LANDFIRE 2012 Executive Summary

Purpose

The purpose of the LANDFIRE 2012 (LF 2012) project was to deliver a suite of updated LANDFIRE (LF) data products for the conterminous United States (CONUS), Alaska, and Hawai'i current as of 2012.

Objectives

The objectives for LF 2012 were largely associated with the creation and delivery of updated data products. For LF 2012 this list consisted of:

Reference – Public Events Geodatabase

Disturbance - Disturbance Grids, Vegetation Disturbance (VDist), Fuels Disturbance (FDist), Vegetation Transition Magnitude (VTM)

Vegetation - Exiting Vegetation Type (EVT), Exiting Vegetation Height (EVH), Exiting Vegetation Cover (EVC)

Fuels - 13 Anderson Fire Behavior Fuel Models (FBFM), 40 Scott and Burgan FBFM, Canadian Forest Fire Danger Rating System (CFFDRS; AK Only), Forest Canopy Base Height (CBH), Forest Canopy Bulk Density (CBD), Forest Canopy Cover (FCC), Forest Canopy Height (FCH), Fuel Characteristic Classification System (FCCS) [Optional], Fuel Loading Models (FLM) [Optional]

Fire Regime: Succession Classes (SClass) [Optional]

Additional production objectives for LF 2012 included:

1. Using Remote Sensing of Landscape Change (RSLC) methods to map disturbance in Hawai'i
2. Provide Gap Fill to correct scan line issues in select Monitoring Trends in Burn Severity (MTBS), and Rapid Assessment of Vegetation Condition after Wildfire (RAVG) disturbance products.
3. Methodological adjustment of the EVC and EVH mapping procedure from LF 2001/2008 to LF 2010.
4. Creation of the Vegetation Transition Rules database.
5. Adding CBH Regression Tree Analysis (RTA) capability to the LF Total Fuel Change (LFTFC) tool.

Schedule

LF 2012 was partially delivered ahead of schedule. LF 2012 began processing submitted disturbance plots on Dec 3, 2013. The formal LF 2012 Project Kickoff occurred on January 22, 2014 with the initiation of data processing and analysis. LF 2012 was scheduled to make updated CONUS data products available via the Data Distribution System (DDS) no later than December 31, 2014. These products consisted of databases readable in relational database format or by geospatial database format, as appropriate. LF CONUS was delivered ahead of schedule on December 29, 2014. The baseline for Alaska and Hawai'i Geo Areas was March 30, 2015. Due to unexpected processing challenges in Alaska and a realized risk in RSLC processing in Hawai'I, the LF Business Leadership Group accepted a delayed delivery of April 30, 2015. Products for Alaska and Hawai'i were finally delivered on April 27, 2015.

Costs

LF 2012 was delivered under budget. The baseline budget for LF 2012 was $1,051,178. The final estimated cost for USGS and associated contractor efforts on LF 2012 for the period January 2014 – April 2015 was $874,120. This represents a 17% under budget delivery. The primary reason was less than expected costs associated with the development of disturbance products.

During the timeline for LF 2012 (January 2014 through April 2015), the LANDFIRE program at USGS EROS incurred costs of $2,732,876. Production costs associated with LF 2012 accounted for 39% of these costs. The three remaining program work areas captured the remaining costs: Governance – 20%, Operations – 20% and Improvements and Innovations – 21%.

<u>Results</u>

LF 2012 met its intended objectives. The following products were delivered with LF 2012:

Reference: Public Events Geodatabase

Disturbance: Disturbance Grids, VDist, FDist, VTM

Vegetation: EVT, EVH, EVC

Fuels: FBFM13, FBFM40, CBD, CBH, CC, CH, CFFDRS [AK Only]

In addition to these deliverables, the following specific improvement objectives were achieved:

1. Using Remote Sensing of Landscape Change (RSLC) methods to map disturbance in Hawai'i

   In LF 2010, LANDFIRE adopted and implemented a RSLC detection algorithm based on the Multi-Index Integrated Change Analysis (MIICA) process developed for the NLCD project. With LF 2012 disturbance mapping was expanded in Hawai'I from previous level of effort methods to now include image composites, RSLC/MIICA processing, and MTBS no-data filling. These techniques significantly reduced the impact on disturbance mapping due to heavily clouded imagery common in Hawai'i. Approximately 19,000 acres of disturbance (37% from RSLC) were recorded in LF 2012 in Hawai'i.

2. Provide Gap Fill to correct scan line issues in select Monitoring Trends in Burn Severity (MTBS), and Rapid Assessment of Vegetation Condition after Wildfire (RAVG) disturbance products.

   Two national fire mapping program datasets were used to locate and characterize large wildfires – MTBS and RAVG. MTBS and RAVG data for 2011 and 2012 contained a large number of no data areas due to the use of Landsat 7 ETM+ SLC-off imagery. These fire mapping programs do not employ methods to fill in the no-data pixels with alternate data. Left "as is" no-data pixels would remain in the disturbance data product and affect subsequent LANDFIRE products (e.g. fuel models). In order to mitigate the no-data issues, decision tree modeling using best-pixel composite imagery (or occasionally, other available imagery), or majority focal filling techniques were employed.

   Despite significantly more time and effort required for decision tree modeling compared to automated techniques, testing showed qualitative improvement over automation in almost all cases. The modeling approach proved most valuable in larger fires containing a wide range of severity levels with varied elevations and fuel conditions. Decision tree modeling, therefore, became the preferred method for filling MTBS and RAVG data gaps when applicable.

