A1

LANDFIRE National:
Contiguous US

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Tobin Smail
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LANDFIRE Webinar,
March 23

Products:
the Deliverables

Fuel Layers

-13 Anderson (1982) Fire Behavior Fuel Models

-40 Scott and Burgan (2005) Fire Behavior Fuel Models

-Forest Canopy Bulk Density

-Forest Canopy Base Height

-Forest Vegetation Height

-Forest Canopy Cover

-Elevation

-Aspect

-Slope

Fire Regime Layers

-FRCC

-FRCC Departure

-Fire Regime Groups

-Simulated Historical Fire Return Interval

-Percent Low-severity Fire

-Percent Mixed-severity Fire

-Percent Replacement-severity Fire

-Succession Classes

Vegetation Layers

-Environmental Site Potential

-Biophysical Settings

-Existing Vegetation

-Existing Vegetation Height

-Existing Vegetation Cover

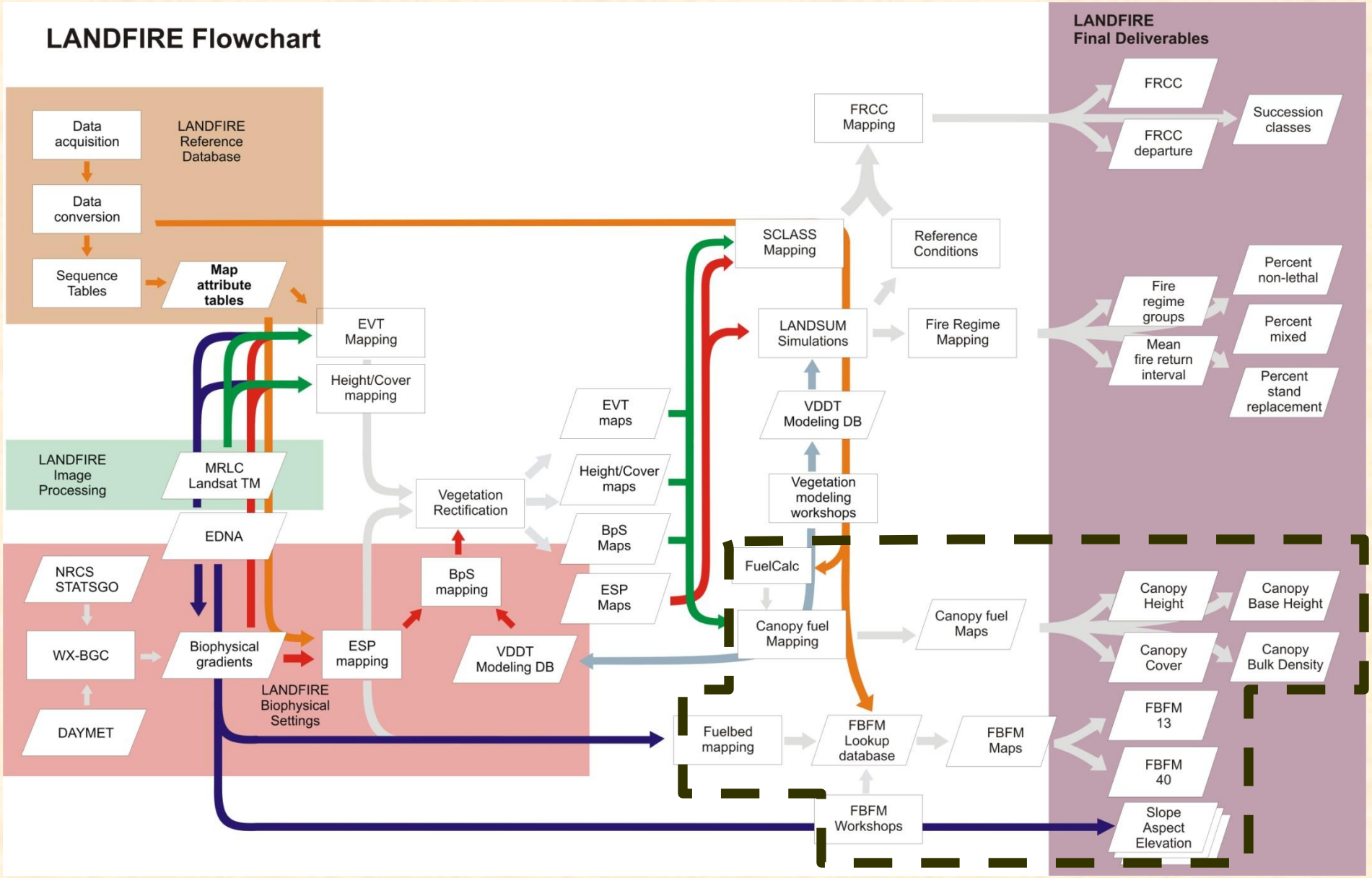
-Vegetation Models

Fire Effects Layers

-Fuel Loading Models
-Fuel Characteristics Classification System (FCCS)

The LANDFIRE System

A3



Some Perspective…

- Number of map zones = 66
- Acres to map = **2,295,358,552**
- 24 products (11 fuel products)
- 2.2 cents/acre or ~ 0.09 Cents/product

