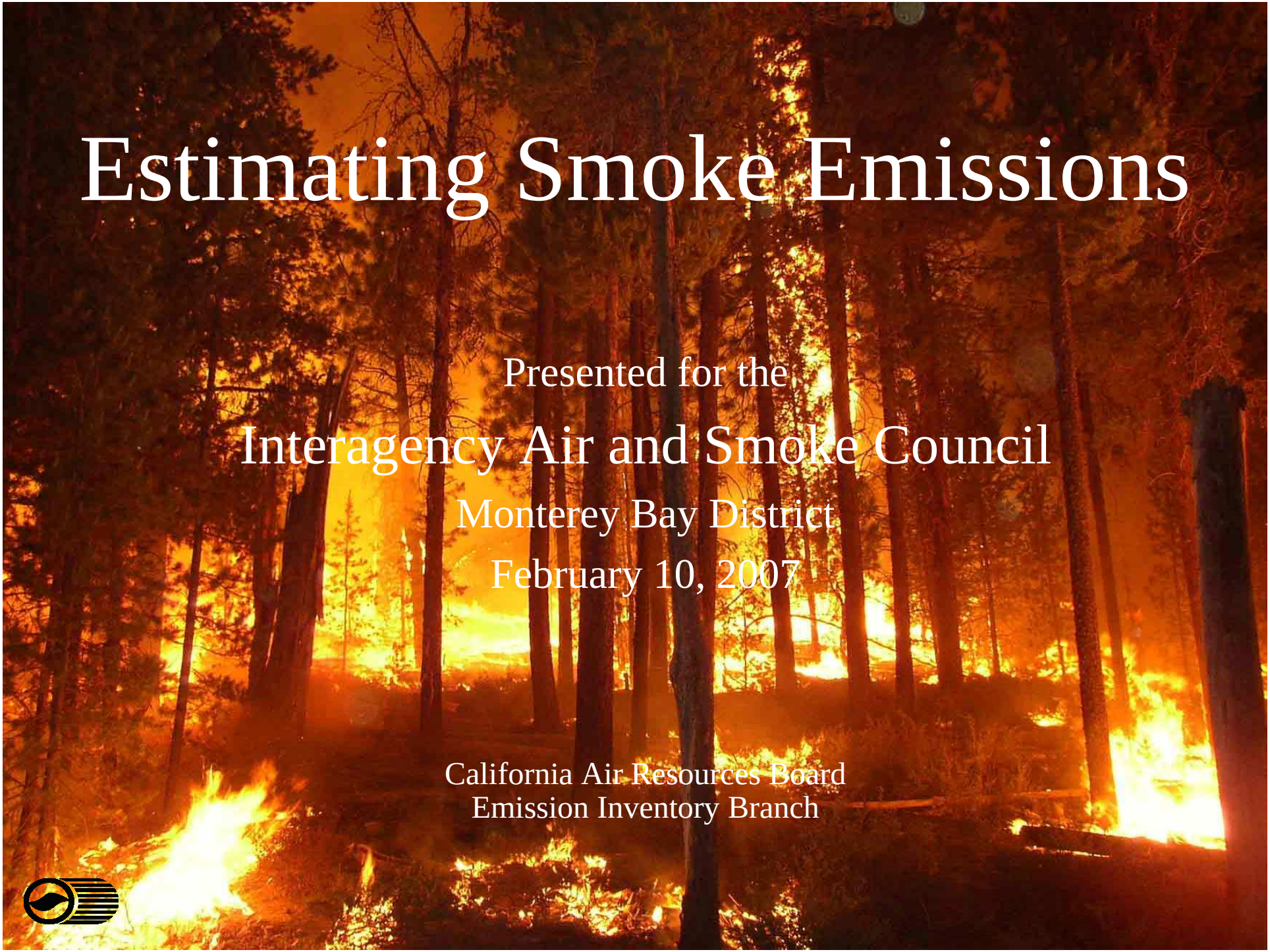


Estimating Smoke Emissions

Presented for the

Interagency Air and Smoke Council

Monterey Bay District

February 10, 2007

California Air Resources Board
Emission Inventory Branch

Links to Inventories and Methods

Methods - Smoke Emissions Estimation Web Page:

http://www.arb.ca.gov/ei/see/see.htm

Inventory – Almanac (snapshot of CEFS):

http://www.arb.ca.gov/html/aqe&m.htm

Inventories- CEIDARS & CEFS:

http://www.arb.ca.gov/app/emsinv/dist/

Overview

- Emission Inventory Structure
- Agricultural & Other Estimation Methodology
  - Emission Factors Table
  - Sample reporting spreadsheet
- Prescribed Burning Methodology
  - EES Model
  - Real Examples
- What's next…

Why We Estimate Emissions

- SIPs – State Implementation Plans
- Modeling – dispersion and photochemical
- Permit programs & SMP
- Projecting past & future conditions
- Analysis
  - Compare sources – top 25
  - Regional & seasonal variations
  - Transport

Area Wide Sources Miscellaneous Processes				**Natural Sources** (Non-Anthropogenic)
Managed Burning and Disposal (EIC)			Residential Fuel Combustion	Wildfires – All Vegetation
Ag Burning[1]	**Other Burning[2]**	**Prescribed Fire[3]**		
Ag-Field[a] *(670-662-0262-0000)*	Non-Ag Open Burning[g] *(670-670-0200-0000)*	Forest Management[d] *(670-666-0200-0000)*	Fireplaces (610-600-0230-0000)	Wildfires–All Vegetation (930-934-0200-0000)
Ag-Pruning[b] *(670-660-0262-0000)*	Other[h] *(670-995-0240-0000)*	WFU[e] *(670-667-0200-0000)*	Wood Stoves (610-600-0230-0000)	
Weed Abatement[c] *(670-668-0200-0000)*		Range Improvement[f] *(670-664-0200-0000)*		

1. Ag Burning -Burning related to agricultural activity

a. Ag-Field –Burning of field and row crop residue.

b. Ag-Pruning – Burning of orchard pruning/clippings.

c. Weed Abatement - Burning to control weeds, primarily in irrigation canals.

2. Other Burning - All other burning

g. Non-Ag Open Burning – backyard or barrel burning of waste.

h. Other – other types of permitted burning such as diseased animals and flood debris.

3. Prescribed Burning - Burning related to public land management, primarily forest

d. Forest Management - Prescribed forest burning primarily by public land management agencies. This category also includes pile burning.

e. WFU (Wildland Fire Use) Fire – A lightning ignited fire managed for resources benefit (unsuppressed).

f. Range Improvement – primarily the burning of grass and chaparral for cattle grazing.

Types of Inventories

Planning Inventory

- Monthly by County, Air Basin and District
- CEIDARS
- CEFS
- Almanac

Modeling Inventory

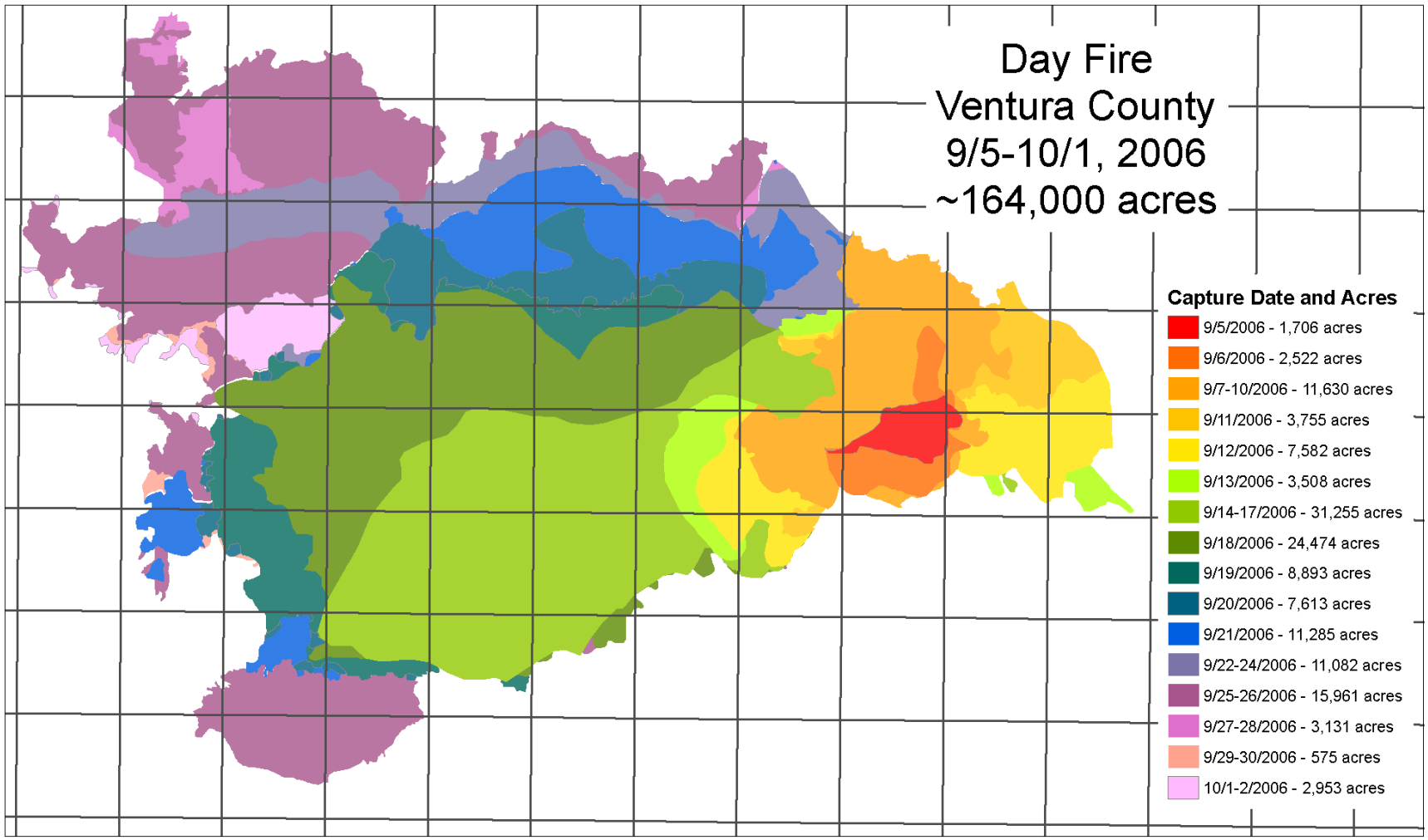
- 4km grid cell statewide
- Daily
- Diurnal variation – 24 hrs
- Vertical distribution of smoke
- For episodes only

