Development And Applications of the LANDFIRE Forest Structure Layers

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Applications of LANDFIRE tree canopy cover and stand height layers

- Fire behavior analyses
  - FARSITE
  - Wildland Fire Decision Support System (WFDDDS)
  - Fire Program Analysis (FPA) system
- Successional stage
- Habitat mapping
- Climate, biomass
LANDFIRE Timeline

Project start

2004

Original LANDFIRE circa 2001 products delivered - Tree canopy cover based on NLCD 2001

2009

“Refresh” circa 2001 / 2008 products - Tree canopy cover and stand height remapped using FIA plot data

2010

2011

2012

2013

2014

Scheduled delivery of 2010 updates and new products
End user feedback and assessments by fuels specialists of the original 2001 tree cover/height layers

- Tree canopy cover values tended to be too high
  - Many western forest types have max 70-80% canopy cover
  - Accuracy low?
- Stand height values tended to be too low
- Significant impact on fire behavior modeling systems

Remap tree canopy cover and stand height as part of Refresh 2008
LANDFIRE “Refresh” 2008 overview

- Remap canopy cover and stand height for 2001 from FIA plots and Landsat
- Map annual disturbances 1999-2008: Landsat and polygon data
- Derive vegetation transition rules from FVS and FIA plot data
- Apply vegetation transitions to 2001 map → 2008
Tree canopy cover of FIA plots was estimated by stem-mapping and modeling crown dimensions

- Vertically projected canopy cover of FIA tally trees ≥ 1.0 in. diameter
- Sapling component modeled from microplot data and spatial pattern of overstory trees
- Calibrated to line intercept field measurements
- Toney et al. 2009
Stand height was calculated as basal-area weighted height of the dominant and co-dominant trees in the plot.

- Canopy top height
- Sapling-stage plots used average height of the saplings only
FIA single-condition forested plots used for training data and validation

- Plots measured 1999-2007 used for mapping 2001 cover/height
- Plots omitted if disturbed following location-specific image dates
  → 54,000 plots in CONUS after screening

- Predictor variables:
  - LANDSAT leaf-on, leaf-off, and spring dates
  - Elevation, slope, aspect
  - Image texture derived from tassel-cap images
  - SRTM-based height metric (Kellndorfer et al. 2004 RSE)
- Regression tree models by map zone
- Seam lines, clouds, and other artifacts addressed
Updating 2001 to 2008

- Annual disturbance maps 1999-2008: MTBS, LANDSAT time series (VCT), and contributed polygon data
  - Disturbance types and severity

- Canopy cover and stand height updated based on modeled vegetation transitions
  - FIA data used in FVS to model 10 years of growth for each combination of vegetation type, disturbance type, severity
  - 2001 map →
    - time since disturbance + transition rule
      → 2008 map

- FVS also used to model transition in undisturbed areas
Plots measured in 2008-2009 were used to assess 2008 canopy cover and height

- Excluded plot locations that were used in mapping
- Assessed 3 x 3 (90 meter) map regions:
LANDFIRE 2008 tree canopy cover compared with FIA plots measured during 2008-2009: western US

- Mean difference: -2
- Mean absolute diff: ± 11
- $R^2 = 0.58$
- $n = 3,589$ plots
LANDFIRE 2008 tree canopy cover compared with FIA plots measured during 2008-2009: eastern US

mean difference: -3.8
mean absolute diff: ± 13
$R^2 = 0.40$
n = 4,587 plots
## LANDFIRE 2008 tree height compared with FIA plots measured during 2008-2009: CONUS

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<th>Field tree height</th>
<th>0-5m</th>
<th>5-10m</th>
<th>10-25m</th>
<th>25-50m</th>
<th>&gt;50m</th>
<th>Row total</th>
<th>Producer accuracy</th>
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<td>49%</td>
<td>89%</td>
<td>59%</td>
<td>12%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Overall accuracy: 74%**
**Within one class: 95%**