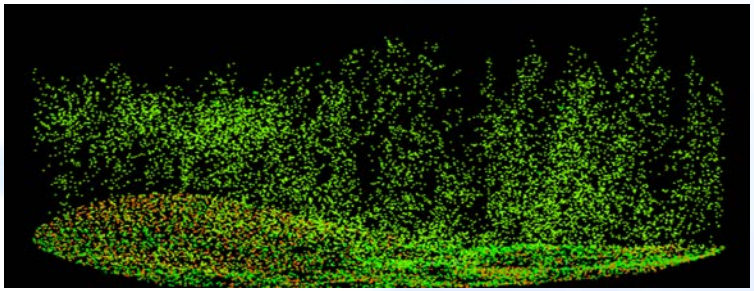
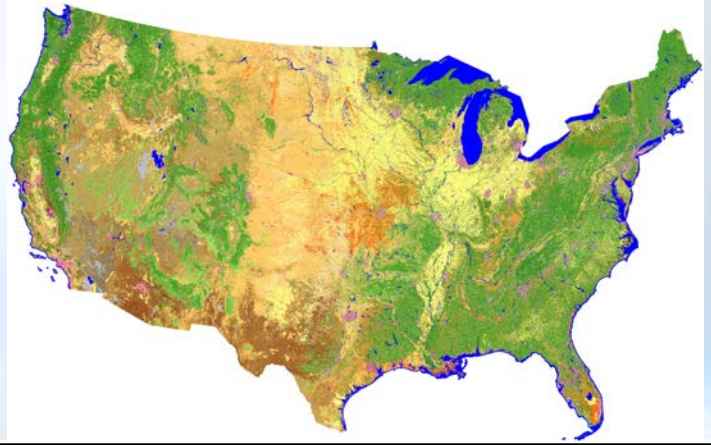
Lidar-Infused LANDFIRE
Peterson, USGS-EROS

- Enhanced Wildland Fire Management Decision Support Using Lidar-Infused LANDFIRE Data
- Project Team: Birgit Peterson (EROS), Matt Jolly (MFSL), Kurtis Nelson (EROS), Russ Parsons (MFSL) and Carl Seielstad (U. of Montana)
- Project Summary: Lidar provides 3D canopy structure information desired for fuel modeling, but currently underutilized by the fire science community. LANDFIRE default dataset does not include lidar in mapping process. Land management units lack capacity to fully utilize data. Building CHISLIC application to fill this need.
- Landsat TM, ETM+ and OLI; GLAS; airborne lidar

CHISLIC =  + 

Applied Sciences Program

Enhanced Wildland Fire Management Decision Support Using Lidar-Infused LANDFIRE Data

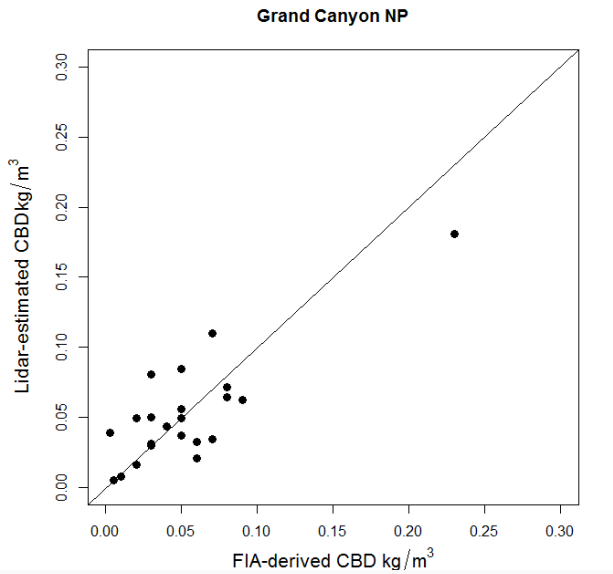
PI: Birgit Peterson, USGS (bpeterson@usgs.gov, 605-594-2742)

AppSci Domain
NASA ROSES A35 Wildfire
ACTIVE PROJECT
February, 2016

Purpose & Objective

This project integrates lidar-derived vegetation structure and fuels information with elements of the LANDFIRE product suite. LANDFIRE is a national vegetation and fuels mapping program that provides continuous, consistent, landscape-scale information to land managers to be used for decision support. LANDFIRE relies on field data and Landsat imagery, among other data sources, to develop its map products. Lidar data are not used in the current LANDFIRE mapping process because they are not nationally available, Locally, land managers fail to use lidar data because of training and infrastructure limitations. This projects seeks to continue to develop an application, CHISLIC, that automatically integrates lidar derived products of canopy height, canopy cover, and canopy base height with the corresponding LANDFIRE data. Over the next three years of Phase 2 CHISLIC functionality will continue to be developed.

