



WESTCARB Annual Business Meeting

Carbon Benefits from Fuel Treatments

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Carbon Benefits from Fuel Treatments

Co-Authors

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WESTCARB Research Questions

Question #1: Do fuel treatments result in an overall carbon benefit through avoided CO₂ emissions from wildfire?

Question #2: If so, can they be observed, measured, and reported to meet a mitigation standard as a carbon offset?

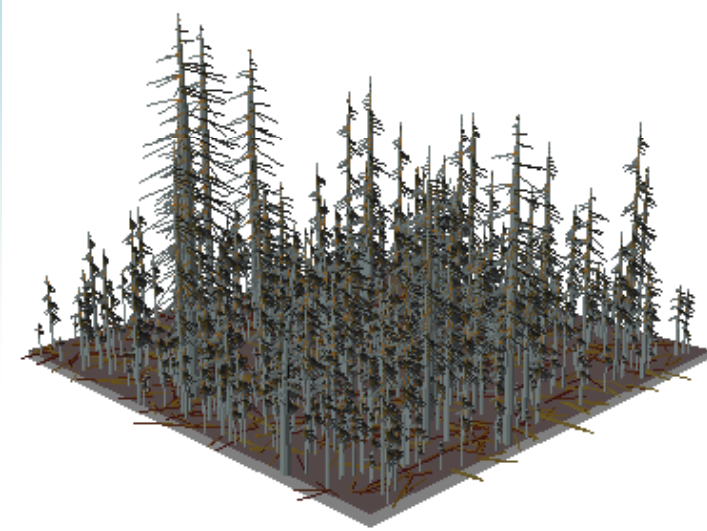


Existing Condition

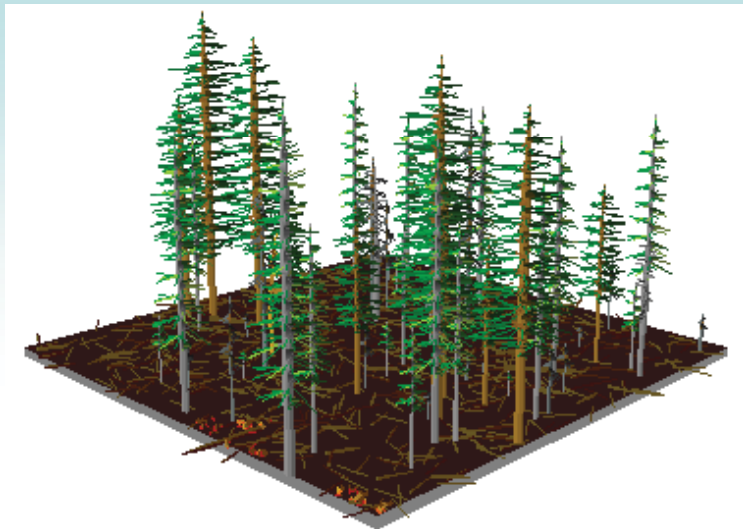




Wildfire, No Fuel Treatment

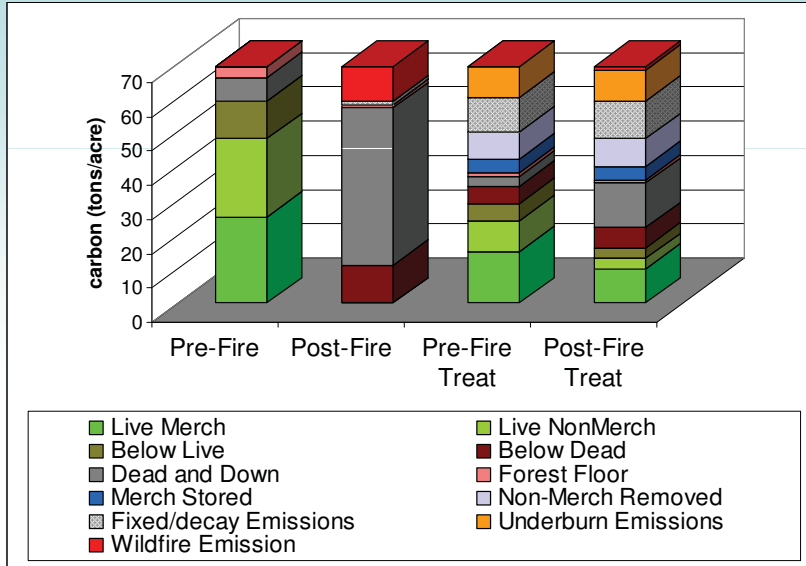


Fuel Treatment and Wildfire

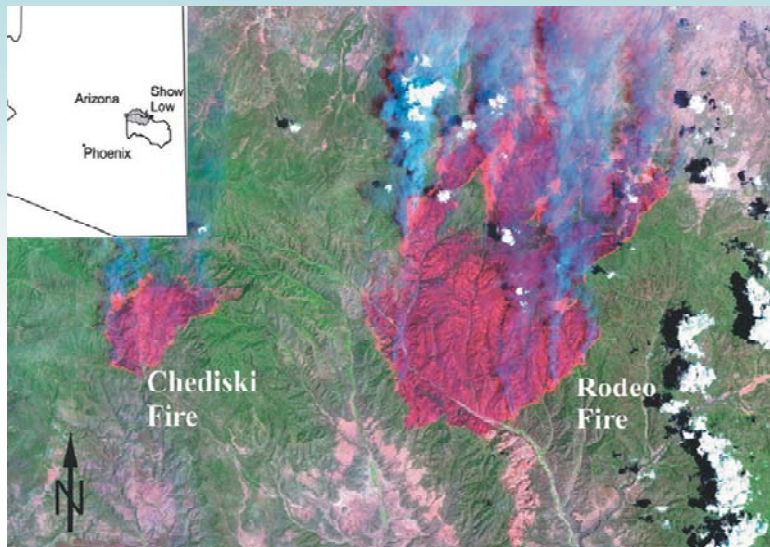




Treatment and Wildfire Effects on Carbon Stocks

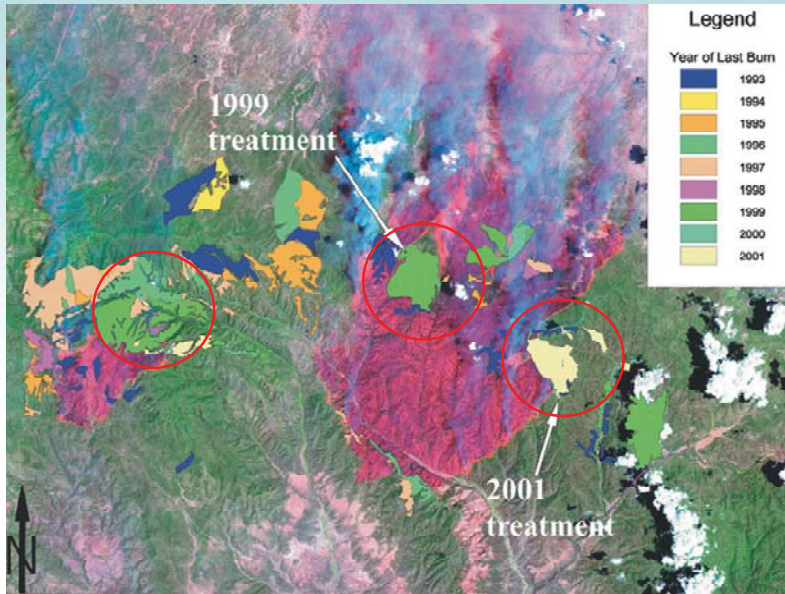


Rodeo Fire, Arizona (2002)





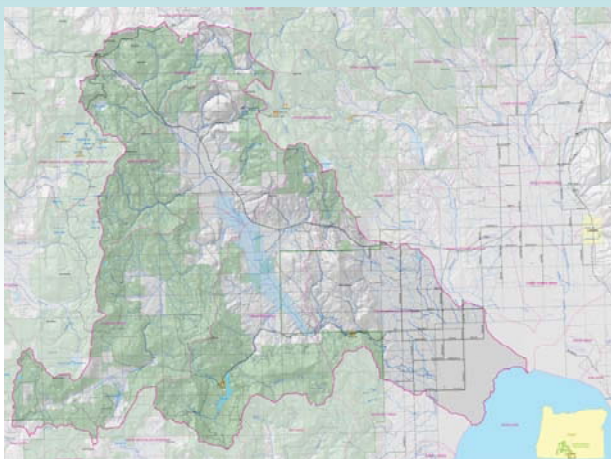
Rodeo Fire, Arizona (2002)



