

# LCMAP Land Cover Classification and Land Cover Change Metrics 1985-2016, Based on the LCMAP Reference Data Set

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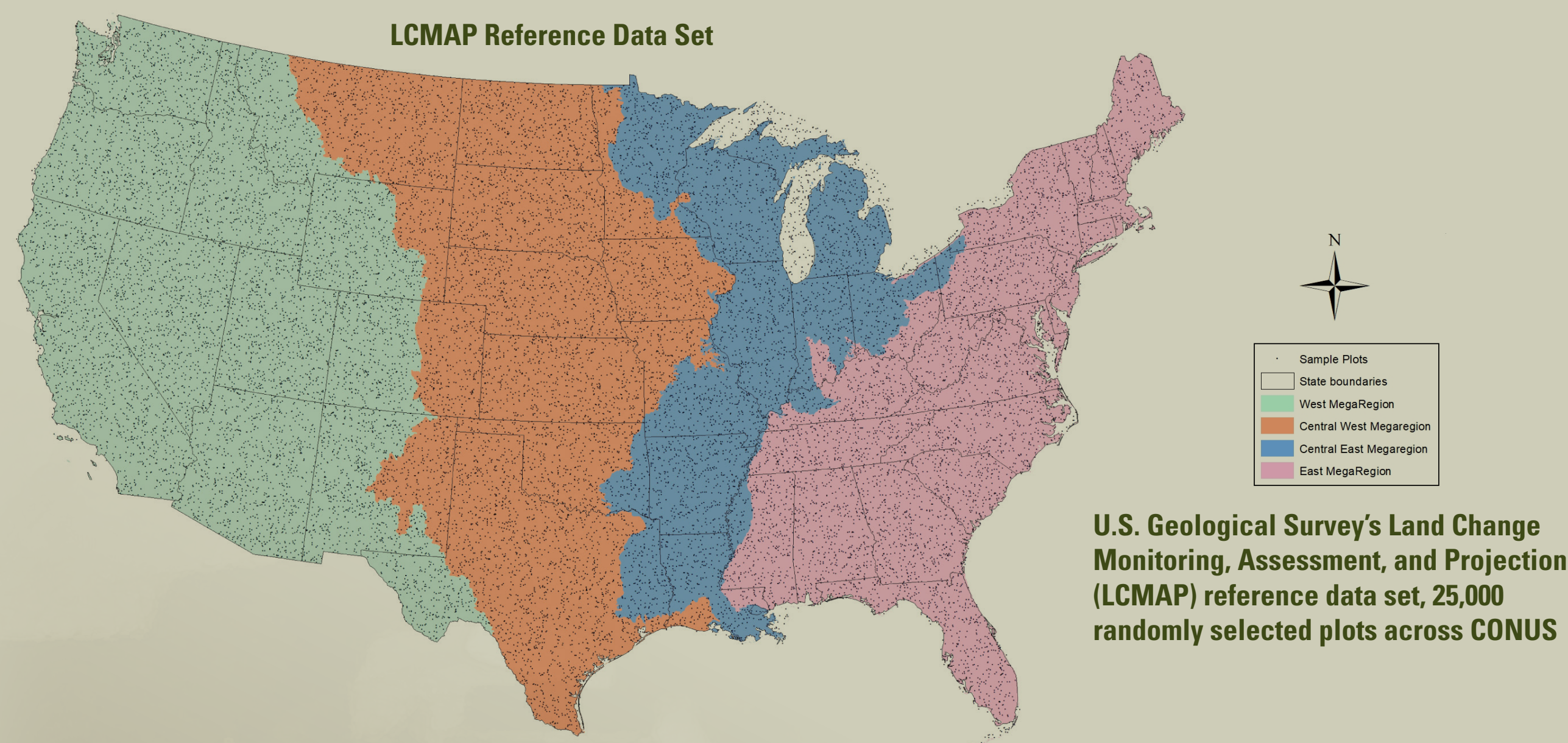
<sup>2</sup>USGS EROS Center, Sioux Falls, SD. <sup>3</sup>Innovate!, contractor to the USGS EROS Center, Sioux Falls, SD. Work performed under USGS contract G15PC00012.