# of Ac. to map Per:

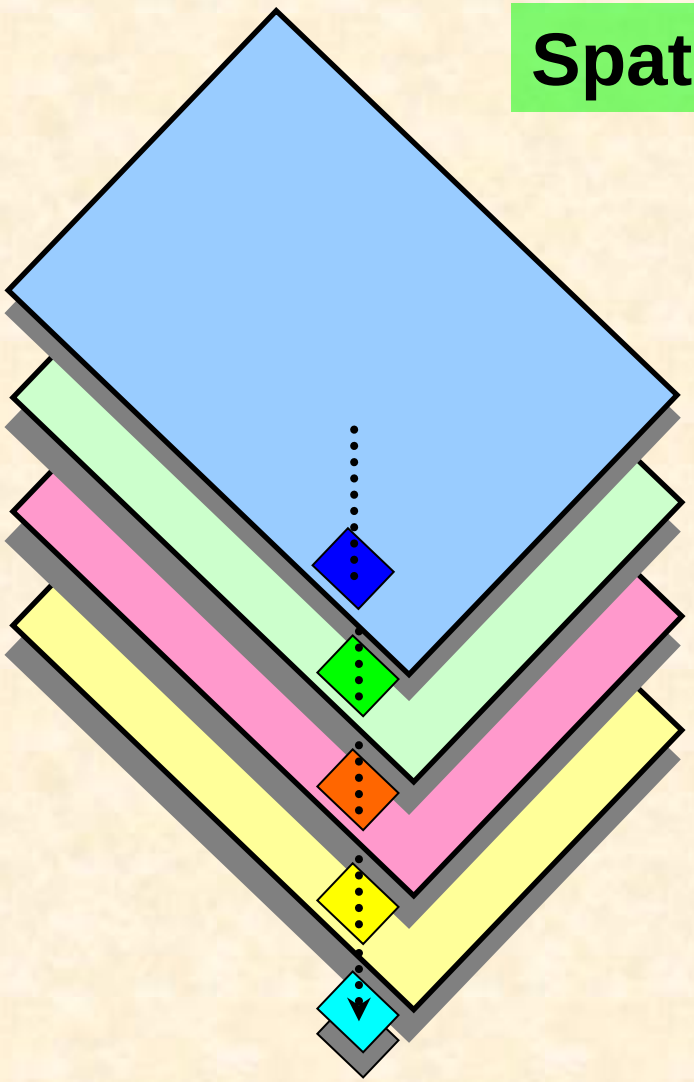
Week	Hour	Minute	Second
8,227,092	48,821	814	14

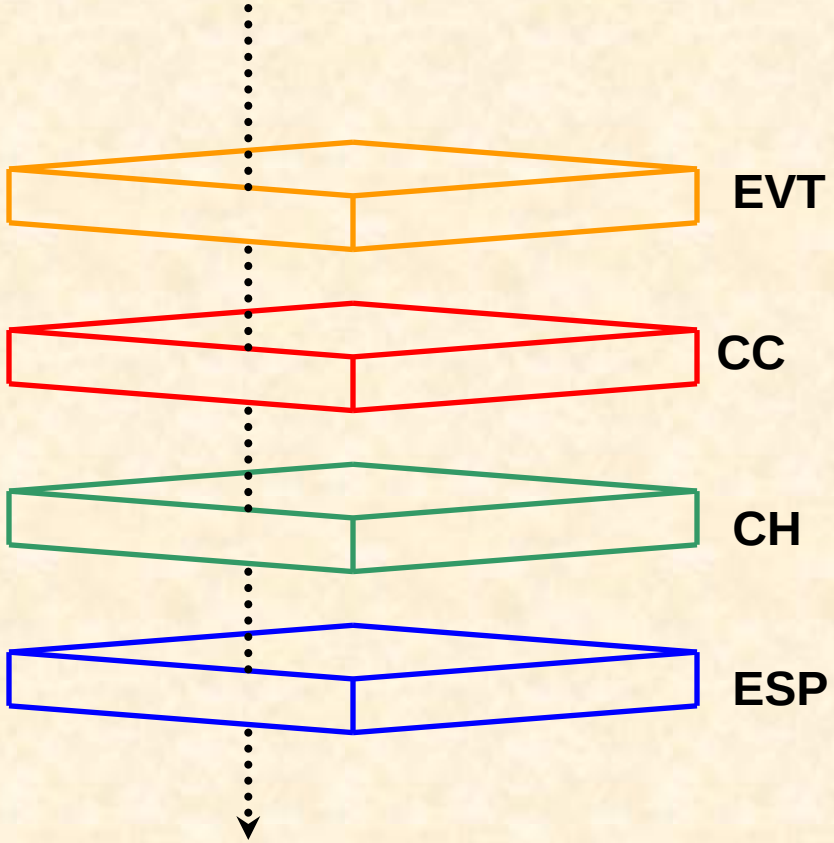
Methods: Fire Behavior Fuel Models

- **Spatial Intersection of EVT/CC/CH/ESP**

Methods: Fire Behavior Fuel Models

Spatial Intersection





Methods: Fire Behavior Fuel Models

- Spatial Intersection of EVT/CC/CH/ESP
- **Develop fuelbed assignment rulesets using expert review**

Methods: Example LANDFIRE Fuelbeds

Laurentian Acadian Northern Hardwood Forest Existing Vegetation Type

Fuelbed #	Cover (%)	Height (ft)	ESP	FBFM13	FBFM40
1	10 - 49	0 - 164	Any		
2	50 - 89	0 - 164	Any		
3	90 - 100	0 - 164	Any		

Methods: Example LANDFIRE Fuelbeds

Laurentian Acadian Northern Hardwood Forest Existing Vegetation Type

Fuelbed #	Cover (%)	Height (ft)	ESP	FBFM13	FBFM40
1	10 - 49	0 - 164	Any	2	GS2
2	50 - 89	0 - 164	Any	9	TL6
3	90 - 100	0 - 164	Any	8	TU1

Methods: Fire Behavior Fuel Models

- Spatial Intersection of EVT/CC/CH/ESP
- Develop fuelbed assignment rulesets using *expert review*
- **Linked in a GIS and mapped**

Methods: LANDFIRE Reference Database (LFRDB)

- **~ 750,000 plots**
- **435 attributes per plot**

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Methods: LANDFIRE Reference Database (LFRDB)

