Comparison of Spatially Explicit Annual Vegetation Disturbance Products Over the Conterminous United States

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I. Abstract and Introduction

- Established programs like LANDFIRE (LF) (Rollins 2009) and relatively recent programs like Land Change Monitoring, Assessment, and Projection (LCMAP) and Landscape Change Monitoring System (LCMS) are producing periodic annual disturbance products for the conterminous United States (CONUS).
- However, each program has distinct objectives with different algorithms (Multi-Index Integrated Change Analysis (MIICA) Jin et al. 2013, LF; Continuous Change Detection and Classification (CCDC) Zhe and Woodcock 2014, LCMAP; Ensemble Classifier Housman et al. 2021 LCMS) and program-specific definitions for disturbance. In this work we compare the spatially explicit vegetation loss as mapped by each of these programs using LF annual vegetation disturbance data as a reference.
- The LF disturbance data are an ideal choice of reference as the data include both remotely sensed imagery and submitted events (i.e., field-collected vegetation loss data) and are visually inspected by analysts. Furthermore, LF disturbance data incorporate spatially explicit fire-related disturbance data from Monitoring Trends in Burn Severity (MTBS), Burned Area Emergency Response (BAER), and Rapid Assessment of Vegetation (RAVG) fire programs.

II. Materials and Methods

- LF maps around Day Of Year (DOY) 175 & DOY 250 +/- 50 days composite
- LCMAP time of spectral breaks maps change DOY but change land cover is defined for DOY 182
- LCMS maps loss between DOY 244 of consecutive years
- Minimum common match is between 2015 DOY 250- 2016 DOY 175 (LF Seasonal Multi-Index Integrated Change Analysis (SMIICA)) of the consecutive year
- Only disturbance clusters that were > 50 contiguous Landsat pixels avoiding regions defined as urban, water or agricultural lands by the National Land Cover Data base 2016 (Homer et al. 2011) were considered
- Tile wise differences were quantified using Cohen's *kappa*

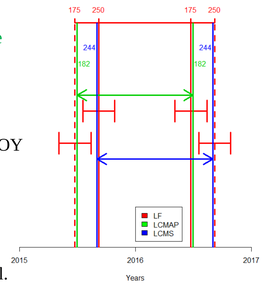

Fig 1. Temporal reporting periods of the three disturbance mapping programs

III. Results

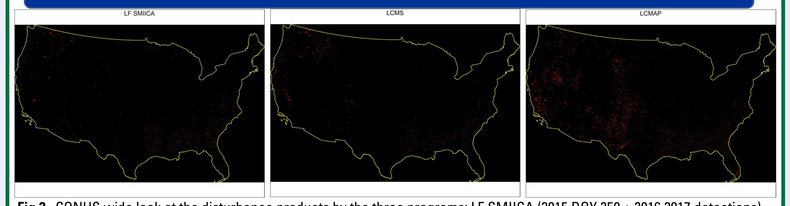

Fig 2. CONUS wide look at the disturbance products by the three programs; LF SMIICA (2015 DOY 250 + 2016 2017 detections), LCMAP (2015 and 2016 LCMAP time of spectral breaks and landcover change), and LCMS (2016 with no temporal adjustment).

- Temporal reporting periods were considered and adjusted before intercomparison
- Large disturbances in the Western United States are captured by all three programs
- Southeastern United States appears similar
- Differences are also evident, especially in central regions

IV. Results (cont.)

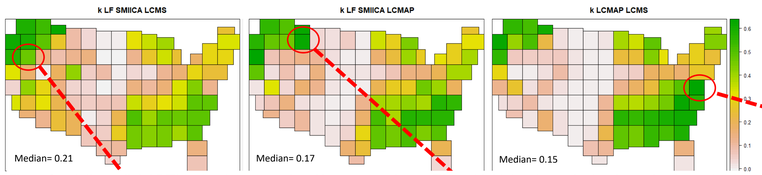

Fig 3. Spatially explicit LF Tile-wise *kappa* results of intercomparisons. Tiles with higher *kappa* in that frame but lower in other frames are marked with circles and examined further

- As evident from Figure 3, spatial correlations between LF SMIICA were poor to moderate
- Overall agreement was stronger between LF & LCMS than LF & LCMAP or LCMAP & LCMS
- Higher *kappa* was observed on East and West coasts
- Despite overall spatial similarity some tiles have contrasting accuracies
- These tiles (r03c02, r05c14 and r02c04) were examined visually in the following figures

Fig 4. r03c02 tile where *kappa* was low with LCMAP data. False color composites of the pre and post disturbances for the tile along with disturbances detected by each of the programs is illustrated. Disturbances are shown in red. Urban, water bodies and agricultural regions not included in the study region is shown in gray. Two regions of interest are also selected and illustrated.

- LCMAP disturbances appear to be vegetation gain and change over the examined dry lakebed
- These are not issues as vegetation gain or change over dry lakes could not be filtered using available data

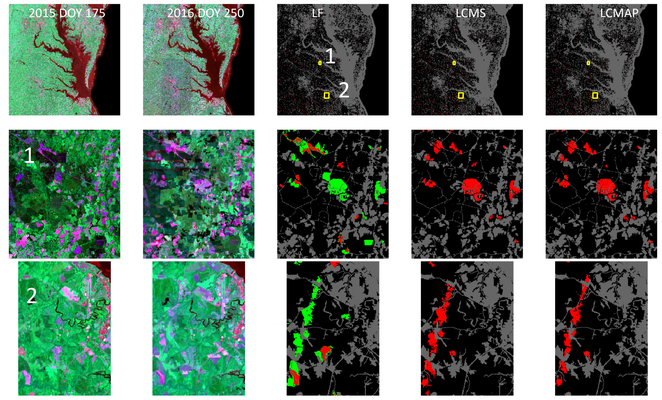

Fig 5. r05c14 tile had low *kappa* w.r.t LF but LCMS vs. LCMAP was higher. False color composites of the pre and post disturbances for the tile along with disturbances detected by each of the programs is illustrated. Disturbances are shown in red. Urban, water bodies and agricultural regions not included in the study region is shown in gray. Two regions of interest are also selected and illustrated.

- Green disturbances were accounted for in the previous years' LF disturbance product
- Inconsistencies are due to the soft reporting periods

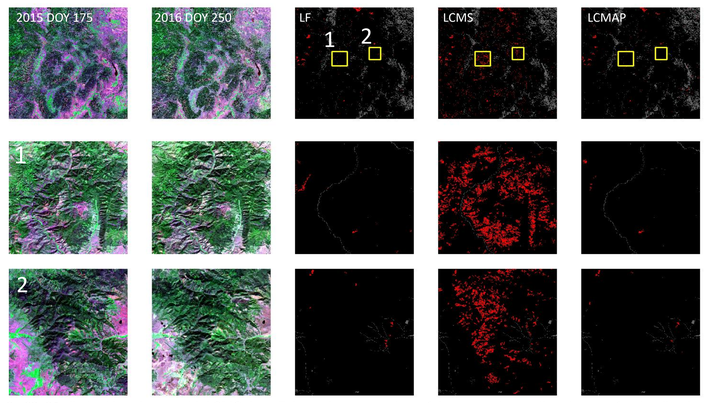

Fig 6. r02c04 tile had low *kappa* with LCMS data. False color composites of the pre and post disturbances for the tile along with disturbances detected by each of the programs is illustrated. Disturbances are shown in red. Urban, water bodies and agricultural regions not included in the study region is shown in gray. Two regions of interest are also selected and illustrated.

- LCMS algorithm may have issues compensating for changing viewing angles in mountainous regions
- LF and LCMAP do not seem affected by this issue

V. Conclusions

- Despite clear differences, a low to moderate spatial correlation was seen across all three products
- *kappa* varied regionally and tended to be lower near the central regions of the US.
- Overall, LCMS disturbances were more spatially correlated with LF than with LCMAP.
- Closer examination of some of the larger discrepancies suggests that along with algorithmic differences, lack of temporal alignment between the three programs (i.e., reporting periods) was a significant factor for some of the observed differences.

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