Societal Benefit Area(s): fire mitigation, fuels treatment planning
Geographic Focus: national
Targeted End-Users: land managers, fire behavior models



Approach

- *Review of existing work and new data analysis will drive the possible implementation of a canopy bulk density algorithm within CHISLIC*
- *To integrate spaceborne lidar data, different data extrapolation methods will be explored and algorithms to derive structure and fuels metrics from waveform data will be refined*
- *The development of the CHISLIC prototype as a desktop application will be completed*
- *A programmer will be hired to enable the hosting of CHISLIC via web server to make the application widely available to potential users*
- *Direct links and searchable databases will be developed and hosted so that users may easily find the data necessary to run CHISLIC*

Co-I's: *Dr. W. Matt Jolly (USFS/MFSL)*
Mr. Kurtis Nelson (USGS/EROS)
Dr. Carl Seielstad (U. of Montana)
Dr. Russell Parsons (USFS/MFSL)

Key Milestones

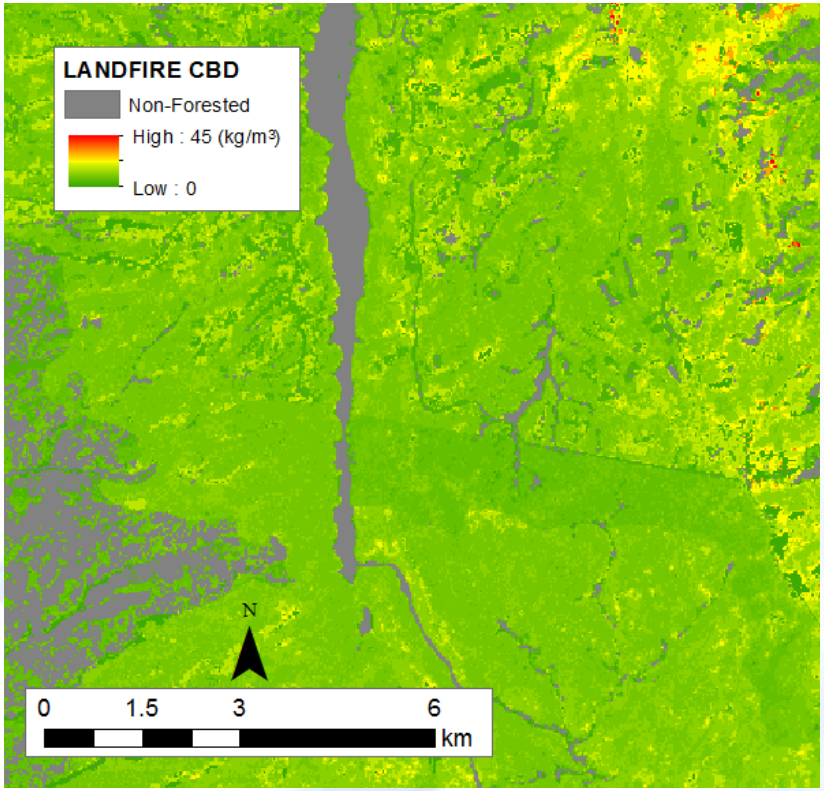
Milestone Statement	Date
Presentation to and discussion with NASA PI V. Ambrosia	07/15
Decision to transfer airborne lidar data processing from LAS-Tools to FUSION to overcome licensing issue	09/15
Development of initial algorithms for estimating CBD from lidar datasets for various study areas	10/15
Airborne lidar data processing flow developed for FUSION and tested on different systems with different datasets	01/16
PI Meeting in Boise, ID	03/16

ARL_{Start} = 1 **$ARL_{Most\ Recent}$ = 5/6** **ARL_{Goal}** = unknown

Significant advancement to date

Estimation of Crown Bulk Density using lidar
Example: North Kaibab Plateau, Ground Canyon NP

LANDFIRE



Lidar

?

