LANDFIRE Webinar

LANDFIRE Remap in California

Presented to California Fire Science Consortium and
Utah State University Forestry Extension

by Kori Blankenship and Jim Smith – The Nature Conservancy's LANDFIRE Team
November 4, 2019

On behalf of the TNC LANDFIRE Team and the entire LANDFIRE Program, Kori and I thank you for the opportunity to present this webinar describing the status and plans for the LANDFIRE Program.

AGENDA

- Background: The Past
- LF Remap: The Present
- LF Update: The Future
- Impacts
- BpS Review
- Support/Resources

Review agenda

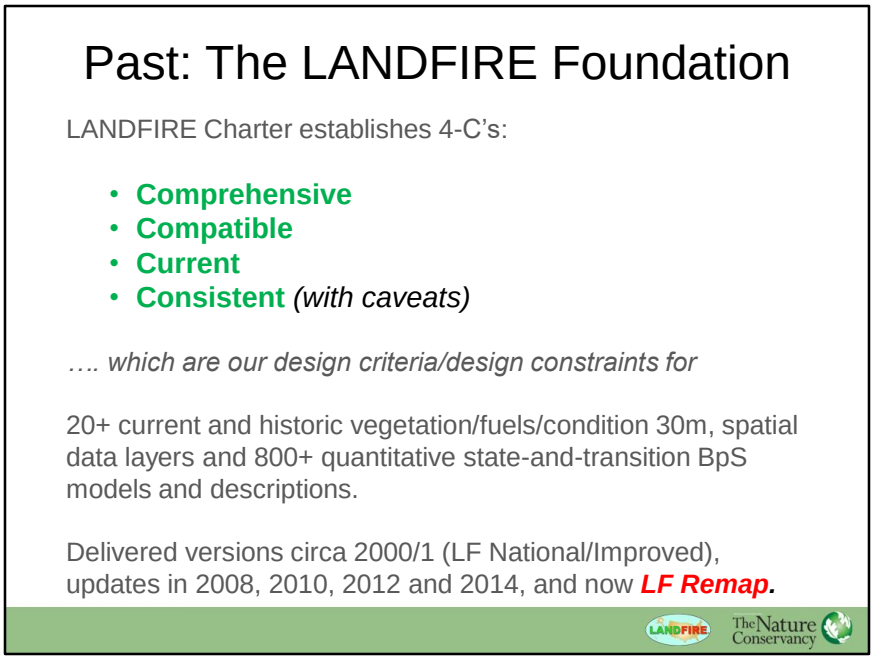
Who is LANDFIRE?

USDA FS, DOI, USGS Production Team, Program Leaders, and GAP

The Nature Conservancy's LANDFIRE Team

An innovative program designed to create and periodically update comprehensive **vegetation**, **fire**, and **fuel** characteristics data using a consistent process for the entire U.S.

LANDFIRE is a partnership between the U.S. Forest Service and the U.S. Department of Interior, and TNC. On the left is a significant part of the LF Production team at EROS, and the right is the TNC team.



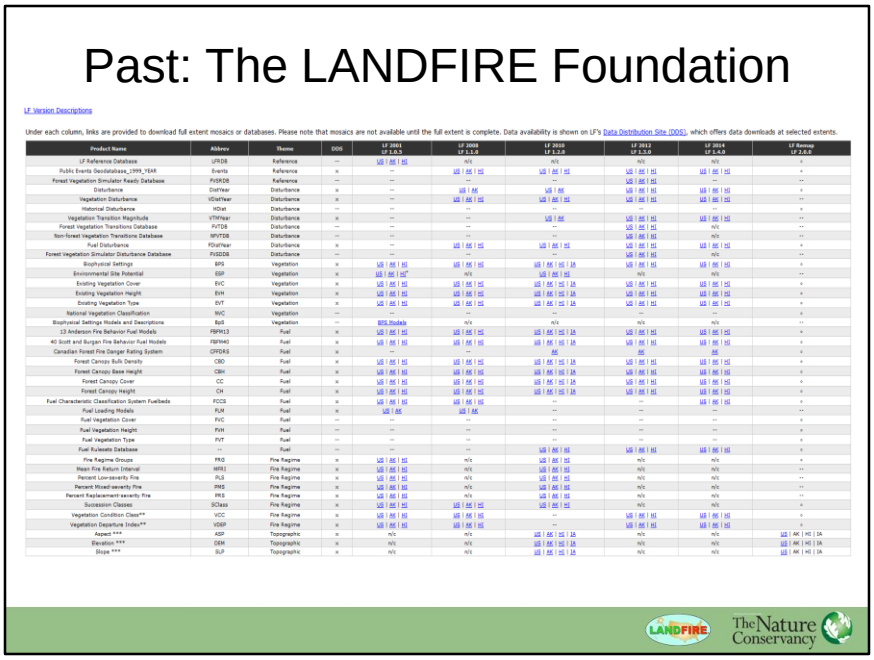
LANDFIRE program products

- are created for every acre in CONUS, AK, HI and the Island Territories - comprehensive
- match thematically and geometrically - compatible
- are produced using similar data sets and processes across time and space - consistent (there are changes due to feedback and product improvement desires
- are produced and delivered as rapidly as possible - current

These criteria have tangible impacts on what the products are, when we can deliver them, and how well they represent ground conditions.