- ~ 750,000 plots
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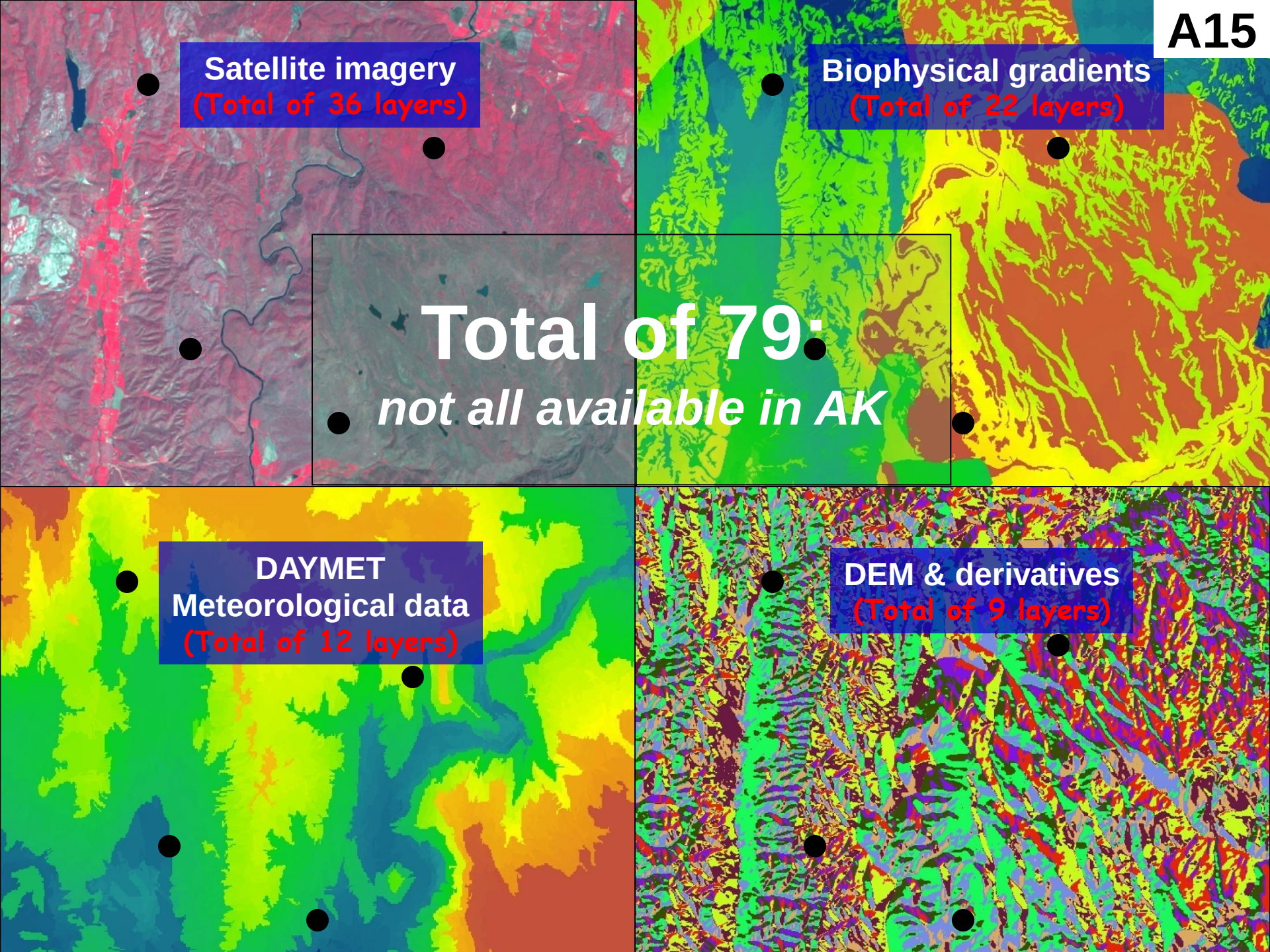
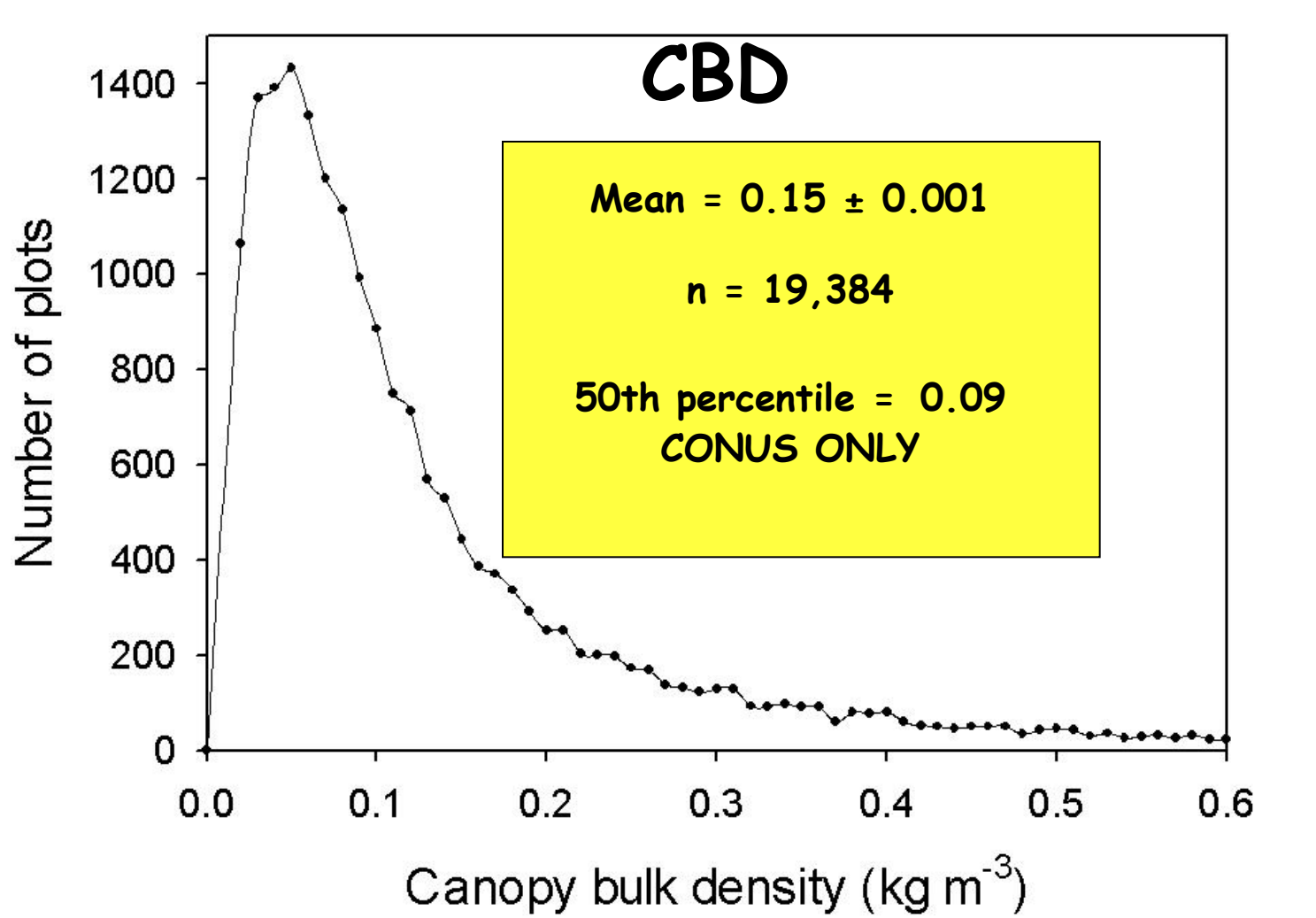
- Foundation for all LANDFIRE products
- Houses all predictor data: results of sampling data layers


