Applications of burn severity mapping on Alaska National Wildlife Refuges

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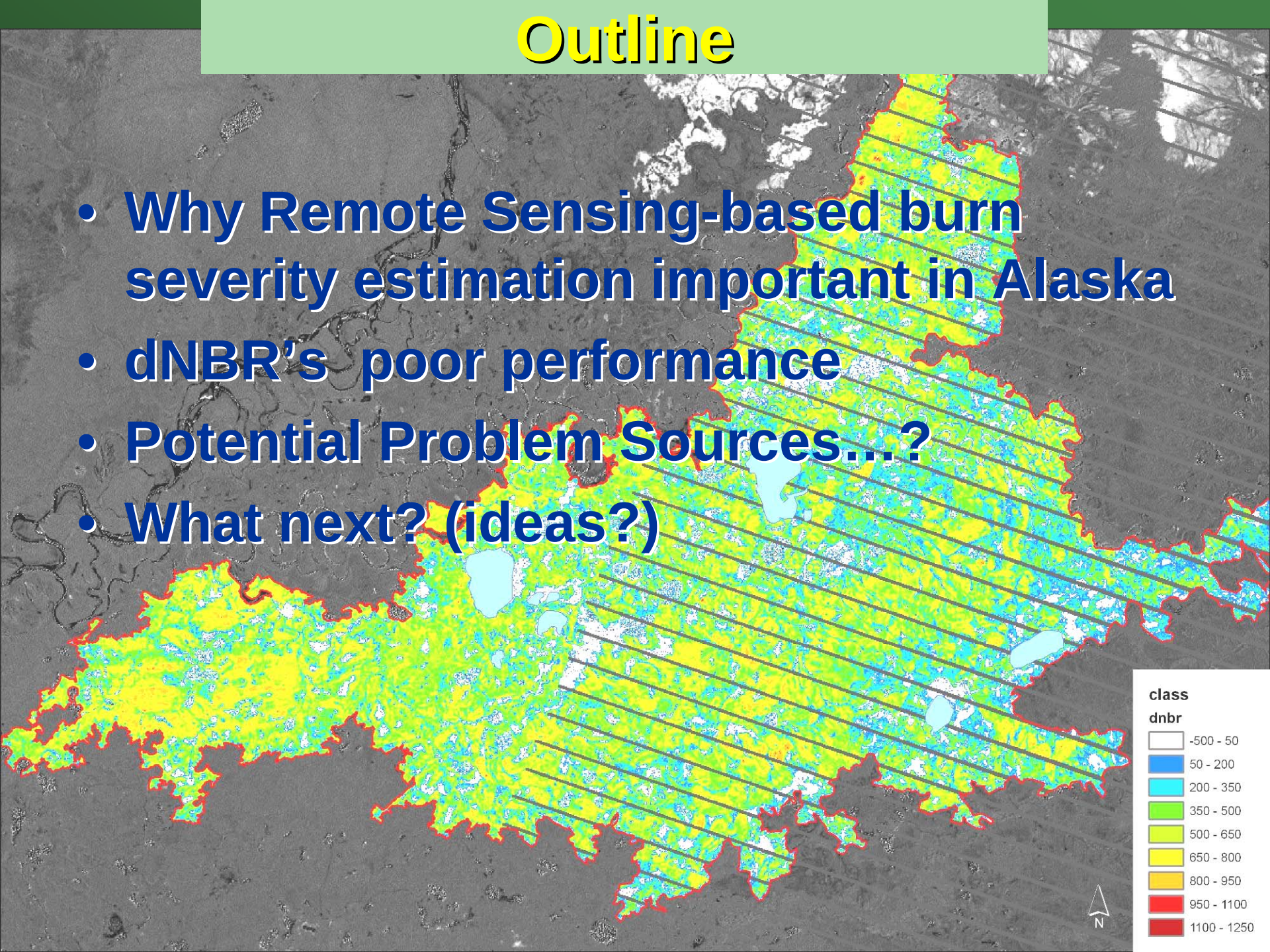
Outline

