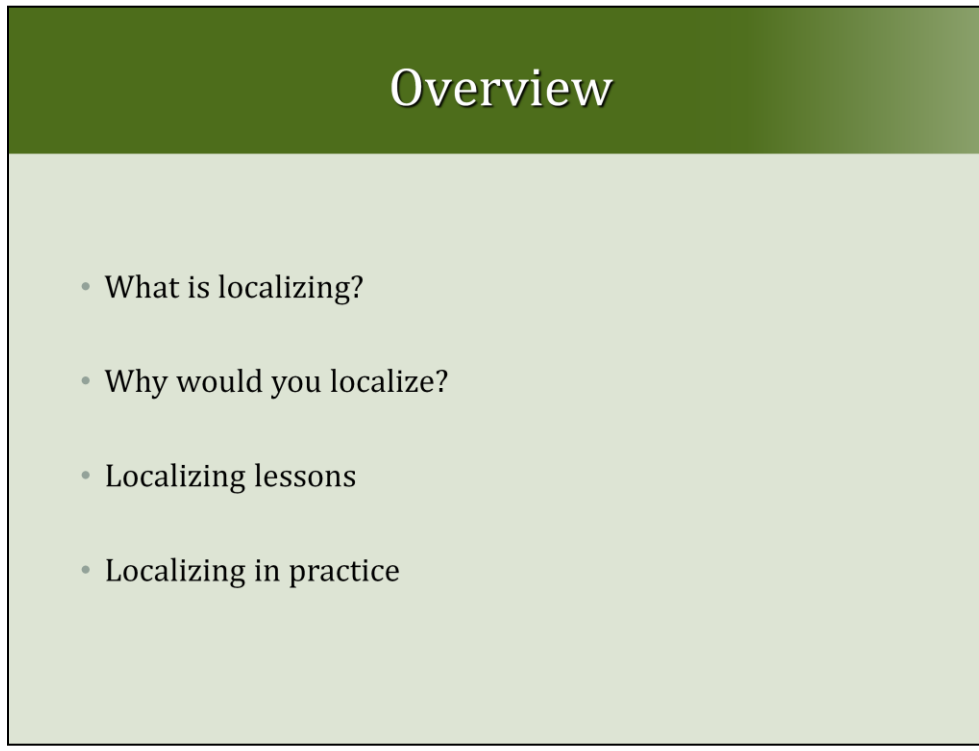
Presentation date July 16 2013 at SCGIS Conference. Kori Blankenship, TNC Fire Ecologist.

- Before we begin I'd like to introduce you to The Nature Conservancy's LANDFIRE team. From left are Jim Smith, LANDFIRE program manager; Kori Blankenship, fire ecologist; Randy Swaty, ecologist; Sarah Hagen, GIS Specialist; Jeannie Patton, Communications Coordinator.



- These are the topics I will cover today:
  - Downscaling or localizing data
  - Reasons why would you would do it
  - Lessons from my work with LANDFIRE
  - Examples of how to localize a dataset

Localizing

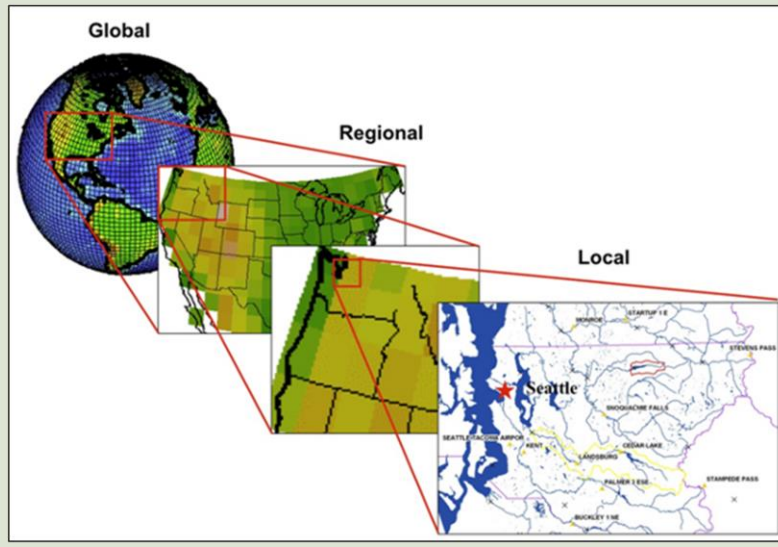


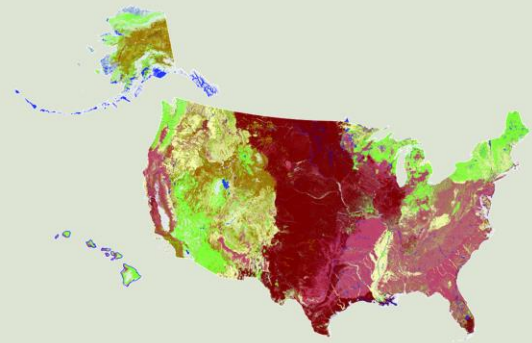
Image: Dr. Andrew Wood, NOAA/NWS NWRFC. Found online at earthsystemcog.org