Satellite imagery
(Total of 36 layers)
Biophysical gradients
(Total of 22 layers)
Total of 79:
not all available in AK
DAYMET
Meteorological data
(Total of 12 layers)
DEM & derivatives
(Total of 9 layers)

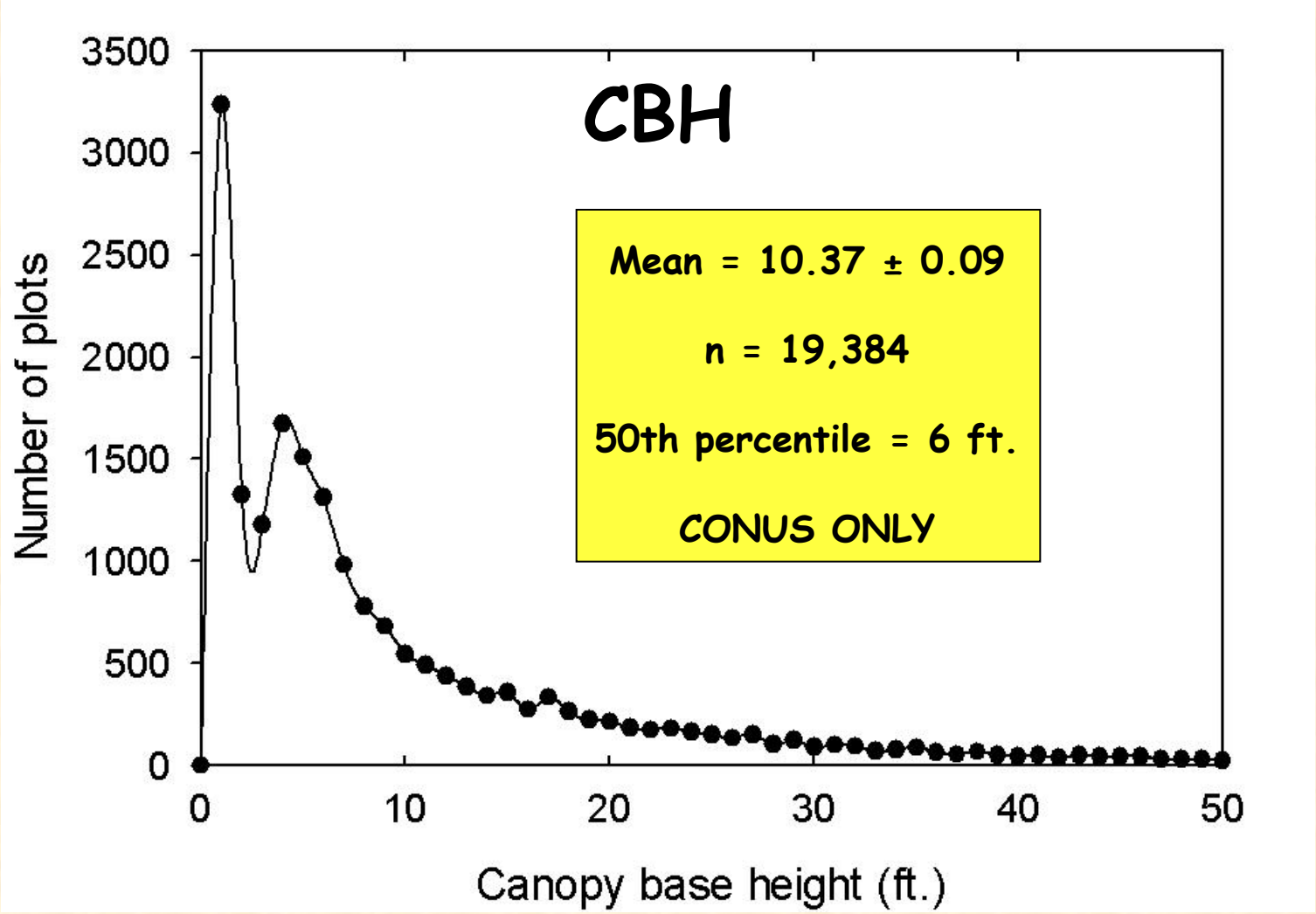
Field-based estimates of CBD/CBH

Stand_ID	Bole	Spp.	Dia.	Hgt.	Ht-LC	CC	Tpa
15006563	1	PSME	25.7	42	16	C	10
15006563	2	PSME	2.4	11	1	S	10
15006563	3	PIPO	8.9	37	15	I	10
15006563	4	PIPO	11.9	50	27	D	10
15006563	5	PSME	3.1	16	2	S	10
15006563	6	PSME	2.7	18	7	S	10
15006563	7	PIPO	6.6	21	18	S	10
15006563	8	PSME	30.4	44	20	D	10

Distribution of CBD



Distribution of CBH



Now the tricky part: *landscape extrapolation*

- **Relate plot level CBD & CBH to *predictor variables* in regression tree analysis:**

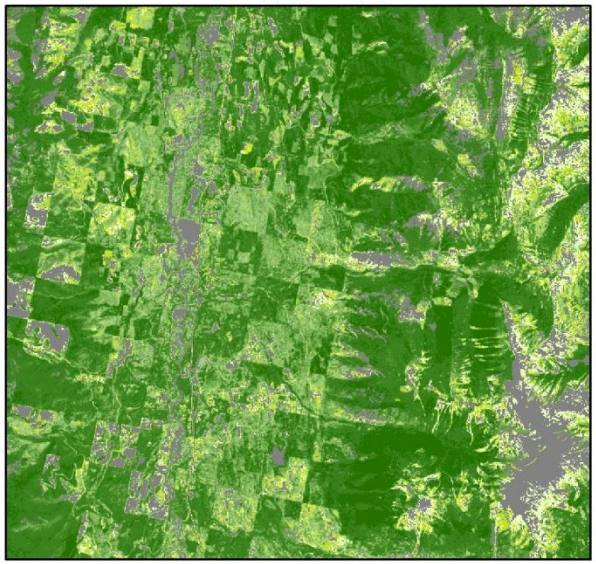
!Sanborn did not use regression trees in AK!

ETM Satellite imagery (4,3,2 band combination)

0 1.25 2.5 5 7.5 10 Miles

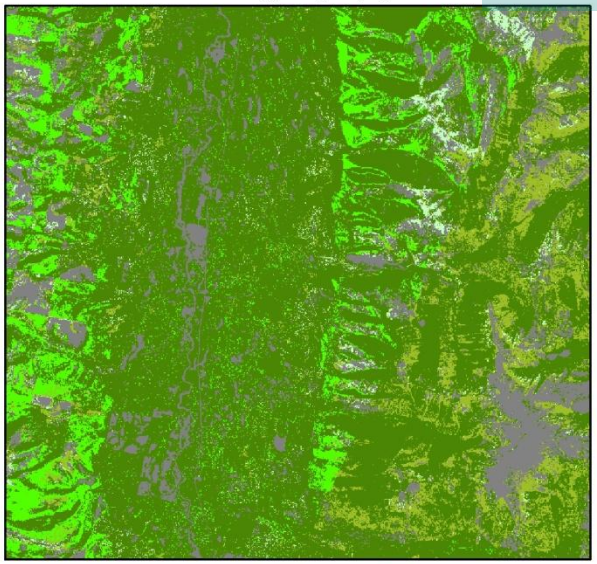
N

Canopy cover (%)



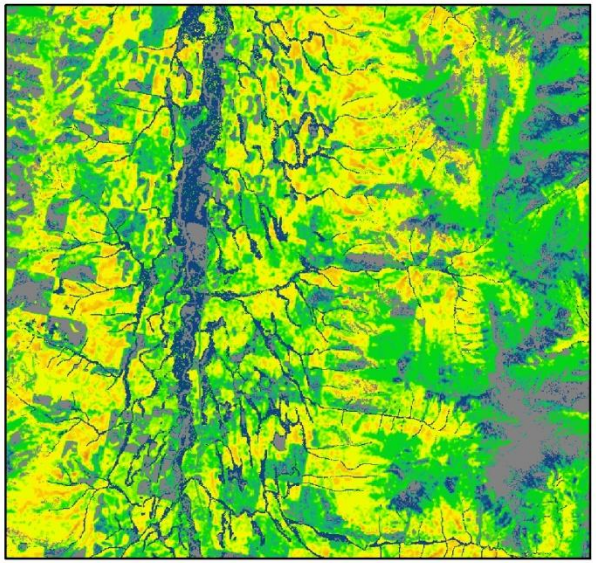
0 15 25 35 45 55 65 75 85 95

Canopy height (m)



0 2.5 7.5 17.5 37.5

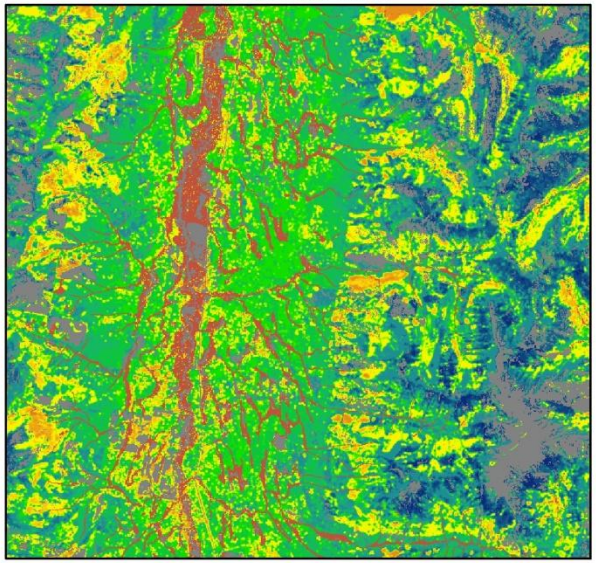
Canopy bulk density



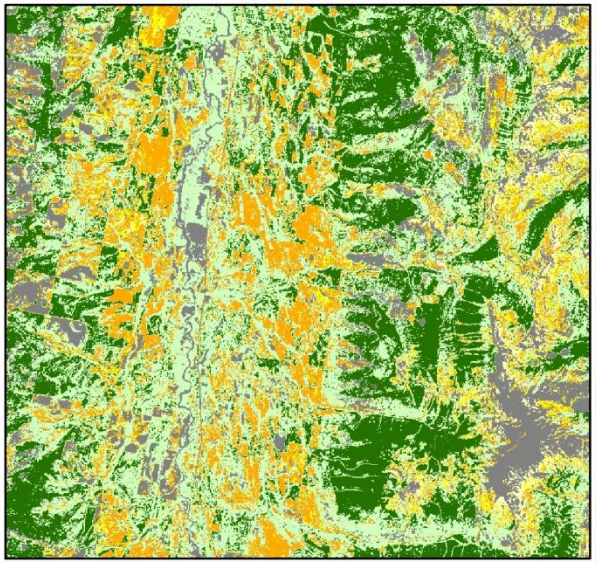
low high

CBD and CBH

Canopy base height



Fire behavior fuel models (Anderson 1982)



1 2 4 5 6 8 9 10 91 92 93 98 99

Regression Trees for CBD & CBH

If EVT == 2022 (P. pine)

And CC < 25%

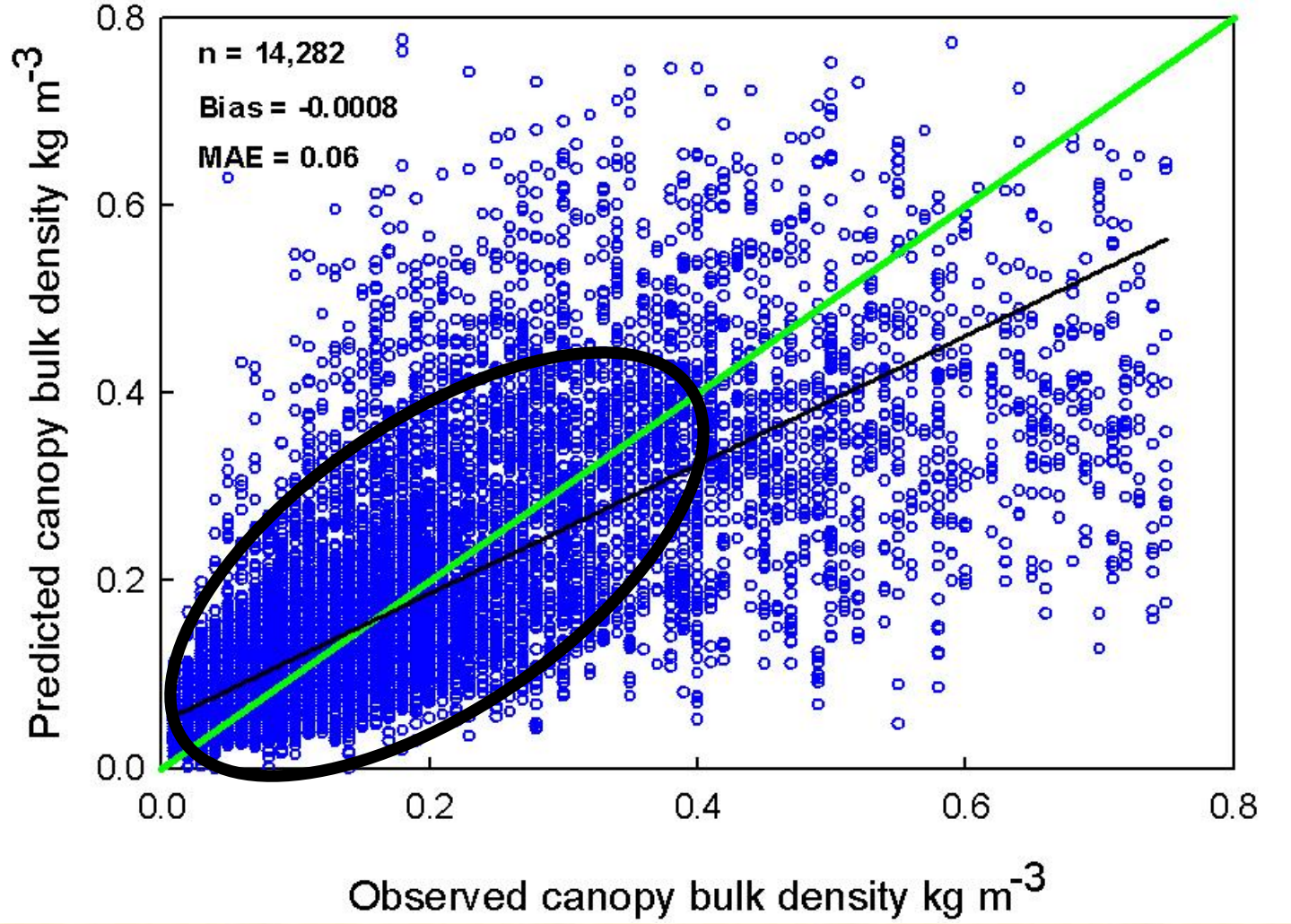
And Slope > 35%

And Npp < 1.2 kg/m^2/yr

Then CBD = 0.01(Prod.) + 51.97 – 0.003(Elev.)

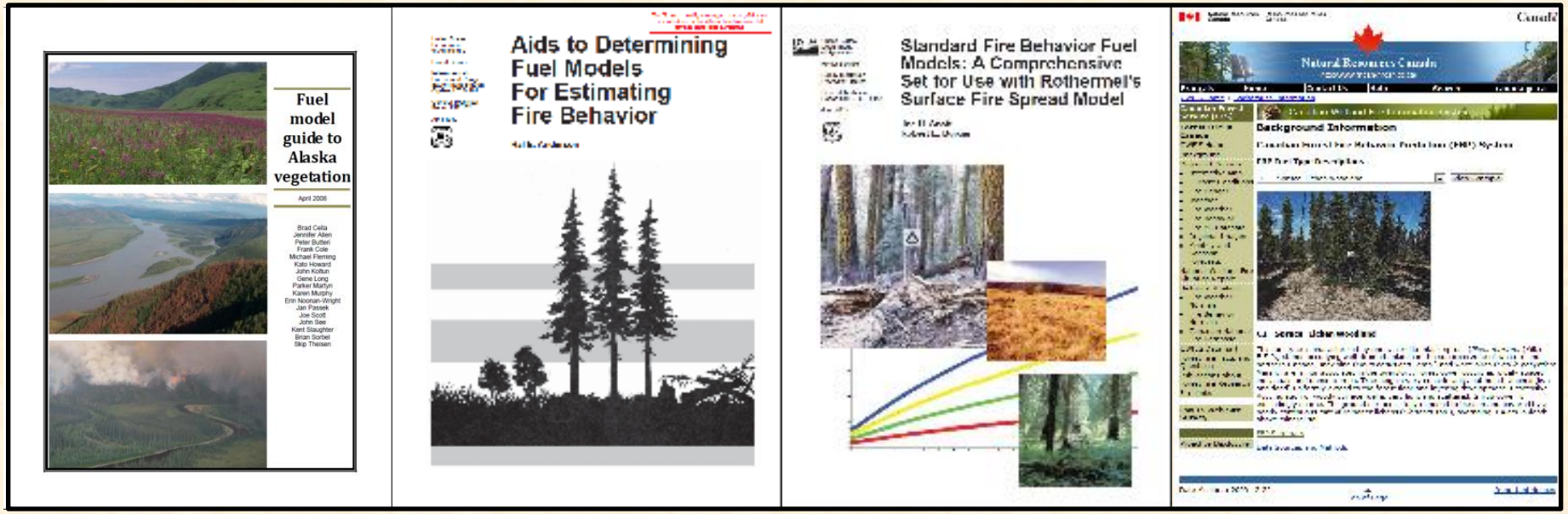
Cross validation of CBD

(20 zones)

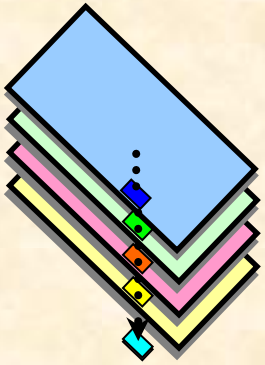


Landfire National Surface Fuel Model Mapping Criteria for Alaska

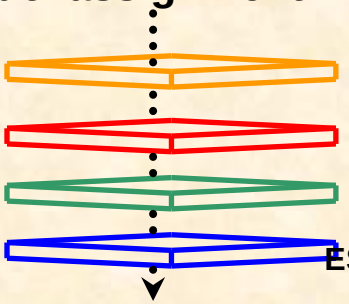
FBFM13, FBFM40, and CFFDRS should capture a reasonable approximation of current fire behavior represented by the Anderson 1982, Scott and Burgan 2005, and Canadian Forest Fire Danger Rating System models. (Far right – website



Fuel models are developed using rules / crosswalks based on EVT. When additional clarity is needed each EVT can be broken into smaller sub pieces using only EVC, EVH. Rules / crosswalks must have notes of generalized rational for each fuel model assignment.

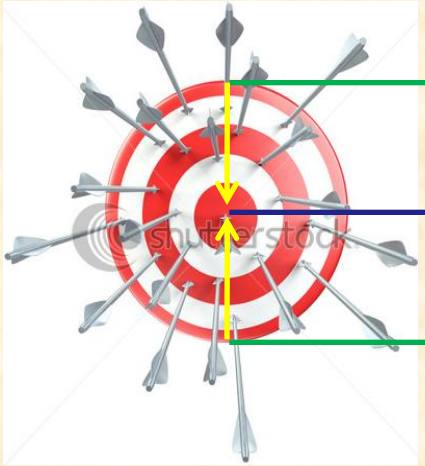


Spatial Intersection

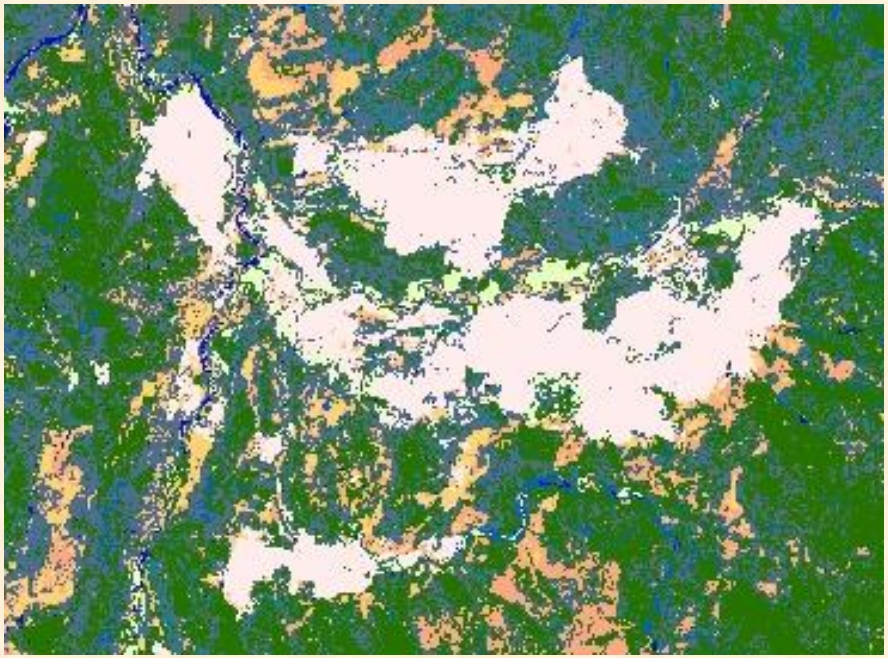


The spatial distribution of map units shall be generally consistent with adjacent map zones to minimize seam lines.

All map units shall represent fire behavior based on average burning conditions. Average burning conditions are not the benign or extreme, but the conditions when the majority of fires occur.



All anthropogenic features present in EVT shall be evident and mapped as the appropriate nonburnable fuel type models per Anderson 1982, Scott and Burgan 2005 and CFFRDS, including roads, developed/urban areas, agricultural fields, etc.



What is Canopy Bulk Density (CBD), Canopy Base Height (CBH), Canopy Cover (CC), and Canopy Height (CH)?

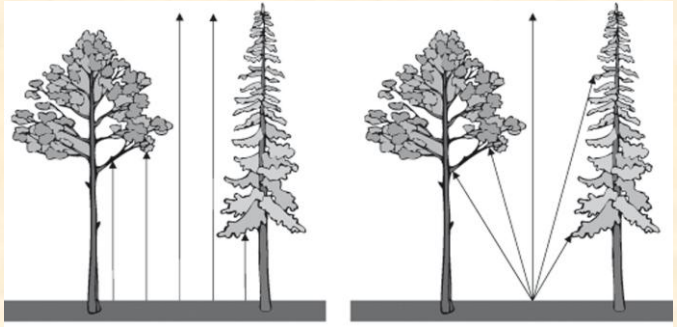


Fig. 1 CC (left) is always measured in vertical direction, whereas canopy closure (right) involves an angle of view.

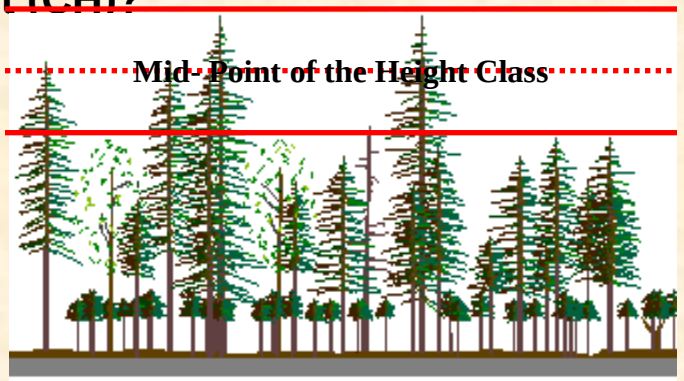


Fig. 2 CH describes the average height of the top of the canopy for a stand. Landfire derives CH from the mid-point of EVH, which is the dominant tree height classified in to height ranges.

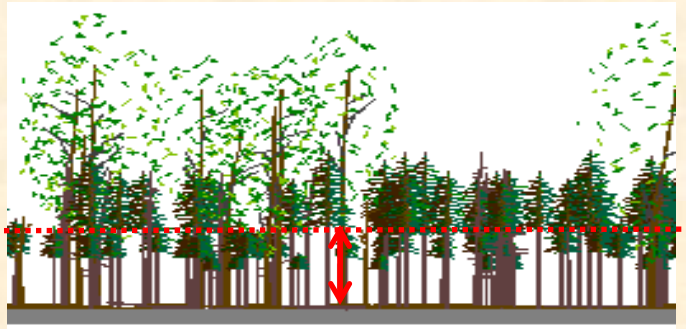


Fig. 3 CBH is computed in FuelCalc as the lowest point at which the running mean CBD exceeds 0.012 kg/m^3.

Fig. 4 CBD is the maximum of the running mean.

CBH should be in values of meters X 10, CBD should be kg/m^3 X 100, CC should be in percent and CH should be in meters X 10.

CBH and CH are usually represented to the tenths of a meter. To preserve the decimal place we multiple the value by 10 to make it an integer, which takes up less room to store in raster GRID format.

Example : CBH = 2.3m, 2.3 X 10 = 23

CBD is usually represented to the hundredths place:

Example: CBD = 0.012kg/m^3, 0.012 X 100 = 12

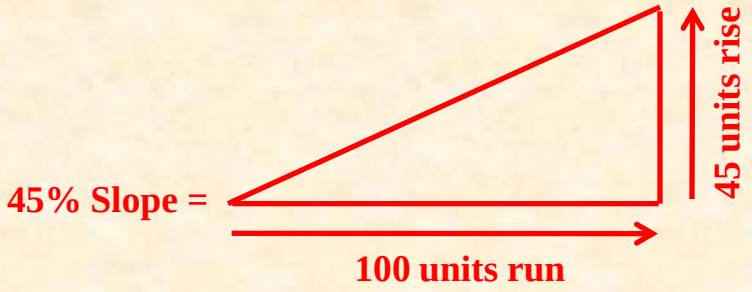
Canopy Cover is in %

LANDFIRE CC is ALWAYS represented in PERCENT (%).

Simulations allow slope to be represented in degrees(°) or percent(%).

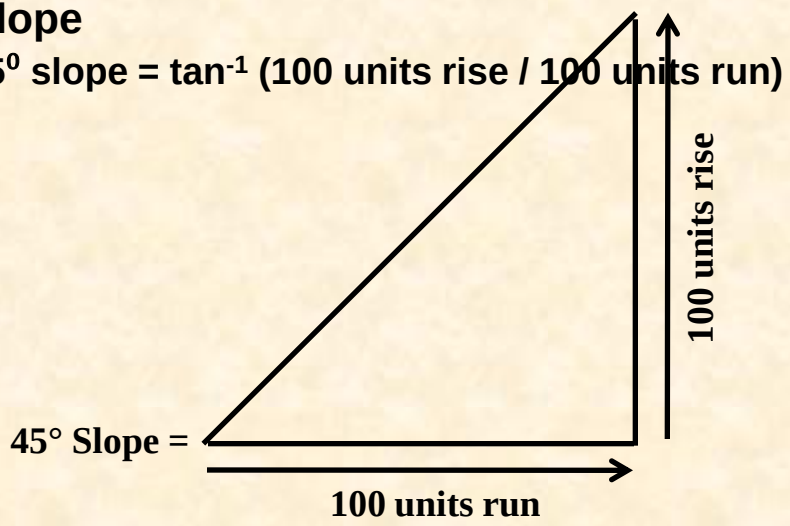
LANDFIRE Slope is also represented in %

45% slope = 45 units rise / 100 units run X 100



Example: ° Slope

45^0 slope = $\tan^{-1}$ (100 units rise / 100 units run)



Areas where torching and crown fire do not occur, but tree cover is present should be represented by a CBH = 10 meters, CBD = 0.012 kg/m^3, CC and CH stay as predicted.

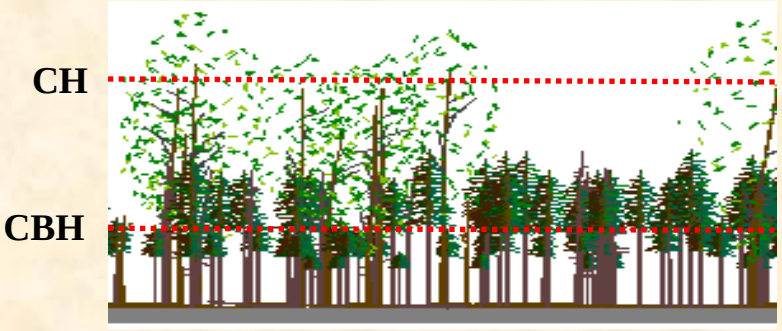
We do this so that CC and CH can still have an affect on the surface fuel model moisture conditioning and wind reduction factors.

No canopy fuel should be present in areas of just shrub or grass cover.

If tree canopies are not present, canopy fuel should not exist. In Landfire data crown fire equations only apply to tree crowns.

CBH should not exceed CH.

If predicted CBH is taller than CH then CBH is rectified to equal CH.



Landfire National Acronyms Used

- EVT - Existing Vegetation Type
- EVC - Existing Vegetation Cover
- EVH - Existing Vegetation Height
- FBFM13 - Fire Behavior Fuel Model, Anderson 1982
- FBFM40 - Fire Behavior Fuel Model, Scott and Burgan 2005
- CFFDRS - Canadian Forest Fire Danger Rating System models
- CC – Percent Canopy Cover not Canopy Closure
- CH - Canopy Height meters times 10
- CBH - Canopy Base Height meters times 10
- CBD - Canopy Bulk Density Kg/m^3 times 100