## Introduction

Estimates of annual land cover class and land cover change were derived from the U.S. Geological Survey's Land Change Monitoring, Assessment, and Projection (LCMAP) reference data set. The reference interpretations were obtained independently of the map classification. The reference data will be used for area estimation and validation of the LCMAP annual land cover products. Land cover and land cover change estimates were made using 25,000 plots that were randomly selected across the conterminous U.S. (CONUS). The net land cover class change, 1985-2016 results were; Developed land increased by 1.7%, Cropland decreased by 1.2%, Tree Cover decreased 0.6%, Water decreased 0.1%, and Grass/Shrub, Wetland, Ice/Snow and Barren classes did not change. Annual rate of land cover class change declined after 2003. The top 2 leading class changes, 1985-2016, were Grass/Shrub to Tree Cover, and Tree Cover to Grass/Shrub, with an estimated 354,000 km<sup>2</sup> and 350,000 km<sup>2</sup> respectively. It is possible for classification changes to occur on the same plot more than once over time. The next two leading changes were Cropland to Grass/Shrub and Grass/Shrub to Cropland, with an estimated 196,000 and 140,000 km<sup>2</sup> respectively. There were an estimated 149,900 km<sup>2</sup> that changed to Developed, 1985-2016, with most of this change before 2006. When the reference data set is divided into 4 regions (West, Central West, Central East, and East) variations in the amount and type of change were seen. The East region had the greatest amount of change and the West had the least. In the East, conversions between Tree Cover and Grass/Shrub far exceeded all other changes and most Developed land came from Tree Cover. In the West region, most Developed land came from Grass/Shrub. In the West Central region, conversions between Grass/Shrub and Cropland exceeded all other changes. Cropland converting to Grass/Shrub was high between 1988 and 1990. After 2008 there was a sustained gain in cropland.

## What is LCMAP

U.S. Geological Survey (USGS) Land Change Monitoring, Assessment and Projection (LCMAP) Initiative will provide a suite of annual map products including land cover and land cover change maps for the conterminous United States (CONUS). These maps are produced using the USGS Analysis Ready Data (ARD), generated from dense time series Landsat data. Coverage will eventually include Hawaii and Alaska.



## LCMAP Reference Data Set

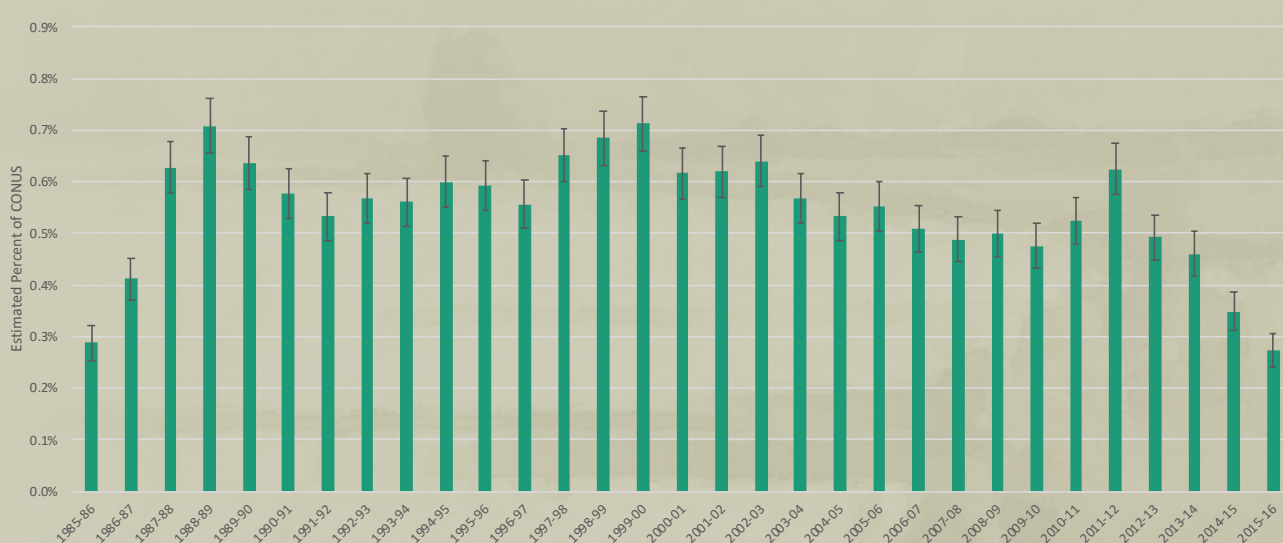
The LCMAP Reference Data Set consists of 25,000 randomly selected sample plots with annual land cover interpretations (1984 – 2016). A “duplicate interpretation” process was employed to enhance the quality of the reference data. From the 25,000, there were a total of 15,199 duplicate interpretations. This reference data set will eventually be used to assess the accuracy of land cover and land change maps developed by LCMAP.

