

# EXISTING DATA SOURCES FOR SCENARIO CONSTRUCTION

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**Workshop on U.S. Land Use/Land Cover Scenarios and  
Projections  
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# Main ideas

- Existing remote sensing-based products provide land cover information
- Scarce information available on Land Use & Land Management
- Integration of RS and survey to generate second generation products
- New sources of information can contribute to fill the gaps

# Land Cover Land Use Change Products

## Global Coarse Resolution:

- International Geosphere Biosphere Programme Land Cover Classification (IGBP).
- Global Land Cover 2000 (GLC2000)
- GlobCover (2005; 2009)
- MODIS Products

PRODUCT	Number of Classes	Agr.	Past.	Built up
GLC	22	3	2	1
GlobCover	22	4	5	1
UMD LC	12	1	2	1
IGBP LC	19	2	1	1

# LCLU Classification Systems

Value	Global Globcover legend
11	Post-flooding or irrigated croplands
14	Rainfed croplands
20	Mosaic Cropland (50-70%) / Vegetation (grassland, shrubland, forest)
30	Mosaic Vegetation (grassland, shrubland, forest)
40	Closed to open (>15%) broadleaved evergreen forest
50	Closed (>40%) broadleaved deciduous forest
60	Open (15-40%) broadleaved deciduous forest
70	Closed (>40%) needleleaved evergreen forest
90	Open (15-40%) needleleaved deciduous forest
100	Closed to open (>15%) mixed broadleaved forest
110	Mosaic Forest/Shrubland (50-70%) / Vegetation (grassland, shrubland, forest)
120	Mosaic Grassland (50-70%) / Forest
130	Closed to open (>15%) shrubland
140	Closed to open (>15%) grassland
150	Sparse (>15%) vegetation (woody savannas, grasslands)
160	Closed (>40%) broadleaved forest
170	Closed (>40%) broadleaved forest regularly flooded - Saline water
180	Closed to open (>15%) vegetation regularly flooded or waterlogged
190	Artificial surfaces and associated areas
200	Bare areas
210	Water bodies
220	Permanent snow and ice

GLC Global Class (according to LCCS terminology)	
1.	Tree Cover, broadleaved, evergreen <i>LCCS &gt;15% tree cover, tree height &gt;3m</i> (Examples of sub-classes at regional level* : <i>closed &gt; 40% tree cover; open 15-40% tree cover</i> )
2.	Tree Cover, broadleaved, deciduous, closed
3.	Tree Cover, broadleaved, deciduous, open ( <i>open 15-40% tree cover</i> )
4.	Tree Cover, needle-leaved, evergreen
5.	Tree Cover, needle-leaved, deciduous
6.	Tree Cover, mixed leaf type
7.	Tree Cover, regularly flooded, fresh water (& saline water)

Value	Description
1	Evergreen Needleleaf Forest
2	Evergreen Broadleaf Forest
3	Deciduous Needleleaf Forest
4	Deciduous Broadleaf Forest
5	Mixed Forest
6	Closed Shrublands
7	Open Shrublands
8	Woody Savannas
9	Savannas
10	Grasslands
11	Permanent Wetlands
12	Croplands
13	Urban and Built-Up
14	Cropland/Natural Vegetation Mosaic
15	Snow and Ice
16	Barren or Sparsely Vegetated
17	Water Bodies