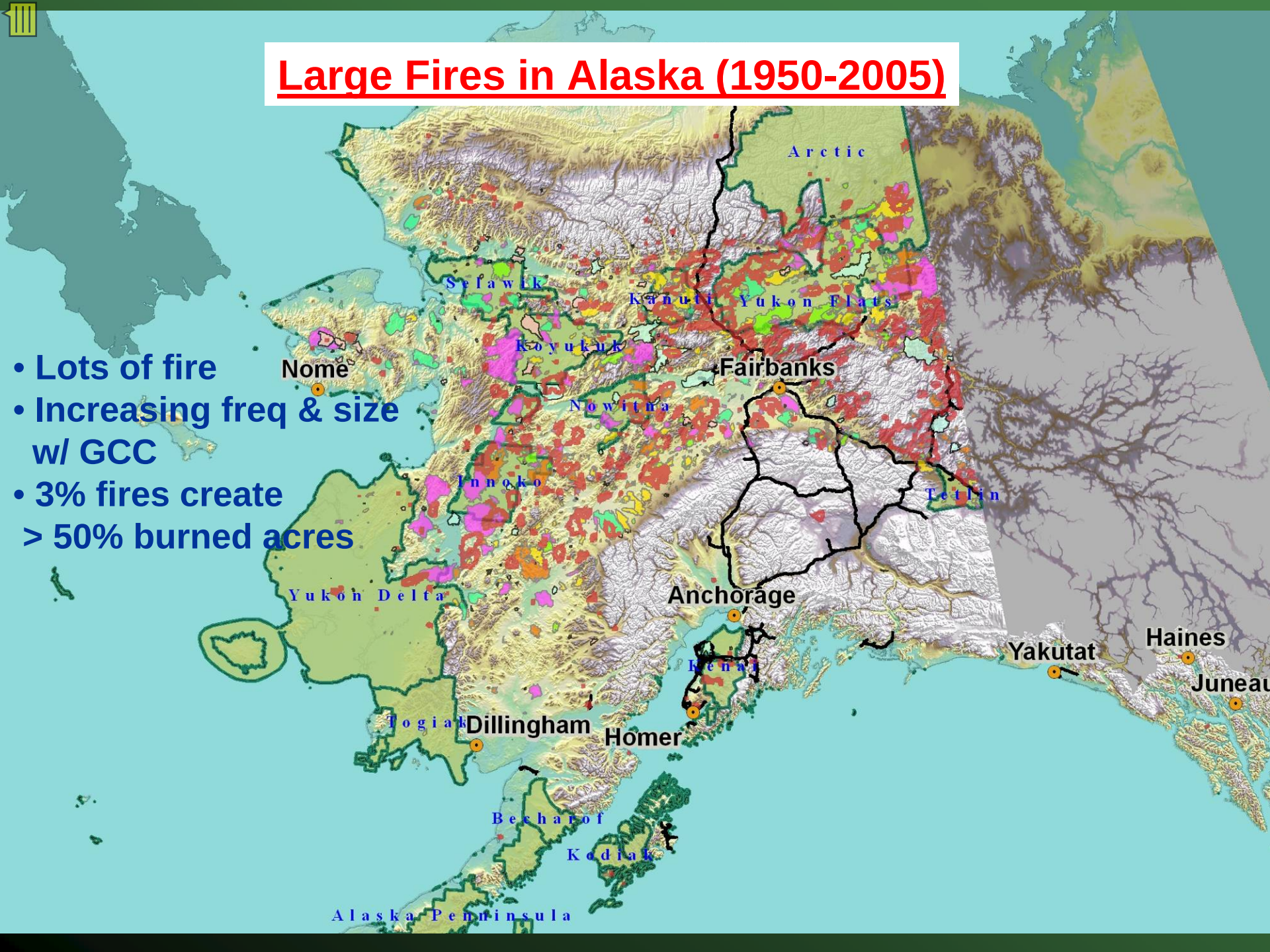
- Why Remote Sensing-based burn severity estimation important in Alaska
- dNBR's poor performance
- Potential Problem Sources…?
- What next? (ideas?)



National Wildlife Refuges in Alaska

- 16 Refuges
- 77 million acres
- 83% National System
- 18% AK lands
- 2 road-accessible

Large Fires in Alaska (1950-2005)



- Lots of fire
- Increasing freq & size w/ GCC
- 3% fires create > 50% burned acres

Burn severity in Boreal systems…

- …tied to vegetation response
  - boreal trees germinate best in mineral soil
  - deciduous colonization best in mineral soil
  - Least likely to get type-conversion to grasses
  - Permafrost melt, erosion…
- …which means habitat change!
  - **Wildlife First mandate**
  - **Detect high severity burned areas and unburned islands**