Sample Inventory Query

2006 Almanac

EMISSIONS INVENTORY CATEGORY	TOG	ROG	CO	NOX	SOX	PM	PM10	PM2.5
670-660-0262-0000 Methodology 660-AGRICULTURAL BURNING - PRUNINGS 0262-AGRICULTURAL WASTE 0000-SUB-CATEGORY UNSPECIFIED	12.55	7.64	70.17	3.95	0.01	8.41	8.26	7.79
670-662-0262-0000 Methodology 662-AGRICULTURAL BURNING - FIELD CROPS 0262-AGRICULTURAL WASTE 0000-SUB-CATEGORY UNSPECIFIED	15.59	9.08	96.01	2.79	0.31	11.57	11.39	10.85
670-664-0200-0000 Methodology 664-RANGE IMPROVEMENT 0200-SOLID FUEL (UNSPECIFIED) 0000-SUB-CATEGORY UNSPECIFIED	39.59	22.56	309.40	3.88	-	45.69	44.89	42.57
670-666-0200-0000 Methodology 666-FOREST MANAGEMENT 0200-SOLID FUEL (UNSPECIFIED) 0000-SUB-CATEGORY UNSPECIFIED	43.57	24.82	671.48	2.05	0.02	47.39	45.76	40.51
670-667-0200-0000 667-WILDLAND FIRE USE (WFU) 0200-SOLID FUEL (UNSPECIFIED) 0000-SUB-CATEGORY UNSPECIFIED	74.35	47.31	675.87	20.30	6.26	97.42	68.19	57.87
670-668-0200-0000 Methodology 668-WEED ABATEMENT 0200-SOLID FUEL (UNSPECIFIED) 0000-SUB-CATEGORY UNSPECIFIED	6.56	3.74	40.92	1.40	0.18	5.76	5.66	5.38
670-670-0200-0000 Methodology 670-NON-AGRICULTURAL OPEN BURNING 0200-SOLID FUEL (UNSPECIFIED) 0000-SUB-CATEGORY UNSPECIFIED	14.08	5.87	46.33	1.84	0.31	7.38	7.25	6.87
670-995-0240-0000 Methodology 995-OTHER 0240-SOLID WASTE (UNSPECIFIED) 0000-SUB-CATEGORY UNSPECIFIED	0.84	0.58	6.93	0.28	0.06	0.88	0.86	0.82
TOTAL	207.13	121.60	1917.11	36.50	7.15	224.50	192.26	172.64

Gridded Outputs for Modeling Inventory



Title 17 Reporting Requirements

Smoke Management Guidelines for Agricultural and Prescribed Burning

Title 17 - California Code of Regulations

Effective: March 14, 2001

§80130. Burning Report.

(a) A report of agricultural burning, including prescribed burning, conducted pursuant to these Guidelines during each calendar year shall be submitted to the ARB by each air district within 45 days of the end of each calendar year. The report shall include the estimated tonnage or acreage of each waste type burned from open burning in agricultural operations and the estimated tonnage of waste from prescribed burning, and the county where the burning was performed.

(b) A report of special permits issued pursuant to subsection (e) of section 80120 during each calendar year shall be submitted to the ARB by each air district within 45 days of the end of the calendar year. The report shall include the number of such permits issued, the date of issuance of each permit, the person or persons to whom the permit was issued, an estimate of the amount of wastes burned pursuant to the permit, and a summary of the reasons why denial of each permit would have threatened imminent and substantial economic loss, including the nature and dollar amounts of such loss.

(c) The ARB Executive Officer may, on a district-by-district basis, alter the frequency or contents of the reports required pursuant to subsections (a) and (b) of this section, based on information needed to conduct or evaluate smoke management programs. The Executive Officer shall provide a justification and reasonable schedule for implementing any revisions.

Category Responsibility

*** AREAWIDE SOURCES ***

MISCELLANEOUS PROCESSES

MANAGED BURNING AND DISPOSAL ---------- D

670,660,0262,0000	AGRICULTURAL BURNING - PRUNINGS	47241	
670,662,0262,0000	AGRICULTURAL BURNING - FIELD CROPS	47258	
670,664,0200,0000	RANGE IMPROVEMENT	47282	
670,666,0200,0000	FOREST MANAGEMENT	47274	
670,667,0200,0000	WILDLAND FIRE USE (WFU)	90142	B
670,668,0200,0000	WEED ABATEMENT	47266	
670,670,0200,0000	NON-AGRICULTURAL OPEN BURNING	47290	
670,995,0240,0000	WASTE BURNING (UNSPECIFIED)	82131	

*** NATURAL (NON-ANTHROPOGENIC) SOURCES ***

NATURAL SOURCES

WILDFIRES ---------- B

930,934,0200,0000	WILDFIRES - ALL VEGETATION	90035

What does ARB need to update emission inventory?

Agricultural and Other Burning

- Crop - crop code, crop type and EIC category
- Location - County, Air Basin, District and Latitude/Longitude
- Activity – acres
- Date - year, month, and day
- Emissions

Forest Burning – Rx and Wildfires

- GIS shapefiles (daily polygons if available)
- Ignition and end date
- Fire name

Update all EIC or rollover

Estimating Emissions
Agricultural and Other Burning

Emission Factor Table Categories

Agricultural Burning – Pruning (orchards)

Agricultural Burning – Field Crops (row crop)

Weed Abatement - roadside, canals, fence line etc.

Range Improvement - chaparral, grass lands, and grazing land

Other (unspecified) - flood debris, raisin trays

Emission Factor Table

Crop Code	Crop Name	EIC Description	EIC Code	Emission Factors (lbs/ton) PM10	PM25	NOX	SO2	VOC	CO	Fuel Loading (tons/acre)
Agriculture - Field Crops										
241	Alfalfa	Agriculture - Field Crop	670-662-0262-00	28.50	27.20	4.50	0.60	21.70	119.00	0.800
247	Asparagus	Agriculture - Field Crop	670-662-0262-00	40.00	39.34	4.49	0.61	66.00	150.00	1.500
242	Barley	Agriculture - Field Crop	670-662-0262-00	14.30	13.80	5.10	0.10	15.00	183.70	1.700
243	Bean/pea	Agriculture - Field Crop	670-662-0262-00	13.70	13.00	5.20	0.10	14.20	148.00	2.500
244	Corn	Agriculture - Field Crop	670-662-0262-00	11.40	10.90	3.30	0.40	6.60	70.90	4.200
245	Cotton	Agriculture - Field Crop	670-662-0262-00	15.90	15.18	4.49	0.61	10.73	113.95	2.175
609	Dried flowers	Agriculture - Field Crop	670-662-0262-00	15.90	15.18	4.49	0.61	10.73	113.95	2.175
246	Flax	Agriculture - Field Crop	670-662-0262-00	15.90	15.18	4.49	0.61	10.73	113.95	2.175
609	Flower straw	Agriculture - Field Crop	670-662-0262-00	15.90	15.18	4.49	0.61	10.73	113.95	2.175
612	Nursery prunings	Agriculture - Field Crop	670-662-0262-00	15.90	15.18	4.49	0.61	10.73	113.95	2.175
248	Oats	Agriculture - Field Crop	670-662-0262-00	20.70	19.70	4.50	0.60	10.30	136.00	1.600
255	Other field crops	Agriculture - Field Crop	670-662-0262-00	15.90	15.18	4.49	0.61	10.73	113.95	2.175
260	Pea vines	Agriculture - Field Crop	670-662-0262-00	13.70	13.00	5.20	0.10	14.20	148.00	2.500
249	Peanuts	Agriculture - Field Crop	670-662-0262-00	15.90	15.18	4.49	0.61	10.73	113.95	2.175
250	Rice	Agriculture - Field Crop	670-662-0262-00	6.30	5.90	5.20	1.10	4.70	57.40	3.000
251	Rye	Agriculture - Field Crop	670-662-0262-00	15.90	15.18	4.49	0.61	10.73	113.95	2.175
252	Safflower	Agriculture - Field Crop	670-662-0262-00	17.70	16.90	4.50	0.60	14.80	144.00	1.300

Example Equation
Emission Factor Table

10 acres Apricot – **Code # 103** (Pruning)

Fuel Loading Factor:	(10 ac)*(1.8 tons/ac) = 18 tons Apricot prunings
PM10 Emission Factor:	(18 tons)*(5.9 lbs PM10/ton) = 106.2 lbs PM10
Convert lbs to tons:	(106.2 lbs)*(1 ton/2000lbs) = 0.0531 tons PM10

250 acres Ditchbank and Canal – **Code # 362** (Weed Abatement)

Fuel Loading Factor:	(250 ac)*(2.175 tons/ac) = 543.75 tons
VOC Emission Factor:	(543.75 tons)*(10.73 lbs VOC/ton) = 5,834.44 lbs VOC
Convert lbs to tons :	(5,834.44 lbs)*(1 ton/2000lbs) = 2.9172 tons VOC

