Changes in population and agricultural land in conterminous United States counties, 1790 to 1997

Pamela J. Waisanen
U.S. Geological Survey EROS Data Center, Sioux Falls, South Dakota, USA

Norman B. Bliss
U.S. Geological Survey EROS Data Center, SAIC, Sioux Falls, South Dakota, USA

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[1] We have developed a data set of changes in population and agricultural land for the conterminous United States at the county level, resulting in more spatial detail than in previously available compilations. The purpose was to provide data on the timing of land conversion as an input to dynamic models of the carbon cycle, although a wide variety of applications exist for the physical, biological, and social sciences. The spatial data represent the appropriate county boundaries for each census year between 1790 and 1997, and the census attributes are attached to the appropriate spatial region. The resulting time series and maps show the history of population (1790–1990) and the history of agricultural development (1850–1997). The patterns of agricultural development reflect the influences of climate, soil productivity, increases in population size, variations in the general economy, and technological changes in the energy, transportation, and agricultural sectors. *INDEX TERMS:* 1615 Global Change: Biogeochemical processes (4805); 1699 Global Change: General or miscellaneous; 1815 Hydrology: Erosion and sedimentation; 9350 Information Related to Geographic Region: North America; *KEYWORDS:* land-use change, historical cropland, population change, county, conterminous United States

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1. Introduction

[2] The conversion of forests and grasslands for agricultural uses has stimulated the release of carbon from soils to the atmosphere. Subsequent abandonment of cropland, allowing it to revert to forest or grassland, may enhance the sequestration of carbon in the soil. A detailed understanding of the effects of land conversion on carbon sequestration is needed to understand the historical pattern of human influences on the global carbon cycle. A more complete understanding of the global carbon budget, based on an understanding of the physical, biological, and human processes that are involved, is essential for developing appropriate carbon management strategies and policies. One way to achieve greater precision is to perform analyses of land conversion that cover large areas with smaller spatial units and incorporate data at additional points in time.

[3] The data set presented in this paper shows changes in population and agricultural land for the conterminous United States at the county level. Previous compilations were based on state-level data and have less spatial detail. There have been many changes in county boundaries through time, and we attached census statistics to the appropriate county boundaries for each census year. We focused on data for population and area of cropland because they are most relevant to our study of the impact of land conversion on the carbon cycle. The land-use patterns reflected in these data should be useful to physical and biological scientists. The database linkages may be useful to social scientists who are interested in attaching additional socioeconomic data from the census to the spatial framework.

[4] A disturbance of the soil such as plowing, breaks up the original soil structure, exposes the soil to oxygen, and causes a decrease in the organic carbon content of the soil. Decreases of 20 to 40% of the soil organic carbon may occur following cultivation, with most of the decrease occurring in the first 20 years [*Davidson and Ackerman*, 1993; *Harden et al.*, 1999]. The rapid decreases in soil carbon were most likely due to poor agricultural practices that did not maintain soil fertility and did not prevent erosion. When the consequences of poor agricultural practices became evident, farmers began to retain plant residue, use fertilizers, and prevent erosion. In some areas, these improved practices have maintained the inputs from net primary production at high enough levels to allow some recovery of soil carbon on agricultural lands. A complete model of the impacts of land conversion on soil carbon will require information from field studies of historical trends of soil organic carbon.

[5] To get a full understanding of the influence of these changes on levels of atmospheric carbon dioxide, it is also necessary to have an understanding of the spatial extent of the land in cropland. The data set presented here provides a new level of spatial detail for the history of agricultural land use in the conterminous United States. Taken together, the field-based process studies that give site-specific histories of the amounts of soil carbon and the spatial databases that show the timing of conversion to cropland will allow detailed modeling of the influences of land-use change on atmospheric CO_2. This will contribute to the requirement identified by the *National Research Council Committee on Global Change Research* [1999], which stated, "An historical record from the beginning of the industrial era is needed to assess the effects of land-use change on climate and the carbon cycle."

[6] Recent estimates of the global carbon budget show that terrestrial ecosystems appear to have been a net source of CO_2 to the atmosphere during the period from 1850 to 1998. Approximately 270 (±30) Pg C was released to the atmosphere from fossil fuel burning and cement production, and 136 (±55) Pg C was released from land-use change, primarily deforestation. The atmosphere retained 176 (±10) Pg C, which is about 43% of total emissions. The 230 (±60) Pg C removed from the atmosphere is estimated to be evenly split between the oceans and terrestrial ecosystems [*Watson et al.*, 2000]. Over the period, terrestrial systems released approximately 21 Pg C (= 136 − 230/2) more than they absorbed.