The purpose of this poster is to show how the reference data represents land cover and land cover change across CONUS.

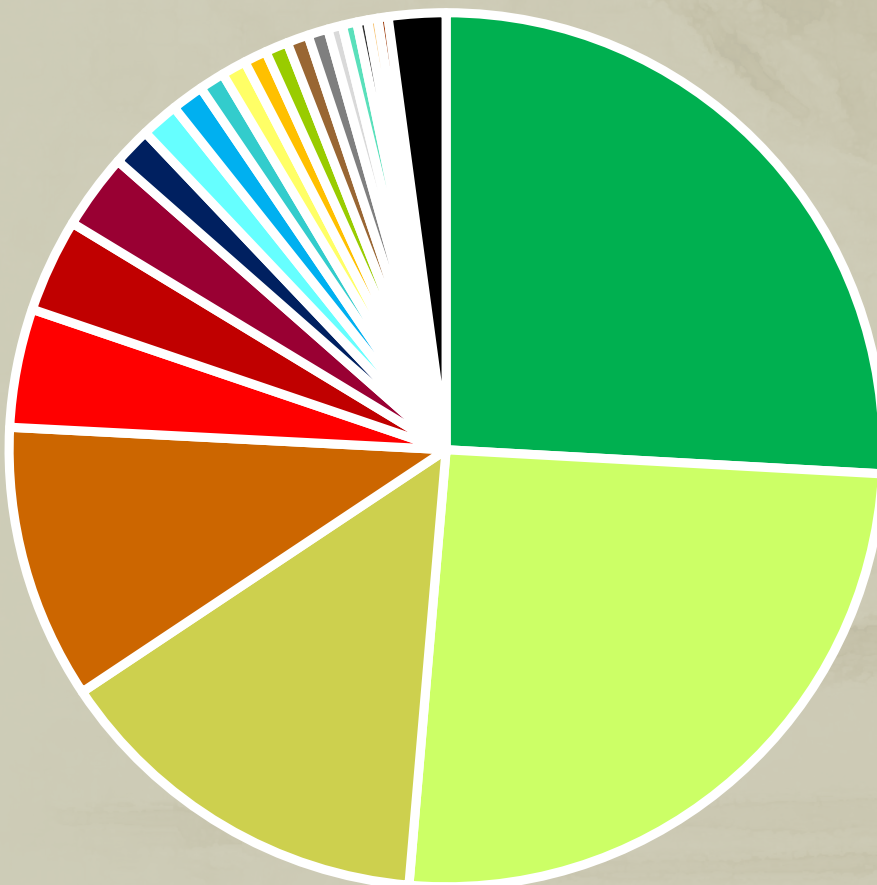
Eight Land Cover Classes: 1985 and 2016, Net Change from Bookend Years

Land Cover Class	1985	2016	Change
Developed	3.9%	5.6%	1.7%
Cropland	18.8%	17.6%	-1.2%
Grass/Shrub	37.8%	37.8%	0.0%
Tree Cover	28.4%	27.8%	-0.6%
Water	5.2%	5.3%	0.1%
Wetland	5.0%	5.0%	0.0%
Ice/Snow	0.0%	0.0%	0.0%
Barren	0.8%	0.8%	0.0%

Rate of Annual Land Cover Class Change  
CONUS, 1985-2016, Reference Data



The rate of annual change varied over time. High rates of change occurred in 1989 and again in 2000. Lower rates of change were seen in 1992 and 2008.