Sample Reporting Spreadsheet

Date:	*date*
Compiled by:	*staff name, title, phone number*

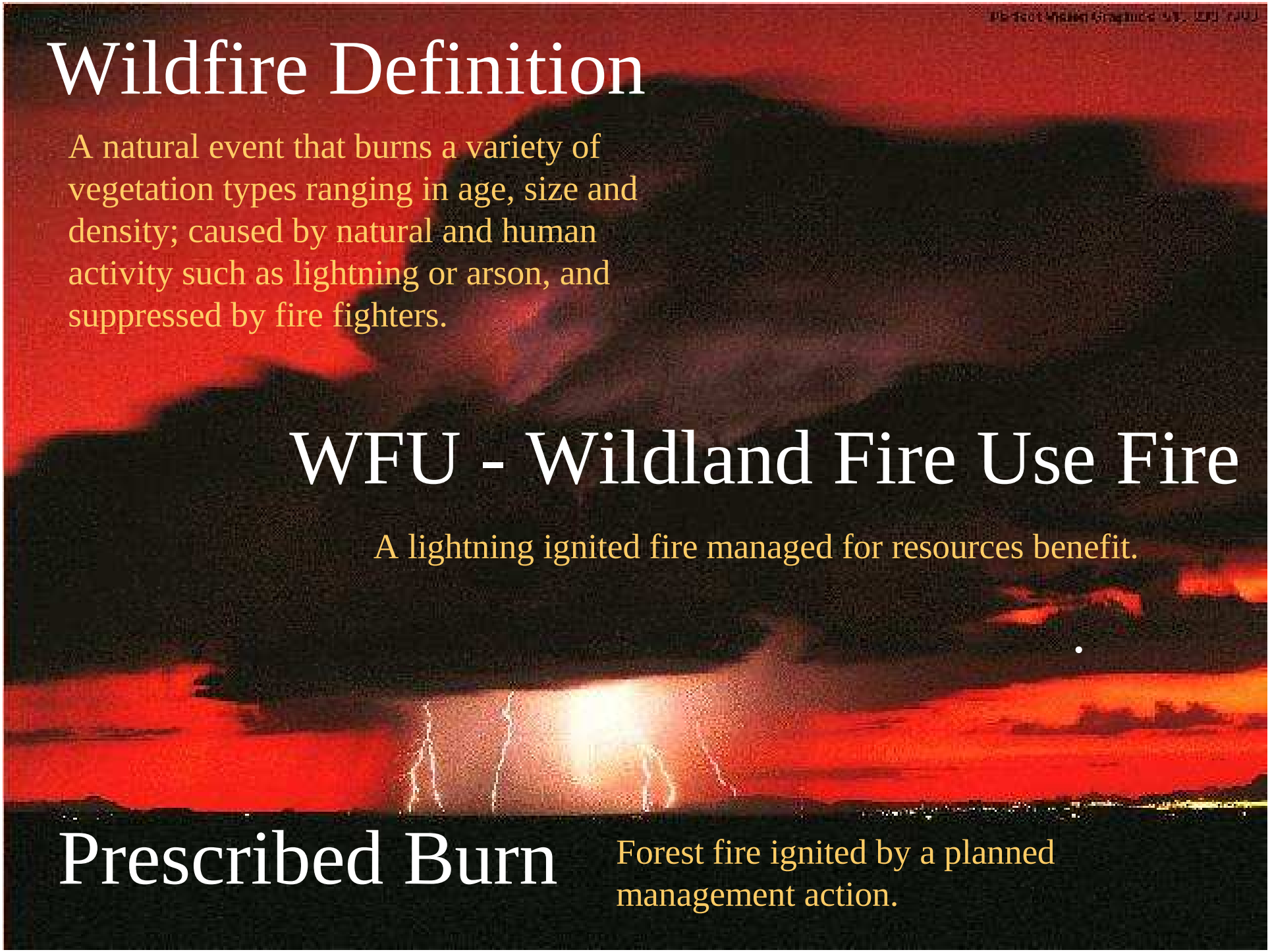
Directions:
This is an example spreadsheet for reporting agricultural and other burning inventory data to ARB. Please fill in the blue fields using the pull-down menus where provided while the light gray fields are self populating.

Unique_ID	Air Basin	District	County Name	County_Nu	Crop_Name	Crop_Code	EIC_Name	EIC_Code	Acres
1	LAKE TAHOE	Bay Area AQMD	BUTTE	4	Apple	102	Agriculture - Prunin	670-660-0262-0	100
2	Salton Sea		COLUSA	6	Wheat	254	Agriculture - Field C	670-662-0262-0	12
3	Salton Sea		CALAVERAS	5	Almond	101	Agriculture - Prunin	670-660-0262-0	5
				###		#N/A	#N/A	#N/A	
				###		#N/A	#N/A	#N/A	
				###		#N/A	#N/A	#N/A	
				###		#N/A	#N/A	#N/A	
				###		#N/A	#N/A	#N/A	
				###		#N/A	#N/A	#N/A	
				###		#N/A	#N/A	#N/A	
				###		#N/A	#N/A	#N/A	
				###		#N/A	#N/A	#N/A	

Emission Estimation System
EES Model

Overview

- EES Model - how it works
- Spatial GIS component
- Inputs
- Methods
- User adjusted perimeters - user interface
- Assumptions
- Results



Wildfire Definition

A natural event that burns a variety of vegetation types ranging in age, size and density; caused by natural and human activity such as lightning or arson, and suppressed by fire fighters.

WFU - Wildland Fire Use Fire

A lightning ignited fire managed for resources benefit.

.

Prescribed Burn

Forest fire ignited by a planned management action.

Forest Burn Emission Estimates

- **GIS -** Geographic Information System
- **EES -** Emission Estimation System (EES)
- Emission calculation methodology – FOFEM
- Emission Factors - ARB & FOFEM
- Moisture Input – WFAS Th-FM
- Activity data – GIS shapefiles
- Vegetation Input – GAP Layer
- EI Categories - Wildfires, Rx, & WFU

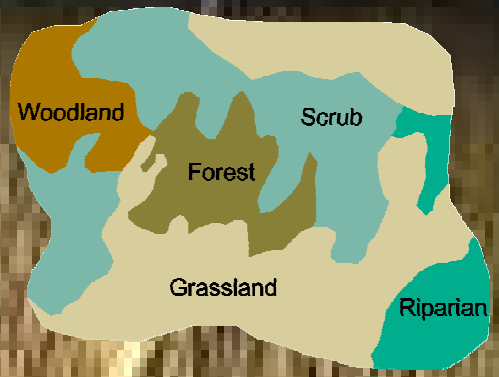
Inputs

- FOFEM 4.0 - U.S. Forest Service FOFEM (First Order Fire Effects Model)
  - Smoke emission estimation methodology
  - Fuel loading by fuel component crosswalked to CA vegetation
- GAP Layer - vegetation landcover of CA
- Thousand-Hour Fuel Moisture Grid - moisture input
- Emission Factors - PM10, PM2.5, CO, TNMCH, CH4, NH3, NOx, SO2
- Fire Perimeter Footprint
  - GIS shapefiles input
  - Digitize, on the fly

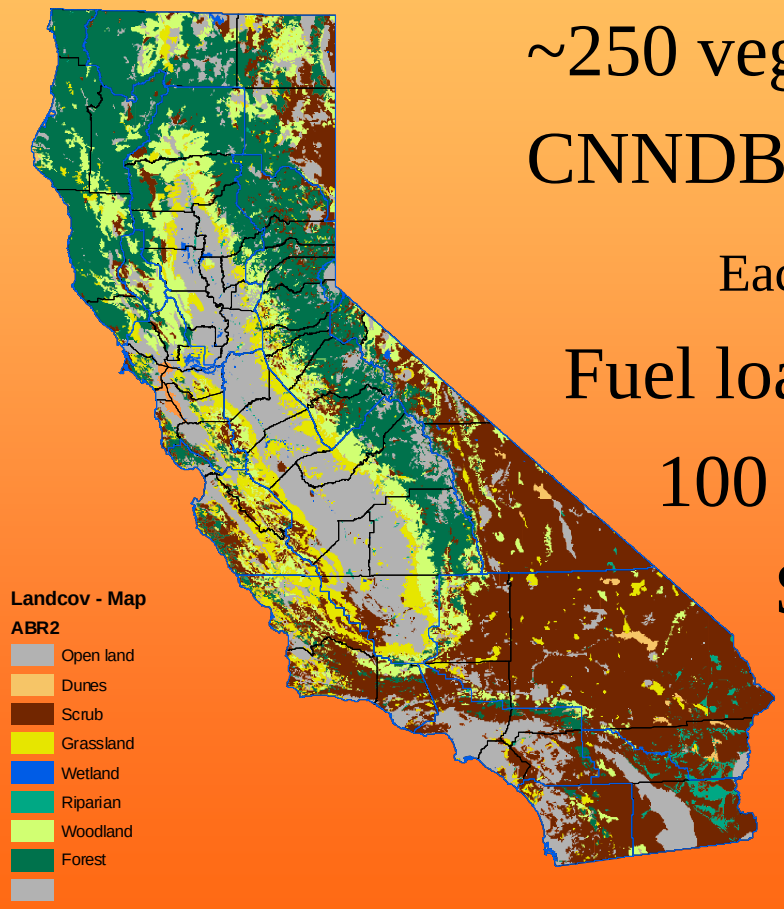
Wildfire footprint is overlaid on GAP vegetation layer, calculating the amount of each fuel consumed in the fire. Fuel loading is assigned for each fuel component that make up the vegetation type.