The LANDFIRE product suite consists of nearly 2 dozen 30-meter spatial data sets (veg, fuels, etc.) and 800+ quantitative state-and-transition models in 5 (1 original + 4 temporal updates) completed delivered versions, and 1 partial delivery (Remap)

Past: The LANDFIRE Foundation



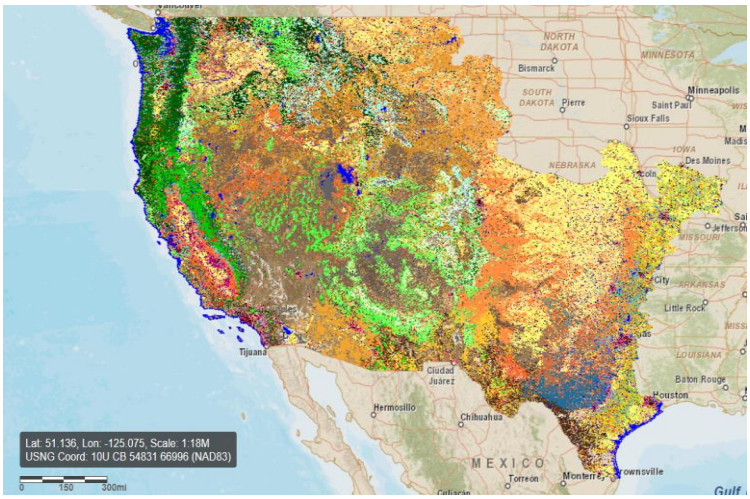
LF Version Descriptions

Under each column, links are provided to download full extent mosaics or databases. Please note that mosaics are not available until the full extent is complete. Data availability is shown on LF's Data Distribution Site (DDS), which offers data downloads at selected extents.

Product Name	Abbrev	Theme	DDS	LF 2001 LF 1.0.5	LF 2008 LF 1.1.0	LF 2010 LF 1.2.0	LF 2012 LF 1.3.0	LF 2014 LF 1.4.0	LF Remap LF 2.0.0
LF Reference Database	LFRDB	Reference	--	US | AK | HI	--	n/c	n/c	n/c	+
Public Events Geodatabase_1999_YEAR	Events	Reference	+	--	--	US | AK | HI	US | AK | HI	US | AK | HI	+
Forest Vegetation Simulator Ready Database	FVSRDB	Reference	--	--	--	--	US | AK | HI	--	--
Disturbance	DistYear	Disturbance	+	--	US | AK	US | AK	US | AK | HI	US | AK | HI	+
Vegetation Disturbance	VDistYear	Disturbance	+	--	US | AK | HI	US | AK | HI	US | AK | HI	US | AK | HI	--
Historical Disturbance	HDist	Disturbance	--	--	--	--	--	--	+
Vegetation Transition Magnitude	VTMYear	Disturbance	+	--	--	US | AK	US | AK | HI	US | AK | HI	--
Forest Vegetation Transitions Database	FVTDB	Disturbance	--	--	--	--	US | AK | HI	n/c	--
Non-forest Vegetation Transitions Database	NFVTDB	Disturbance	--	--	--	--	US | AK | HI	n/c	--
Fuel Disturbance	FDistYear	Disturbance	+	--	US | AK | HI	US | AK | HI	US | AK | HI	US | AK | HI	+
Forest Vegetation Simulator Disturbance Database	FVSDDB	Disturbance	--	--	--	--	US | AK | HI	n/c	--
Biophysical Settings	BPS	Vegetation	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
Environmental Site Potential	ESP	Vegetation	+	US | AK | HI*	n/c	US | AK | HI	n/c	n/c	--
Existing Vegetation Cover	EVC	Vegetation	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
Existing Vegetation Height	EVH	Vegetation	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
Existing Vegetation Type	EVT	Vegetation	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
National Vegetation Classification	NVC	Vegetation	--	--	--	--	--	--	+
Biophysical Settings Models and Descriptions	BpS	Vegetation	--	BPS Models	n/c	n/c	n/c	n/c	--
13 Anderson Fire Behavior Fuel Models	FBFM13	Fuel	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
40 Scott and Burgan Fire Behavior Fuel Models	FBFM40	Fuel	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
Canadian Forest Fire Danger Rating System	CFFDRS	Fuel	+	--	--	AK	HI	AK	+
Forest Canopy Bulk Density	CBD	Fuel	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
Forest Canopy Base Height	CBH	Fuel	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
Forest Canopy Cover	CC	Fuel	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
Forest Canopy Height	CH	Fuel	+	US | AK | HI	US | AK | HI	US | AK | HI | IA	US | AK | HI	US | AK | HI	+
Fuel Characteristic Classification System Fuelbeds	FCCS	Fuel	+	US | AK | HI	US | AK | HI	--	--	US | AK | HI	+
Fuel Loading Models	FLM	Fuel	+	US | AK	US | AK	--	--	--	--
Fuel Vegetation Cover	FVC	Fuel	--	--	--	--	--	--	+
Fuel Vegetation Height	FVH	Fuel	--	--	--	--	--	--	+
Fuel Vegetation Type	FVT	Fuel	--	--	--	--	--	--	+
Fuel Rulesets Database	--	Fuel	--	--	--	US | AK | HI	US | AK | HI	US | AK | HI	+
Fire Regime Groups	FRG	Fire Regime	+	US | AK | HI	n/c	US | AK | HI	n/c	n/c	+
Mean Fire Return Interval	MFRI	Fire Regime	+	US | AK | HI	n/c	US | AK | HI	n/c	n/c	--
Percent Low-severity Fire	PLS	Fire Regime	+	US | AK | HI	n/c	US | AK | HI	n/c	n/c	--
Percent Mixed-severity Fire	PMS	Fire Regime	+	US | AK | HI	n/c	US | AK | HI	n/c	n/c	--
Percent Replacement-severity Fire	PRS	Fire Regime	+	US | AK | HI	n/c	US | AK | HI	n/c	n/c	--
Succession Classes	SCClass	Fire Regime	+	US | AK | HI	US | AK | HI	US | AK | HI	n/c	n/c	+
Vegetation Condition Class**	VCC	Fire Regime	+	US | AK | HI	US | AK | HI	--	US | AK | HI	US | AK | HI	+
Vegetation Departure Index**	VDEP	Fire Regime	+	US | AK | HI	US | AK | HI	US | AK | HI	US | AK | HI	US | AK | HI	+
Aspect ***	ASP	Topographic	+	n/c	n/c	US | AK | HI | IA	n/c	n/c	US | AK | HI | IA
Elevation ***	DEM	Topographic	+	n/c	n/c	US | AK | HI | IA	n/c	n/c	US | AK | HI | IA
Slope ***	SLP	Topographic	+	n/c	n/c	US | AK | HI | IA	n/c	n/c	US | AK | HI | IA

I don't expect you to read this, but to appreciate the depth and breadth of program products

Present: LF Remap



Remap is NOT an update…it is a re-creation of the majority of the product suite from scratch…new plots, new imagery, new processes, etc.