Workbook of Potential Successional Trajectories

in Burned Stands of Black Spruce in Interior Alaska

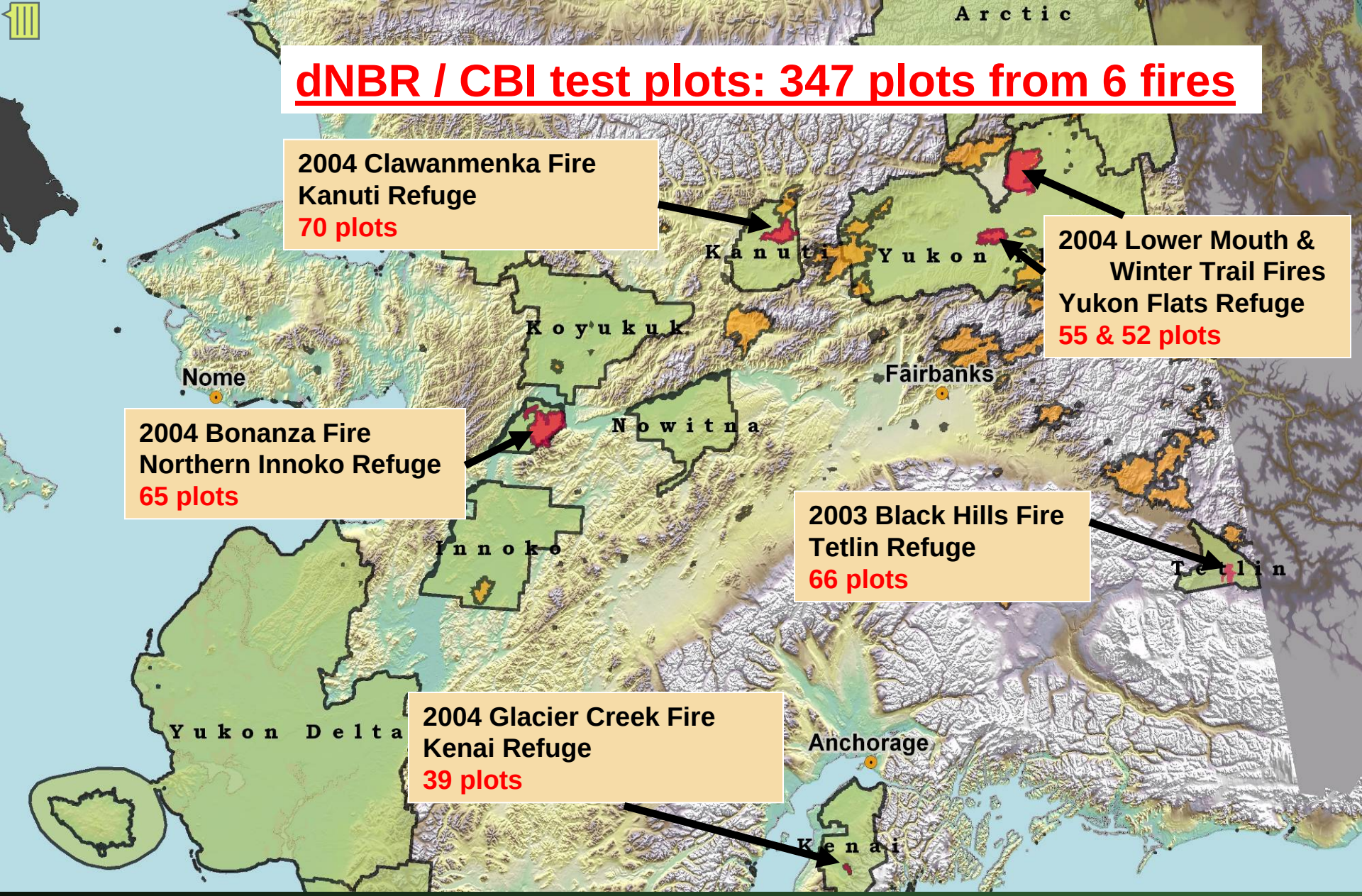
Produced as part of the JFSP Project,
"Managing Fire with Fire in Alaskan Black Spruce Forests"