+

=



GAP Vegetation



~250 vegetation types

CNNDB classification

Each crosswalked to fuel model

Fuel loading - typical, sparse & abundant

100 hectare minimum mapping unit

Statewide data

Fuel Models

Fuel Loading by fuel Components

Vegetation Type
fuel loading by fuel component
(Tons/Acre)

- Canopy fuels
- Ladder fuels
- Shrub
- Regeneration
- Herbaceous
- 0-1 inch diameter down wood
- 1-3 inch diameter down wood
- 3+ inch diameter down wood
- Litter
- Duff

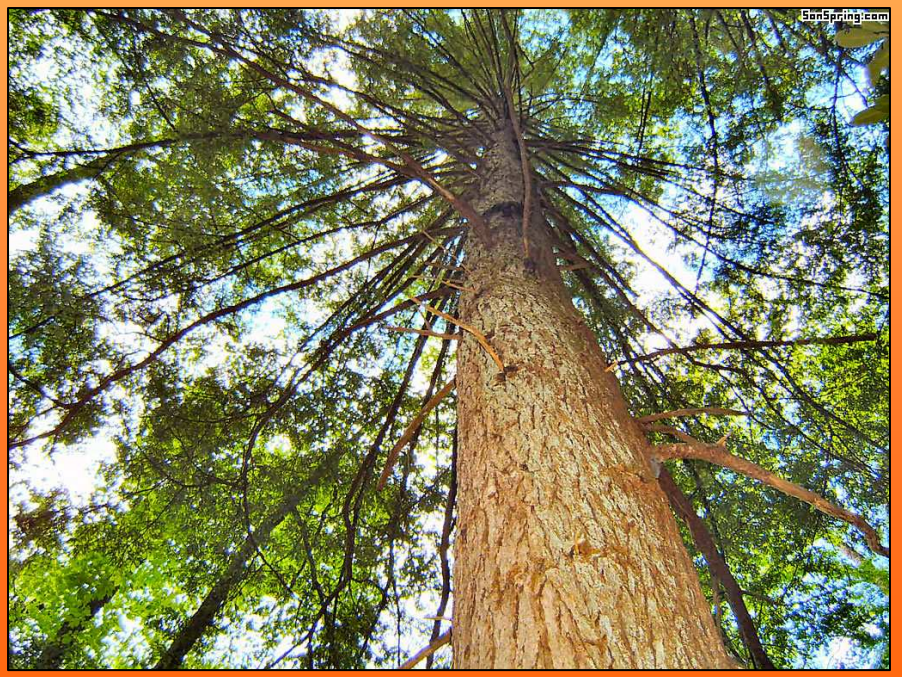
Fuel Components Cont…

Canopy Fuels

Tree Tops

Lateral Fuels

Ladder branches along a tree that lead to canopy



Fuel Components Cont…

Shrubs
Brush - Chaparral

Herbaceous
Grass

Regeneration
Saplings & New Growth

Fuel Components Cont…

Dead and down woody fuel

- 3 + inch diameter (Thousand hour fuels)
- 1-3 inch diameter
- 0-1 inch diameter

Fuel Components Cont…

Litter

Forest floor litter

Pine cones & needles

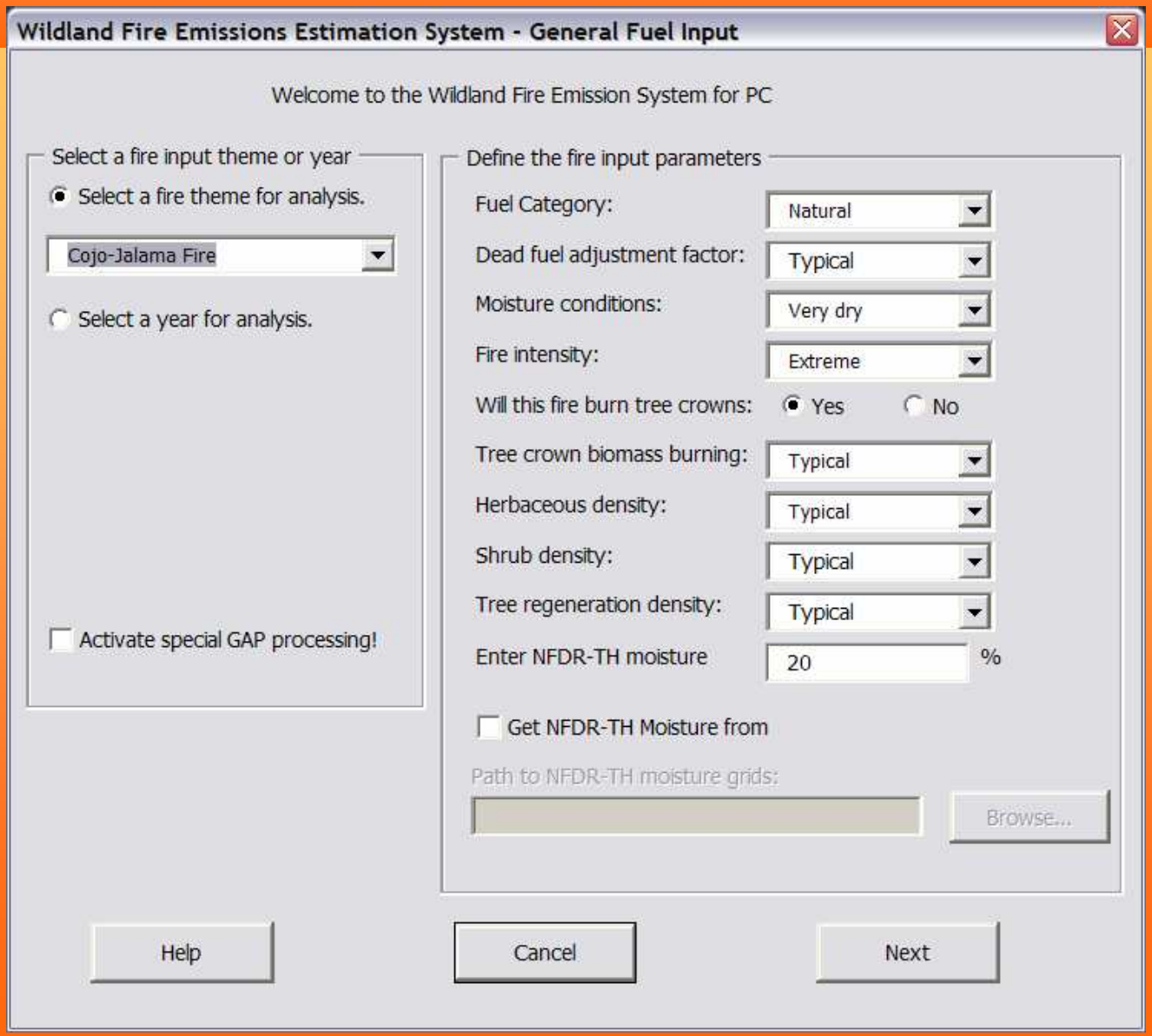
Duff

Partially decomposed organic matter beneath litter

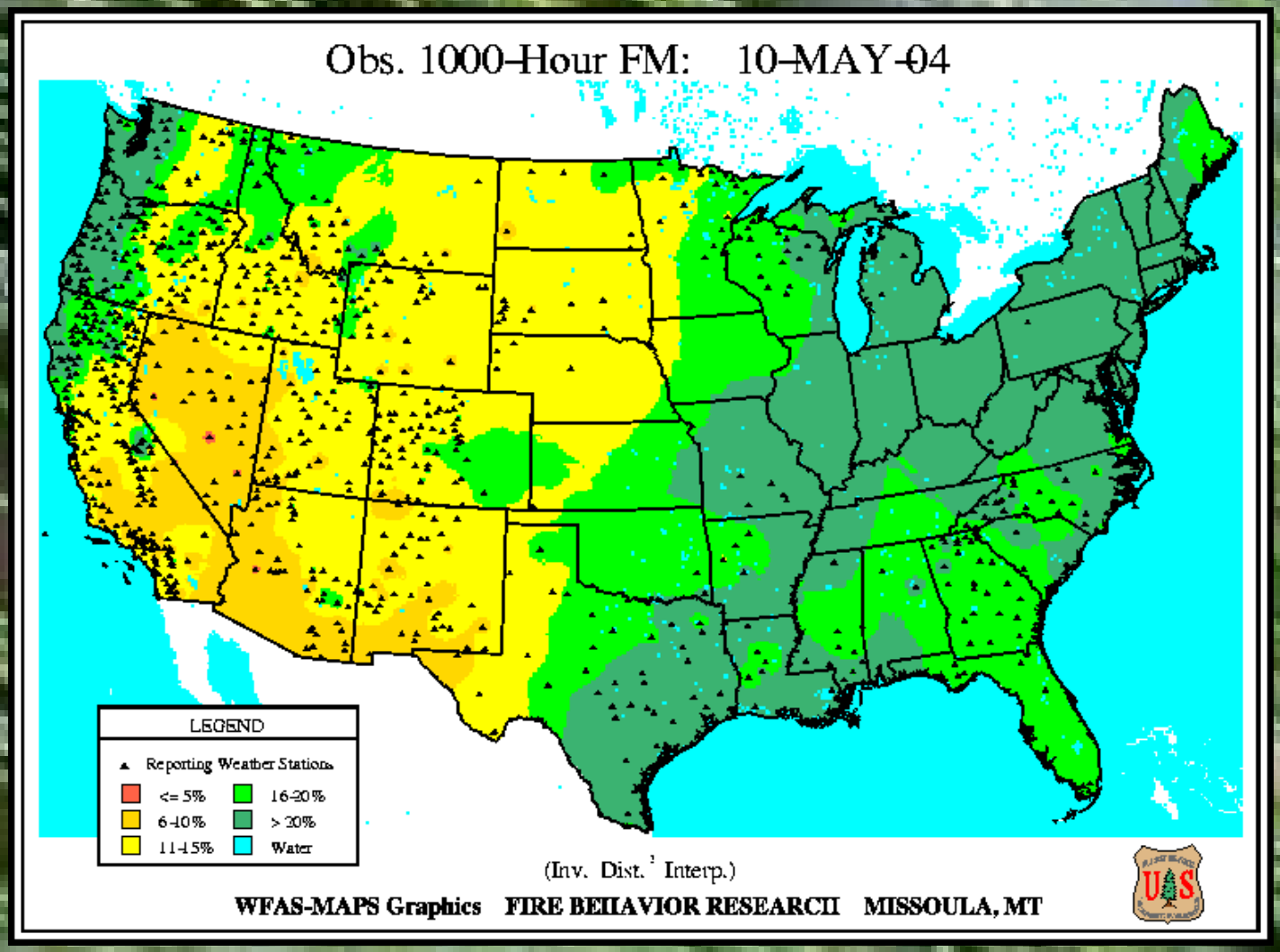
Emission Factors
by fuel component
(lbs/ton)

	PM10			PM2.5			N2O			CH4			CO2		
Fuel Component	**Wet**	**Mod**	**Dry**	**Wet**	**Mod**	**Dry**	**Wet**	**Mod**	**Dry**	**Wet**	**Mod**	**Dry**	**Wet**	**Mod**	**Dry**
Litter, wood 0-1 in	9.3	9.3	9.3	7.9	7.9	7.9	0.5	0.5	0.5	2.1	2.1	2.1	3,482.7	3,482.7	3,482.7
Wood 1-3 in	14	14	14	11.9	11.9	11.9	0.5	0.5	0.5	4.5	4.5	4.5	3,372.7	3,372.7	3,372.7
Wood 3+ in	26.6	21.6	19.1	22.5	18.3	16.2	0.4	0.4	0.4	10.8	8.2	7	3,079.4	3,196.8	3,255.4
Herb, shrub, regen	25.1	25.1	25.1	21.3	21.3	21.3	0.4	0.4	0.4	10	10	10	3,116.1	3,116.1	3,116.1
Duff	28.2	30.4	30.4	23.9	25.8	25.8	0.4	0.4	0.4	11.5	12.6	12.6	3,042.8	2,991.5	2,991.5
Canopy Fuels	25.1	25.1	25.1	21.3	21.3	21.3	0.4	0.4	0.4	10	10	10	3,116.1	3,116.1	3,116.1
	TNMHC			**NH3**			**NOx**			**SO2**			**CO**		
Fuel Component	**Wet**	**Mod**	**Dry**	**Wet**	**Mod**	**Dry**	**Wet**	**Mod**	**Dry**	**Wet**	**Mod**	**Dry**	**Wet**	**Mod**	**Dry**
Litter, wood 0-1 in	3.7	3.7	3.7	0.5	0.5	0.5	8.2	8.2	8.2	2.5	2.5	2.5	52.4	52.4	52.4
Wood 1-3 in	7.8	7.8	7.8	1.1	1.1	1.1	8	8	8	2.5	2.5	2.5	111.4	111.4	111.4
Wood 3+ in	18.8	14.4	12.2	2.7	2.1	1.7	7.3	7.6	7.7	2.2	2.3	2.4	268.9	205.8	174.4
Herb, shrub, regen	17.4	17.4	17.4	2.5	2.5	2.5	7.4	7.4	7.4	2.3	2.3	2.3	249.2	249.2	249.2
Duff	20.2	22.1	22.1	2.9	3.2	3.2	7.2	7.1	7.1	2.2	2.2	2.2	288.6	316.1	316.1
Canopy Fuels	17.4	17.4	17.4	2.5	2.5	2.5	7.4	7.4	7.4	2.3	2.3	2.3	249.2	249.2	249.2

EES Parameters

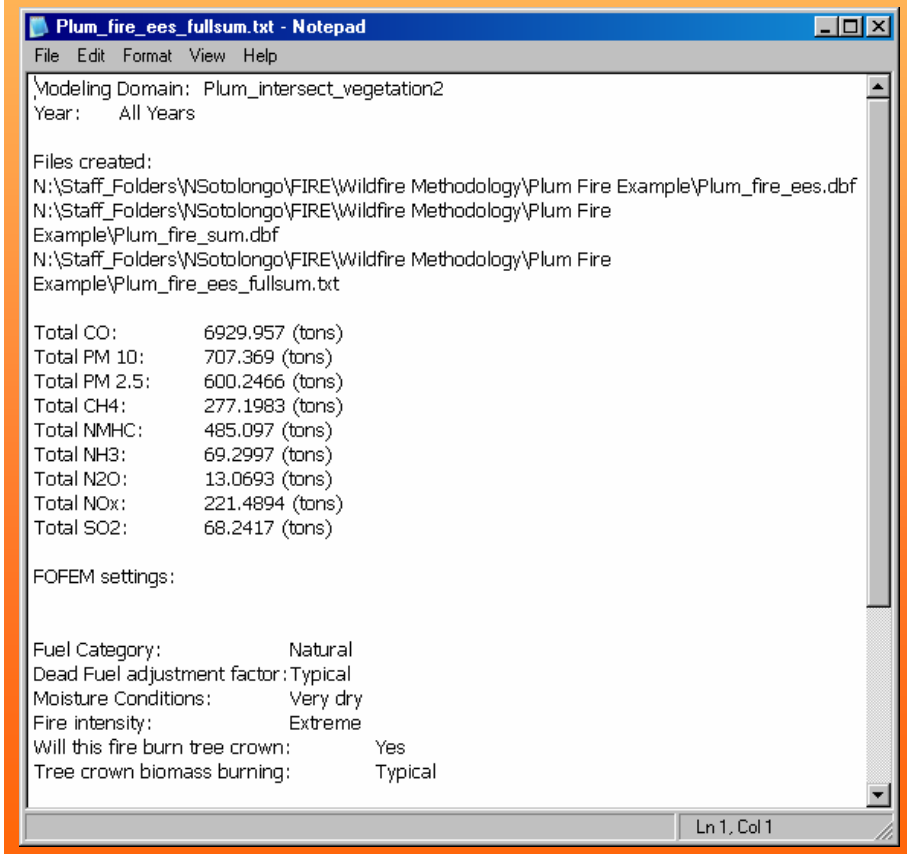


Thousand-Hour Fuel Moisture



Outputs Files

EES_fullsum.txt:



EES_sum.dbf

Emissions by fire polygon

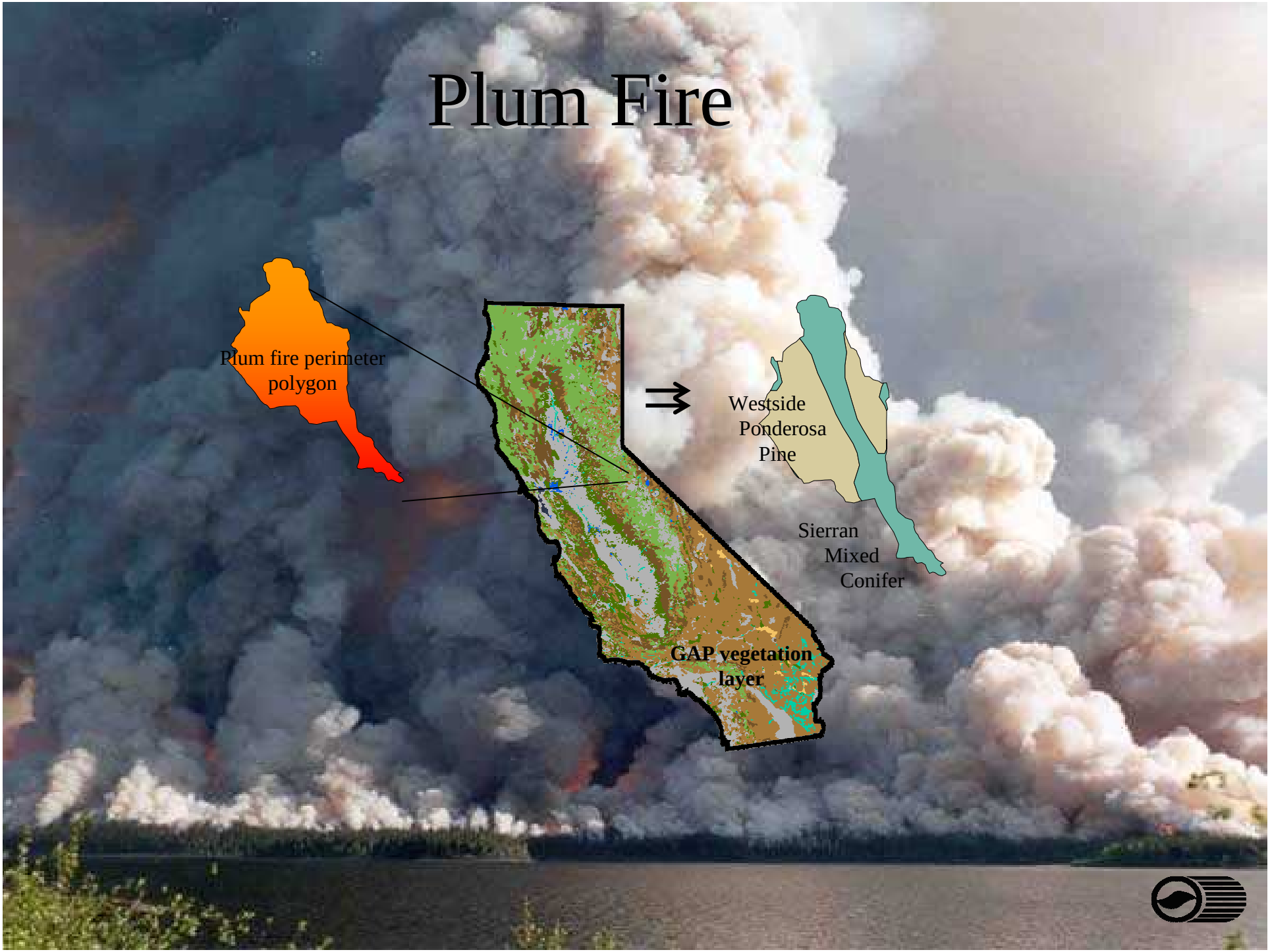
EES.dbf - Most detailed

- Fuel loading and emissions by
  - Vegetation classification
  - Fuel component
  - Fire polygon
- Acres of each veg type by polygon