Land Cover Changes  
22 Top Class Changes, Summed Annual (1985-2016),  
CONUS, Reference Dataset



## Class Changes 1985-2016

- The greatest gross change in class was related to shifts between Tree Cover and Grass/Shrub, it amounted to greater than 50% of all change. Some of the causes of Tree Cover loss include forest harvest, wild fire, and insect damage.

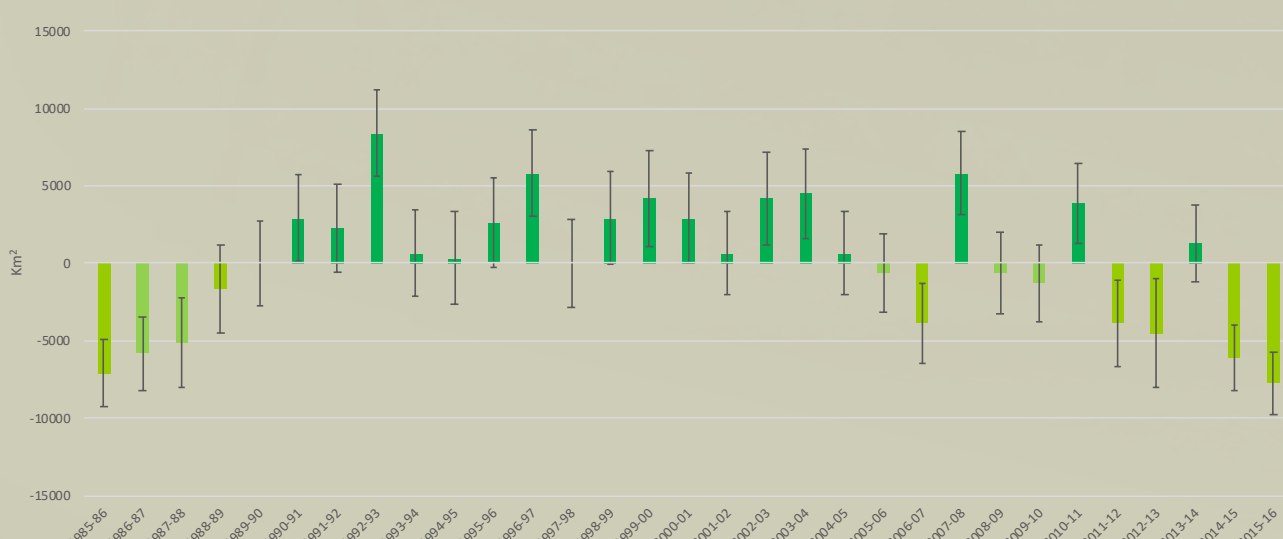
- Shifts between Cropland and Grass/Shrub added up to almost 25% of all change

- Land converting to Developed uses amounted to approximately 10% of all change

- The time series approach enables the monitoring of annual land cover class conversions, those that are obvious, as well as detecting more subtle, conditional changes on the landscape