[7] Several databases have been developed that are useful for analyzing relationships between land-cover change and the global carbon cycle. Previous work in constructing land-use histories for global change studies [*Houghton and Hackler*, 2000b; *Ramankutty and Foley*, 1999; *Klein Goldewijk*, 2001] have used state-level data sources. The county-level data set presented in this paper provides a capability for more detailed analysis than is possible using state-level data.

[8] *Houghton and Hackler* [2000a] estimated carbon stocks and fluxes, including analysis of cropland change, for nine continental-scale regions. *Houghton and Hackler* [2000b] have also used a cohort model to evaluate carbon uptake and release from agriculture and forestry in the conterminous United States. The model calculated the total flux between 1700 and 1990 as a release of 32.6 Pg C, of which they attributed 29 Pg C to a decrease in the area of forests and woodlands. Their analysis of CO_2 fluxes due to land-use change was sensitive to the level of spatial disaggregation, and they were more confident in their results when they used seven regions rather than considering the entire United States as one region. They concluded that knowing the spatial distribution of historical land-use change is important for extrapolating the results of site-specific CO_2 measurements to larger regions.

[9] *Ramankutty and Foley* [1999] reconstructed a cropland history of the world from 1700 to 1992, creating a data set with a spatial resolution of 5 min of latitude and longitude. They also modeled areas of grasslands and abandoned lands. For the United States portion, they used state-level census data on improved farmland and cropland starting in 1850. They used a 1992 land-cover classification derived from remotely sensed sources, as well as a data set of potential vegetation to represent conditions prior to human settlement. They used a simple land-cover change model to extrapolate backwards from the 1992 land cover to the potential vegetation, constrained by the historical crop data for each political unit. For the United States, they made adjustments for the change in definition between plowable pasture and cropland used for pasture by applying ratios computed from data in the 1940s back through time to 1850. The effect was to develop a smoothed time series with a definition of total cropland that included a component for "cropland used for pasture," rather than the more broadly defined "plowable pasture" category.

[10] The History Database of the Global Environment (HYDE, version 2.0) includes historical cropland maps, represented on a grid with a resolution of 0.5° longitude and latitude [*Klein Goldewijk*, 2001]. The maps were formed by allocating national and subnational cropland and pastureland statistics to the grid using global data sets of historical population and land cover. The methods use different data sets for current and historical land cover than used by *Ramankutty and Foley* [1999], and the allocation from political units to grid cells is based on population rather than land cover. For the United States portion, the state-level historical cropland statistics were obtained by personal communication from Ramankutty. *Klein Goldewijk* [2001] recognized some of the limitations of using population data as a basis for allocating land-use statistics from political units onto a uniform grid and concluded with a comment that the scientific community "could clearly benefit from the translation of more historical statistical information into a digital (spatial) format."

[11] The work reported in this paper was undertaken as a part of the U.S. Geological Survey's (USGS) Mississippi Basin Carbon Project (MBCP). The focus of the MBCP is to investigate the impacts of erosion and sedimentation on the balance between carbon in the soil and in the atmosphere [*Sundquist et al.*, 1998; *Stallard*, 1998]. At a local site and in a specific time period, carbon sequestration occurs if there is a net storage of atmospheric carbon in the ecosystem, particularly the soil. Conversely, changes in land management may cause a release of soil carbon to the atmosphere. The carbon transfers are often in the form of carbon dioxide or methane, which are greenhouse gases, and thus relevant to the analysis of factors contributing to global climate change. Measurements and modeling being conducted in MBCP studies address the hypothesis that part of this reduction may be due to a direct transfer of CO_2 to the atmosphere as the soil carbon is oxidized by microbial processes, and another part may be moved by erosion and redeposited lower on the landscape. The environment in depositional areas may result in a lower rate of microbial respiration than would have occurred in the undisturbed ecosystem, so that the release rates to the atmosphere are not as large as would have occurred if erosion and deposition were ignored. If the hypothesis is correct, then previous estimates may have overestimated the contribution of land-use change to the buildup of carbon in the atmosphere.