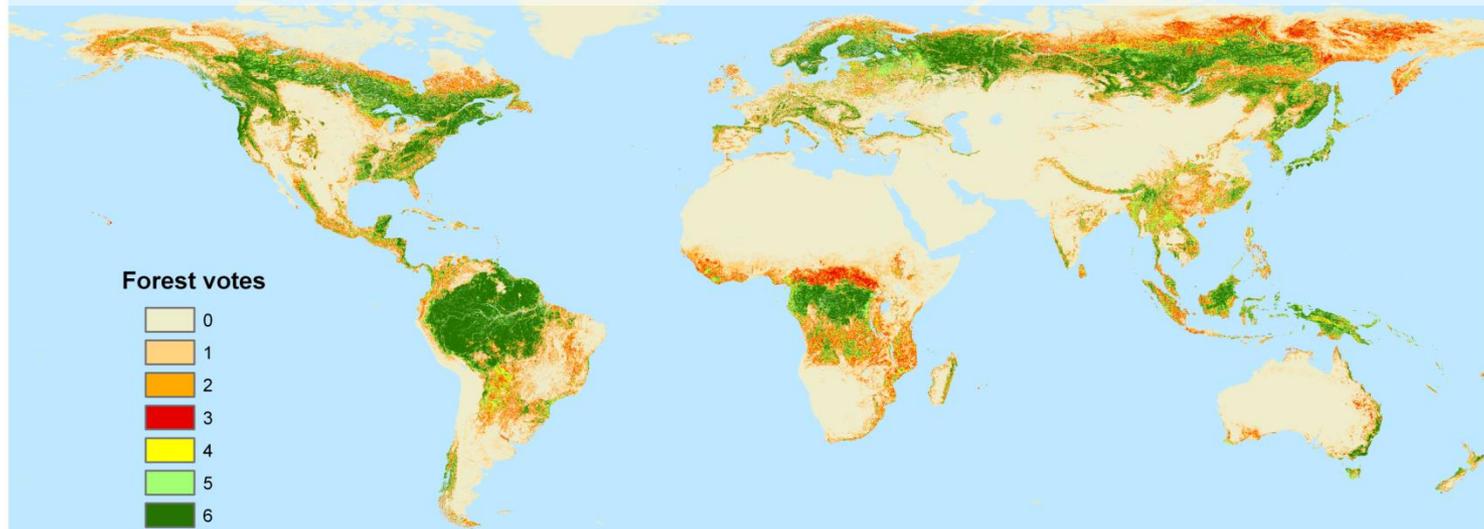
  

20.	Water Bodies (natural & artificial)
21.	Snow and Ice (natural & artificial)
22.	Artificial surfaces and associated areas

Label
Water
Evergreen Needleleaf Forest
Evergreen Broadleaf Forest
Deciduous Needleleaf Forest
Deciduous Broadleaf Forest
Mixed Forest
Woodland
Wooded Grassland
Closed Shrubland
Open Shrubland
Grassland
Cropland
Bare Ground
Urban and Built