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Site	Equation	R^2
North Kaibab Plateau	0.035+0.32MaxHt +0.0018Cov40+0.01D10-0.019P05-0.0086Kur	0.57
Lake County	0.0032-0.00022MaxHt+0.00034AvgHt- 0.0007Cov06 -0.00099D07-0.0012P25	0.20
Pierce County	-0.033+0.12MaxHt+0.015D12+0.0013Cov04-0.009Kur	0.69
Calaveras/ Tuolumne Counties	0.109-0.00049Cov18+0.0042D10-0.0024P10	0.94

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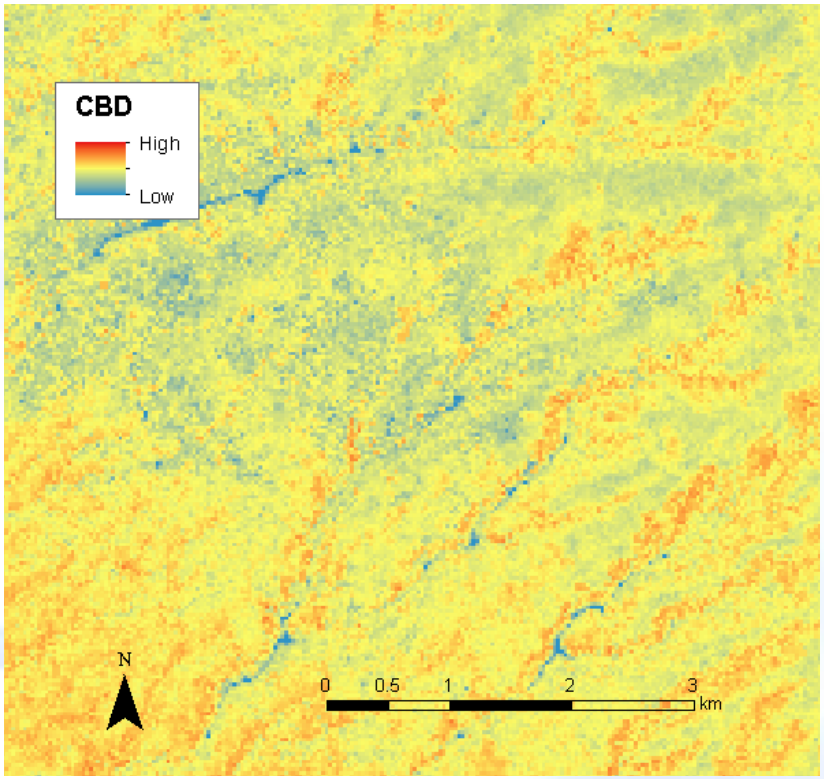
As of:
Date

Lidar-based CBD



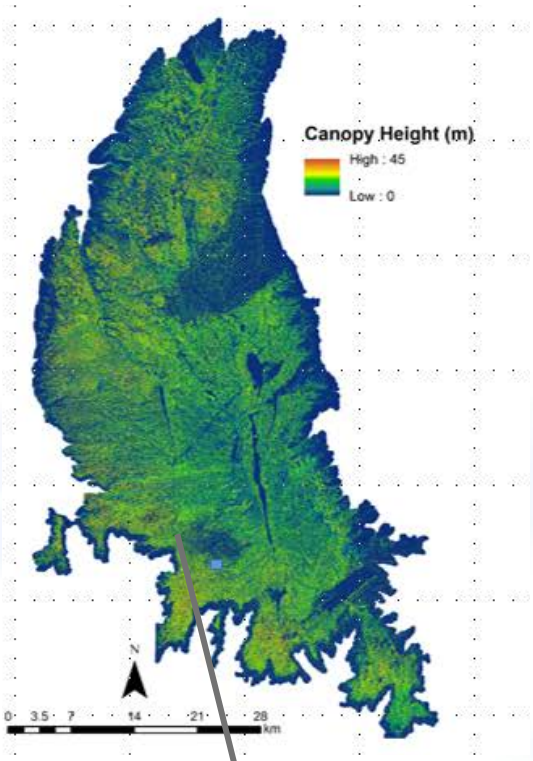
High-resolution imagery

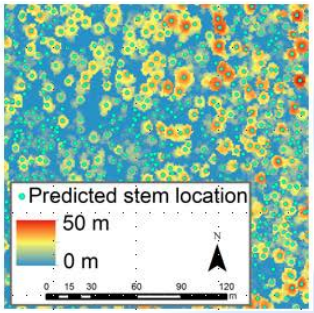
Challenge

LasTools License
Issue:
- **Licensing costs – too high for project maintenance**
- **Uncertainty in future accessibility to package at EROS**

Solution:
- **Convert processing to Fusion**
- **Open-source**
- **Developed by USFS**

Partner/End User Moment – Grand Canyon NP





Table

lidar_derived_tree_list.txt

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857	858	10.929999	390242.596454	4023679.15504	0.089885	898.852	33.8384	0.088858	888.582	34
858	859	12.13	390257.433368	4023678.943	0.105125	1051.25	36.5947	0.107184	1071.84	37
859	860	27.92	390436.957131	4023679.03104	0.483132	4831.32	78.4509	0.48065	4806.5	78
860	861	26.469999	390744.828551	4023679.15017	0.452518	4525.18	75.9247	0.436655	4366.55	75
861	862	30.179998	390802.409931	4023679.83063	0.547015	5470.15	83.4766	0.552937	5529.37	84
862	863	23.209999	390879.05316	4023679.94529	0.339072	3390.72	65.7221	0.344664	3446.64	66
863	864	11.03	390932.957131	4023679.03104	0.089885	898.852	33.8384	0.090327	903.269	34
864	865	15.23	390937.828551	4023679.15017	0.157089	1570.89	44.734	0.161451	1614.51	45
865	866	16.76	390969.052509	4023678.55845	0.196784	1967.84	50.068	0.191811	1918.11	49
866	867	18.119999	391044.798277	4023678.92952	0.218108	2181.08	52.711	0.220732	2207.32	53
867	868	30.859999	391072.798277	4023678.92952	0.580273	5802.73	85.9768	0.575564	5755.64	86
868	869	25.25	391146.433368	4023678.943	0.393979	3939.79	70.8438	0.401099	4010.99	71
869	870	16.01	391267.155373	4023678.82835	0.17644	1764.4	47.4093	0.176639	1766.39	47
870	871	20.549999	391857.222488	4023679.52989	0.287856	2878.56	60.5554	0.276849	2768.49	59
871	872	23.969999	391876.957131	4023679.03104	0.366068	3660.68	68.2883	0.365245	3652.45	68
872	873	21.83	392006.957131	4023679.03104	0.312998	3129.98	63.1446	0.308658	3086.58	63
873	874	20.02	392015.173928	4023678.94479	0.263655	2636.55	57.954	0.264129	2641.29	58
874	875	23.25	392246.711736	4023679.45991	0.339072	3390.72	65.7221	0.345734	3457.34	66
875	876	10.32	392528.798277	4023678.92952	0.075715	757.149	31.0567	0.080132	801.318	32

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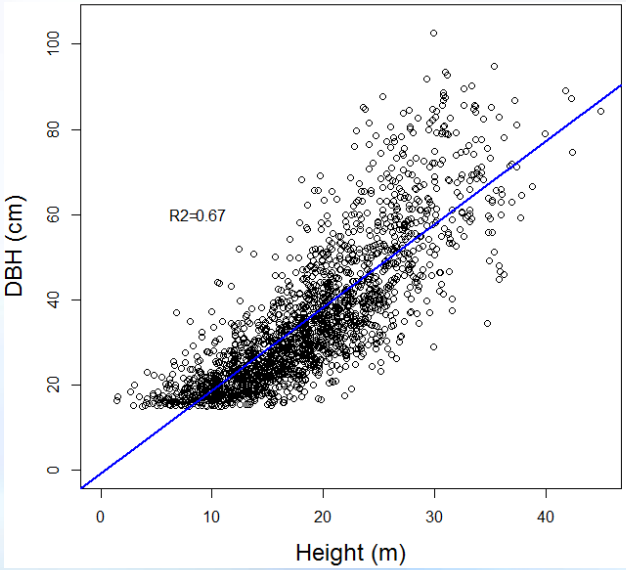
lidar_derived_tree_list.txt



PI Overall Assessment

Summary of Challenges; Problems; Objective Analysis

Estimating CBD from lidar remains a significant challenge – working to test forest-type specific predictor variables

Data extrapolation – identifying Landsat composites/mosaics and methods to use for extrapolation beyond ALS acquisitions

Lots to do in remaining time, but roadmap developed

Cost of USGS programmer

Summary of Positive Progress

LasTools workaround being implementated, testing underway, desktop release soon

Initial results for CBD work presented at AFE

Initial steps for remaining FARSITE inputs identified

Overall Assessment

Current progress slowed by Fusion transition, streamlining remaining steps.

PI Assessment of Future Project Progress

Remaining steps

Transition to server processing

Finalize data access issues

Finalize algorithms for remaining steps for easiest implementation

Test application

Write various documentation

Dreams

Centralized data repository

Project management

ARL_{Start} = 11 $ARL_{Most\ Recent}$ = 5/6 ARL_{Goal} = 9

Relevant Publications, Awards, Accomplishments

- **Published paper in Remote Sensing Letters**
- **Published USGS Fact Sheet**
- **Several conference presentations**
- **Conducted two workshops on CHISLIC**
- **Numerous follow-up conversations with people interested in using CHISLIC**
- **Initiated new investigation through Lake States Consortia**

Deserving Team Member:
Greg Cohn

Big thanks for
working diligently to figure out
lidar processing steps in
FUSION and providing excellent
documentation

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