- Downscaling data is the process of deriving finer scale data or model outputs from data or processes of coarser scale.
- It is most commonly associated with applying global circulation models at regional scales, but in a general sense, downscaling is what occurs whenever a dataset is applied at a finer scale than it was designed for.
- In this presentation, I'm going to use the term "localizing" to distinguish what I'm talking about from what is done in climate modeling.

- I became interested in this topic from my work with a national mapping program called LANDFIRE.
- The LANDFIRE program creates continuous spatial data and ecological models for the entire U.S. and its island territories. This graphic depicts one of our vegetation layers.
- The data are designed for regional and national level use, but we've also found a demand for it a finer scales because of its consistent and continuous nature.
- My discussion today will focus on how my colleagues and I have helped various projects localize a national dataset for local application.

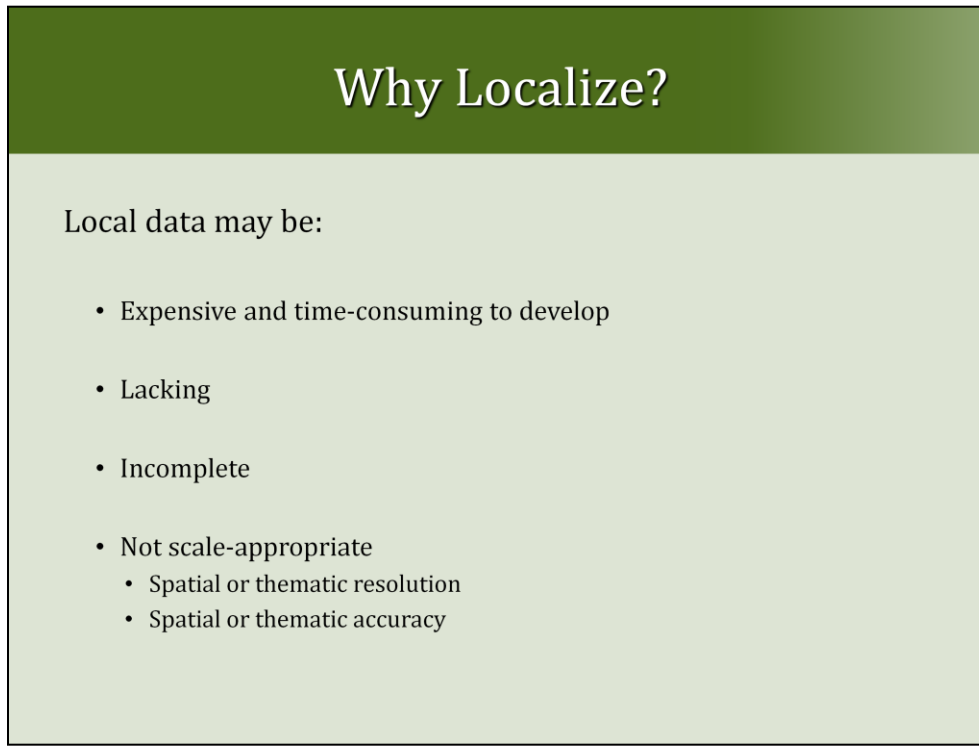
LANDFIRE Scale

LANDFIRE data products facilitate **national and regional level** strategic planning and reporting of wildland fire management activities. LANDFIRE products are designed to be used at a **landscape scale** in support of strategic vegetation, fire, and fuels management planning to evaluate management alternatives across boundaries.