Shadow Effect of Treatments



Drews Creek Watershed, Lake County, Oregon



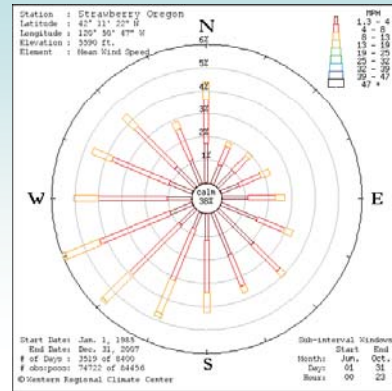
- 492,000 acres total
- 170,000 inside the watershed
- Vegetation and fuels
 - Ag lands at lowest elevations
 - Juniper woodlands
 - Dry forest Ponderosa Pine
 - Mixed Conifer
- Fire History
 - 70,000 acres over the past 50 years



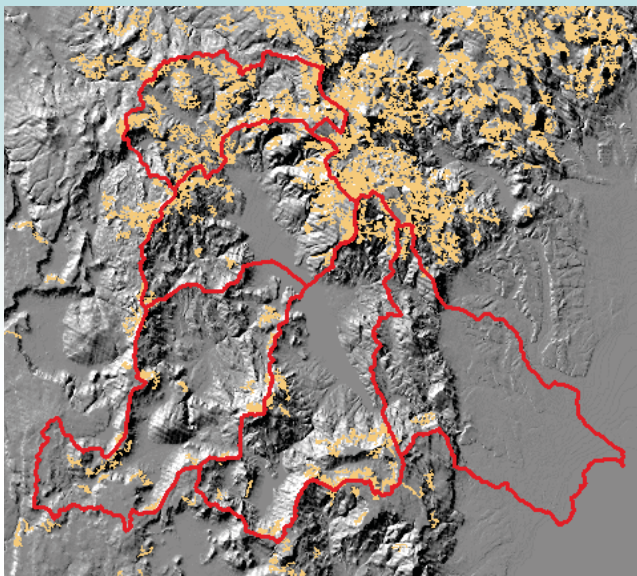


Avoiding the “Problem Fire” Event

- Fire Size – 11,000 acres
- Burn Period – 4-6 hours
- Fuel Moistures (%)
 - 1 hour - 3
 - 10 hour - 4
 - 100 hour - 7
 - Live herbaceous - 59
 - Live woody - 65
- Wind Direction – SSW; Wind Speed – 15 mph
- Mid-flame Wind Speed – 8+ mph



The “Project” – Collection of Fuel Treatments Units



 Fuel Treatment Units



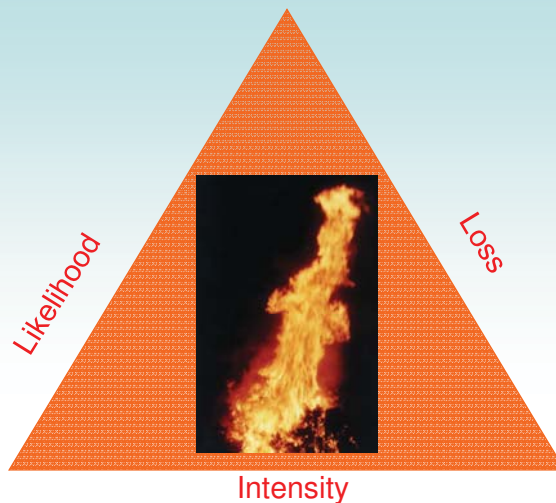


ArcFuels - Modeling Fuel Treatments and Wildfire

- Gradient nearest neighbor (GNN) tree list data
- Thin from below, seral species retained, fuels mastication, under burn.
- Prescription priority based on basal area threshold and stand structure that varied by potential vegetation
- Treated area = 17,740 acres, 10% of the forested area within the watershed; 20% of federal ownership
- Stand Wildfire Outcomes – Forest Vegetation Simulator w/ fuel model override (used LANDFIRE fuel models)
- FLAMMAP – Minimum travel time algorithm
- Critical Flame Length Calibration – Crown Fires in FVS