Example 1 - Plum Fire

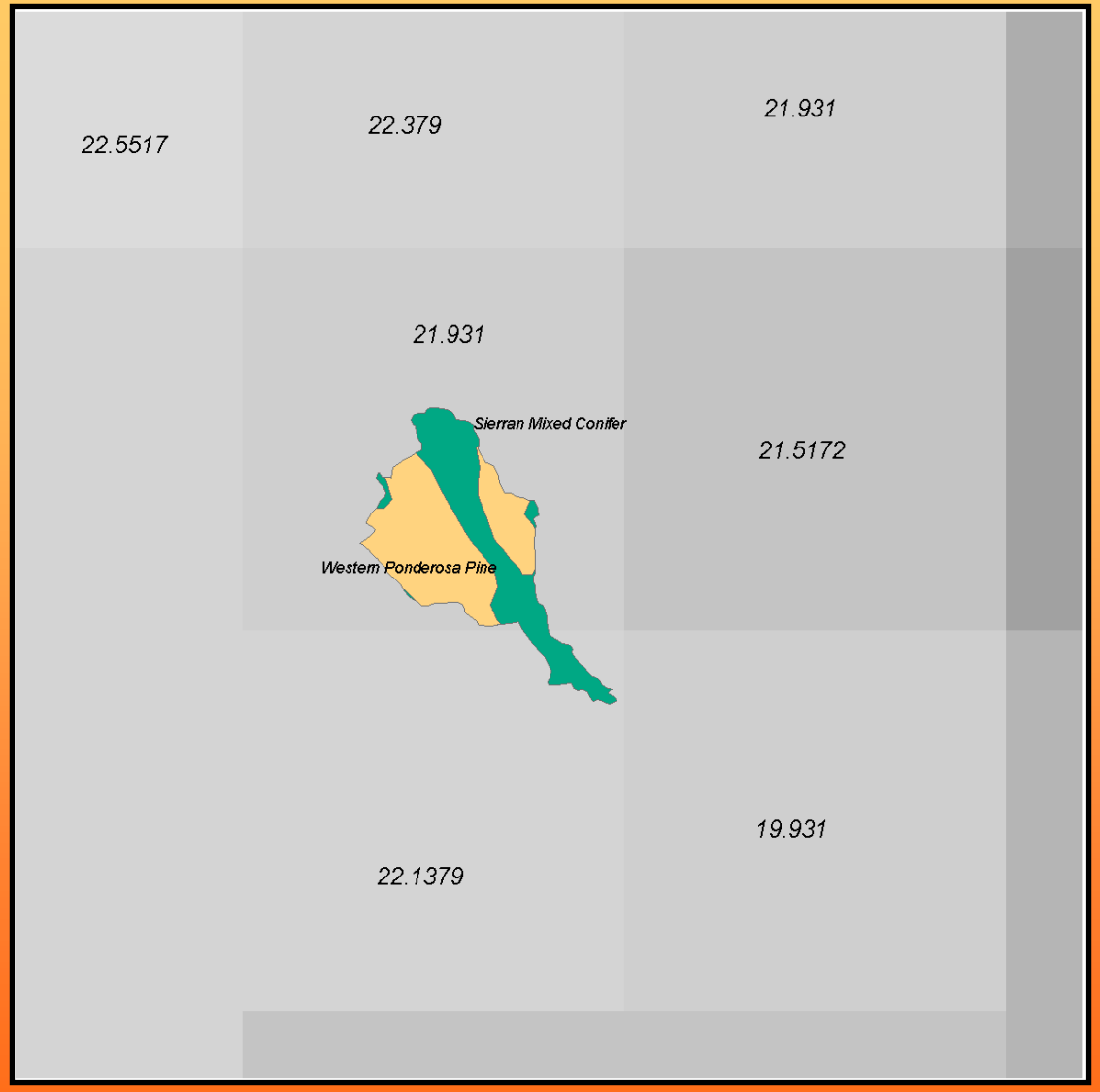
Fire Name:	Plum Fire
Date:	November 12, 2002
Size:	1762 acres
Location:	El Dorado County
	Mountain Counties AB
Elevation:	~5000 ft
Vegetation:	Sierran Mixed Conifer
	Western Ponderosa Pine

Plum Fire


Plum fire perimeter polygon
Westside Ponderosa Pine
Sierran Mixed Conifer
GAP vegetation layer

Fuel Components Consumption

	Sierra Nevada Mixed Conifer		
Fuel Component	**Fuel Loading**	**Consumption Assumption**	**Total Consumed**
Litter	*1.8*	100%	*1.8*
Wood 0-1 inch	*1.3*	90%	*1.2*
Wood 1-3 inch	*1.9*	65%	*1.2*
Wood 3+ inch	*32.0*	NFDR-TH	NFDR-TH
Duff	*56.0*	NFDR-TH	NFDR-TH
Herbaceous	*0.2*	100%	*0.2*
Shrub	*0.3*	60%	*0.2*
Tree regeneration	*0.1*	60%	*0.1*
Canopy branchwood	*3.0*	50%	*1.5*
Canopy foliage	*6*	100%	*6.0*



Thousand Hour Moisture Grid

TH-HR Fuel Moisture

	Sierra Nevada Mixed Conifer			
Fuel Component	***Fuel Loading***	***Flaming***	***Smoldering***	***Total Consumed***
Litter	*1.8*	--	--	*1.8*
Wood 0-1 inch	*1.3*	--	--	*1.2*
Wood 1-3 inch	*1.9*	--	--	*1.2*
Wood 3+ inch	*32.0*	*21.5*	*5.4*	26.9
Duff	*56.0*	*15.5*	*23.2*	38.7
Herbaceous	*0.2*	--	--	*0.2*
Shrub	*0.3*	--	--	*0.2*
Tree regeneration	*0.1*	--	--	*0.1*
Canopy branchwood	*3.0*	--	--	*1.5*
Canopy foliage	*6*	--	--	*6.0*

Final PM10 Emissions

Fuel Component	Westside Ponderosa Pine	Sierran Mixed Conifer	Plum Fire Total Fuel Loading (tons)	Fuel Consumption (percent)	Fuel Consumed (tons)	PM10 Emission Factors (lbs/ton)	PM10 Emissions (lbs)	PM10 Emissions (tons)
	Acres * Fuel Loading							
Litter	1,416.8	1,125.0	2,541.8	100%	2,541.8	9.3	23,638.7	11.8
Wood 0-1 inch	708.4	750.0	1,458.4	90%	1,312.6	9.3	12,206.8	6.1
Wood 1-3 inch	809.6	1,125.0	1,934.6	65%	1,257.5	14.0	17,604.9	8.8
Wood 3+ inches	5,060.0	15,000.0	20,060.0	82%(1)	16,451.6	19.1(3)	314,225.0	157.1
Herbs	202.4	150.0	352.4	100%	352.4	25.1	8,845.2	4.4
Shrubs	253.0	187.5	440.5	60%	264.3	25.1	6,633.9	3.3
Regen	151.8	112.5	264.3	60%	158.6	25.1	3,980.4	2.0
Duff	5,060.0	30,000.0	35,060.0	34%(2)	12,088.7	30.4(3)	367,496.1	183.7
Canopy foliage	6,072.0	4,500.0	10,572.0	100%	10,572.0	25.1	265,357.2	132.7
Canopy branchwood	708.4	2,250.0	2,958.4	50%	1,479.2	25.1	37,127.9	18.6
							Total	528.6

“EES.dbf” Output

COMPONENT	PRELOAD	PM10	AREA	PM10TOT	FIRES_	COVERDESC
Litter	1.50	13.9	687.70	4.7967	0	SIERRAN MIXED CONIFER FOREST
Wood 0-1 inch	1.00	8.4	687.70	2.8780	0	SIERRAN MIXED CONIFER FOREST
Wood 1-3 inch	1.50	13.6	687.70	4.6935	0	SIERRAN MIXED CONIFER FOREST
Wood 3+ inches	20.00	382.0	687.70	131.3506	0	SIERRAN MIXED CONIFER FOREST
Herbs	0.20	5.0	687.70	1.7261	0	SIERRAN MIXED CONIFER FOREST
Shrubs	0.25	3.8	687.70	1.2946	0	SIERRAN MIXED CONIFER FOREST
Regen	0.15	2.3	687.70	0.7768	0	SIERRAN MIXED CONIFER FOREST
Duff	40.00	748.4	687.70	257.3460	0	SIERRAN MIXED CONIFER FOREST
Canopy foliage	6.00	150.6	687.70	51.7838	0	SIERRAN MIXED CONIFER FOREST
Canopy branchw ood	3.00	37.7	687.70	12.9459	0	SIERRAN MIXED CONIFER FOREST
Litter	1.40	13.0	551.43	3.5898	1	WESTSIDE PONDEROSA PINE FOREST
Wood 0-1 inch	0.70	5.9	551.43	1.6154	1	WESTSIDE PONDEROSA PINE FOREST
Wood 1-3 inch	0.80	7.3	551.43	2.0072	1	WESTSIDE PONDEROSA PINE FOREST
Wood 3+ inches	5.00	95.5	551.43	26.3309	1	WESTSIDE PONDEROSA PINE FOREST
Herbs	0.20	5.0	551.43	1.3841	1	WESTSIDE PONDEROSA PINE FOREST
Shrubs	0.25	3.8	551.43	1.0381	1	WESTSIDE PONDEROSA PINE FOREST
Regen	0.15	2.3	551.43	0.6228	1	WESTSIDE PONDEROSA PINE FOREST
Duff	5.00	93.6	551.43	25.7941	1	WESTSIDE PONDEROSA PINE FOREST
Canopy foliage	6.00	150.6	551.43	41.5228	1	WESTSIDE PONDEROSA PINE FOREST

Example 2

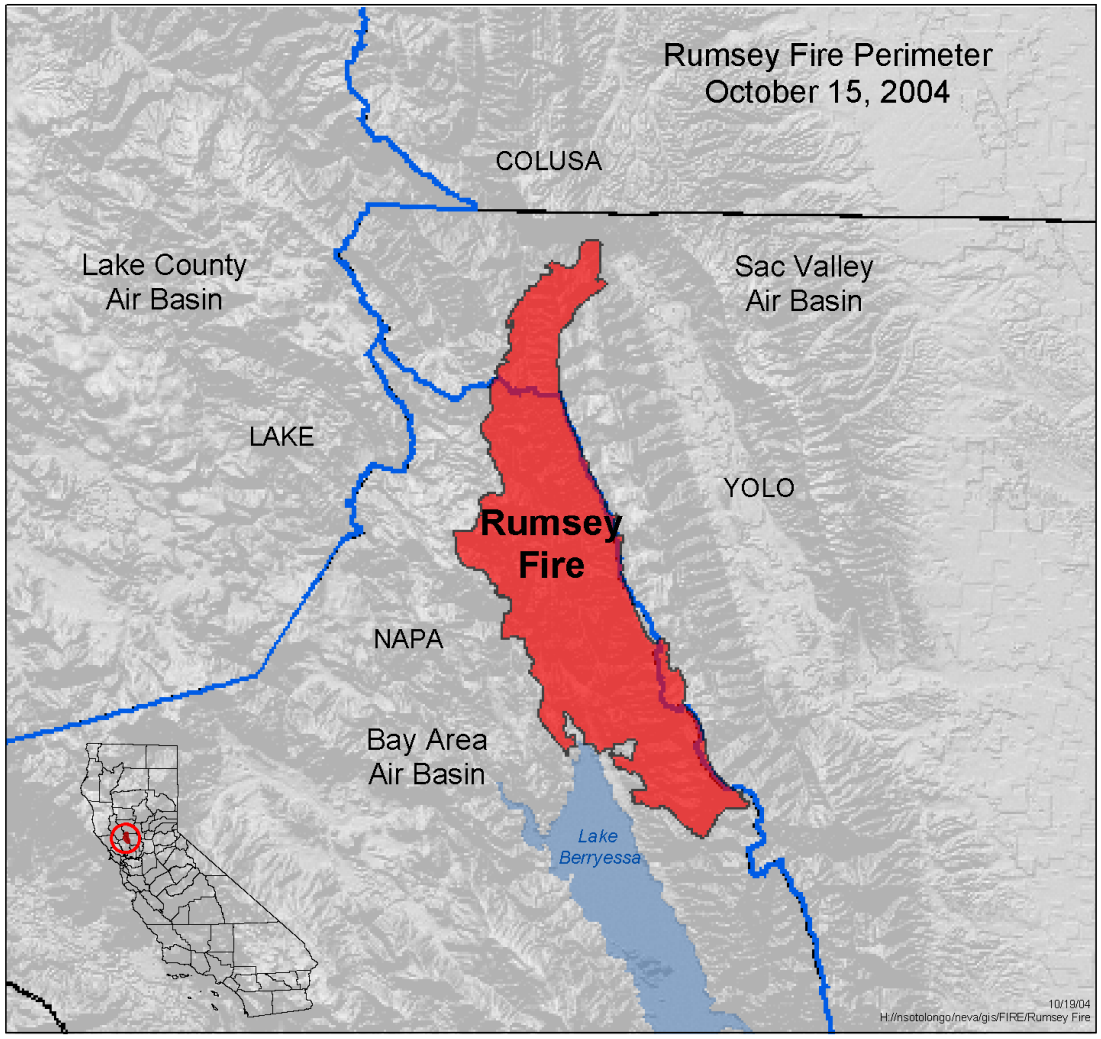
Rumsey Fire

Date: October 10-14, 2004

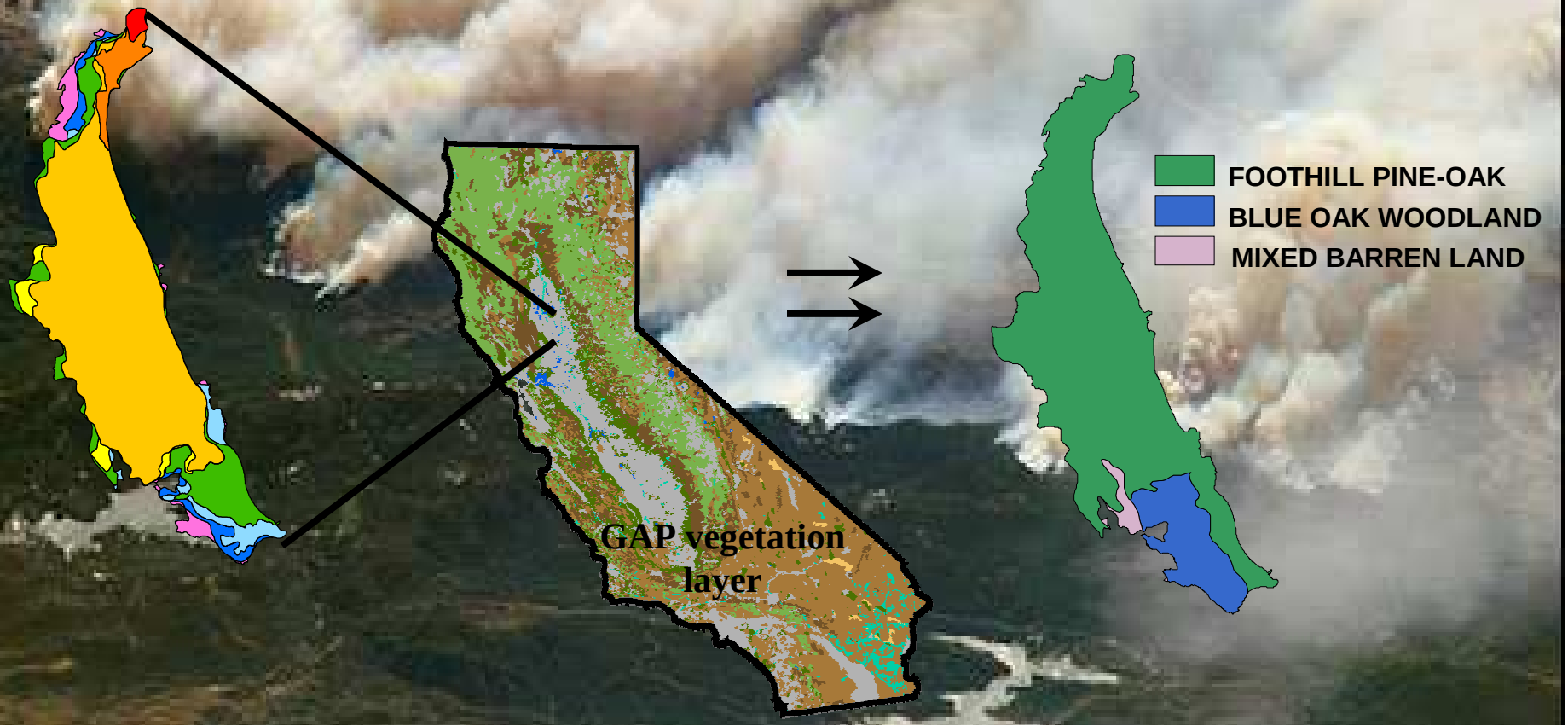
Location: Near the Napa/Yolo County line

Size: ~39,000 acres

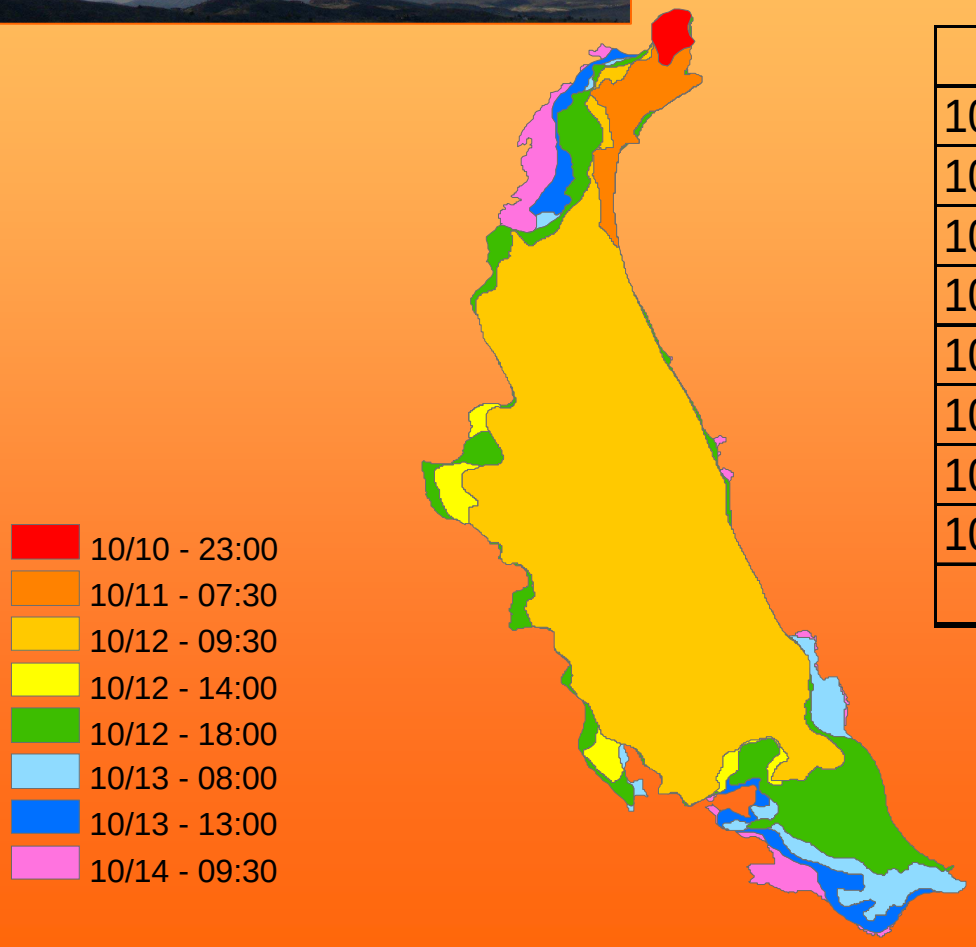
Smoked out Bay Area



The EES model overlays the wildfire footprint on vegetation GAP layer, calculating the amount of each vegetation type consumed by the fire.

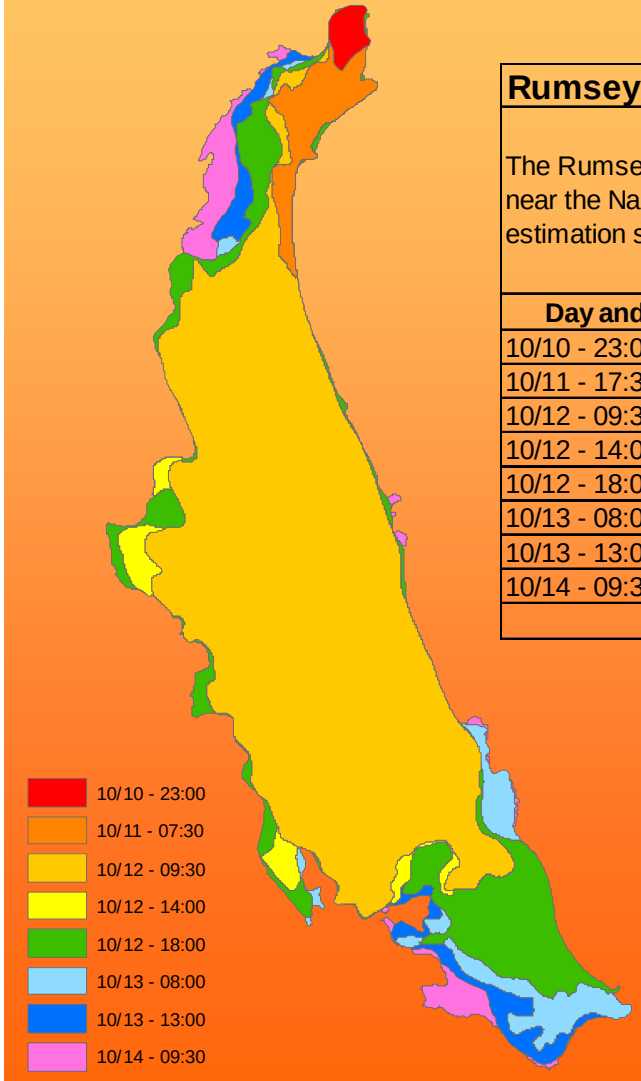


Rumsey Fire
Daily Fire Perimeter



Day and Time	Acres
10/10 - 23:00	380
10/11 - 17:30	1,530
10/12 - 09:30	26,200
10/12 - 14:00	981
10/12 - 18:00	5,396
10/13 - 08:00	1,905
10/13 - 13:00	1,452
10/14 - 09:30	1,549
TOTAL	**39,393**

Rumsey Fire Emission Estimates



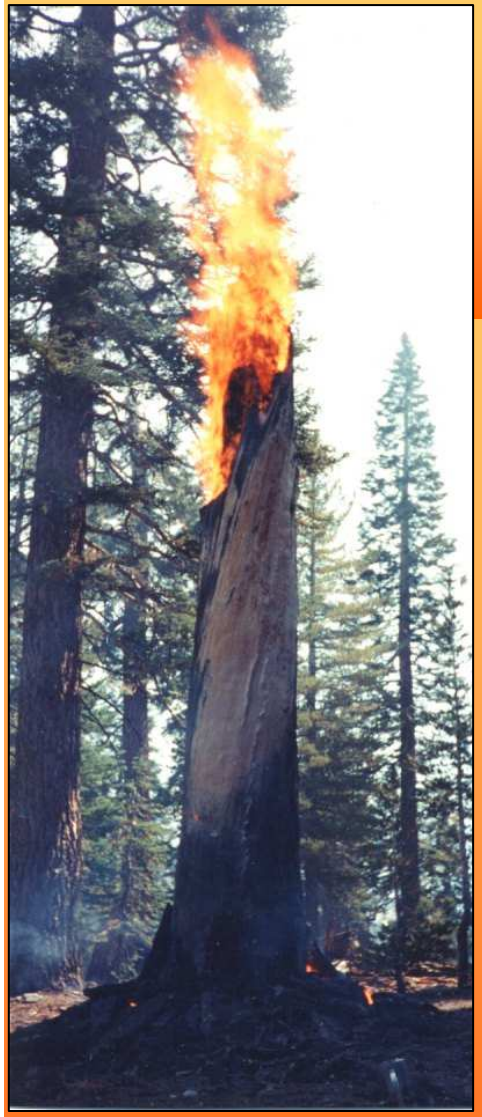
Rumsey Fire Emission Estimates

The Rumsey fire burned approximately 39,000 acres October 10-14, 2004. The fire was primarily in Napa County near the Napa-Yolo county line. Fire emission were calculated using the ARB's GIS based wildfire emission estimation system (EES) model. Daily

Day and Time	Acres	PM10	PM25	CO	CH4	TNMHC	NH3	NOx	SO2
10/10 - 23:00	380	168	143	1,644	66	115	16	53	16
10/11 - 17:30	1,530	677	574	6,621	265	463	66	213	66
10/12 - 09:30	26,200	10,760	9,130	105,246	4,210	7,367	1,052	3,390	1,044
10/12 - 14:00	981	349	296	3,413	137	239	34	111	34
10/12 - 18:00	5,396	1,715	1,455	16,740	670	1,172	167	544	168
10/13 - 08:00	1,905	499	423	4,861	194	340	49	159	49
10/13 - 13:00	1,452	314	266	3,052	122	214	31	101	31
10/14 - 09:30	1,549	477	404	4,651	186	326	47	152	47
TOTAL	**39,393**	**14,958**	**12,692**	**146,228**	**5,849**	**10,236**	**1,462**	**4,722**	**1,455**

Model Assumptions

- Gridded NFDR-TH moisture - 2000
- FOFEM -100% of area experiences fire
- Set consumption levels
- Dataset limitations
- Spatial distribution – point provided
- Temporal distribution – limited information



What's Next…

Proposed EES model updates

- Update vegetation maps – NFS, NPS & CDF
- Update fuel models
- Add CO2 EF
- Update consumption algorithms
- Improve model interface & user interaction
- Provide "typical" Rx & WF toggle
- Improve output tables
- Add daily distribution of emissions option
- Model ready outputs
  - Diurnal variation & heat release

Rx vs. Wildfire

- Wildfires
  - Dryer
  - Larger events
  - Longer events
- Rx Burns
  - Better understanding of fuels (heavy, moderate or light)
  - Higher thousand hour fuel moisture
  - Higher RH
  - Smaller events
  - Average 1 or 2 day
- WFUs - conditions similar to wildfires

Projecting Emissions

- Planning
  - Ten-year average - 1994 through 2003 wildfires
  - Normalize erratic annual spatial wildfire distribution
  - Ample yet manageable sample set
  - Adjusts for reporting inconsistencies
  - Consistency and quality data available
- Modeling - methodology not established yet

What's Next
What's Needed….

- Spatially forecast future WF and Rx emissions
- Rx emission inventory Statewide
- Expand suite of EF for pile burning
- GHG
- Update residential fuel combustion methodology and emissions

Other Related Projects

PFIRS - Prescribe Fire Information Reporting System

Blue Skies - Dispersion Modeling

WRAP-FRAP - Regional Haze

Regional Inventories and Modeling

Links to Inventories and Methods

Methods - Smoke Emissions Estimation Web Page:

http://www.arb.ca.gov/ei/see/see.htm

Inventory – Almanac (snapshot of CEFS):

http://www.arb.ca.gov/html/aqe&m.htm

Inventories- CEIDARS & CEFS:

http://www.arb.ca.gov/app/emsinv/dist/

Contact Information

Neva Sotolongo

Air Resources Board

(916) 323-4887

nsotolon@arb.ca.gov