

# Modeling Fire Behavior and Assessing Post Fire Burn Severity for the 2007 Big Turnaround Fire Complex

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2007 SHRUG GIS Workshop

# Project Overview

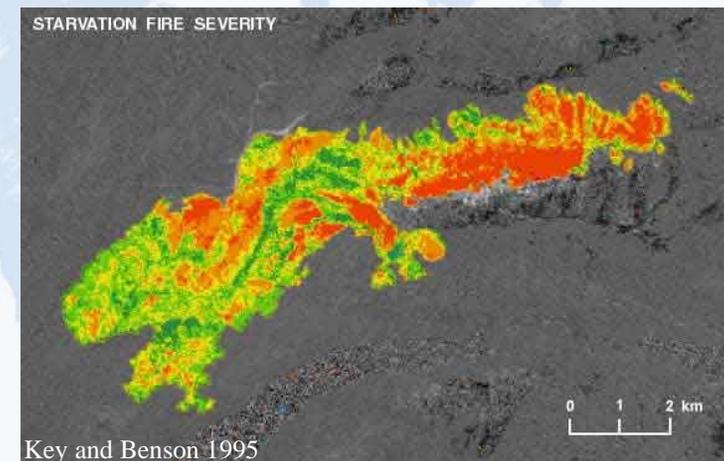
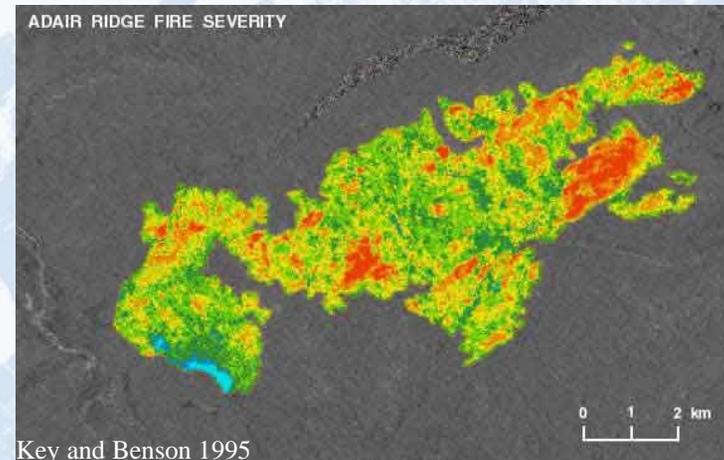
- Background
- Project Questions
- Results
- Conclusions



**Mark Jamieson** May 31, 2007

# Background-Burn Severity and Joint Fires Science Program (JFSP)

- Burn Severity-ecosystem change and landscape change
- System developed in 1996 by Carl Key and Nate Benson
- Started in the Western United States
  - Initial Fires Assessed-1994 Glacier National Park Fires
  - Needs more work in East
- JFSP was formed in 1998 to provide support for fuel and fire management programs



# Background-Composite Burn Index (CBI) and Normalized Burn Ratio (NBR)

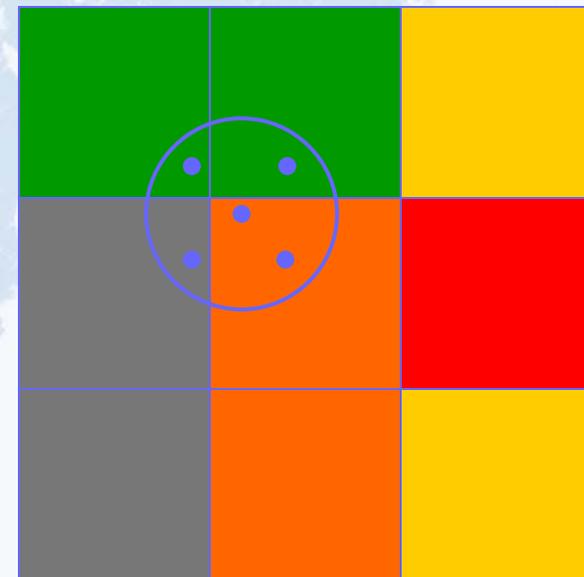
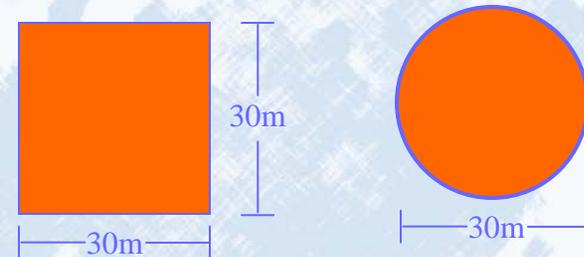
- NBR-Remote sensing of burn severity
- Landsat  $R_4$  (NIR, Veg) and  $R_7$  (SWIR, Soil)
  - $NBR = (R_4 - R_7) / (R_4 + R_7)$
  - $dNBR = NBR_{\text{prefire}} - NBR_{\text{postfire}}$
- CBI-Ground measure of burn severity
  - 30 m plot
- CBI should validate NBR values