3. Methodological adjustment of the EVC and EVH mapping procedure from LF 2001/2008 to LF 2010.

   LF National utilized three vegetation lifeforms (tree, shrub, and herbaceous) and created EVC and EVH separately for each lifeform. The modeled shrub and herbaceous layers were created as intermediate layers and were not distributed as an end product. A normalization algorithm was applied that adjusted shrub and herbaceous cover based on the amount of tree and shrub cover mapped for each pixel. The tree cover data used in LF National was based on the NLCD tree cover product. The final EVH and EVC layers were contingent on the LF EVT map, which was the determining factor in assigning lifeform to each pixel.

In LF 2001, tree cover was remapped using USFS FIA stem mapped plot data. The intermediate LF National modeled shrub and herbaceous cover layers (previously undistributed) were used to provide structure information for the pixels that changed lifeform. These intermediate cover layers did not have the normalization algorithm applied. Shrub and herbaceous pixels that did not change lifeform kept the LF National EVC pixel values. LF 2008 used the same mapping process as LF 2001 EVC. The only difference was updating vegetation transitions based on disturbance or succession from 1999 through 2008.

LF 2010 EVC products were created using a baseline LF 2001 layer that combined the LF 2001 re-mapped tree cover with the LF National modeled (non-normalized) shrub and herbaceous layers based on the lifeform of the EVT. This layer was then updated to reflect vegetation change, due to disturbance or succession, from 2001 through 2010. Analysis of the LF 2010 products revealed significant changes in the distribution of shrubland fuels. These changes were not caused by disturbance or succession but were traced back to the use of the non-normalized LF National intermediate shrub and herbaceous layers that were applied to all shrub and herbaceous pixels.

To mitigate the distribution shift in the LF 2010 products, and bring the EVC data back in line with previous LF releases, the LF 2012 products were reverted back to the normalized EVC data where available. This was accomplished by modifying the LF 2010 EVC product to use the LF 2001 herbaceous and shrub EVC data. The areas that had changed since 2010, due to disturbance or succession, were then transitioned using the re-mapped LF 2001 tree cover for pixels with a tree lifeform, and the modeled (non-normalized) LF National intermediate shrub and herbaceous data only where the lifeform changed to shrub or herbaceous. The LF 2012 process resulted in EVC data that is more compatible with data from pre-LF 2010 and the distribution shift seen in the LF 2010 is no longer apparent in the data

4. Creation of the Vegetation Transition Rules database

   The effects of disturbances on the vegetation are modeled or predicted using a series of tables that link pre-disturbance EVT, EVC, EVH, and a range of possible disturbance types and severities with post-disturbance EVT, EVC, and EVH. For forested vegetation, these tables were informed by computer simulations found in the Forest Vegetation Simulator (FVS) while for non-forest vegetation they were informed by a series of simple rule-sets generated heuristically for each individual map zone. Final updating occurred when the tables were linked with a spatial overlay of vegetation and mapped occurrences of disturbance and used to assign LF 2012 EVT, EVC, and EVH. Finally, a unique code was assigned to all pixels that associate them with a particular disturbance type as well as categories of change magnitude expressed either in a change in vegetation lifeform or a change in tree cover

5. Adding CBH Regression Tree Analysis (RTA) capability to the LF Total Fuel Change (LFTFC) tool.

The primary focus for updating CBH mapping in LF 2012 was to develop a regression tree modeling process using canopy fuel characteristics. Similar processes were previously implemented but focused on different cover/height groupings. Although these methods performed well, they proved somewhat cumbersome to develop and tedious to update. In an attempt to streamline this issue, reduce processing time, and simplify updates, an RTA approach was implemented, leveraging the FVS FIA-plot analysis. Utilizing the FVS outputs an RTA was performed for each LF vegetation type (and associated sub-groupings) based on associated canopy characteristics (cover/height). Analysis was batched using the R statistical software package and resulted in a CBH assignment equation for each vegetation type. Prior to implementation, comparisons were made against previous LF versions by testing performance using Nexus 2.1. In areas that had been disturbed over the last ten years, values for FCC, FCH, and CBD were recalculated using the post-disturbance EVT, EVC, and EVH. The change in CBH attributes due to disturbance were modeled through FVS and then modelled through the same RTA process for each disturbance type, severity, and TSD. The CBH data layers were updated by leveraging these disturbance type, severity, and time-step specific RTA-CBH equations.

<u>Partnerships</u>

LF 2012 relied on the involvement of several of its partners to produce its required products. In particular, the Pubic Events Geodatabase was built from data acquired from both national databases and contributions from various land management groups including federal, state, tribal, and local agencies, along with private and non-profit organizations. A total of 159,191 raw events were processed. The largest contributor was the USFS, including the Forest Activity Tracking System (FACTS), who contributed over 91,000 plots (or 57.2%). Next was the BLM at 13.8%, followed by multi agency groups, such as the Geo-Spatial Multi-Agency Coordination (GeoMac) group, at 13.3% and a variety of state organizations at 10.9%. The remaining data originated from a mix of tribal or other government sources.

The LANDFIRE program continues to enjoy a productive relationship from both MTBS and RAVG programs. They remain an increasingly important source for disturbance event information. In LF 2012, disturbance contributions from these fire mapping initiatives amounted to more than 45% of all received contributions. This compares to 25% – 30% of total contributions in 2008 – 2010.