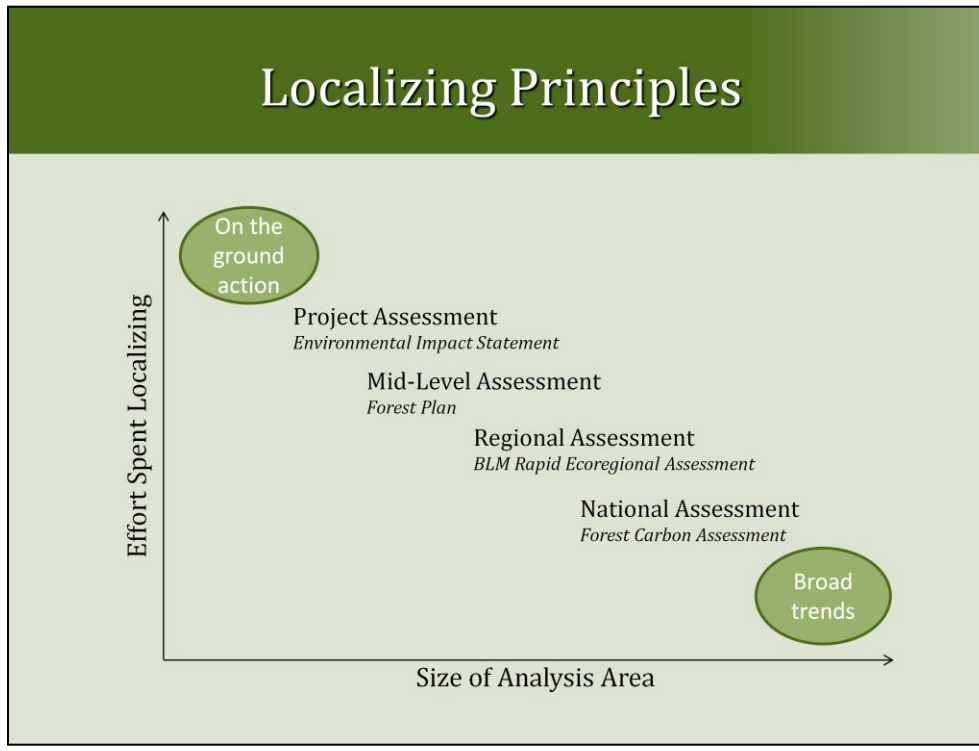


Cartography: Sarah Hagen

- As I mentioned, LANDFIRE data, like all data, have a scale, and LANDFIRE states its intended scale quite clearly.
- We try to make it clear that the data are intended for use on national, regional and large landscapes, and yet the team I work with spends a fair amount of time helping folks apply the data at finer scales.
- But, when we do that, we help users review and localize the dataset.



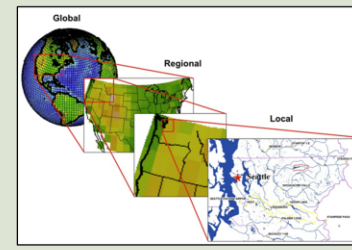
- We localize national level data because:
  - Developing local datasets is too expensive and too time consuming,
  - Local data may be completely lacking,
  - Local data may be incomplete (e.g. they don't cover your entire study area), or
  - The available data are not scale (or scope) appropriate.
- For all these reasons, it is common for a GIS analyst to end up in a situation where he/she is working with other people's data – data that is not designed for the analyst's needs.
- The analyst then has to cobble together datasets from multiple sources and review and rectification are needed to make the data meet his/her needs.



- This graphic illustrates the idea that there is a continuum of time and effort for reviewing and localizing datasets.
- The larger the analysis area the less time and effort you may devote to localizing a dataset.
- Of course there are exceptions, but in general, when working with a national level dataset, it is more likely to meet the needs of a national level analysis. The results of the analysis might be more strategic in nature and focus on relative comparisons. In contrast, a project level assessment that might result in work on the ground will require a higher data standard, and that likely means that you need to spend more time reviewing and more effort localizing.
- Match the level of effort and time you spend localizing to your project needs

Localizing Lessons

1. Understand your needs
2. Identify and engage local experts
3. Set appropriate expectations
4. Review all datasets and modify as needed
5. Document and share findings



1. What do you intend to do with the data? This sounds like an easy question to answer, but sometimes it isn't quite clear what is really needed from a data perspective.
2. Engage subject matter experts to help localize the data. I often work with vegetation data, so I find myself engaging local ecologists to help me review data.
3. Set appropriate expectations -- all methods have inherent limitations and these limitations need to be communicated to folks working on the project and the experts whom you engage so that they can have realistic expectations for a dataset. For example, the LANDFIRE, Landsat- based mapping approach can't detect cheat grass under 10% cover.
4. All data should be reviewed to ensure they are suitable for the intended application whether you are using a national or a local dataset. Often local data is perceived as being "better" than LANDFIRE data and while we generally start with that assumption, it is not always the case. In particular, local data may not be as current as LANDFIRE.
5. Provide appropriate interpretation of the results. The GIS analyst often has the most familiarity with the strengths and weaknesses of a dataset and can help ensure appropriate data use.