# Background-deltaNormalized Burn Ratio (dNBR)

▪dNBR: Change in reflectance between pre-fire (1 year pre-fire) and post-fire NBR values

$$\text{dNBR} = \text{NBR}_{\text{prefire}} - \text{NBR}_{\text{postfire}}$$

▪Weighted dNBR = Average of plot center and corners (N=5)



Severity	dNBR
Unburned	-100 - 99
Low	99 - 269
Low-Moderate	269 - 439
Moderate-High	439 - 659
High	659 - 1300

# Background-Composite Burn Index (CBI)

- Burn Index: 0-3
  - 0-Unburned
  - 3-Severe Burn
- Five Strata
  - 4-5 Ratings Factors
  - Averaged
- CBI Score
  - Average of Five Strata

**FIREMON LA Form**

**BURN SEVERITY -- COMPOSITE BURN INDEX (BI)**

<b>PD - Abridged</b>		Examiners:		Project Code		Fire Name:	
Registration Code						Plot Number	
Field Date mmmddyyyy	/ /	Fire Date mmyyyy	/			UTM Zone	
Plot Aspect		UTM E plot center				GPS Datum	
Plot Diameter Overstory		UTM N plot center				GPS Error (m)	
Plot Diameter Understory							
Number of Plot Photos		Plot Photo IDs					

<b>BI - Long Form</b>	% Burned 100 feet (30 m) diameter from center of plot =						Fuel Photo Series =	
<b>STRATA RATING FACTORS</b>	<b>BURN SEVERITY SCALE</b>							<b>FACTOR SCORES</b>
	No Effect	Low	Moderate	High				
	0.0	0.5	1.0	1.5	2.0	2.5	3.0	

**A. SUBSTRATES**

% Pre-Fire Cover: Litter =	Duff =	Soil/Rock =	Pre-Fire Depth (inches): Litter =	Duff =	Fuel Bed =		Σ =
Litter/Light Fuel Consumed	Unchanged	-- 50% litter	-- 100% litter	>80% light fuel	98% Light Fuel		
Duff	Unchanged	-- Light char	-- 50% loss deep char	-- Consumed			N =
Medium Fuel, 3-8 in.	Unchanged	-- 20% consumed	-- 40% consumed	-- >60% loss, deep ch			
Heavy Fuel, > 8 in.	Unchanged	-- 10% loss	-- 25% loss, deep char	-- >40% loss, deep ch			X =
Soil & Rock Cover/Color	Unchanged	-- 10% change	-- 40% change	-- >80% change			

**B. HERBS, LOW SHRUBS AND TREES LESS THAN 3 FEET (1 METER):**

<b>Pre-Fire Cover =</b>	<b>% Enhanced Growth =</b>						Σ =
% Foliage Altered (blk-ben)	Unchanged	-- 30%	-- 80%	95%	100% + branch loss		
Frequency % Living	100%	-- 90%	-- 50%	< 20%	None		N =
Colonizers	Unchanged	-- Low	-- Moderate	High-Low	Low to None		
Spp. Comp. - Rel. Abund.	Unchanged	-- Little change	-- Moderate change	-- High change			X =

**C. TALL SHRUBS AND TREES 3 TO 16 FEET (1 TO 5 METERS):**

<b>Pre-Fire Cover =</b>	<b>% Enhanced Growth =</b>						Σ =
% Foliage Altered (blk-ben)	0%	-- 20%	-- 60-90%	> 95%	Signifem branch loss		
Frequency % Living	100%	-- 90%	-- 30%	< 15%	< 1%		N =
% Change in Cover	Unchanged	-- 15%	-- 70%	90%	100%		
Spp. Comp. - Rel. Abund.	Unchanged	-- Little change	-- Moderate change	-- High Change			X =