[12] Carbon sequestration and release can only be calculated for defined periods in time. An adequate understand-

ing of the processes requires a historical view, in which a sequence of time periods is evaluated [*Sundquist*, 1993]. To evaluate the timing of land conversion into agriculture, we have brought together the census data and the related county-boundary data. Additional processing of the time series presented here will be needed to construct interpolations and extrapolations into more detailed categories of land disturbance. We will use the timing of land-use conversions as input to a model of ecosystem carbon dynamics that is able to account for erosion and deposition. The model is able to replicate the decline or recovery of soil carbon with land-use change and account for the impacts of soil erosion and deposition on the simulated carbon content of soil through time [S. Liu, personal communication, 2001]. The data on the timing of land conversion will contribute to modeling historic erosion rates; these erosion rates and land-use change can then be used as inputs to modeling historical carbon cycling.

[13] In the conterminous United States, a census of population has been taken every 10 years since 1790, and information on agricultural land use has been collected since 1850 at 10-year or 5-year intervals. The census statistics have been published for each county for these time periods. A county is a subdivision of a state, and the states subdivide the country. Land areas that were annexed often became territories before becoming states. The territory, state, and county boundaries changed through time as the country expanded and developed. Boundary changes were frequent in the early years, with shifts, mergers, and splits, but the boundaries became more stable about 1920. The mean area of a county in 1997 was 2534 km^2 and the median area was 1609 km^2, with counties east of the 100th meridian typically being smaller than those to the west. We have obtained digital data for the historical county boundaries and for the census attributes related to agricultural land areas. The data were edited for consistency with original sources, spatial data were linked to tabular data, and integrated data sets and maps were produced, resulting in a spatial-temporal database.

2. Data Sources

2.1. Spatial Data Sources

2.1.1. Louisiana State University Historic County Boundary Files

[14] Data on historic county boundaries were purchased from Louisiana State University (LSU) [*Earle and Cao*, 1991; *Earle and Heppen*, 1996] and loaded into a geographic information system. The level of accuracy was described as being ‘‘excellent at the national level and good at the regional level.’’ The LSU boundaries were used with census data for the years 1790–1930.

2.1.2. USGS County Boundary File

[15] A USGS county boundary data set (CTY2M hereafter) was used with census data from 1940 to 1997 [*National Atlas*, 1994]. The 1:2,000,000-scale USGS source was used in preference to the 1:100,000-scale USGS data set because it included a better definition of coastlines. The data include the Federal Information Processing Standards (FIPS) code, a five-digit state and county code that was first assigned in 1972. A FIPS code consists of a numeric state code (two digits) and county code (three digits).

2.2. Tabular Data Sources

2.2.1. ICPSR Data

[16] Data for the decades 1790 through 1960 were purchased from the *Inter-university Consortium for Political and Social Research* (*ICPSR*) [1999]. The county-level decadal data used from this source were as follows: 1790–1960, population by county; 1850–1930, numerous categories of agricultural area by county.

[17] This data set did not include population or agricultural area counts for areas that had not achieved statehood by the given census date, such as territories and Indian reservations. We coded these numbers when they were published by the census as tables, text, or footnotes.

2.2.2. Economic Research Service

[18] A data set with county agricultural land area for 1949, 1954, 1959, 1964, 1969, and 1974 was purchased from the National Archives [*Economic Research Service*, 1999].

2.2.3. Census of Agriculture and National Agriculture Statistical Service

[19] A time series with data for the years 1978, 1982, 1987, 1992, and 1997 is available digitally on CD-ROM. For the years 1978 to 1992, the data were published by the *Bureau of the Census* [*U.S. Census*, 1991, 1995, 1999], and starting in 1997 by the *U.S. Department of Agriculture*, *National Agricultural Statistics Service* (*USDA*) [1999]. Data for the previous years in the time series are often included in the later releases. Because corrections may be included, we used the most recent source possible in preference to the original year of publication.

2.2.4. Other

[20] Digital data were not available for the years 1925, 1935, 1940, and 1945. We keyed several categories of cropland data for 1940 and 1945 from census volumes [*U.S. Census*, 1946]. We keyed three pasture variables for 1930 [*U.S. Census*, 1932a]. Population data for 1970, 1980, and 1990 were extracted from a commercial source [*GeoLytics, Inc.*, 1999].