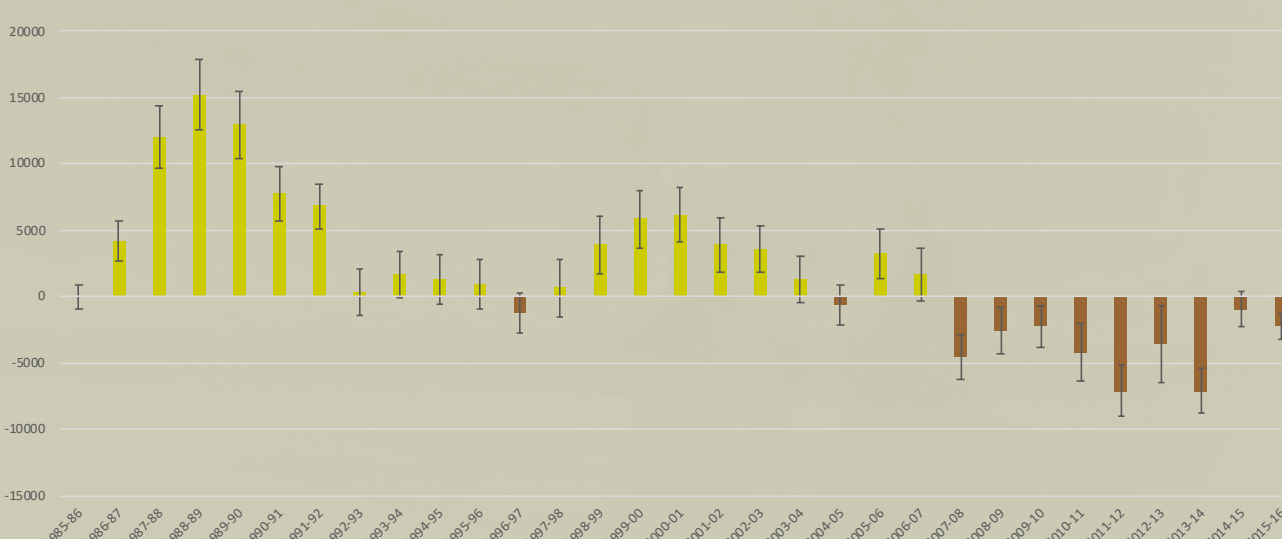
Tree Cover: Losses and gains over time

Annual Estimated Net Area of Tree Cover Class, Change Between Tree Cover and Grass/Shrub Land Cover Classes, CONUS, 1985-2016, Reference Dataset



Grass/Shrub: Losses and gains over time

Annual Estimated Net Area Grass/Shrub, Class Change Between Grass/Shrub and Cropland Land Cover Classes, CONUS, 1985-2016, Reference Dataset