Jill Johnstone, Teresa Hollingsworth, and Terry Chapin

Draft Version: October 2007

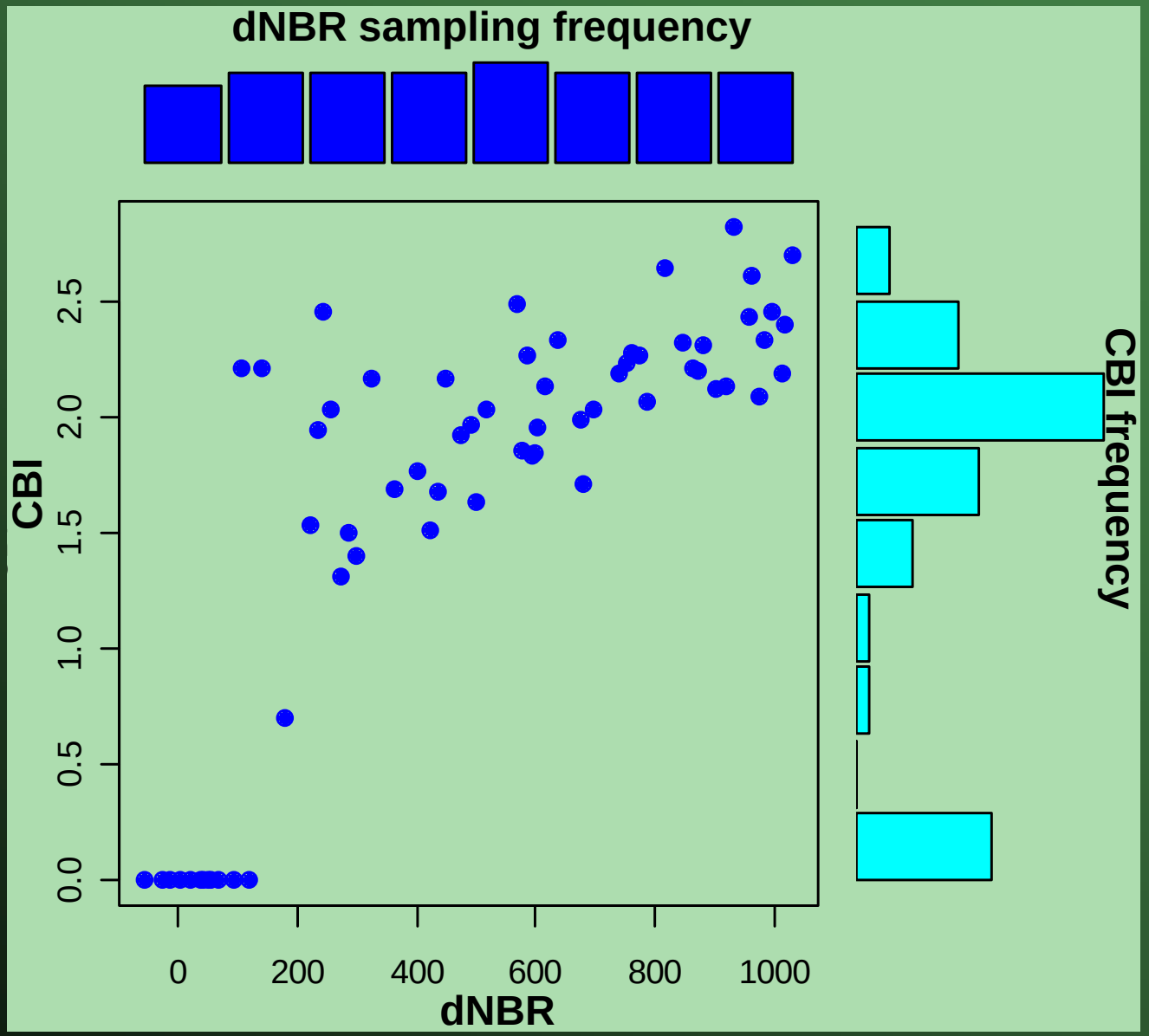
dNBR

- Expected dNBR to give provide good representation of on the ground severity levels
  - Results showed dNBR to be inconsistent across fires
  - dNBR appears to be limited in its ability to predict distinctions at moderate and high severity levels

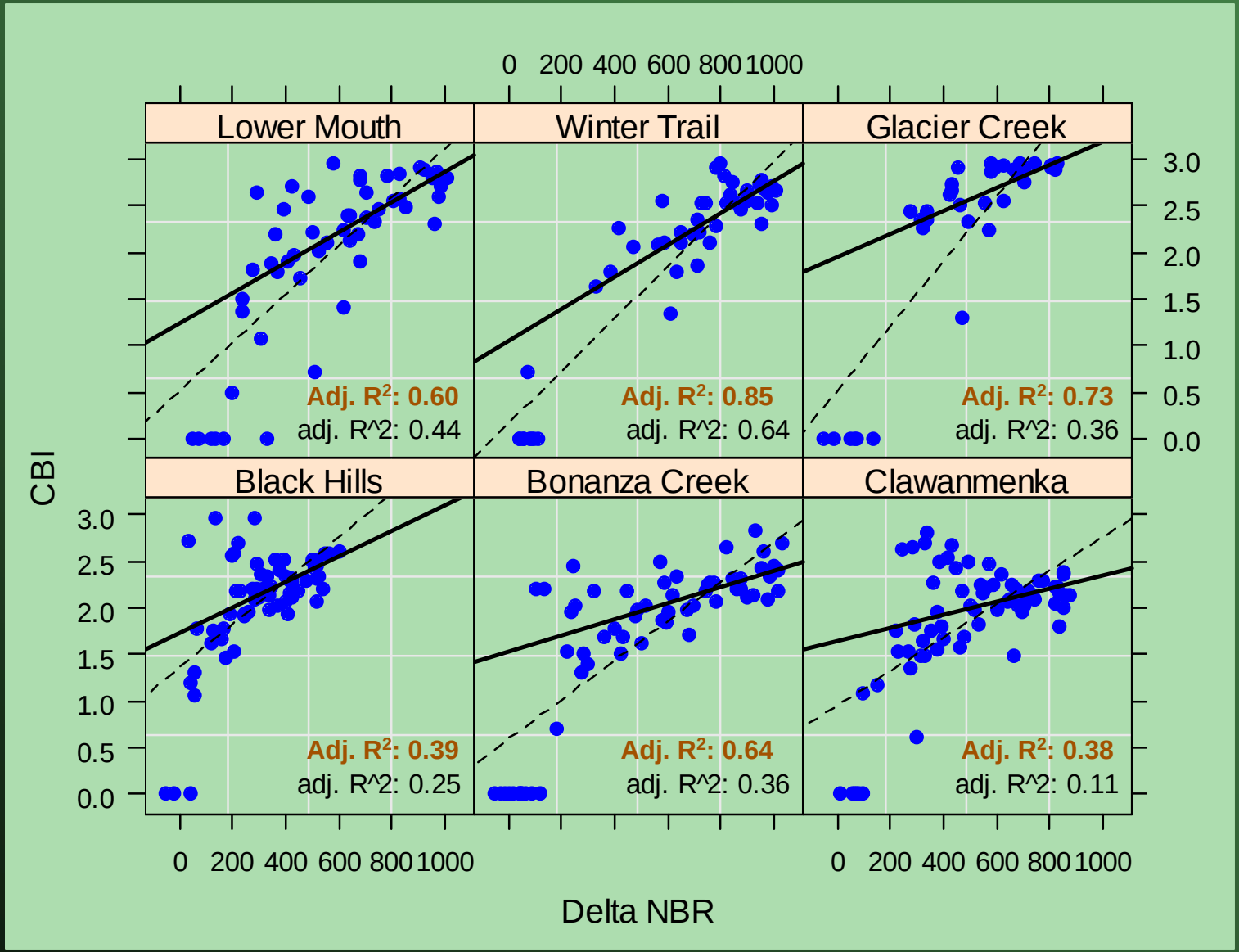


Ground verification used composite burn index (CBI) plots

Bonanza Creek Fire – Innoko Refuge



Alaska National Wildlife Refuge Fires



Why so lame?