**D. INTERMEDIATE TREES (SUBCANOPY, POLE-SIZED TREES)**

<b>Pre-Fire % Cover =</b>	<b>Pre-Fire Number Living =</b>		<b>Pre-Fire Number Dead =</b>		Σ =	
% Green (Unaltered)	100%	-- 80%	-- 40%	< 10%	None	
% Black (Torch)	None	-- 5-20%	-- 60%	> 85%	100% + branch loss	
% Brown (Scorch/Girdle)	None	-- 5-20%	-- 40-80%	< 40 or > 80%	None due to torch	
% Canopy Mortality	None	-- 15%	-- 60%	80%	%100	
Char Height	None	-- 1.5 m	-- 2.8 m	-- > 5 m		

Post Fire: %Girdled =      %Felled =      %Tree Mortality =

**E. BIG TREES (UPPER CANOPY, DOMINANT, CODOMNANT TREES)**

<b>Pre-Fire % Cover =</b>	<b>Pre-Fire Number Living =</b>		<b>Pre-Fire Number Dead =</b>		Σ =	
% Green (Unaltered)	100%	-- 95%	-- 50%	< 10%	None	
% Black (Torch)	None	-- 5-10%	-- 50%	> 80%	100% + branch loss	
% Brown (Scorch/Girdle)	None	-- 5-10%	-- 30-70%	< 30 or > 70%	None due to torch	
% Canopy Mortality	None	-- 10%	-- 50%	70%	%100	
Char Height	None	-- 1.8 m	-- 4 m	-- > 7 m		

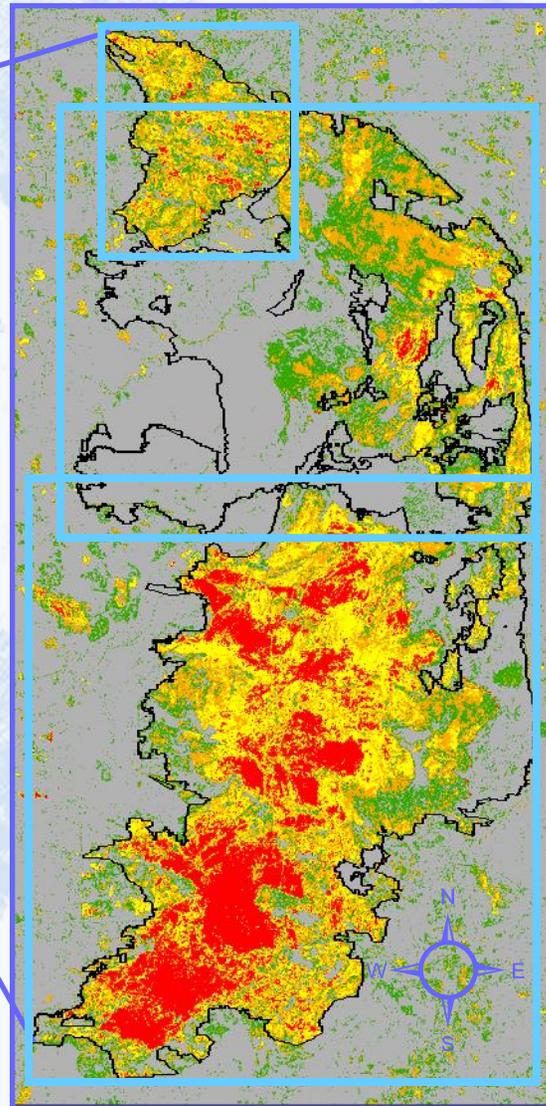
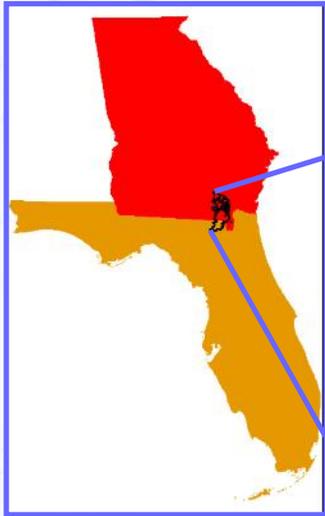
Post Fire: %Girdled =      %Felled =      %Tree Mortality =

<b>Community Notes/Comments:</b>	<b>CBI = Sum of Scores / N Rated:</b>	<b>Sum of Scores</b>	<b>N Rated</b>	<b>CBI</b>
	<b>Understory (A+B+C)</b>			
	<b>Overstory (D+E)</b>			
	<b>Total Plot (A+B+C+D+E)</b>			