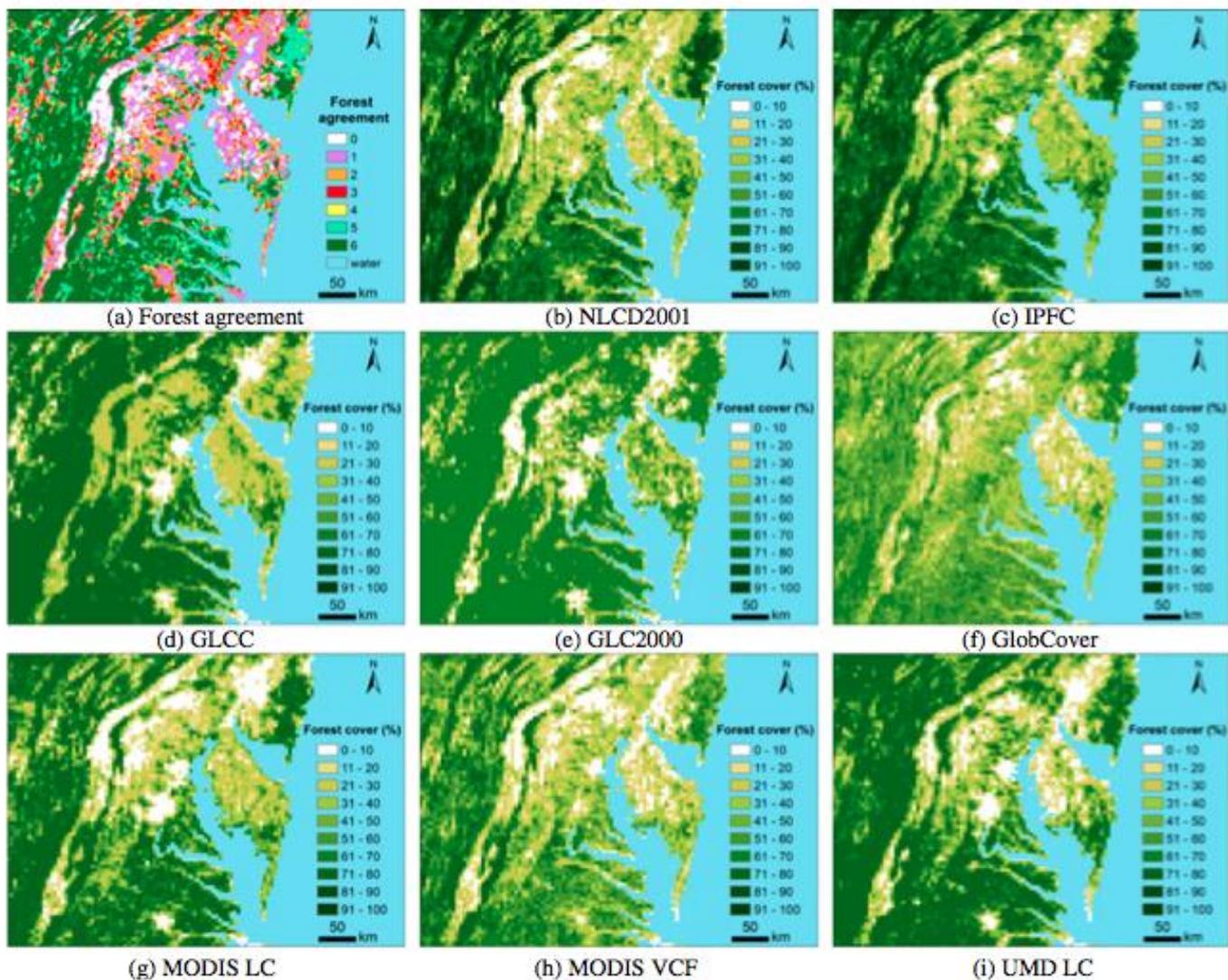
# Land Cover Land Use Change Products

*Agreement and disagreement between six satellite-based global land cover maps*



Product	Sensor	Date	Resolution	Classification approach	Publication
GLCC	AVHRR	Apr. 1992 – Mar. 1993	1-km	Clustering – labeling	(Loveland et al., 2000)
GLC2000	SPOT-4	Nov. 1999 – Dec. 2000	1-km	Depends on individual region	(Bartholome and Belward, 2005)
GlobCover	MERIS	Dec. 2004 – Jun. 2006	300-m	Supervised and unsupervised	(Bicheron et al., 2008)
MODIS LC	MODIS	Oct. 2000 – Oct. 2001	1-km	Decision tree	(Friedl et al., 2002)
MODIS VCF	MODIS	Oct. 2000 – Dec. 2001	500-m	Regression tree	(Hansen et al., 2003)
UMD LC	AVHRR	Apr. 1992 – Mar. 1993	1-km	Decision tree	(Hansen et al., 2000)

# Land Cover Land Use Change Products



# Land Cover Land Use Change Products

## **Global Finer Resolution:**

- Landsat Tree Cover Continuous Fields (VCF)
- Global Forest Change
- Finer Resolution Observation and Monitoring of Global Land Cover (FROM-GLC)

# Land Cover Land Use Change Trajectories

## **Global Products:**

- Harmonization of Land-Use Scenarios for period 1500–2100
- Millennium Ecosystem Assessment (MEA).

# Land Cover Land Use Change Products: National Level

## Remote sensing-based:

- **Enhanced Historical Land-Use and Land-Cover Data Sets**
  - Historical LCLU vector maps (mid-1970s)
  - Manually delineated from aerial photography
- **USGS Land Cover Trends**
  - Land cover change between 1973 and 2000
  - Manual interpretation of Landsat imagery
  - 30 ecological regions

# Land Cover Land Use Change Products: National Level

- **National Land Cover Database (NLCD)**
  - Gridded 30 m spatial resolution LCLUC products
  - 20(16)-class land cover classification scheme
  - Five year updates (2001, 2006, 2011)
- **LandFire**
  - Inputs for National Fire Plan
  - 20 gridded layers at 30 m
  - Vegetation, fuel accumulation, disturbances, vegetation dynamics...
- **NASS-Cropland Data Layer**
  - Crop-specific, land cover map updated annually
  - Medium resolution satellite imagery

# Land Cover Land Use Change Products: National Level

- **National Biomass and Carbon Dataset for the year 2000**
  - Year 2000 baseline (30 m),
  - Basal area-weighted canopy height, aboveground live dry biomass, and standing carbon stock
  - InSAR (SRTM) and Landsat ETM+
- **USDA-USFS Forest Biomass**
  - Gridded map at 250 m spatial resolution
  - FIA sample plots, DEM, MODIS and Landsat climate data
- **U.S. General Soil Map (STATSGO2)**
  - Soil survey maps, geology, topography, vegetation, climate and Landsat images
  - Soil vector maps (scale 1:250,000) (scale 1:1,000,000 for Alaska )