Data Quality?

- Observer bias?
- Data entry errors?
- Site selection process?

Errors had no effect

Wetness?

- 6 combinations of TM bands
  - B7 & B2
  - B5 & B2
  - 52NWI = (B5-B2)/(B5+B2)
  - Change in wetness (pre- & post-fire) in all equations
- Linear and quadratic models
- No single index worked on all fires

⇒ doesn't explain the poor fit

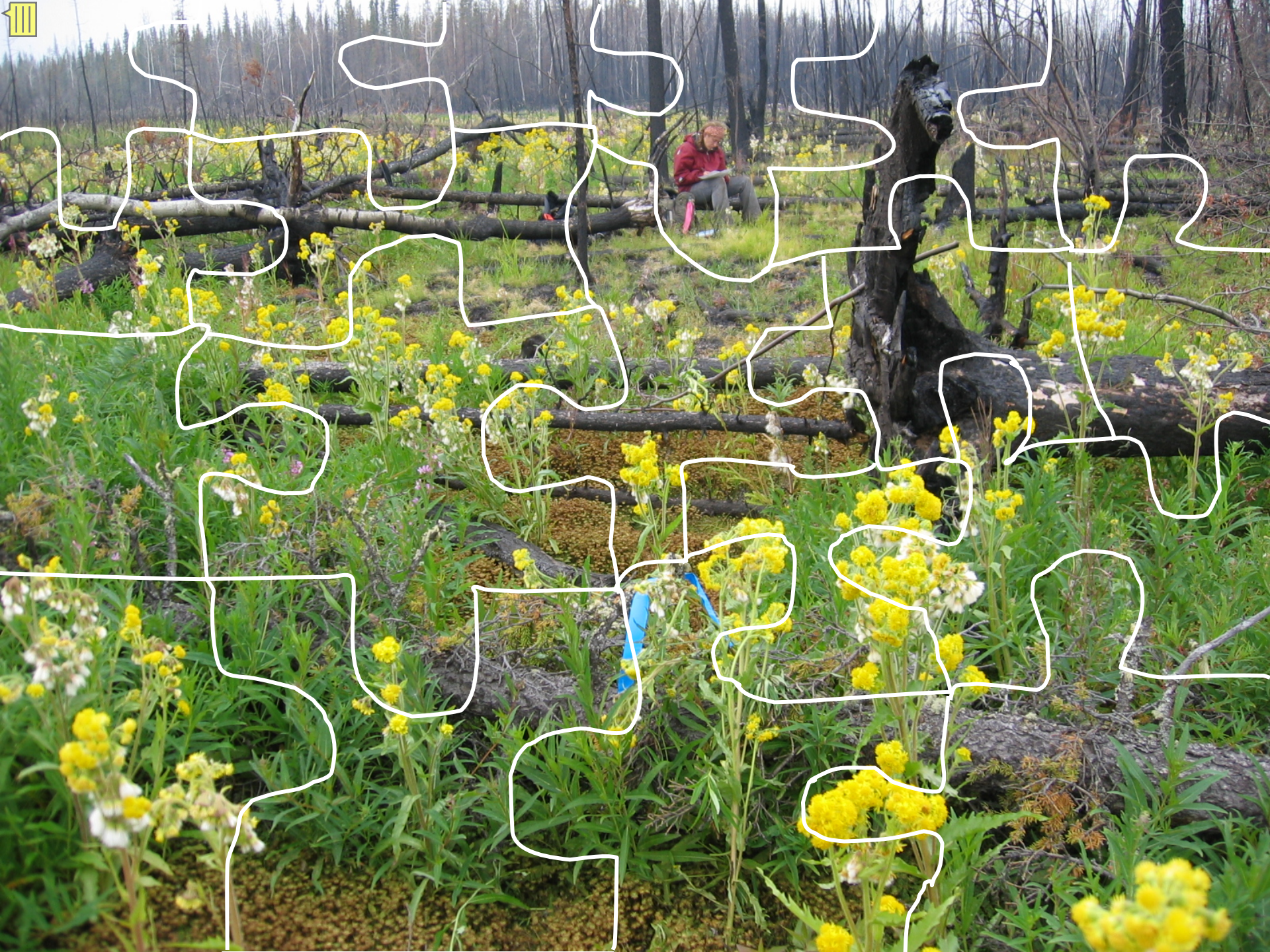
Aberrant Site Characteristics?