% Estimator: 20 m Plot: 314 m<sup>2</sup> 1% = 1x3 m 5% = 3x5 m 10% = 5x6 m After Key and Benson 1999, USGS NRMGC, Glacier Field Station  
30 m Plot: 707 m<sup>2</sup> 1% = 1x7 m (<2x4 m) 5% = 5x7 m 10% = 7x10 m Version 4.0 8/27, 2004

Strata and Factors are defined in FIREMON Landscape Assessment, Chapter2, and on accompanying BI "cheatsheet." www.fire.org/firemon/c/bi.htm

# Background-Big Turnaround Fire Complex Burn Severity



0 10 20 40 Kilometers

## Burn Severity

- Unburned
- Low
- Low-Moderate
- Moderate-High
- High

# Background-Assessed Habitats Within the Big Turnaround Fire Complex

## A. Flatwood Pineland

- Palmetto
- Long-Leaf/Slash Pine

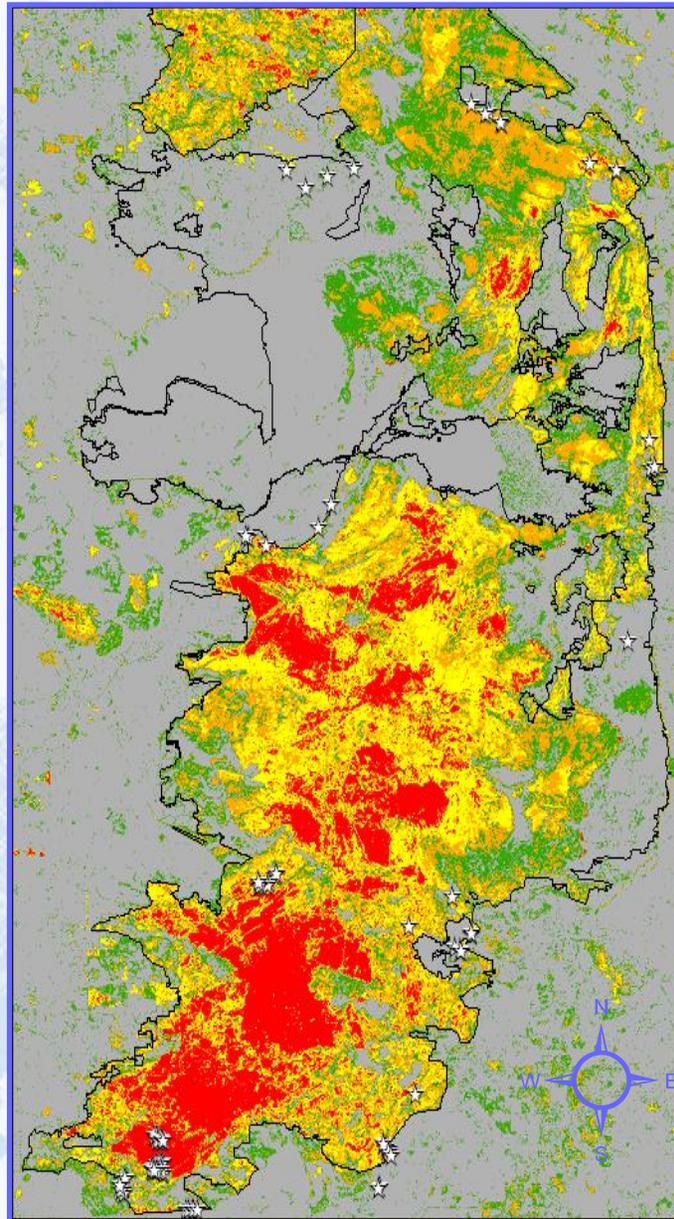
## B. Depression Swamp

- Cypress
- Titi
- Pond Pine
- *Ilex* sp.