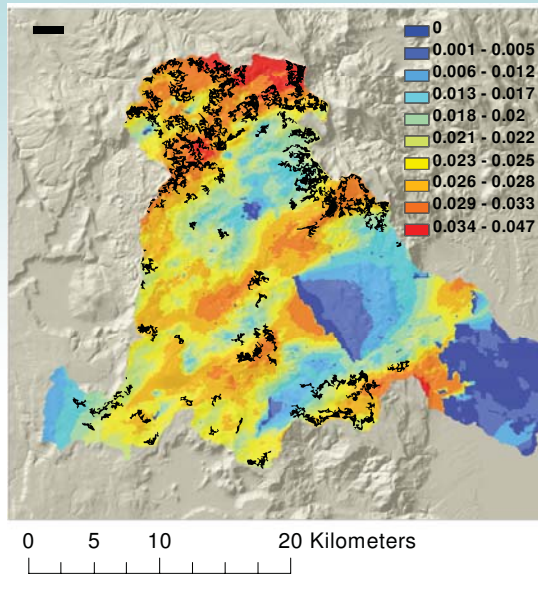


Fire Risk Triangle

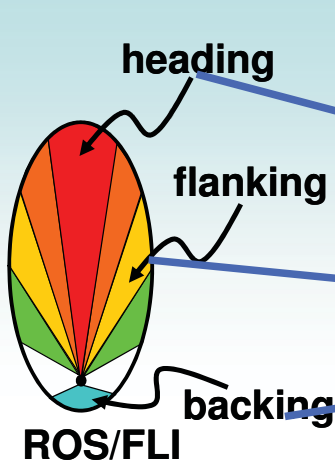




Likelihood – Conditional Burn Probabilities



Wildfire Intensity Probabilities

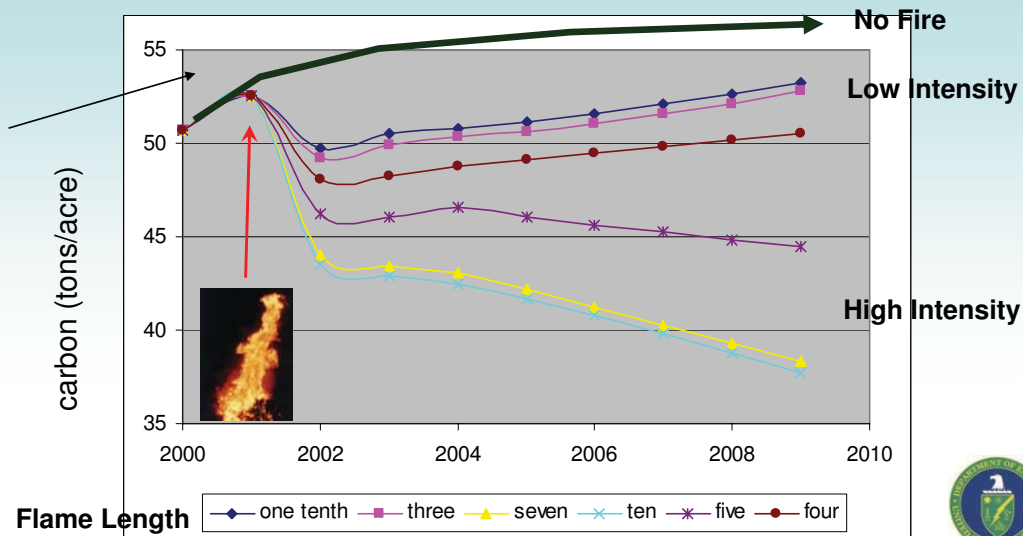


Attributes of x10000_FLP.txt Events								
XPos	YPos	PBurn	FIL1	FIL2	FIL3	FIL4	FIL5	FIL6
534950	923850	0.01285	0	0	0.031128	0	0.338521	0.6303
535050	923850	0.013	0	0.042308	0.338462	0.165385	0.003846	0.45
535150	923850	0.01305	0	0.045977	0.685824	0.264368	0.003831	0
535250	923850	0.0133	0	0.992481	0.007519	0	0	0
535350	923850	0.01325	0	0.803774	0.196226	0	0	0
535450	923850	0.01305	0	0	0	0.08046	0.08046	0.8390
535550	923850	0.0131	0	0.003817	0.160305	0.635878	0	0
535650	923850	0.0129	0	0.007752	0.992248	0	0	0
535750	923850	0.01305	0	0.030651	0.969349	0	0	0
535850	923850	0.01295	0	0.150579	0.849421	0	0	0
535950	923850	0.0125	0	0.608	0.392	0	0	0
536050	923850	0.0128	0	0.003906	0.054687	0.027344	0.125781	0.4882
536150	923850	0.01295	0	0.081081	0.120571	0.490347	0	0
536250	923850	0.0127	0	0	0.015748	0.279528	0.689291	0.0354
536350	923850	0.0126	0	0.047619	0.853175	0.099206	0	0
536450	923850	0.01245	0	0.088353	0.911647	0	0	0
536550	923850	0.01225	0	0.008163	0	0.232653	0.759184	0
536650	923850	0.0121	0	0	0.028926	0.966942	0.004132	0
536750	923850	0.0115	0	0.104348	0.895652	0	0	0
536850	923850	0.0116	0.00431	0.047414	0.948276	0	0	0