# Land Cover Land Use Change Products: National Level

## Surveys & Geodatabases:

- **USDA National Resource Inventory (NRI)**
  - Field survey at county level (on non-Federal lands)
  - Status, condition, and trends of land, soil, water, and related resources
  - Stratified, two-stage, area-sampling scheme
  - Every 5 years since 1982; annually since 2000
- **USFS - Forest Inventory and Analysis (FIA) Program**
  - Status, trends, and sustainability of forests
  - Initiated in 1930
  - Continuous two-stage survey and annual report system
  - One sample location plot every 6,000 acres

# Land Cover Land Use Change Products: National Level

- **Census of Agriculture**

- Survey of all U.S. farms
- Updated every five years
- County level vector maps
- Information about land use, ownership, operator characteristics, production practices, income and expenditures

- **Agricultural Resource Management Survey**

- Survey of U.S. farms
- Updated annually
- Production practices: chemicals and seeds, equipment, previous crops, highly erodible land, irrigation, and pest, nutrient, and crop residue management practices

# Land Cover Land Use Change Products: National Level

- **USFS-Automated Lands Program (ALP) Land Status Record System Data (LSRS)**
  - National Forest System (NFS) lands
  - Vector data layers (25)
  - Land status (title, rights and uses) and boundary management
- **Atlas of Rural and Small-Town America**
  - County level vector maps of 60 indicators
  - Four categories:
    - Demographics
    - Economic data
    - Agriculture
    - County classifications

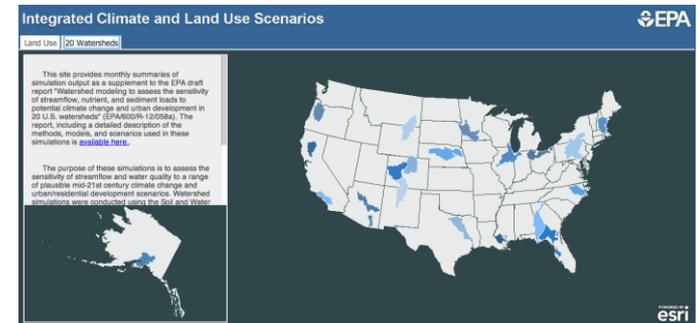
# Land Cover Land Use Change Products: National Level

- **Biomass Resource Availability in the United States (The National Renewable Energy laboratory)**
  - Compiles information from several Agencies
  - County-level vector maps at national level
  - Biomass feedstock resources available in the United States in 2005
  
- **SSURGO database**
  - Soil properties collected over a century
  - Field surveys and laboratory analysis
  - Vector maps

# Land Cover Land Use Change Trajectories

## A. Integrated Climate and Land Use Scenarios (ICLUS)

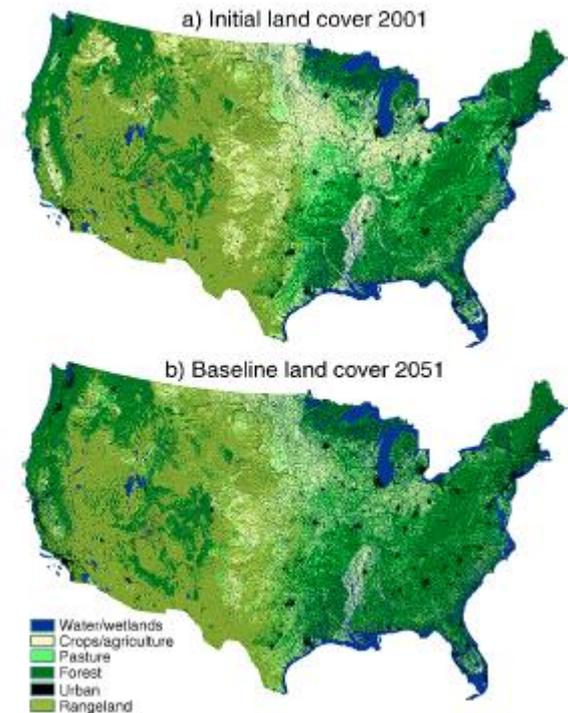
- Downscaled socioeconomic and land use scenarios consistent with IPCC-SRES
- Decadal land-use change scenarios from 2000 to 2100
- Population-growth model
- Gravity model (domestic migration)
- Explicit Regional Growth Model (SERGoM)
- County-level housing-density changes (CONUS)
- Impervious surface cover (selected watersheds)



# Land Cover Land Use Change Trajectories

## B. SILVIS Lab (University of Wisconsin - Madison)

- Four scenarios consistent with IPCC-SRES
- Econometric model of land-use change parameterized with NRI (1992 to 1997) and NLCD (2001) land cover information
- Future land use (year 2051), CONUS
- Five land-use classes (cropland, pasture, range, forest, and urban) at a fine spatial scale