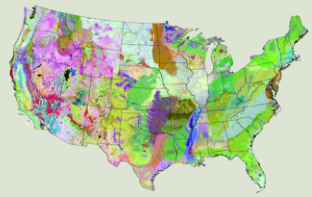
Localizing in Practice

What to look for:

- Thematic accuracy and resolution
  - Classification units
- Spatial resolution
- Map accuracy
- Temporal resolution

- For the remainder of the talk I'll discuss how you might apply these lessons.
- This is a list of the things that I look for when localizing a dataset, and I'll go into these in detail in the following slides. This is just an overview.
- I like to look at thematic accuracy and resolution first because I think it is easier to assess than spatial accuracy and sometimes changing thematic resolution improves map accuracy.
    - Classification units are a subset of resolution, different maps use different classification schemes which you might need to crosswalk.
- Spatial resolution: you can think of this in terms of cell size or minimum mapping unit. It might also include the platform that collected the data (Landsat vs. LIDAR) because that effects the resolution.
- Map accuracy: are things in the right place or close enough?
- Temporal resolution: How current is the data? Have landscape changes occurred since mapping (e.g. wildfire, hurricane)?

Thematic Resolution

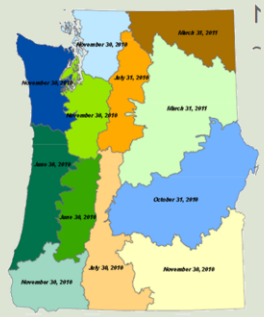


Biophysical Setting	Biophysical Setting Group	Group Type
Northern Rocky Mountain Subalpine Woodland and Parkland	Whitebark Pine-3	Conifer
Mediterranean California Subalpine Woodland	Whitebark Pine-3	Conifer
Southern Crowley`s Ridge Mesic Loess Slope Forest	Beech-Tuliptree-3	Hardwood
Mississippi River Alluvial Plain Dry-Mesic Loess Slope Forest	Beech-Tuliptree-3	Hardwood
Acadian-Appalachian Subalpine Woodland and Heath-Krummholz	Spruce-Bog Blueberry-Crowberry-5	Shrubland
Acadian-Appalachian Alpine Tundra	Spruce-Bog Blueberry-Crowberry-5	Shrubland
East Gulf Coastal Plain Jackson Plain Prairie and Barrens	White Oak-Post Oak- Big Bluestem-1	Grassland
Western Highland Rim Prairie and Barrens	White Oak-Post Oak- Big Bluestem-1	Grassland
Eastern Highland Rim Prairie and Barrens	White Oak-Post Oak- Big Bluestem-1	Grassland
Southern Atlantic Coastal Plain Wet Pine Savanna and Flatwoods	Longleaf Pine-Slash Pine-Saw Palmetto-1	Riparian
Central Florida Pine Flatwoods	Longleaf Pine-Slash Pine-Saw Palmetto-1	Riparian
East Gulf Coastal Plain Near-Coast Pine Flatwoods	Longleaf Pine-Slash Pine-Saw Palmetto-1	Riparian
West Gulf Coastal Plain Wet Longleaf Pine Savanna and Flatwoods	Longleaf Pine-Slash Pine-Saw Palmetto-1	Riparian
Central Atlantic Coastal Plain Wet Longleaf Pine Savanna and Flatwoods	Longleaf Pine-Slash Pine-Saw Palmetto-1	Riparian
East Gulf Coastal Plain Southern Loblolly-Hardwood Flatwoods	Loblolly Pine-Willow Oak-1	Riparian

- Sometimes the dataset will contain multiple levels in a hierarchy, and you can choose the most appropriate.
- This is a sample of the LANDFIRE BpS legend showing three levels in the vegetation classification hierarchy. I've worked on several projects that choose the coarser BpS group rather than the original BpS attribute because it more closely matches the types to which they apply management activities.
- In other cases, we have to split and/or lump groups by hand to "localize" a dataset.
- Changing from a finer to a coarser level in the hierarchy will often improve the map accuracy.

LANDFIRE BpS map, cartography Sarah Hagen

Classification Units



ILAP Region	ILAP Potential Vegetation Type	LANDFIRE Biophysical Setting
Oregon Blue Mountains	Douglas-fir - Dry	PNW Mixed Conifer - Dry
Oregon Blue Mountains	Grand fir - Cool/moist	PNW Mixed Conifer - Mesic
Oregon Blue Mountains	Wyoming big sagebrush - With juniper	Great Basin Wyoming Big Sagebrush Wet
Oregon Coast Range	Western hemlock - Moist (Coastal)	PNW Wet Douglas-Fir Hemlock
Oregon South East	Wyoming big sagebrush - No juniper	Great Basin Wyoming Big Sagebrush
Washington Columbia Basin	Bluebunch wheatgrass - Sandberg bluegrass	PNW Bluebunch Wheatgrass
Washington Columbia Basin	Idaho fescue - Prairie junegrass	PNW Idaho Fescue Grasslands
Washington Columbia Basin	Wyoming big sagebrush - No juniper	Great Basin Wyoming Big Sagebrush
Washington Northeast	Douglas-fir - Dry	PNW Mixed Conifer - Dry