# Background-Plot Locations

## ☆ Plot Locations Burn Severity



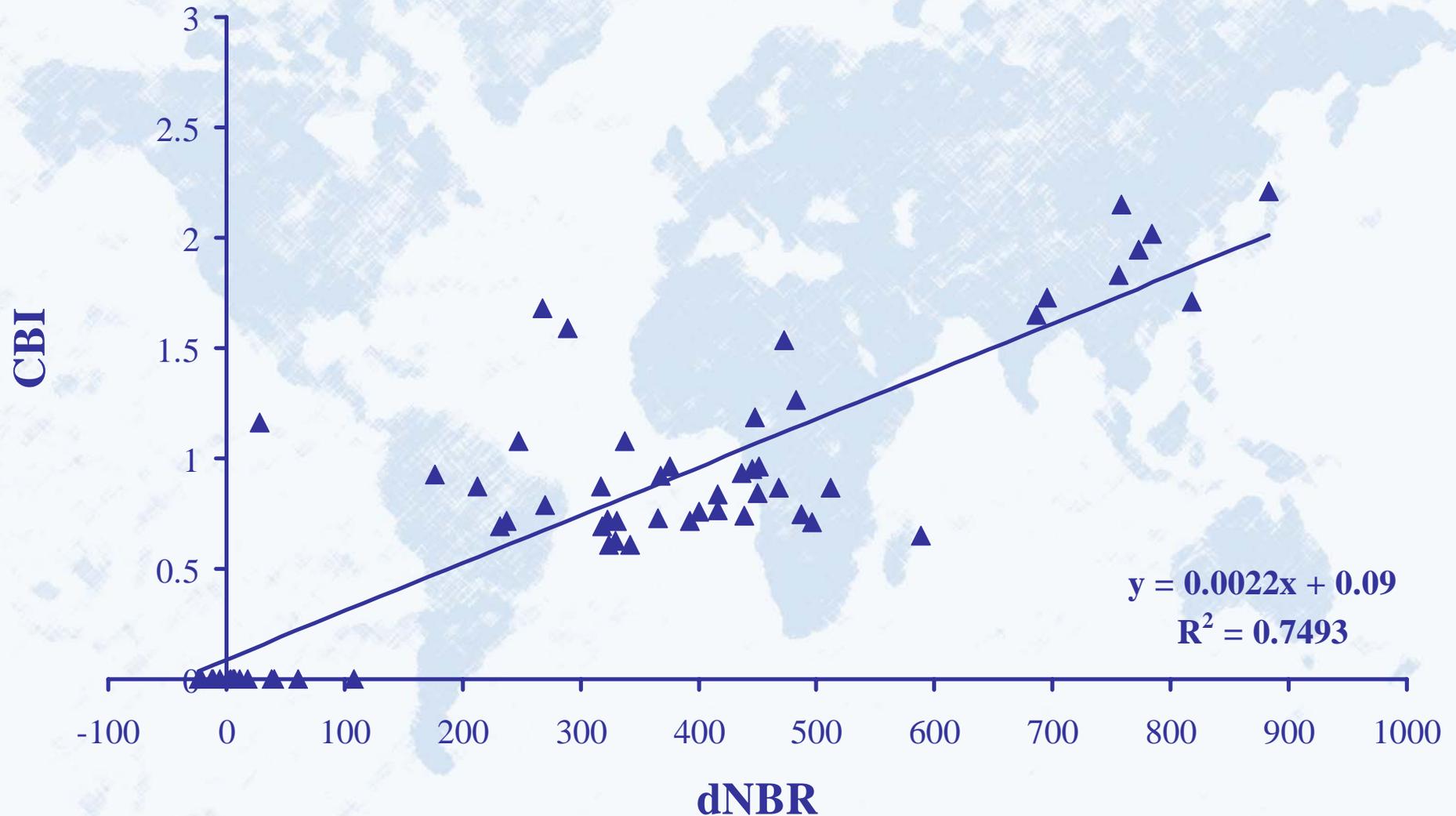
## Plots:

- 89 CBI
- 32 “Virtual”