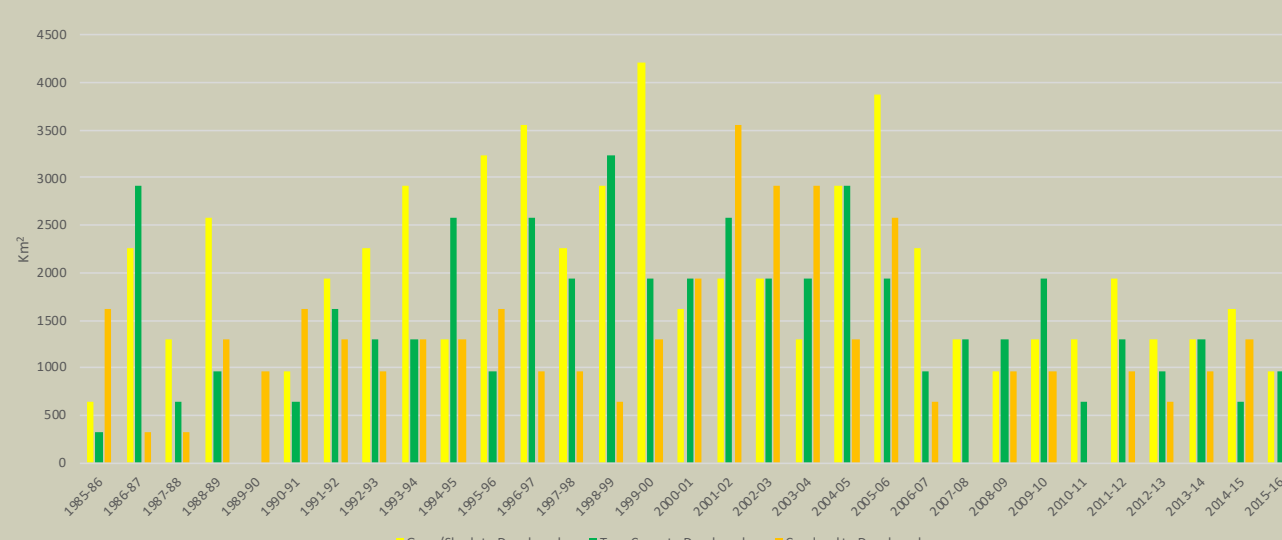


- There was a greater amount of Tree Cover converting to Grass/Shrub in the 1980s and then again 2012 – 2016. Common causes of Tree Cover loss include forest harvest, wild fire, and insect damage. The rate of forest regrowth is dynamic and varies across CONUS.

- Cropland converting to Grass/Shrub was more common 1984-2007. The highest annual conversion rate was seen 1987 – 1990. Starting in 2008 conversion to Cropland became more common. Some of the causes behind these shifts include Conservation Reserve Programs, changing Federal Farm Policies, and agricultural commodity prices.

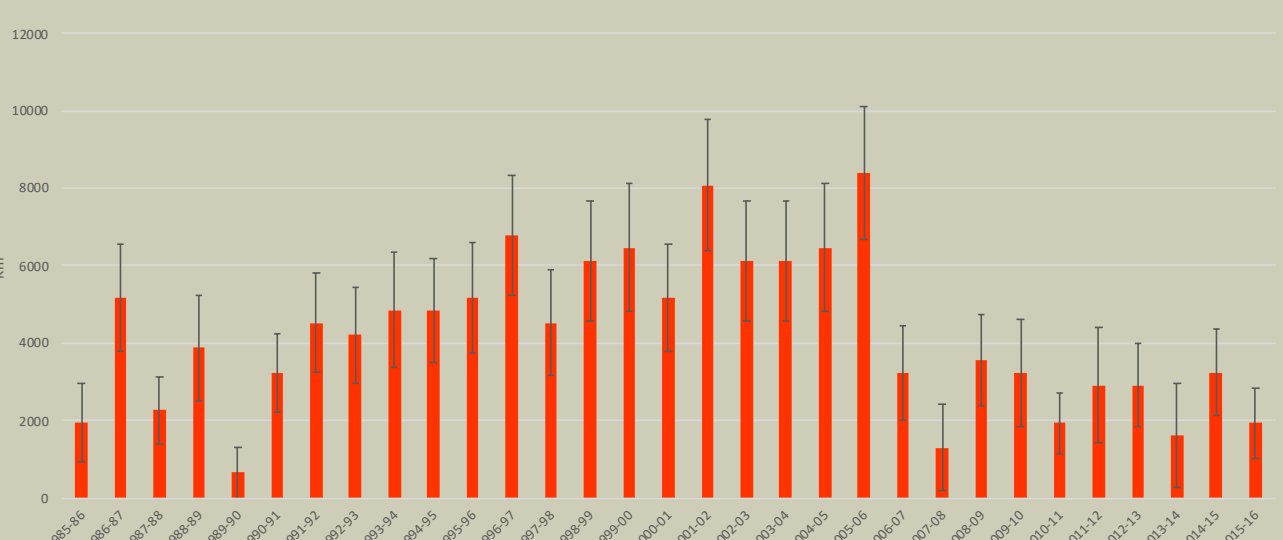
Leading Sources of Developed Land Cover

Annual Estimated Area of Leading Sources of Developed Land Cover, CONUS, 1985-2016, Reference Dataset



Annual increase in Developed Land Cover

Annual Estimated Area of Developed Land Cover increase from all classes, CONUS, 1985-2016, Reference Dataset



- In most cases, land cover change to Developed is irreversible. The most common sources of land cover converting to Developed include Grass/Shrub, Tree Cover, and Cropland.

- The amount of Developed land cover increased over time. However, the amount of change per year fluctuated. The greatest amount of increase in Developed land cover occurred 2002 and 2006. The least amount occurred in 1990 and 2008.