536950	923850	0.01155	0	0.047619	0.952381	0	0	0





Carbon Loss Outcomes

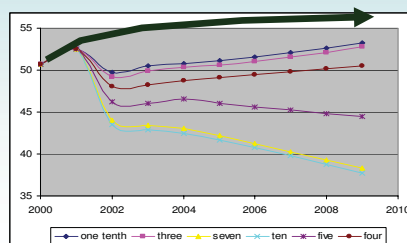


Expected Carbon Stocks

Expected Carbon =

Attributes of s10000_FIP.tbl Events								
XPts	YPos	YMean	FL.1	FL.2	FL.3	FL.4	FL.5	FL.6
534950	0.2350	0.0126	0	0	0.017120	0	0.030621	0.0303
535050	0.2350	0.0113	0	0.042300	0.330402	0.165305	0.003046	0.45
535150	0.2350	0.01305	0	0.043977	0.005024	0.264360	0.003031	0
535250	0.2350	0.0133	0	0.062481	0.001019	0	0	0
535350	0.2350	0.01325	0	0.803774	0.196226	0	0	0
535450	0.2350	0.01305	0	0	0	0.00046	0.00046	0.0390
535550	0.2350	0.0131	0	0.003917	0.192240	0.030076	0	0
535650	0.2350	0.0129	0	0.007752	0.192240	0	0	0
535750	0.2350	0.01305	0	0.030951	0.989349	0	0	0
535850	0.2350	0.01295	0	0.150578	0.068421	0	0	0
535950	0.2350	0.0125	0	0.030	0.392	0	0	0
536050	0.2350	0.0128	0	0.003906	0.054697	0.027344	0.425781	0.4882
536150	0.2350	0.01295	0	0.001081	0.426971	0.468347	0	0
536250	0.2350	0.0127	0	0	0.015740	0.279528	0.669281	0.0354
536350	0.2350	0.0125	0	0.047619	0.053175	0.099206	0	0
536450	0.2350	0.01345	0	0.000393	0.011647	0	0	0
536550	0.2350	0.01225	0	0.000163	0	0.232853	0.719184	0
536650	0.2350	0.0121	0	0	0.029926	0.969942	0.004132	0
536750	0.2350	0.0115	0	0.104360	0.069521	0	0	0
536850	0.2350	0.0116	0.00431	0.047414	0.048276	0	0	0
536950	0.2350	0.01155	0	0.047619	0.952381	0	0	0

X



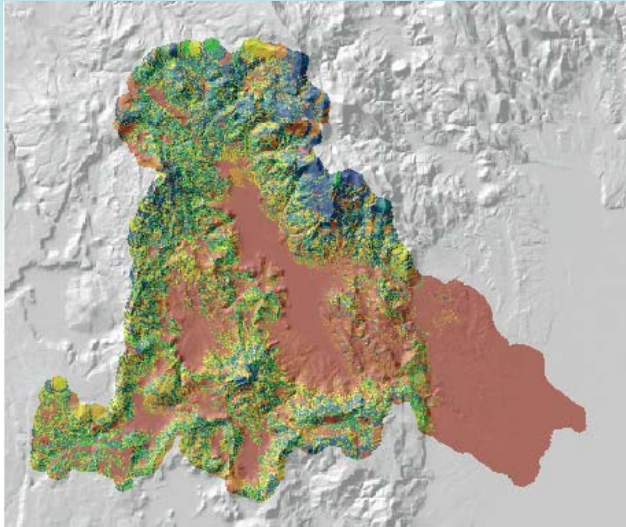
Probability

Loss





Expected Carbon



-  Lots
-  Some
-  Little



Carbon Offset

Carbon Offset =

“With Project Scenario” – “Without Project Scenario”

Carbon Offset =

“Treated Landscape – Post Wildfire, Post Treatment”
– “Untreated Landscape, Post Wildfire”



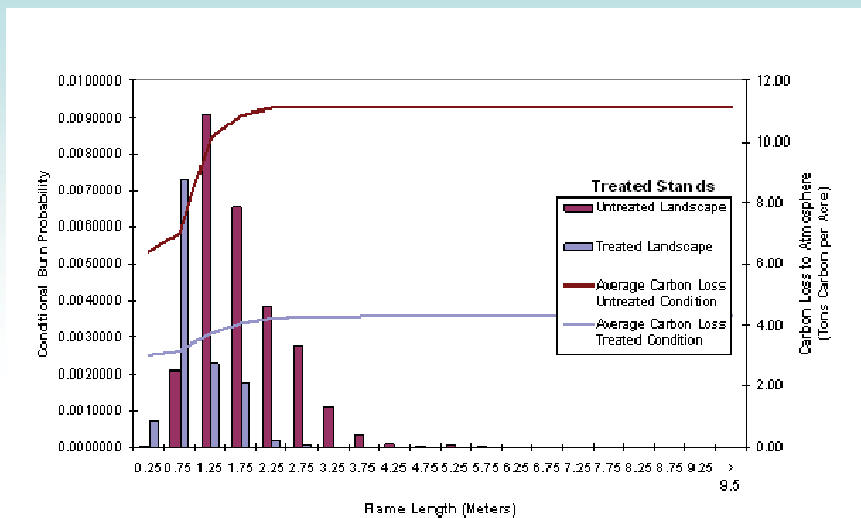


Treatment Effect – Likelihood Goes Down

	Treated Landscape	Untreated Landscape	Difference
Treated Stands	0.01235	0.02602	-0.01367
Untreated Stands	0.01709	0.02106	-0.00397
All Stands	0.01665	0.02152	-0.00487

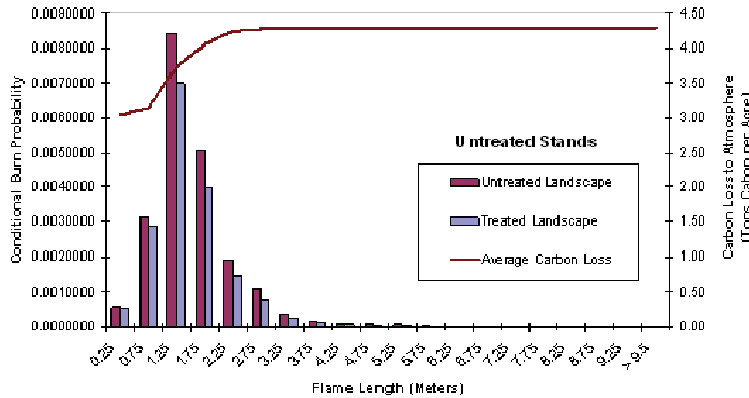


Treatment Effect – Intensity Goes Down – Treated Stands

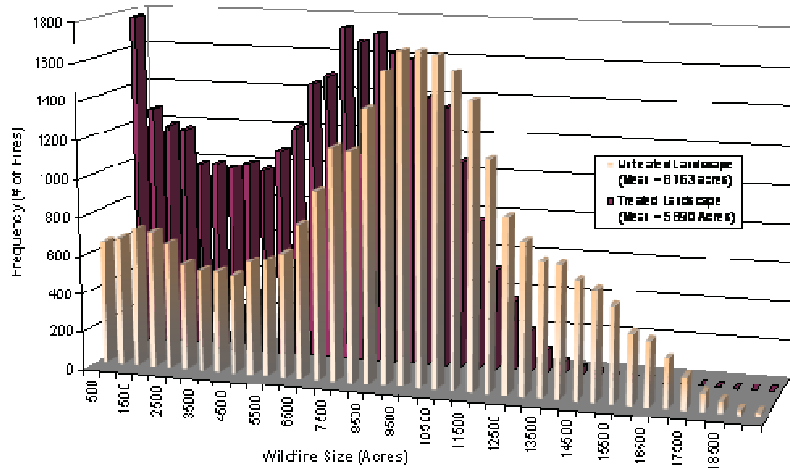




Treatment Effect – Intensity Goes Down – Untreated Stands

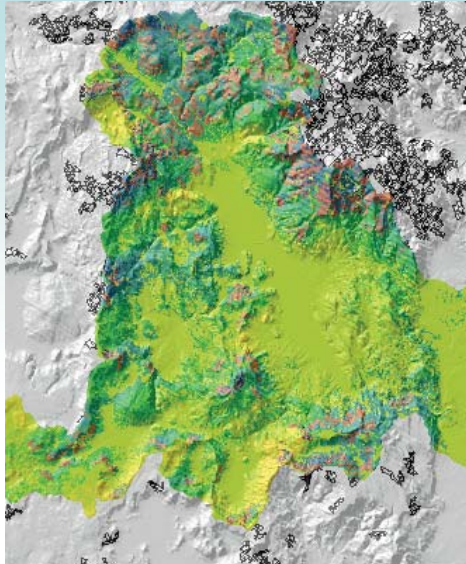


Treatment Effect – Extent Goes Down





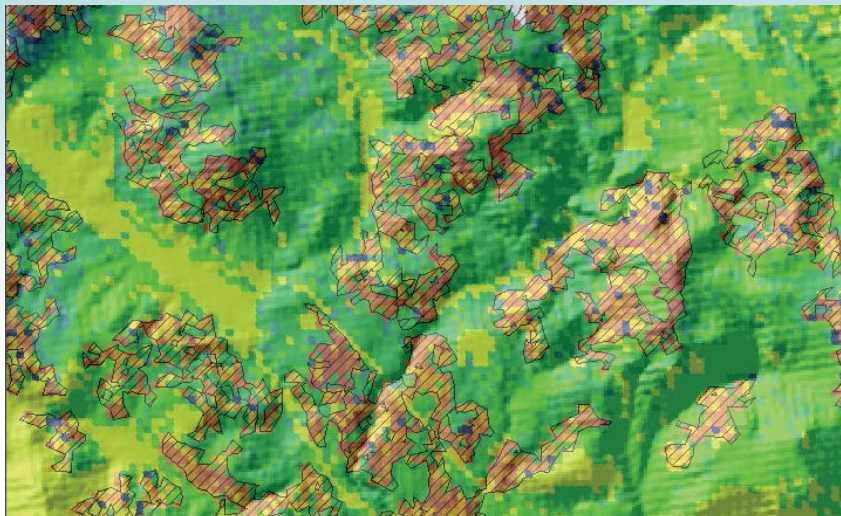
Expected Carbon Offset from Fuel Treatment



- Benefit
- No Change
- Loss



Expected Carbon Offset from Fuel Treatment

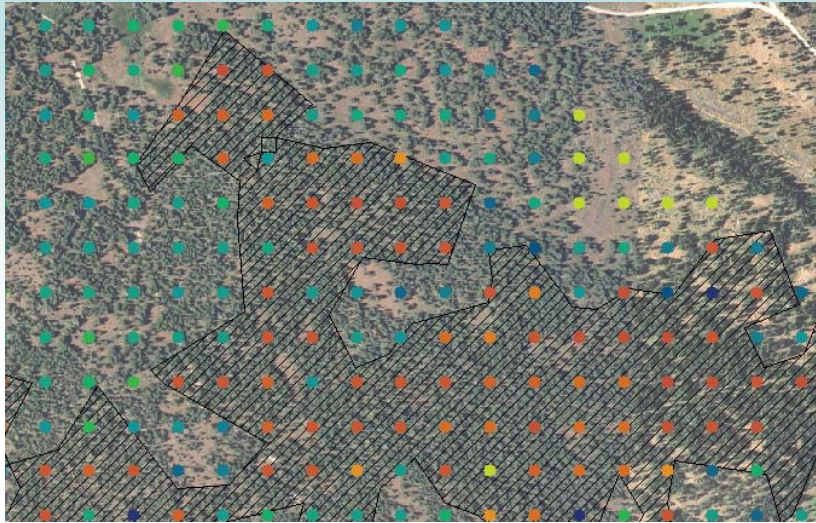


- Benefit
- No Change
- Loss





Expected Carbon Offset from Fuel Treatment



- Benefit
- No Change
- Loss



Expected Carbon Offset Fuel Treatments - Stocks

	Treated Landscape	Untreated Landscape	Difference
--- short tons carbon ---			
Treated Stands ^a	632,458	842,398	-209,940
Untreated Stands	2,961,484	2,957,948	3,836
		OFFSET	-206,104





Expected Carbon Offset Fuel Treatments - Emissions

Emission Source	Treated Landscape	Untreated Landscape	Difference
--- short tons carbon ---			
Merchantable Material Removed from Treatment	-41,884	0	-41,884
Non-Merchantable Material Removed from Treatment	-62,796	0	-62,796
Prescribed Fire in Treatments	-111,893	0	-111,893
Wildfire Treated Stands	-157	-3,857	3,700
Wildfire Non-Treated Stands	-8,936	-12,023	3,087
		OFFSET	-209,786

Treatment Loss

Expected Treatment Benefit



Carbon Variability – Non-Merchantable Removal



This



Or This?

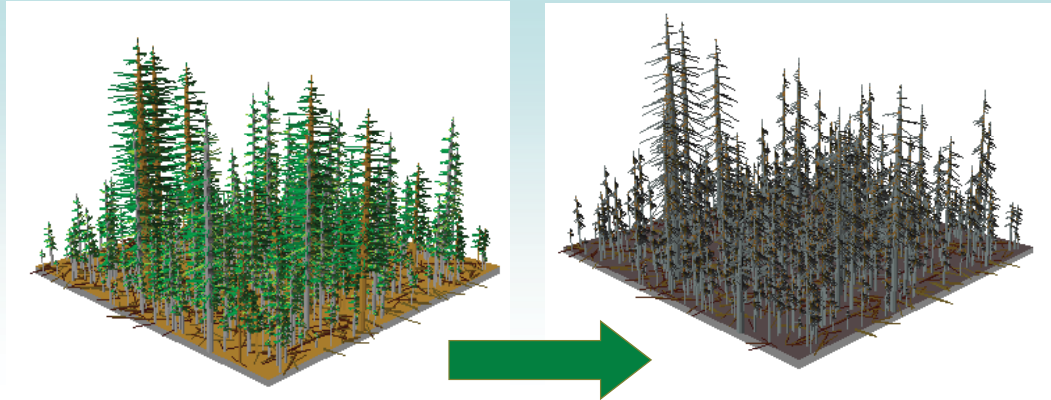


Or This?





Existing Condition



“Dead Trees Do Not Go to Heaven”

Olga Krankina



Life Expectancy of Fuel Treatment “Investment”

- Carbon “loss” from conducting fuel treatments is a one-time investment designed to avoid the “problem fire” for multiple ignitions in a year and for multiple years.
 - 5 ignitions per year under “problem fire” weather and fuel moisture conditions.
 - Expected carbon benefit of 6,087 tons of avoided carbon emissions for each “ignition” on the landscape.
 - Carbon benefit in the year following treatment = $6,087 \times 5 = 30,435$ tons.
- Question is: What is the shelf life of the fuel treatments?
 - Carbon investment cost of fuel treatments is 212,873 tons.
 - Break even shelf life of fuel treatment project is 7 years ($212,873 / 30,435 = 6.994$)