- Sometimes the thematic resolution is suitable but the classification units are not.
- In this example from USFS Region Six the GIS analyst cross-walked the LANDFIRE BpS classification to a regional classification (Integrated Landscape Assessment Project Potential Vegetation Types) for expert input
    - The analyst stratified the information by region because ILAP types are different by region and to facilitate review.
- The thematic resolution is similar and there is mostly one-to-one correspondence between types from the different projects, but the naming conventions differ.
- Sometimes to get informed review you need to translate to a familiar classification scheme.
- Another reason to cross-walk units is to merge maps with different classifications into a seamless map for your project area.

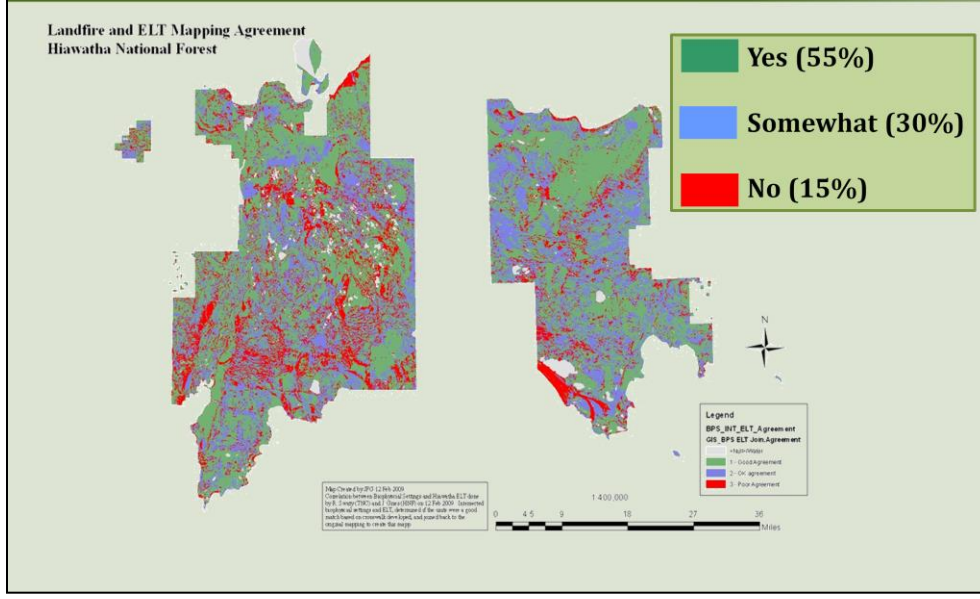
Thematic Agreement

Hiawatha ELT Map	LANDFIRE BpS Map	Match Evaluation
Northern Hardwood	Northern Hardwood	Yes
Acid Peatland	Alkaline Swamp	Somewhat
Jack Pine Barrens	Coastal Wetland	No