# Land Cover Land Use Change Trajectories

## c. USGS Scenarios of land use and land cover change

- Downscale IPCC-SRES to national/regional scale
- FORE-SCE model spatially allocated land changes.
- Decadal estimates from 1970 to 2100 (CONUS)
- LCLU projections at 250-meter grid cells (complete suite of land-cover types)

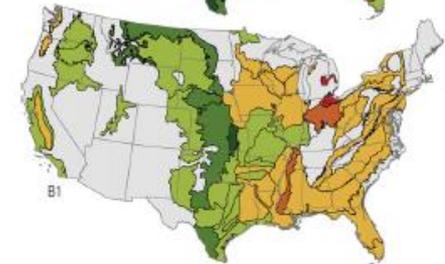
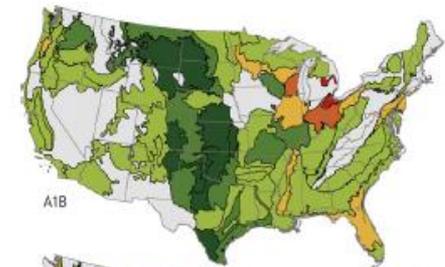
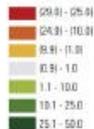
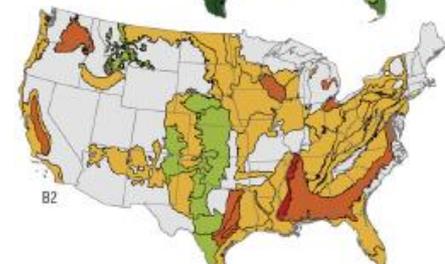


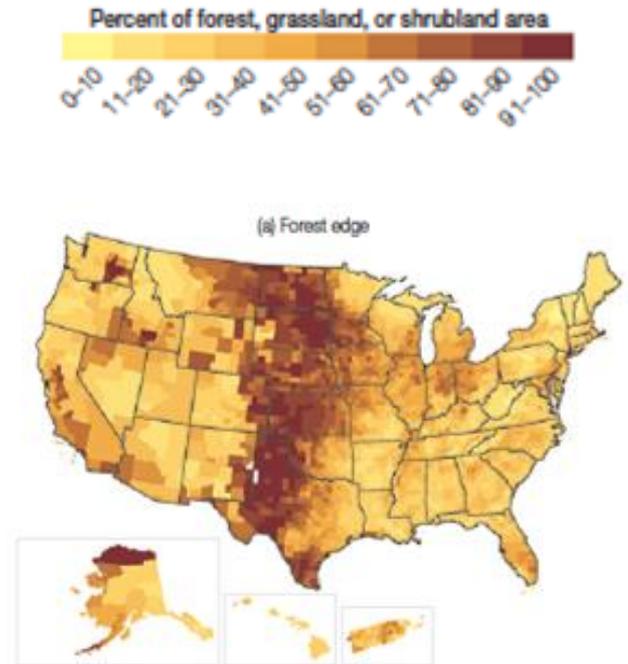
Fig. 9. Distribution of change in agricultural land use (2000)



# Land Cover Land Use Change Trajectories

## D. USFS Renewable Resources Planning Act Assessment

- Future scenarios downscaled from IPCC SRES
- 50 years into the future.
- Set of econometric models fit to historical data
- Separate models tuned separately for each (South, North, Rockies, and Pacific).
- County-level LCLUC trajectories for four classes forest, crops, range, and pasture
- Forecast urbanization in response to the population and economic projections.



*Future of America's Forests and Rangelands: Forest Service 2010 Resources Planning Act Assessment*

# Land Cover vs. Land Use & Land Management

## A. More sensors & sensor integration

- PROBA-V, Sentinel-3
- Landsat 8, DMC, Sentinel-2
- Nano satellites

## B. Time series (exploit temporal patterns)

- Statistical models / Data assimilation techniques
- Object-based image processing

## C. Growing historic archive (Landsat 1972)

# Land Cover vs. Land Use & Land Management

- D. Increasing use of LiDAR
  - 3-D information (biomass, land management)
  - State level vs. National level
  
- E. Hyperspectral (e.g. HyspIRI)
  
- F. Combine Data Sources:
  - Field information (e.g. FIA)
  - Socioeconomic information
  - Crowd mapping (e.g. GeoWiki Project)