3. Methods

3.1. Spatial Data

3.1.1. Editing the LSU Data

[21] The data were processed using the Arc/Info geographic information system software [*ESRI*, 2000]. We developed a routine in the Arc/Edit subsystem that made it possible to load the LSU files into Arc/Info. For each decade, the files of county-level data for each state were joined into a single spatial data set for the conterminous United States. Boundary discrepancies, such as overlaps and undershoots, were eliminated by selecting a single arc to represent the boundary. For the decades 1790 through 1840, boundary discrepancies of less than 5 km^2 were resolved. With the addition of the larger counties in the west after 1840, discrepancies of less than 49 km^2 were resolved. Tests were run for label errors and topology errors, such as unclosed polygons.

[22] The LSU files contain state and county names. The county names are not unique. For instance, in 1880, 30 states had a county named Washington. A unique identifier was formed with the state abbreviation and county name fields appended together, all uppercase (for example, ALWASHINGTON, ARWASHINGTON).

3.1.2. Editing the Modern County Boundary Data

[23] Most of the county boundary changes occurred before 1930, but a few counties dissolved, split, or changed after that date. The FIPS code was used as the primary identifier for relating the spatial data to the census data. Details of changes between 1949 and 1997 are given in Appendix A.

3.1.3. Other Issues

[24] The census data for Virginia cities and Washington, D. C. are sometimes lumped into the surrounding counties. The appropriate edits were made to the LSU and CTY2M data sets for each decade or 5-year interval.

[25] There can be multiple spatial polygons for each county, often owing to islands. For each time period, geographic information system tools were used to build a new relational table, called a region table, with only one record per county. The census data were attached to the region table. For making maps, the population or farmland was assumed to be uniformly distributed across a county.

3.2. Tabular Data

[26] Population and agricultural data from the three sources were extracted from the source files and loaded into Arc/Info. State abbreviations were appended to county names to make a unique identifier for matching with the spatial data.

3.2.1. ICPSR Data

[27] The ICPSR data set sometimes used compound historical names, such as Orange/Mosquito County in Florida, which was simply Orange County in the census volumes. A new data field was defined to contain the name of the county as given in the original census volumes.

3.2.2. Economic Research Service

[28] The Economic Research Service data were in a single file for the intervals from 1949 to 1974 [*Economic Research Service*, 1999]. The data were extracted and loaded into Arc/Info using an array structure. In a data recovery at the National Archives, 225 records had been lost. Comparison with the ICPSR agricultural data showed that only data for Clarke County, Alabama (FIPS code 01025), were missing, and we keyed these data from original census volumes [*U.S. Census*, 1952, 1956, 1960a, 1965, 1972, 1975].

3.2.3. Census of Agriculture

[29] Data for 1978 and 1982 were extracted from a Census of Agriculture CD-ROM [*U.S. Census*, 1991]. This CD-ROM contained preliminary data for 1987, which we did not use. Data for 1987, 1992, and 1997 were extracted from a National Agricultural Statistics Service CD-ROM [*USDA*, 1999]. In some cases, county data were not published if they would have disclosed information on the operations of an individual farm.

3.2.4. Definitional Changes

[30] Up through 1920, the "improved land in farms" category defined a consistent time series. In 1925 and later years, the term improved land in farms was no longer used and the term "cropland" was introduced. The category "total cropland" included the subcategories of harvested cropland, crop failure, idle cropland, cropland in summer fallow, and plowable pasture. We use the term "improved farmland" to refer to the combined time series of improved land in farms and total cropland.

[31] The term plowable pasture was used through 1940, and then the term "cropland used for pasture" was used. A footnote to a table for the 1945 census [*U.S. Census*, 1947] describes the change: "The 1940 figures are not strictly comparable with those for 1945. The 1945 figures include land used only for pasture, which has been plowed within 7 years. The 1940 figures include land pastured, which could have been plowed and used for crops without additional clearing, drainage, or irrigation. This land may not have been plowed within 7 years prior to 1940."

[32] A recent report from the *Economic Research Service* [*USDA*, 2000] notes, "Cropland pasture and permanent grassland pasture have not always been clearly distinguished in agricultural surveys." Differences in definitions used by the census over time and geographic boundary changes that may influence the interpretation of the maps are given in Appendix B. Many of the details of boundary changes were based on the descriptions by *Thorndale and Dollarhide* [1997].

3.3. Matching Tabular Data and Maps

[33] The tabular data from census sources were matched with the spatial data using the common identifier, consisting of the state abbreviation and county name in the earlier years, or the FIPS code in the later years. Fields for the common identifier were added to both the census and the spatial sources. There were often discrepancies in the county names between the spatial and tabular data sources, requiring us to develop iterative procedures to match the data sets with each other. