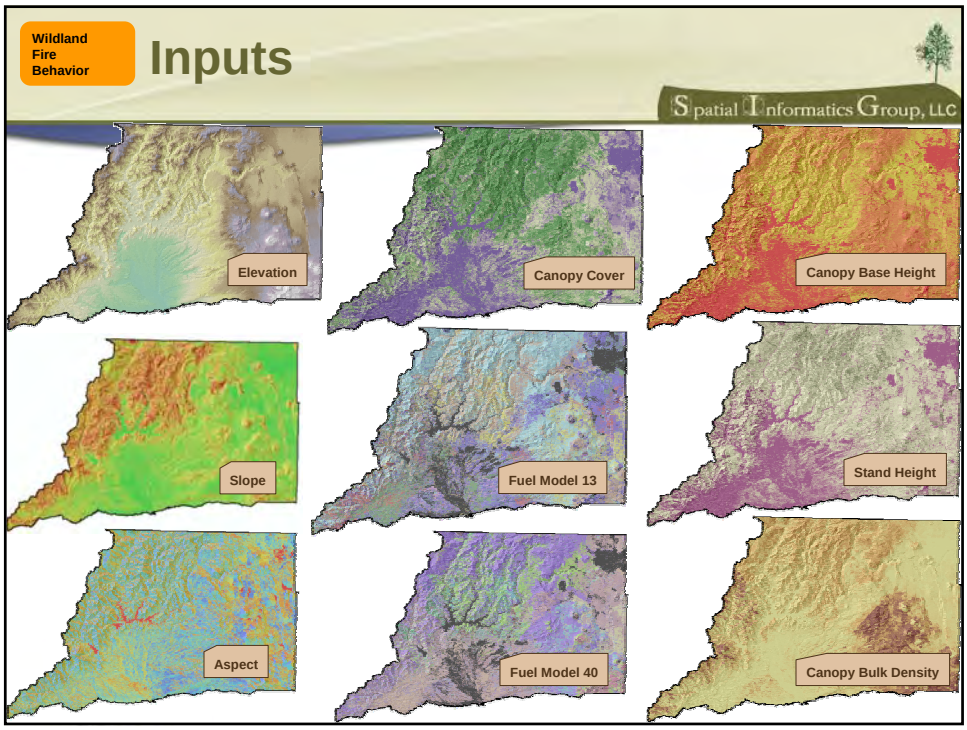
How do we do this?

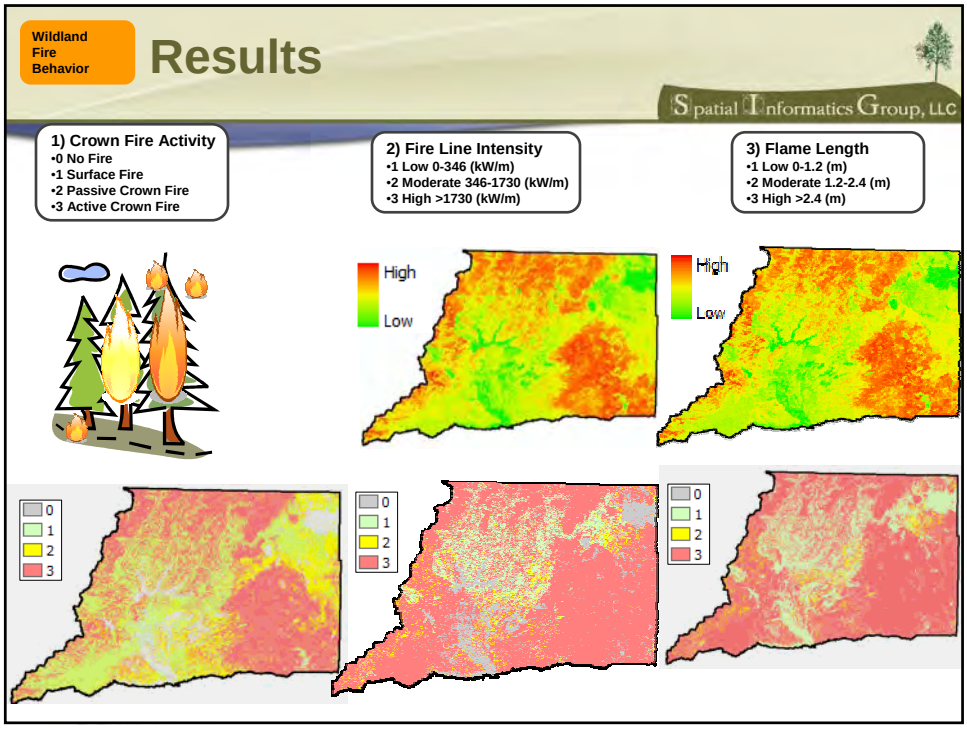
Spatial Informatics Group, LLC

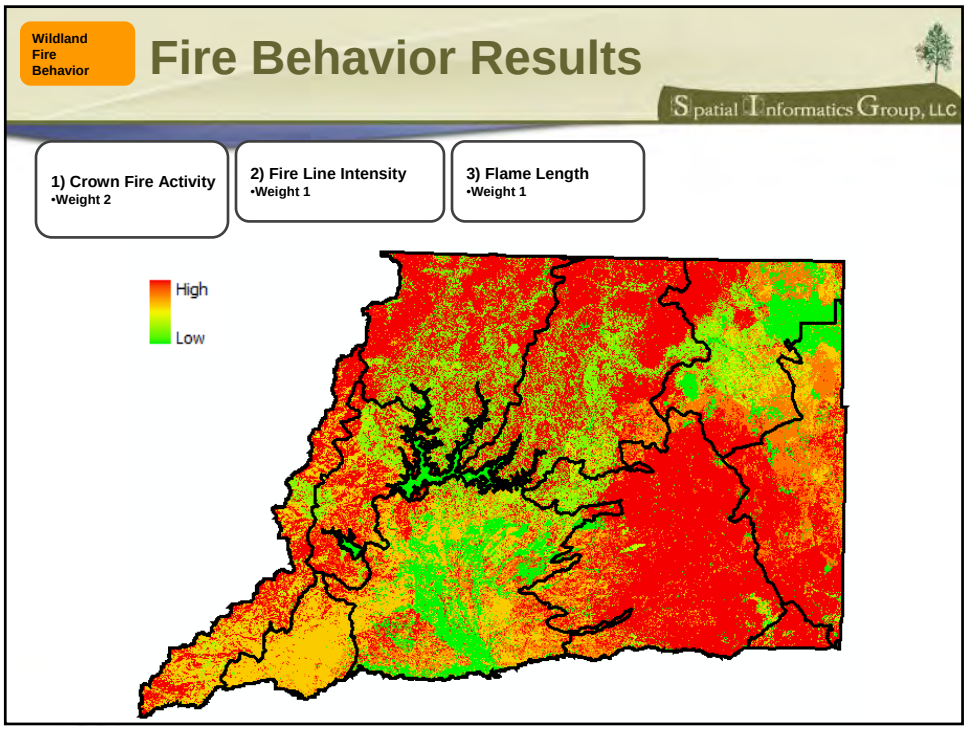





Wildland Fire Behavior
How do we do this?
Spatial Informatics Group, LLC
FlamMap 3.0
Fire Sciences Lab
1) Crown Fire Activity
•No Fire
•Surface Fire
•Passive Crown Fire
•Active Crown Fire
2) Fire Line Intensity
•Low 0-346 (kW/m)
•Moderate 346-1730 (kW/m)
•High >1730 (kW/m)
3) Flame Length
•Low 0-1.2 (m)
•Moderate 1.2-2.4 (m)
•High >2.4 (m)
Pre-treatment Fire Behavior
Post-treatment Fire Behavior
Difference in Fire Behavior
Inputs
Terrain
Elevation
Slope
Aspect
Fuel Loading
Canopy Cover
Fuel Model
Crown Fuels
Stand Height
Canopy Base Height
Canopy Bulk Density
Climate
Weather
Wind Vectors

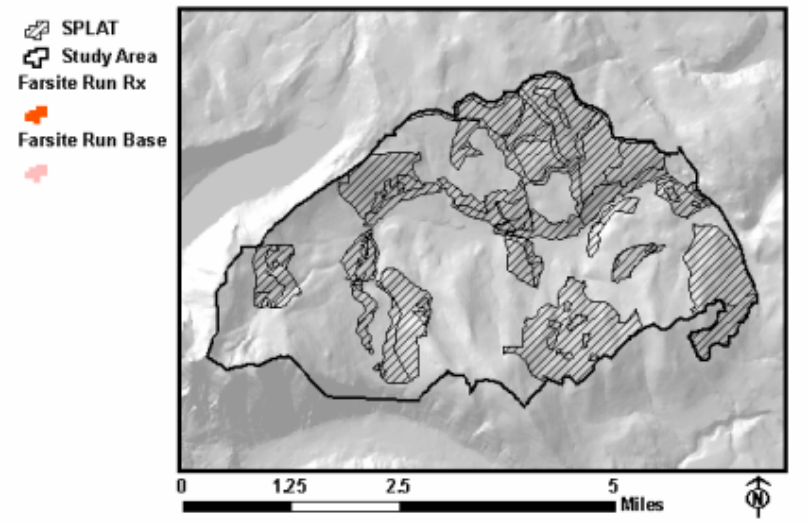

Wildland Fire Behavior
Inputs
Spatial Informatics Group, LLC
Elevation
Canopy Cover
Canopy Base Height
Slope
Fuel Model 13
Stand Height
Aspect
Fuel Model 40
Canopy Bulk Density


Wildland Fire Behavior
Results
Spatial Informatics Group, LLC
1) Crown Fire Activity
•0 No Fire
•1 Surface Fire
•2 Passive Crown Fire
•3 Active Crown Fire
2) Fire Line Intensity
•1 Low 0-346 (kW/m)
•2 Moderate 346-1730 (kW/m)
•3 High >1730 (kW/m)
3) Flame Length
•1 Low 0-1.2 (m)
•2 Moderate 1.2-2.4 (m)
•3 High >2.4 (m)
High
Low
0
1
2
3


Wildland Fire Behavior
Fire Behavior Results
Spatial Informatics Group, LLC
1) Crown Fire Activity
•Weight 2
2) Fire Line Intensity
•Weight 1
3) Flame Length
•Weight 1
High
Low

Sagehen: Shadow Effects

Spatial Informatics Group, LLC



Results: SPLAT Time Delay

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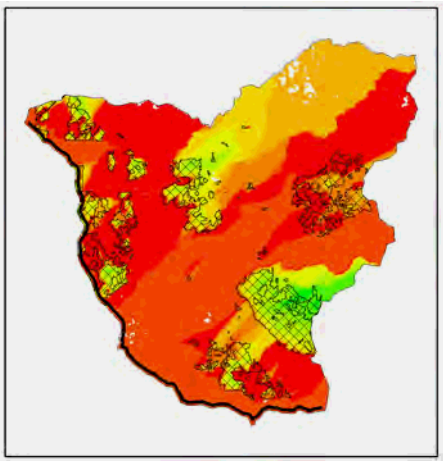
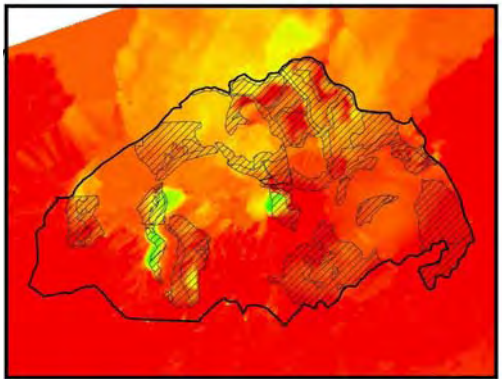
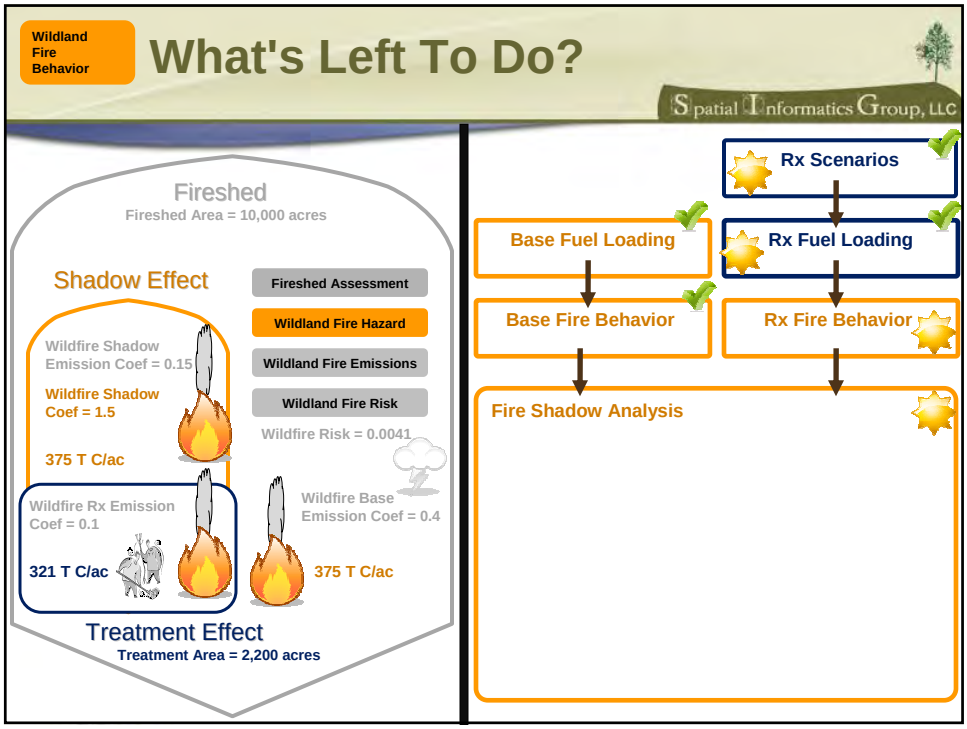
Kings River



Sagehen




Wildland Fire Behavior
What's Left To Do?
Spatial Informatics Group, LLC
Fireshed
Fireshed Area = 10,000 acres
Shadow Effect
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375 T C/ac
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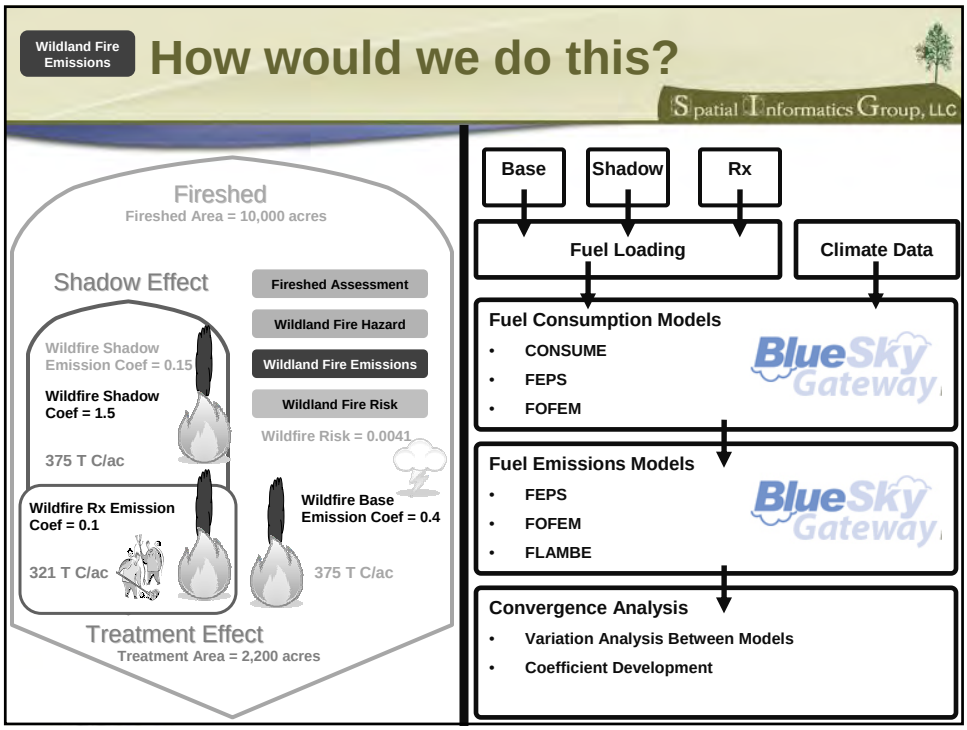
Treatment Effect
Treatment Area = 2,200 acres
Fireshed Assessment
Wildland Fire Hazard
Wildland Fire Emissions
Wildland Fire Risk
Wildfire Risk = 0.0041
Rx Scenarios
Base Fuel Loading
Rx Fuel Loading
Base Fire Behavior
Rx Fire Behavior
Fire Shadow Analysis


Wildland Fire Emissions
How would we do this?
Spatial Informatics Group, LLC
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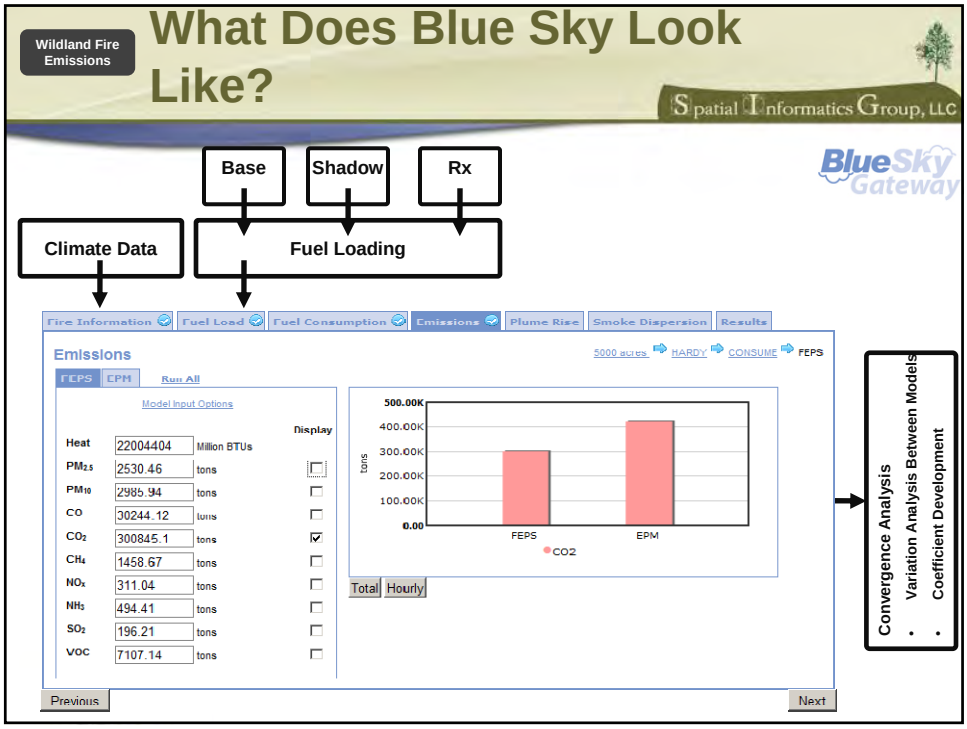
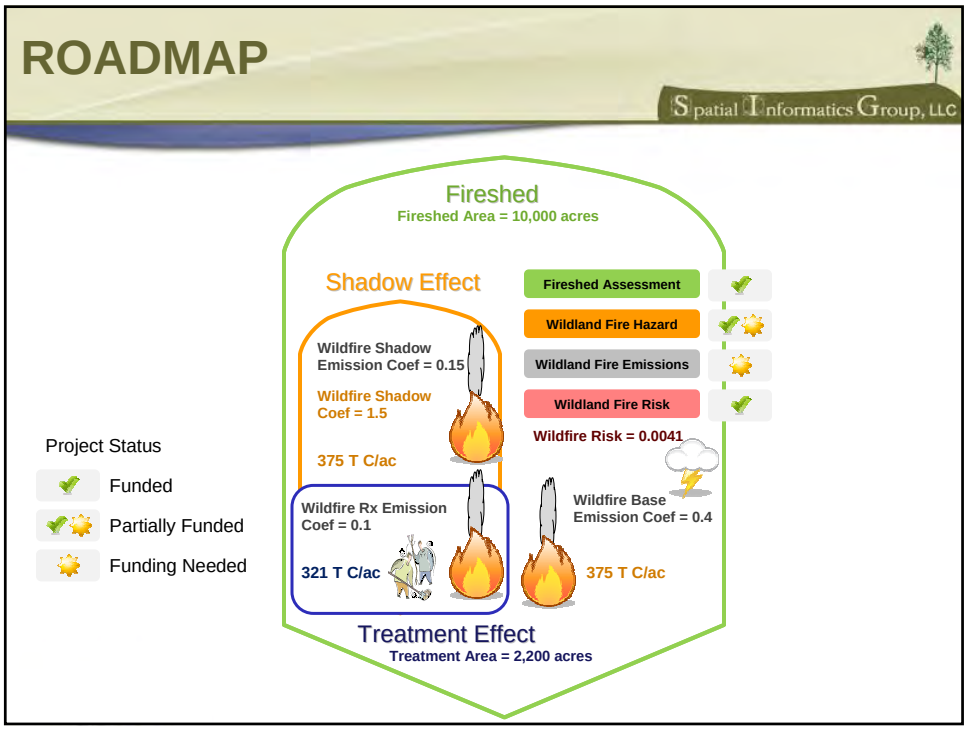
Wildland Fire Emissions
Wildland Fire Risk
Wildfire Risk = 0.0041
Base
Shadow
Rx
Fuel Loading
Climate Data
Fuel Consumption Models
CONSUME
FEPS
FOFEM
BlueSky Gateway
Fuel Emissions Models
FEPS
FOFEM
FLAMBE
BlueSky Gateway
Convergence Analysis
Variation Analysis Between Models
Coefficient Development


Wildland Fire Emissions
What Does Blue Sky Look Like?
Spatial Informatics Group, LLC
BlueSky Gateway
Base
Shadow
Rx
Climate Data
Fuel Loading
Fire Information
Fuel Load
Fuel Consumption
Emissions
Plume Rise
Smoke Dispersion
Results
Emissions
5000 acres
HARDY
CONSUME
FEPS
FEPS
EPM
Run All
Model Input Options
Display
Heat 22004404 Million BTUs
PM2.5 2530.46 tons
PM10 2985.94 tons
CO 30244.12 tons
CO2 300845.1 tons
CH4 1458.67 tons
NOx 311.04 tons
NH3 494.41 tons
SO2 196.21 tons
VOC 7107.14 tons
500.00K
400.00K
300.00K
200.00K
100.00K
0.00
tons
FEPS
EPM
CO2
Total
Hourly
Convergence Analysis
Variation Analysis Between Models
Coefficient Development
Previous
Next


ROADMAP
Spatial Informatics Group, LLC
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Wildland Fire Emissions
Wildland Fire Risk
Wildfire Risk = 0.0041
Treatment Effect
Treatment Area = 2,200 acres
Project Status
Funded
Partially Funded
Funding Needed

Questions…

Spatial Informatics Group, LLC

David Saah
- Kevin Deniz

Max Moritz
- Tadashi Moody
- Eric Waller
- Erica Newman

Mark Nechodom

David Ganz

John Kadyszewski
Sandra Brown
Tim Pearson
Katherine Goslee