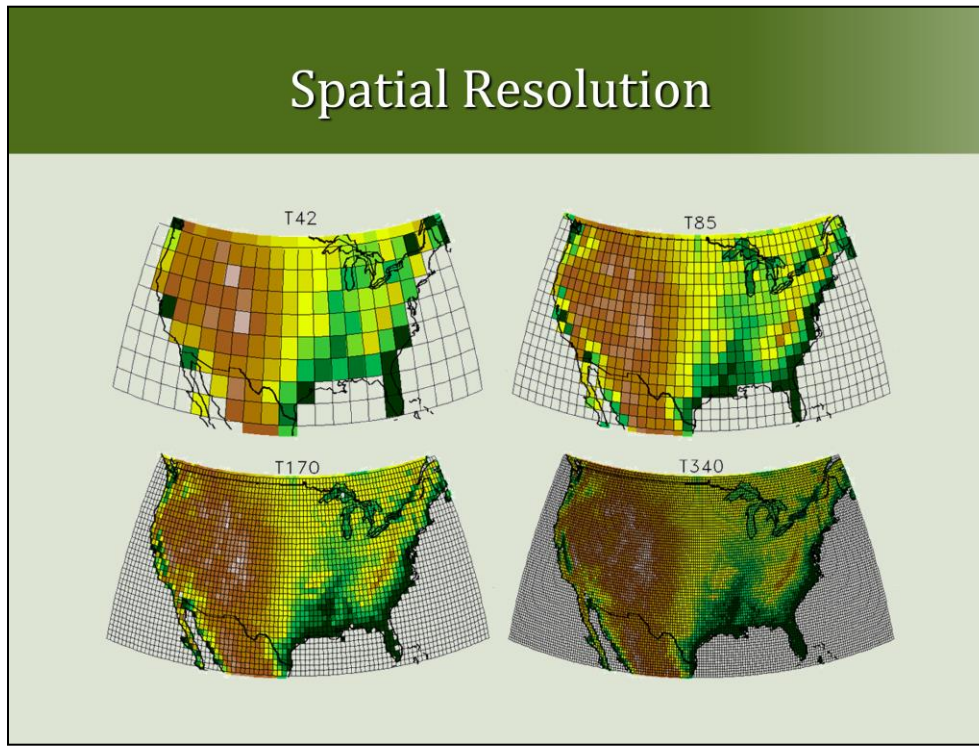
- This is an example of assessing thematic agreement.
- In this example, a colleague of mine worked with partners on the Hiawatha National Forest to compare a LANDFIRE BpS map with the local Ecological Land Type (ELT) map.
- The ELT map adequately met the mapping needs on Forest lands but did not cover any of the surrounding private land. The goal of the comparison was to determine if the BpS map could be used when mapped data was needed outside of the Forest boundaries.
- A qualitative comparison was done by overlaying the ELT and BpS maps and evaluating the combinations using a three class system:
    - Yes, the types matched,
    - Somewhat, the types matched partially (e.g. at least two dominant indicator species and edaphic factors were similar),
    - No, the types did not match (e.g. edaphic factors and/or species composition were substantially different).
- The "somewhat" category was particularly important because it shows that cross-walking data is not always straightforward. ELT and BpS are not identical vegetation concepts.
- In some cases the distinction between the "somewhat" types will matter more than others. For example, the mismatch between acid and alkaline wetlands might be

acceptable for certain applications but not for others.

Thematic Agreement



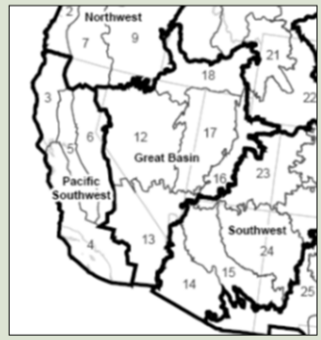
- After making the comparison on a spreadsheet, the "match evaluation" column was joined to the LANDFIRE BpS grid so they could see the spatial distribution of the match evaluation.
- It is important to note that neither map is necessarily right. They both have strengths and weaknesses, but in this case, the folks working on the Forest had higher confidence in their local ELT map and so it was generally assumed to be more accurate.
- As a result of this evaluation the Hiawatha National Forest team was able to 1) determine that the LANDFIRE BpS map was adequate to cover non-forest lands, and 2) prioritize specific classes and geographies within the LANDFIRE BpS map where improvements could be made (e.g. blue areas are mostly wetlands where LANDFIRE had difficulty distinguishing acid vs. alkaline soils).



- For raster data we often think of pixel size when considering resolution; however, having a 30m cell size doesn't mean that the data are accurate at the pixel level.
- You can also think in terms of minimum mapping unit or traditional map scale.
- You can re-sample the data to change the resolution of raster data or dissolve polygons for vector. When re-sampling, it is fairly safe to re-sample from a finer to a coarser scale but more problematic to go the other way.
- In my experience, working with land managers and planners, 30m resolution has been adequate for the most part.