- Fallen trees with *Marchantia* (fireweed and horsetail indicators)
- Standing water
- Sphagnum
- Tussocks and sphagnum
- Green fallen trees

Photo Assessment

- No trait present in sufficient frequency in all fires
- Some characteristics appeared to be outliers (fallen trees, standing water)
- Others were sometimes outliers and sometimes integral to relationship (tussocks and sphagnum)
- Sphagnum had no effect

⇒ **doesn't explain the poor fit**



CBI evaluation

- CBI – weighted towards overstory
- Boreal forest burn severity weighted towards understory

Fire regimes IV and V = overstory killed in all but lightest of fires

Compared results for Understory (stratas A, B & C) and for Overstory (stratas D & E) separately

- All fires showed a decrease in R^2 for Understory strata
- Overstory Analysis: R^2 either improved or remained constant for all but one fire with few overstory plots

CBI = 0.61 dNBR = 300

CBI = 1.5 dNBR = 376

CBI Range = 0.61 to 2.63

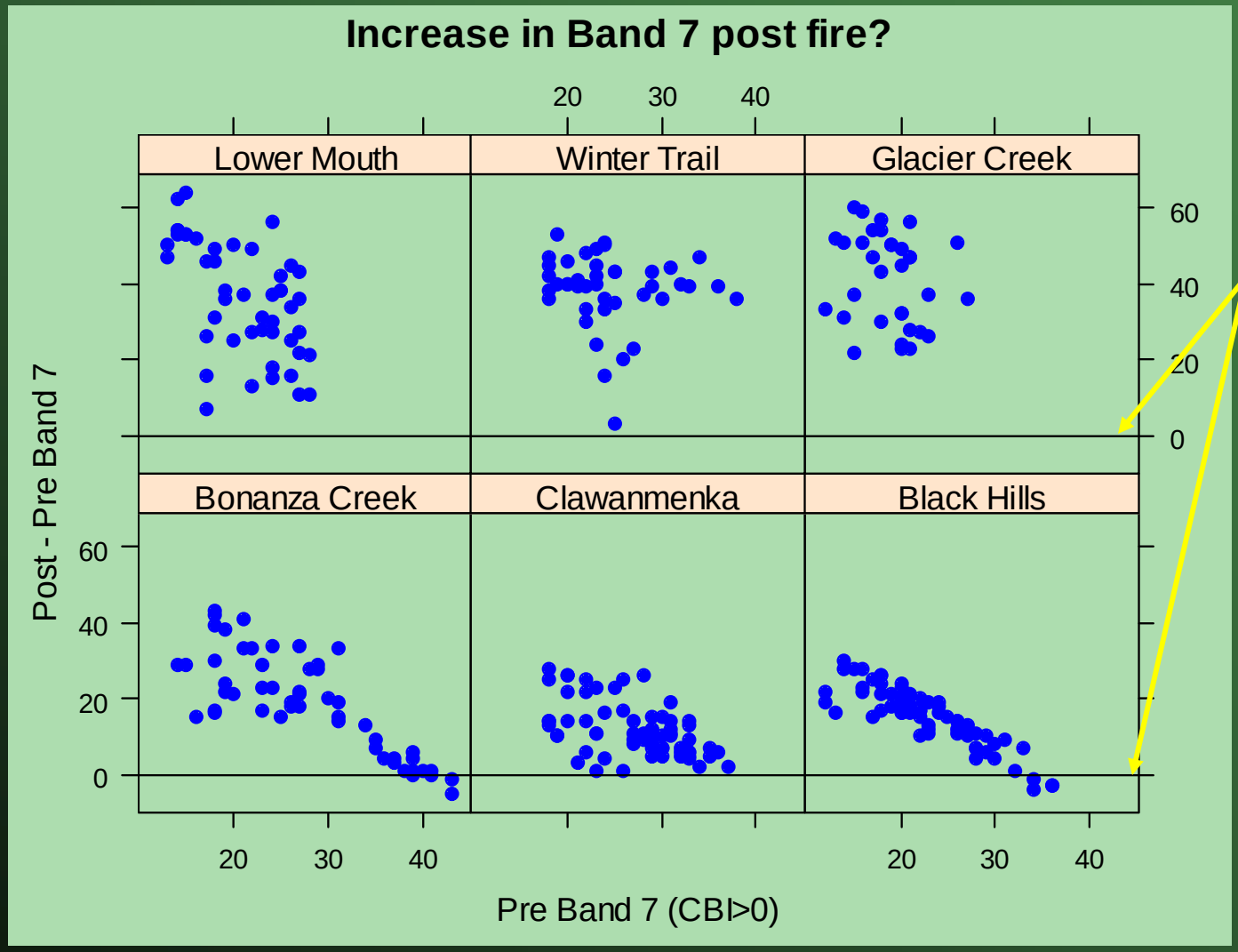
dNBR Range = 300 to 388

CBI = 1.9 dNBR = 380

CBI = 2.63 dNBR = 388

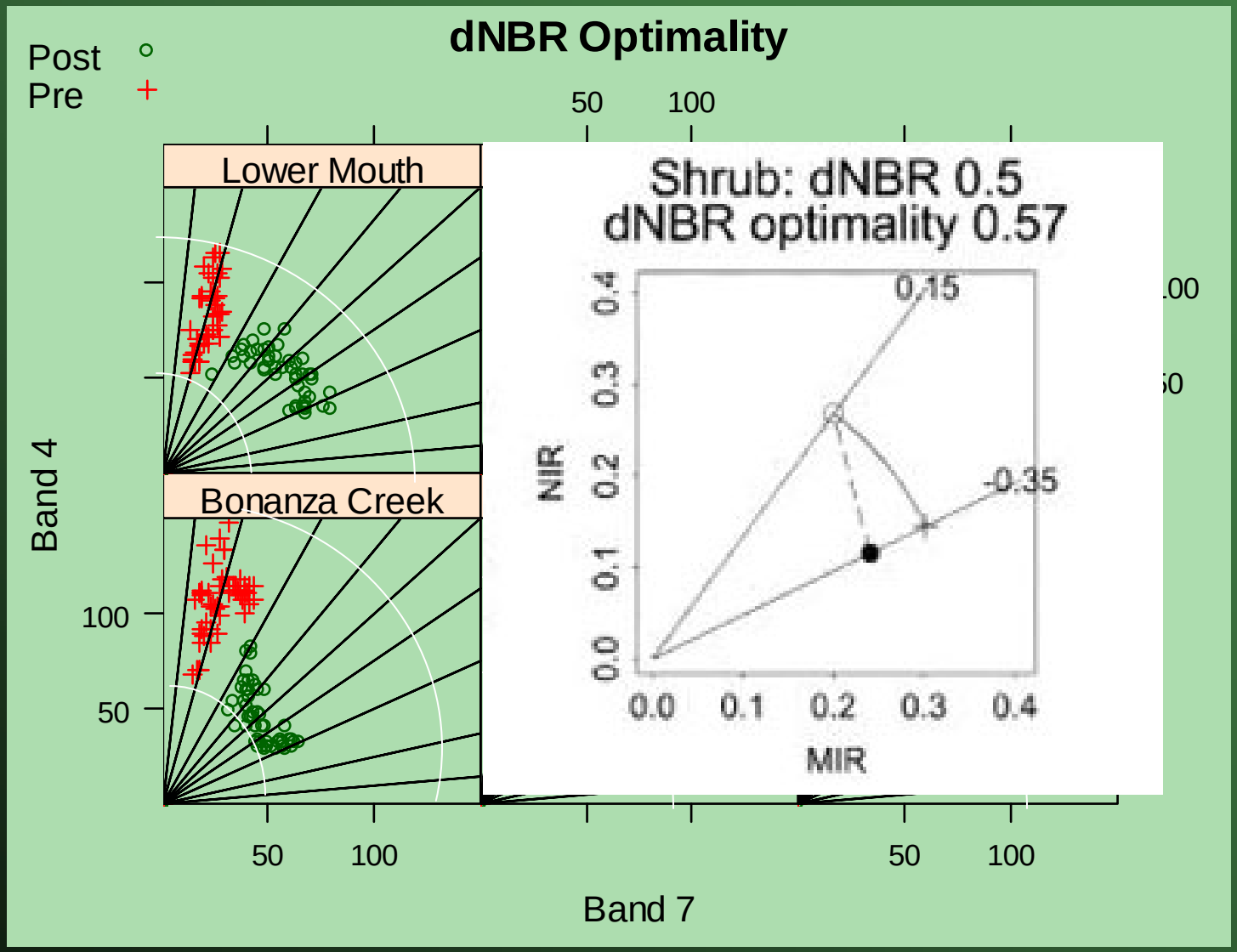
Imagery Evaluation

- Registration ✓
- Rapid vs Extended Assessment imagery
  - Slight improvement with rapid imagery ✓
- Band 7 & 4 response **?**



0 – line signifying no change. Positive change shows increase in post-fire band 7 values

Is dNBR an optimal metric



Roy, DP, L. Boschetti and S N Simon. 2006. Remote sensing of fire severity: assessing the performance of the Normalized Burn Ratio. Geoscience and Remote Sensing Letters. Vol 3, pp. 112-116