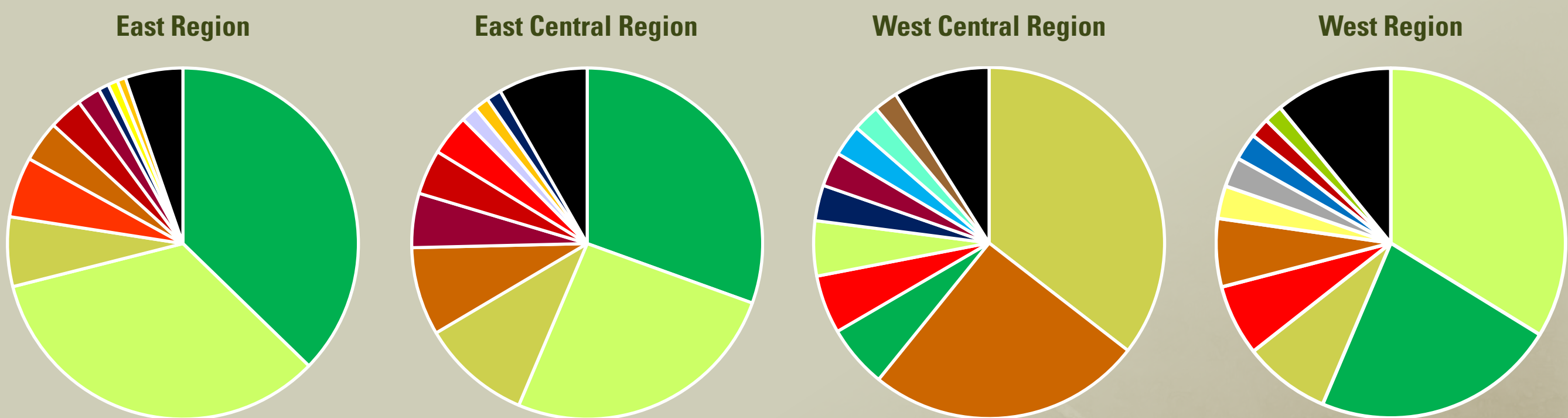
## Regional Change

- Greatest amount of change occurred in the East and least amount in the West.

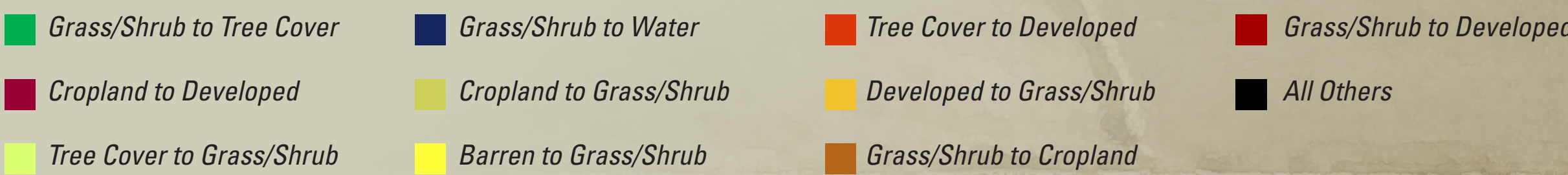
- Tree Cover switching back and forth between Grass/Shrub
  - 70% of all change in the East
  - 56% of all change in the East Central
  - 57% of all change in the West

- In the West Central, 60% of all change was Cropland switching back and forth between Grass/Shrub

- Developed land increased in all regions
  - East: 10.5 % of all changes
  - East Central: 12.7% of all changes
  - West Central: 8.2% of all changes
  - West: 8.4% of all changes



Top 10 Class Changes  
Summed Annual, 1985-2016, Reference Dataset



## Conclusions

Land cover class change is rare. Forestry, agriculture, and urbanization are the leading causes of change. Regionally, land cover composition varies greatly across CONUS. Climate, geography, and vegetation dictate the leading stories of land cover composition and change.

## Acknowledgments

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