NW, SW, and South Central U.S. GeoArea Vegetation and Fuels (EVT, EVC, EVH, FBFM, Canopy Fuels, BpS) have been delivered.

Fire Regime data will be created and delivered when veg and fuels are complete for CONUS.

LF Remap – What Remains the Same?

LANDFIRE Program has the same design criteria/constraints: comprehensive, compatible, consistent and current.

The basic product suite is the same, but there are changes to mapping processes and thematic content intended to improve product usability.

Should still be considered a large landscape, regional, national data set as delivered out-of-the-box.

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Should still be considered a large landscape, regional, national data set as delivered out-of-the-box.

LF Remap – What's New?

- Mapping footprints based on Omernik Level III ecoregions instead of NLCD Map Zones.
- New compositing/tiling/masking methods that provide an improved and more consistent image base.
- New, improved plot "Auto-Keys" for assigning vegetation type to field plots.
- Landsat 8 imagery and Landsat Analysis Ready Data Sets (image stacks).
- Included external review of the Existing Vegetation Type legend and draft products.
- Independently mapped NVC Group.

LF Remap – What's New?

- Many more field-plots and more diverse field-plots to support mapping.
- Incorporation of lidar data sets to improve the thematic resolution of structure products.
- Incorporation of NLCD Continuous Shrub Cover mapping project processes/products.
- Review of Biophysical Settings models and descriptions.
- New products: Historic disturbance, Year-Capable Fuels Products.
- New, backwardly compatible Fire Regime Group schema.

New Fire Regime Group Schema

Original Fire Regime Group	New Group Designation	All Fire Fire Return Interval	% Replacement Fire
I	I-A	0 - 5 years	Less than 66.7%
	I-B	6 - 15 years	
	I-C	16 - 35 years	
II	II-A	0 - 5 years	66.7% or greater
	II-B	6 - 15 years	
	II-C	16 - 35 years	
III	III-A	36 - 100 years	Less than 80%
	III-B	101- 200 years	Less than 66.7%
IV	IV-A	36 - 100 years	80% or greater
	IV-B	101- 200 years	66.7% or greater
V	V-A	201 to 500 years	Any severity
	V-B	501+ years	

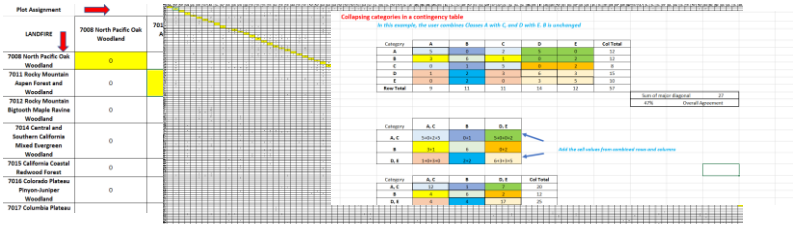
LANDFIRE The Nature Conservancy

Based on user comments from previous versions the FRG schema was often problematic….insufficient FRI resolution

Wendel Hann LF did an analysis of FRG, and then developed a new, backwardly compatible FRG definitions that we hope is more useful.

LF Remap Quality

- EVT assessments for Ecological Systems, NVC Group, NVC Macrogroup, and SAF/SRM cover type
- Thousands of independent plots
- Traditional Contingency Table
- Example of how to collapse categories in the



Vegetation Height (EVH)---and exploring FBFM

LF Remap Quality

- Category Agreement Table

EVT Map Value	EVT_Name	Row Total (pixels)	% of Row Pixels	Row Agreement	Primary Within Row Mismatch	Secondary Within Row Mismatch	Tertiary Within Row Mismatch	Data Source
7023	Madrean Encinal	45	0.35%	60.0%	7025 Madrean Pinyon-Juniper Woodland; 13 Incorrect Pixels	7104 Mogollon Chaparral; 3 Incorrect Pixels	7054 Southern Rocky Mountain Ponderosa Pine Woodland; 1 Incorrect Pixels	LANDFIRE LFRDB
7114	California Lower Montane Blue Oak-Foothill Pine Woodland and Savanna	122	0.94%	59.84%	9302 Californian Ruderal Forest; 22 Incorrect Pixels	7105 Northern and Central California Dry-Mesic Chaparral; 9 Incorrect Pixels	7030 Mediterranean California Lower Montane Conifer Forest and Woodland; 7 Incorrect Pixels	LANDFIRE LFRDB
7087	Sonora-Mojave Creosotebush-White Bursage Desert Scrub	286	2.21%	59.09%	9654 North American Warm Desert Wash Shrubland; 36 Incorrect Pixels	7082 Mojave Mid-Elevation Mixed Desert Scrub; 27 Incorrect Pixels	7109 Sonoran Paloverde-Mixed Cacti Desert Scrub; 24 Incorrect Pixels	LANDFIRE LFRDB
7110	Southern California Dry-Mesic Chaparral	260	2.01%	58.46%	7097 California Mesic Chaparral; 41 Incorrect Pixels	7092 Southern California Coastal Scrub; 34 Incorrect Pixels	9337 California Ruderal Scrub; 16 Incorrect Pixels	LANDFIRE LFRDB
7050	Rocky Mountain Lodgepole Pine Forest	346	2.67%	58.09%	7146 Southern Rocky Mountain Montane-Subalpine Grassland; 39 Incorrect Pixels	7145 Rocky Mountain Subalpine-Montane Mesic Meadow; 38 Incorrect Pixels	7055 Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland; 20 Incorrect Pixels	LANDFIRE LFRDB

- Planning on an assessment of Vegetation Cover (EVC) and Vegetation Height (EVH), and perhaps FBFM.

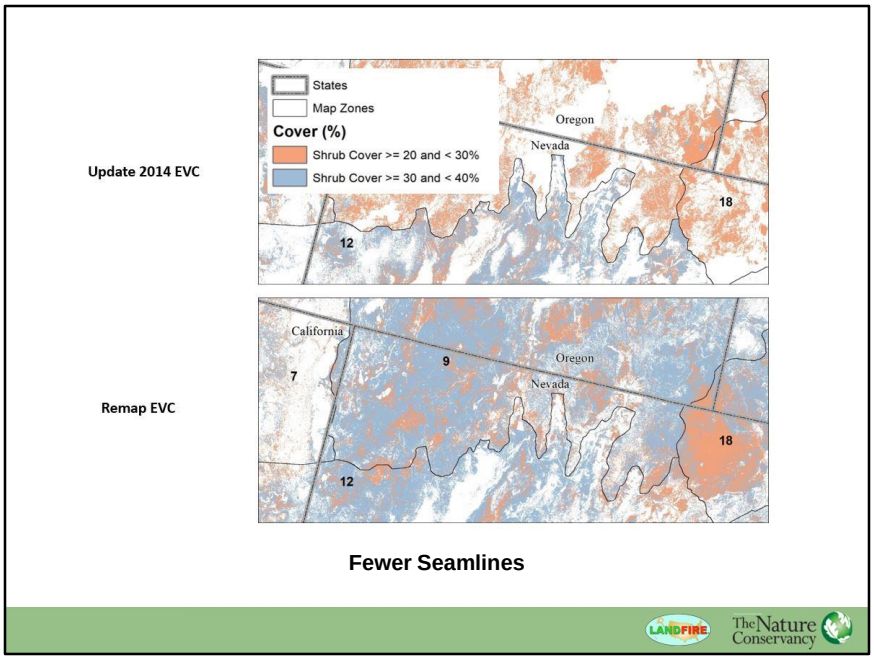
Vegetation Height (EVH)---and exploring FBFM

LANDFIRE Future

- Remap 2016 will wrap up in CONUS during the summer of 2020, and then Alaska, Hawai'i, and the island territories over the following months.
- Because "remapping" is more expensive than "updating," we may not be able to conduct another remap in the future.
- The goal is to find a way to provide more frequent, updates representing more current conditions with improved quality.

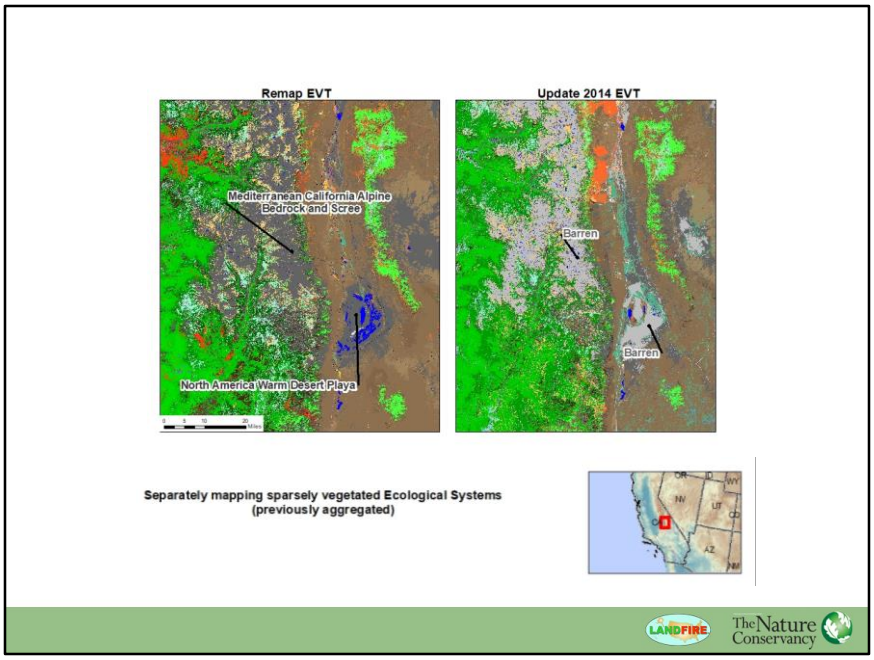
- We expect to complete Remap in CONUS, followed by AK, HI and Insular areas
- Then we will begin an update cycle, final plan impacted by budget
- Updating alternatives being explored
    - Annual, next year rapid updates based on submitted disturbances/landscape changes
    - Bi-annual updates based on submitted disturbances + remotely sensed landscape change
- Communications and support---listening as much as talking
- Now I will turn over the presentation duties to Kori Blankenship, Fire Ecologist on our team and a NW native

Remap Improvements



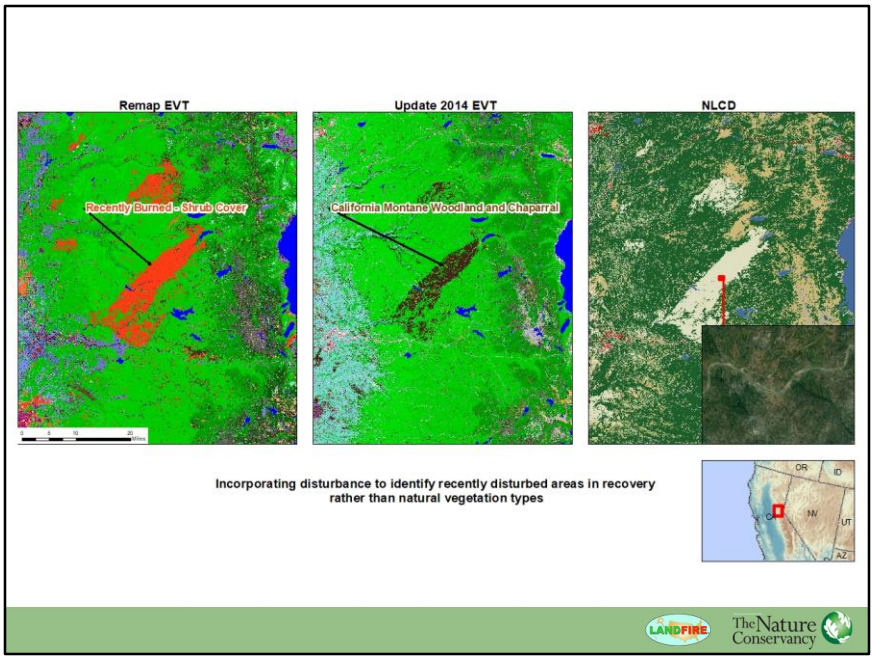
Fewer Seamlines

- As mentioned previously by Jim the way we process the imagery now (e.g. using tiling, larger processing unit) leads to fewer seamlines.
- Here you can see a seamline created at the mapzone border where shrub cover abruptly changes in the 2014 cover product.
- In Remap, the seamline is not evident due to improvements in how LANDIFRE mapping teams process the imagery.



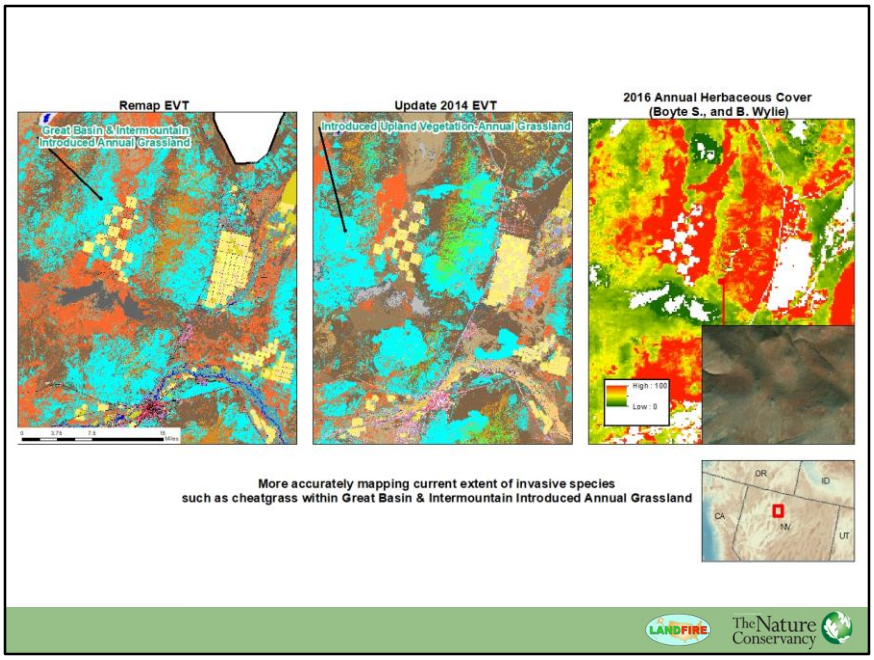
Finer Level Distinctions in Aggregate Types

- In previous LANDFIRE versions sparsely vegetated types were aggregated into coarse types.
- Here you can see how we have split out these previously aggregated types: for example what we mapped in 2014 as Barren is now mapped as a Bedrock and Scree and a Desert Playa
- A similar change was made to aggregated riparian and wetland types. In the Remap legend you'll find areas previously mapped as N.A. Warm Desert Riparian Forest and Woodland is now mapped as Riparian Woodland, Lower Montane Riparian Woodland, and Riparian Mesquite Bosque Woodland types



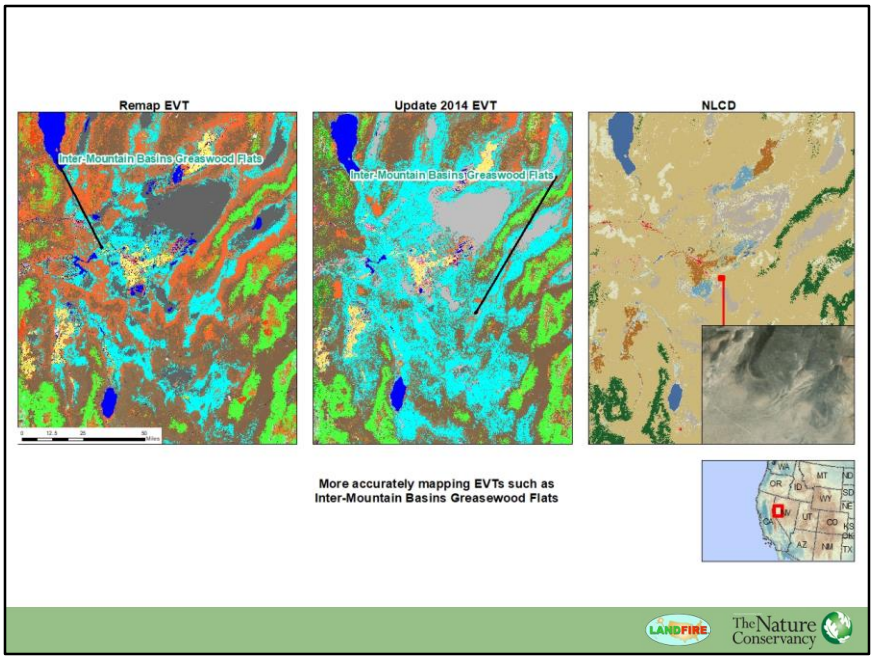
Improved EVT Mapping in Disturbed Areas

- In previous LF versions natural EVTs were mapped regardless of disturbance history.
- We've changed that in Remap to more accurately reflect the vegetation on the ground post-disturbance.
- In this example, starting on the right you can see an area mapped as shrub by NLCD. In 2014, shown in the middle, we mapped the area as CA Montane Woodland and Chaparral.
- Based on LF disturbance data we know that this area was recently burned and so in the Remap product, shown on the left, we have assigned it to the EVT class Recently Burned – Shrub Cover, more accurately reflecting the vegetation currently on the ground.



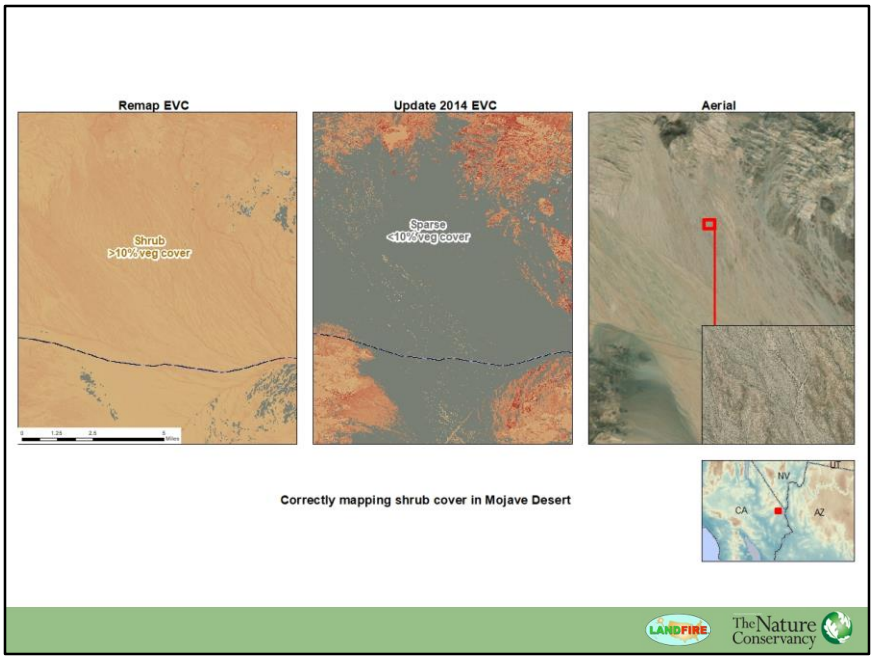
Improved Mapping of Invasives

- Mappers made an effort to improve the mapping of invasive species such as cheatgrass.
- Here you see a comparison of Remap (left) and 2014 EVT (middle) to the Near Real Time Annual Herbaceous Cover product (on the right; Boyte and Wylie). You can see the Remap product aligns more closely with the Near Real Time product.



Improved EVT

- In previous LF versions Greasewood Flat was mapped in higher slope positions where other shrub types are more appropriate. In Remap, mappers restricted it to lower slopes.

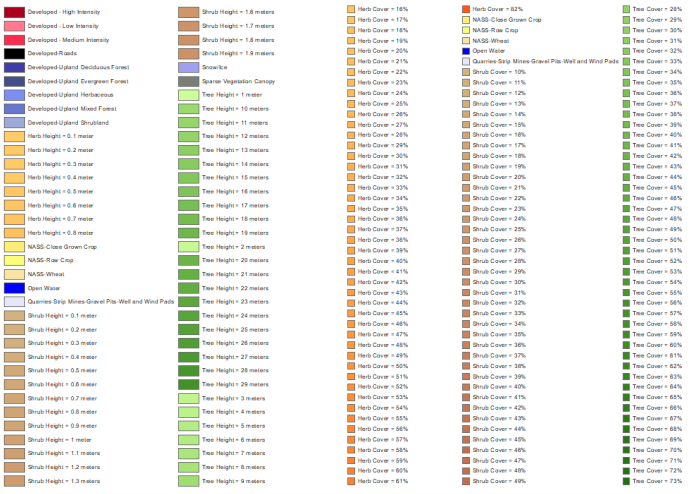


Improved Shrub Cover

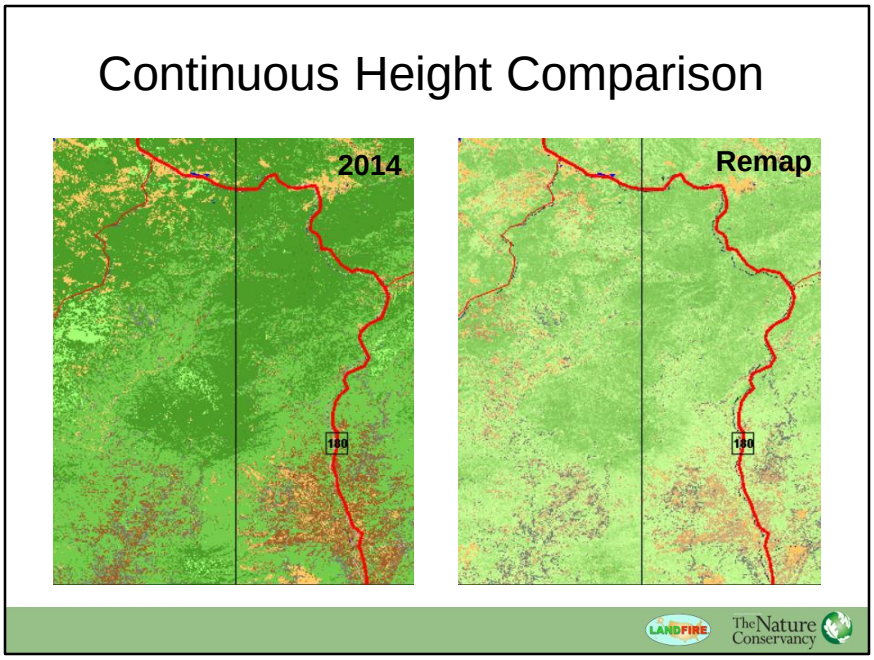
- Used NLCD fractional shrub cover dataset to sample additional shrub cover training data in Remap
- Here you can see an area mapped in the Mojave that has some vegetation according to the aerial imagery on the right.
- In 2014 LANDFIRE mapped is as <10% or sparse cover, but in Remap it is mapped as >10% cover.
- Additional non-forest plots and sampling techniques have increased the training data we have for shrub and grasslands improving our ability to accurately map non-forest areas.

Note: "NLCD 2016 Shrub Component products characterize the percentage of each 30-meter pixel in the Western United States covered by shrub, herbaceous, bare ground, litter, sagebrush, big sagebrush and annual herbaceous, along with estimating shrub height and sagebrush height."

Continuous Height & Cover

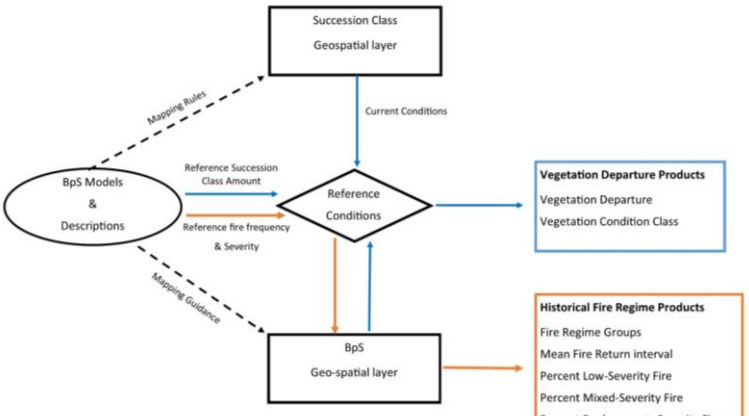


- LANDFIRE EVH (left) and EVC (right) are now delivered in continuous classes. Previously the data were binned into broader classes; e.g. 10% classes for EVC.
- Graphic shows partial legends, too many classes to display.



- 2014 EVH data on the left is dominated by two shades of green representing forest.
- Remap EVH data on the right show many shades of green representing more fine scaled variation in height.
- Similar patterns are shown in the brown tones that represent shrubs.

BpS Review


Succession Class
Geospatial layer
Mapping Rules
Current Conditions
BpS Models
&
Descriptions
Reference Succession
Class Amount
Reference fire frequency
& Severity
Reference
Conditions
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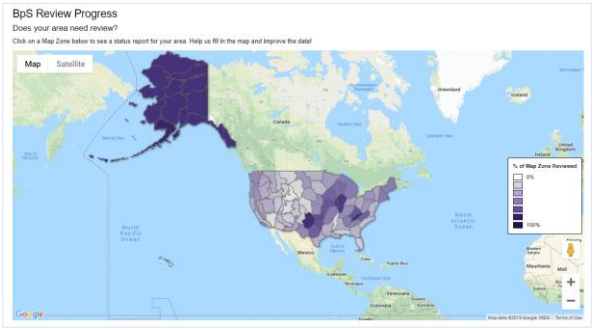
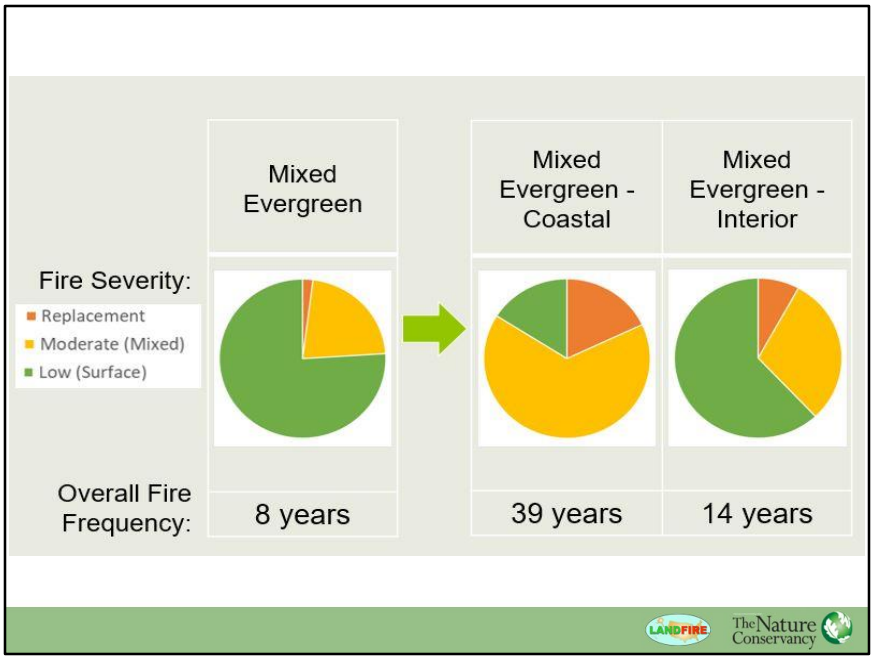
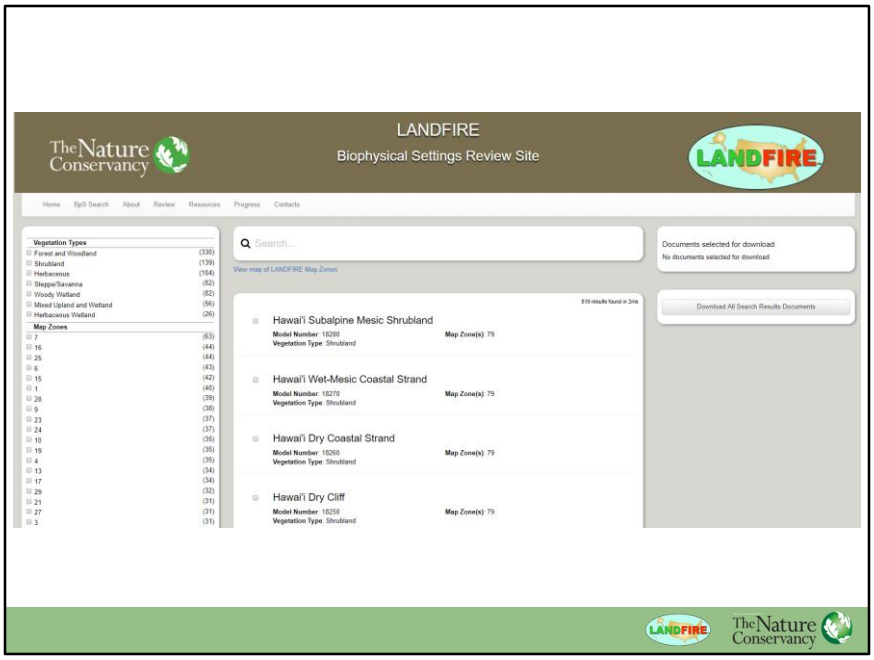
Vegetation Departure
Vegetation Condition Class
Mapping Guidance
BpS
Geo-spatial layer
Historical Fire Regime Products
Fire Regime Groups
Mean Fire Return interval
Percent Low-Severity Fire
Percent Mixed-Severity Fire
Percent Replacement–Severity Fire



- BpS updated with new science
- Succession class mapping rules completed
- New model description document



- Many improvements were made to the BpS models.
- I'll illustrate the types of changes users can expect using one example – Mixed Evergreen Forest.
- This is a major forest type in SW-OR and NW-CA that spans a wide gradient in precipitation, temperature and topography.
- Prior to the BpS review we had one model to represent Mixed Evergreen Forest across its entire range (see column on the left).
- During the review, participants indicated that this type should be split into two models:
    - A coastal type for areas with more maritime influence generally found west of the Coast Range crest or in inland coves on northerly aspects (typically below 2,000 feet elevation in SW OR, Atzet et al. 1996),
    - An Interior type generally found east of the Coast Range crest, at higher elevations, and on relatively drier sites.
- The two columns on the right show how different the fire regimes are for the Coastal and Interior Mixed Evergreen models.



- LANDFIRE has developed a new, searchable, user interface for downloading model information.
- The reviewed and updated BpS model dataset for CONUS and HI are complete, but not publicly available yet.
- AK models are still being finalized.

Application

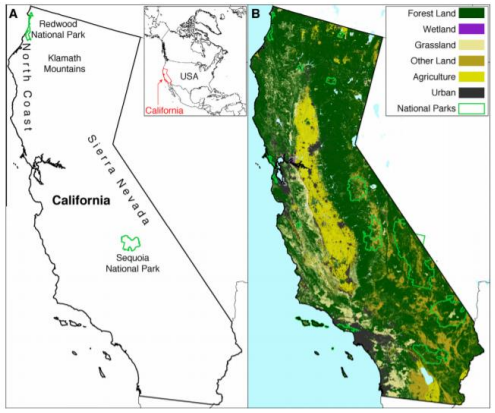


Fig. 1. Analysis area. (a) Location in North America, with map showing places mentioned in the text. (b) Land cover 2010, using Intergovernmental Panel on Climate Change (IPCC, 2006) land categories and vegetation data from Landfire (Ryan and Opperman, 2013).

Gonzales et al. 2015. Aboveground live carbon stock changes of California wildland ecosystems, 2001–2010. Forest Ecology and Management. 348 (2015). 68-77

- Gonzales and others used LANDFIRE data as the primary spatial data source for estimating aboveground live carbon stocks in CA.
- They wanted a repeatable method using data that met the following criteria: complete coverage, repeat observations, publicly available, continuity of data into the future, moderate to fine spatial resoloution and limited pre-processing.
- LANDFIRE data best met these criteria.

- They used LANDFIRE EVT, EVC and EVH from 2001 and 2010 and assigned an aboveground biomass estimate to all unique combinations of these variables.
- Biomass for shrubs was estimated from plot data in the LFRDB and other sources. Forest and grass estimates came from other sources. (Forest and grass biomass estimates came from FIA and MODIS net primary productivity data.)

Citation: Gonzales et al. 2015. Aboveground live carbon stock changes of California wildland ecosystems, 2001–2010. Forest Ecology and Management. 348 (2015). 68-77. https://www.landfire.gov/documents/Gonzalez_et_al_2015.pdf

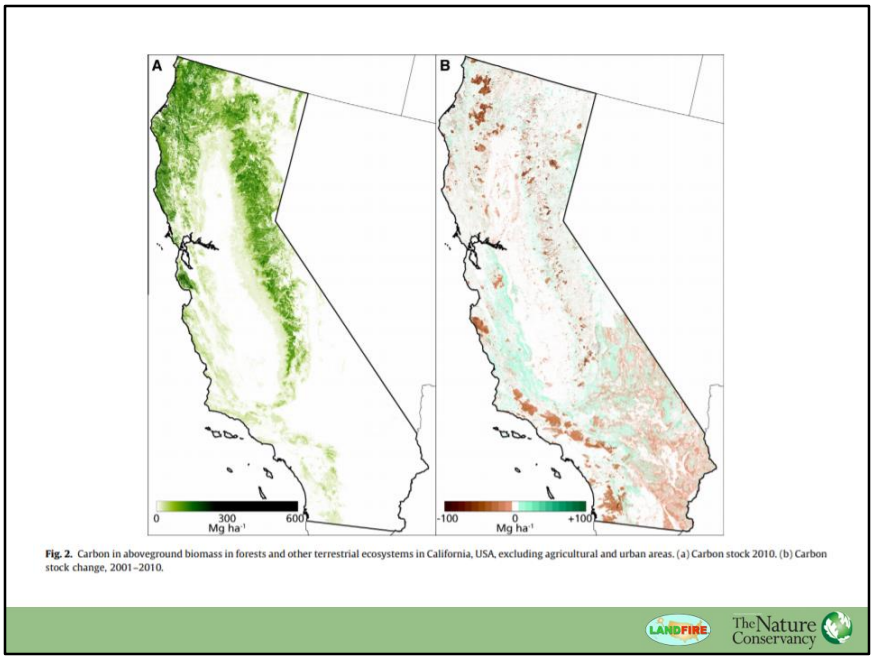


Fig. 2. Carbon in aboveground biomass in forests and other terrestrial ecosystems in California, USA, excluding agricultural and urban areas. (a) Carbon stock 2010. (b) Carbon stock change, 2001–2010.

- Their results estimate the 2010 above ground biomass (left) and they found a net carbon loss from 2001 to 2010 (right).
- The authors make several recommendations for improving their estimates:
    - 1) Use of continuous height and cover products. They used pre-Remap data where the height and cover were binned into classes. Small changes in these variables, changes that didn't cause a class change, couldn't be detected. Remap continuous

height and cover data should improve these estimates in the future.

- 2) Improvements in EVT map accuracy. This is something we certainly aimed to do in the Remap and the accuracy assessment does show some improvement.

Take-home Messages

LANDFIRE products

- are comprehensive, compatible, consistent and current. (4 C's)
- are designed for use at regional and national scales.
- can be modified for local use.

LF Remap incorporated new processes and data sets to improve usability of the products, and represents conditions in 2016.

Users can help improve LANDFIRE products by providing plots and data + feedback.

LANDFIRE welcomes feedback. Contact the helpdesk and/or provide feedback via the LANDFIRE website.

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