graphic: www.vets.ucar.edu

Map Accuracy

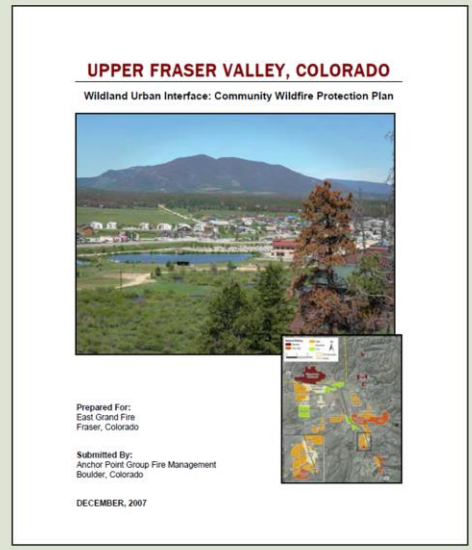


Name	Code	Class Specific Holdout Plot Agreement: LFRDB Plots	Mapped Plots	Plots with Agreement	Producer Agreement	User Agreement
Great Basin Pinyon-Juniper Woodland	2019	84	79	65	77.4%	82.3%
Inter-Mountain Basins Big Sagebrush Shrubland	2080	77	94	46	59.7%	48.9%
Colorado Plateau Pinyon-Juniper Woodland	2016	36	31	28	77.8%	90.3%
Introduced Upland Vegetation - Annual and Biennial Forbland	2183	34	18	12	35.3%	66.7%
Inter-Mountain Basins Mixed Salt Desert Scrub	2081	33	72	14	42.4%	19.4%
Sonora-Mojave Creosotebush-White Bursage Desert Scrub	2087	33	29	23	69.7%	79.3%
Artemisia tridentata ssp. vaseyana Shrubland Alliance	2220	32	26	15	46.9%	57.7%
Rocky Mountain Aspen Forest and Woodland	2011	29	35	24	82.8%	68.6%
Great Basin Xeric Mixed Sagebrush Shrubland	2079	27	35	7	25.9%	20.0%
Inter-Mountain Basins Big Sagebrush Steppe	2125	27	27	9	33.3%	33.3%
Inter-Mountain Basins Greasewood Flat	2153	24	26	11	45.8%	42.3%
Mojave Mid-Elevation Mixed Desert Scrub	2082	23	20	10	43.5%	50.0%
Inter-Mountain Basins Sparsely Vegetated Systems	2001	16	2	2	12.5%	100.0%

- An accuracy assessment, if available, could be a starting point for assessing map accuracy, but I haven't found it very useful when working with LANDFIRE data because it has some limitations.
- The comparison shown in this table is for certain LF EVTs in the Great Basin Super Zone, which is shown in the map on this slide.
- Limitations include:
  - pixel by pixel accuracy assessment on a dataset designed for regional and national uses,
  - few holdout plots for agreement assessment,
  - plots not evenly distributed,
  - some classes had no holdout sample plots,
  - agreement information is only available for super zones and accuracy within the zone can vary geographically and thematically.
- Agreement Assessments are only one piece of information for evaluating a dataset, and in my personal experience, they haven't been as helpful as working with local experts.

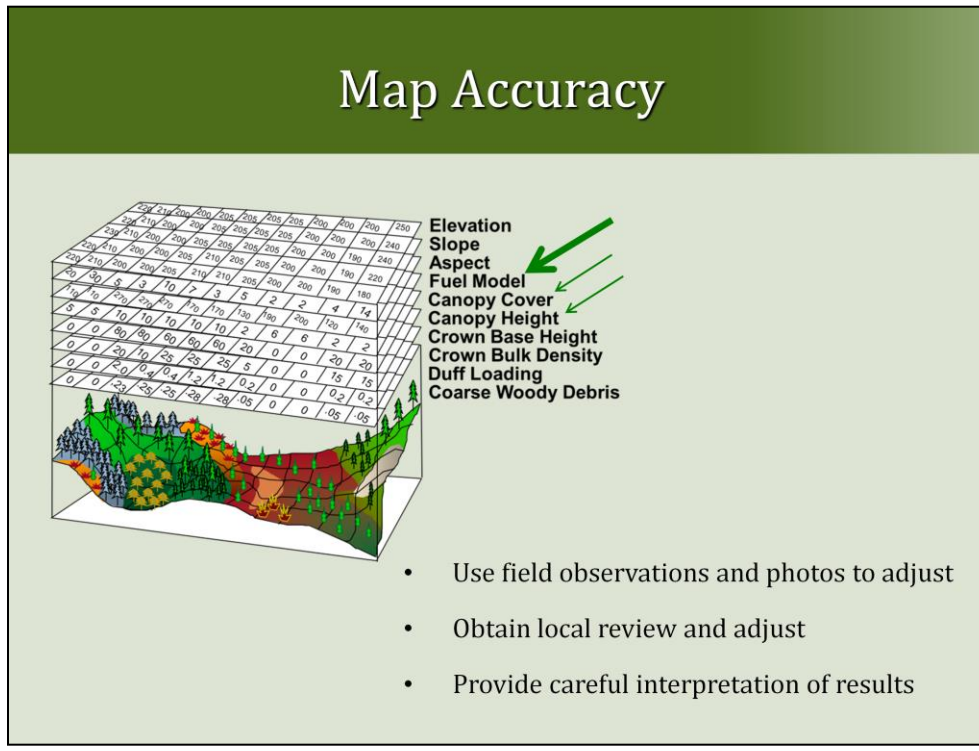
Table from LANDFIRE National Western Milestone Agreement Assessment Super Zone Analysis