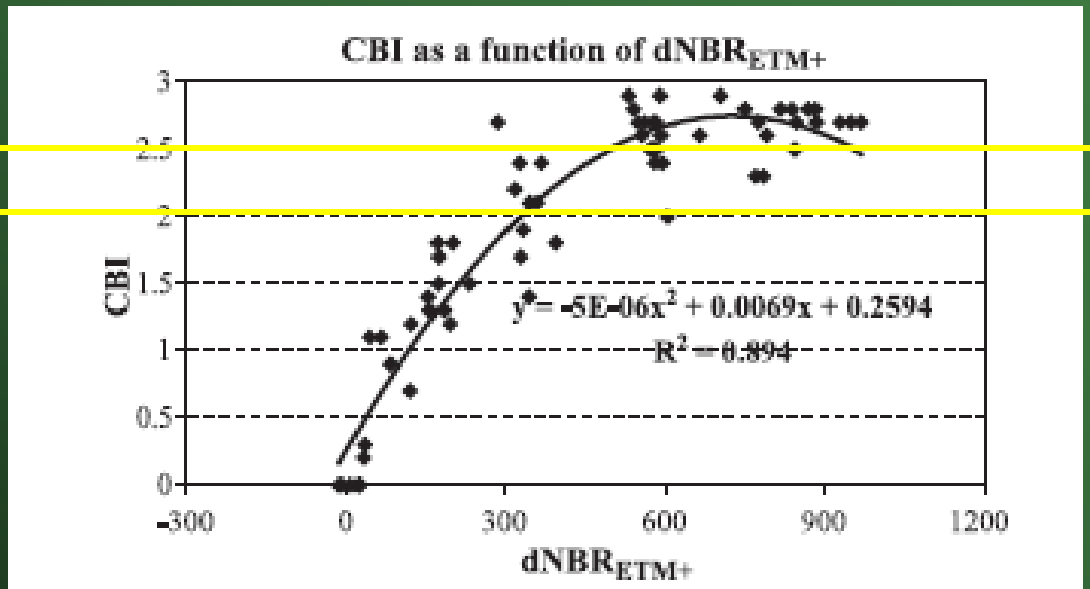
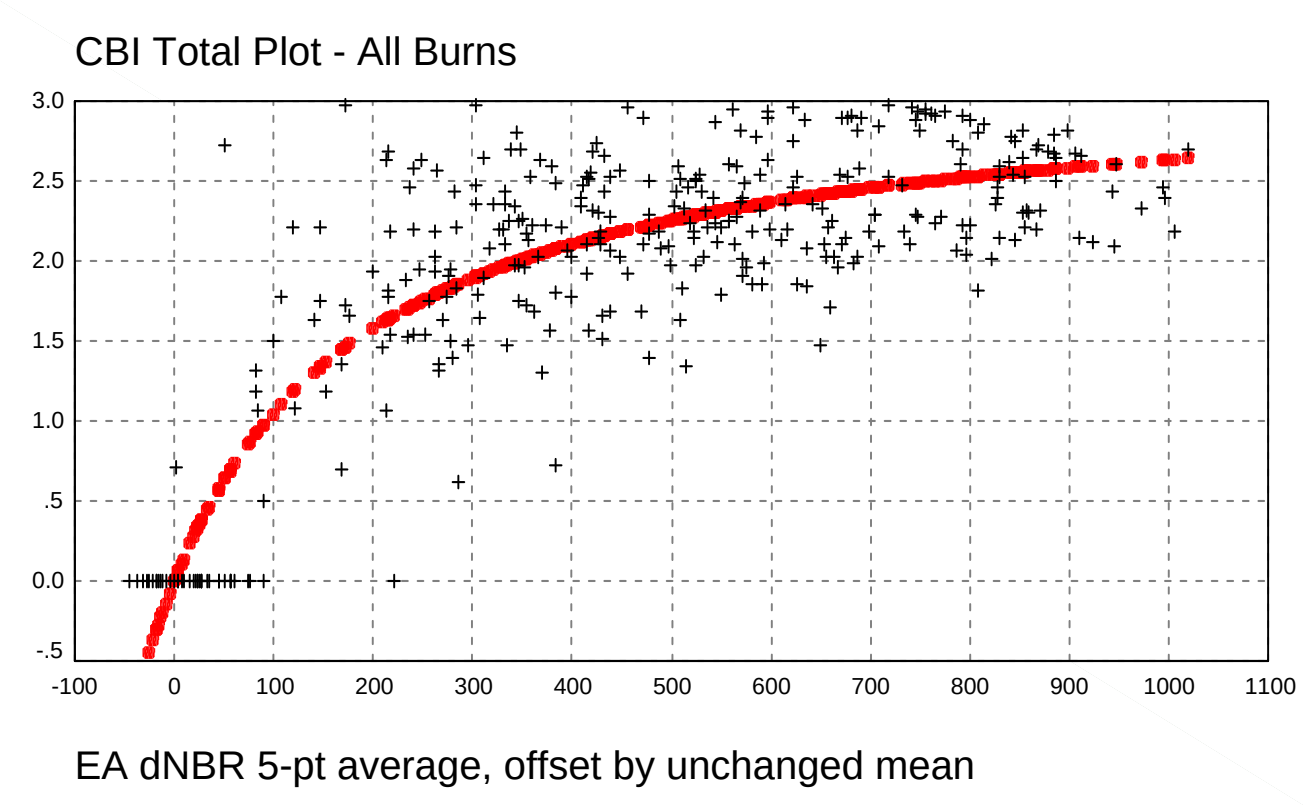


Fig. 11. Regression of the Composite Burn Index as a function of the differenced Normalized Burn Ratio based on ETM+ data using a second order polynomial. The r^2 was 0.894 and the CBI reached a maximum at about dNBR = 750.

Van Wagtendonk J.W., R.R. Root, C.H.Key. 2004. Comparison of AVIRIS and Landsat ETM+ detection capabilities for burn severity. Remote Sensing of Environment 06122, 12 pp

Non-linear high R^2



- Extended Assessment dNBR 5-point average, offset by unchanged mean
- Using: non-linear model Y= X/(A*X + B) from Ron Hall et al.
- Analysis by Carl Key using FWS 2004 fire data
- R-square = 0.73

What’s going on?

- dNBR appears to have lower predictive capability at higher severity sites
- Few sites CBI < 1.0 weakened our analysis
- Extreme conditions in 2004 (and 2005) created proportionately higher burn severity conditions

FWS next steps

- 2008 test low elevation aerial photography to ground-severity ratings
- Support research that expands knowledge of site conditions (i.e. topography) that influence severity

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