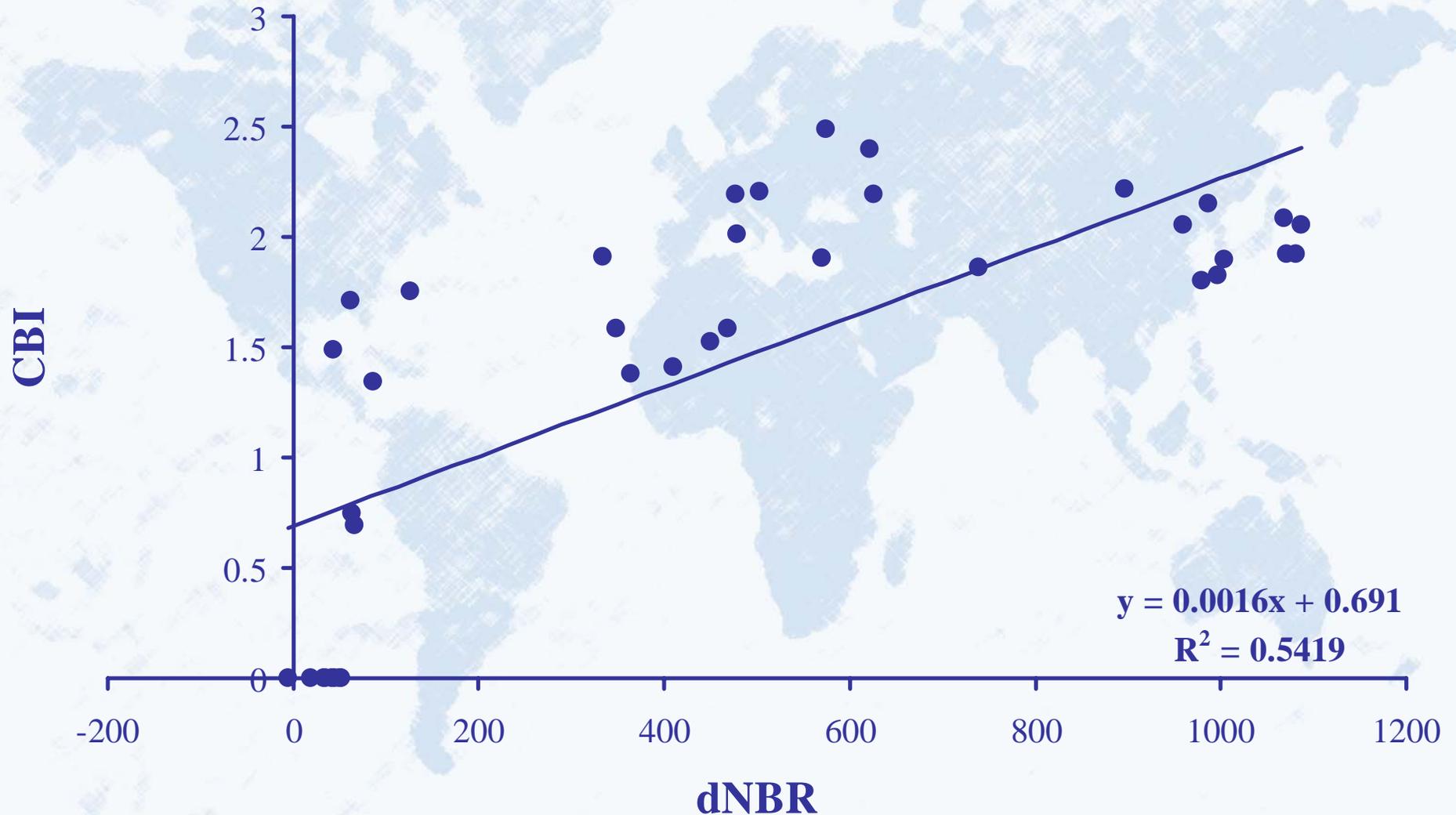
# Project Questions

- 1) Does this system adequately describe burn severity within ecosystems affected by the Big Turnaround Fire Complex?
- 2) Are there differences in the effectiveness of using CBI and dNBR to categorize burn severity in flatwood and depression swamp community types?
- 3) What are the appropriate dNBR breakpoints for a given burn severity categories?

# Results-Correlations Between CBI and dNBR Within Flatwoods



# Results-Correlations Between CBI and dNBR Within Depression Swamps



# Results-Flatwood Vs. Depression Swamp dNBR Breakpoints

Severity	Calculated	Average	Western
Unburned	<300	<109	<100
Low	300	109	100
Low-Moderate	527	303	270
Moderate-High	755	496	440
High	982	690	660



Severity	Calculated	Average	Western
Unburned	<37	<109	<100
Low	37	109	100
Low-Moderate	349	303	270
Moderate-High	662	496	440
High	974	690	660

# Conclusions

- dNBR images accurately represented the burn severity of the 2007 Big Turnaround Complex
- dNBR Breakpoints differed between vegetation types
- dNBR Breakpoints calculated per vegetation type differ from suggested Western Breakpoint range of  $\pm 100$
- If possible, dNBR breakpoints should be calibrated with CBI plots for each fire
  - Increased accuracy
- More research needs to be done
  - Effects of time since fire
  - Accuracy of extended assessments

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