Map Accuracy



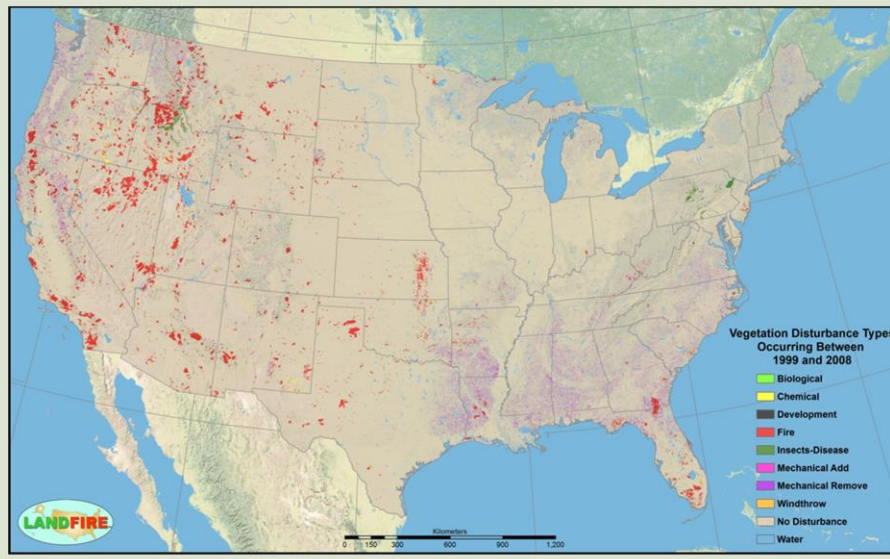
- Another strategy for assessing map accuracy is a combination of field review and local expertise.
- The Anchor Point group in CO used LANDFIRE data (elevation, slope, aspect, fuel model, canopy cover, canopy base height, stand height and canopy bulk density) to generate estimates of fire behavior for a Community Wildfire Protection Plan (CWPP) in Upper Fraser Valley, CO and in a variety of other places.
- Even though they work at a relatively fine scale, they use LANDFIRE data for the fire behavior modeling because it is generally the only source of consistent spatial data for their entire area.
- However, out of the box LANDFIRE data is generally not adequate for their purposes and so they invest time and effort in refining it.

Picture: fig 25 in CWPP (http://csfs.colostate.edu/pages/documents/UpperFraserCWPP.pdf)



- The data layers used for fire behavior modeling are shown here (the last two, Duff and CWD, don't apply).
- Anchor Point addresses the scale issue in a few ways:
    1. They adjust the data up front based on field survey and photos (e.g. change fuel assignments, modify CBH and CC).
    2. They run the fire behavior models, review the results with local experts and fine tune the data as needed.
    3. Finally, they carefully interpret the results in final documents/reports to focus on larger trends rather than single pixel findings.

Temporal Resolution



- Temporal resolution is another area to consider when reviewing a dataset.
- Users need to consider the base data date, e.g. when the aerial photos or satellite imagery were taken, and changes that have occurred since that date.
- For LANDFIRE, we assemble a database of events from various data sources to help update our data on a biannual update cycle. This map is the result of that process.
- Our data are always two to three years behind so we encourage folks to do the same to localize their data for any disturbances/changes we missed that happened since our last update.
- It is important to make a decision about what changes are important for you to capture; e.g. do you need to capture a 5 acre thinning project? Will the change affect your results?
- On most of the projects I have worked on, we did not update the data for recent disturbances. Instead, the vintage of the data was clearly stated in the project documentation and accepted as one of the limitations of the data.

Localizing Lessons

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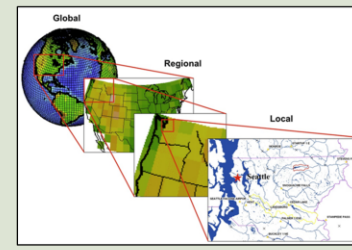

- To wrap up, I want to come back to the lessons I started the discussion with.
- I hope I presented a clear and organized description of the localizing process; however, the actual process is not so neat.
- In practice, steps one through three can be more challenging than anticipated because they require the most cooperation from others.
- In particular, step three can take time, and it may require helping colleagues to understand the strengths and weaknesses of a dataset or a mapping method.
- The review process can be limited if there is limited ancillary data to compare to or limited expert engagement. Often time is not allotted for review in a project schedule and so you make only the most critical modifications.
- Even once you have completed your review and modification, no dataset will be perfect, and providing an appropriate interpretation of the results is important.

1. To the extent possible, time should be built into the project schedule for review and localization.
2. Recognize your needs and balance the tradeoffs between accuracy and time/resources accordingly.
3. Localization takes time and effort but may be less time-consuming and more cost-effective than developing new data.

Helpful Links

LANDFIRE
www.landfire.gov

LANDFIRE @ The Nature Conservancy
http://nature.ly/landfire

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LANDFIRE Videos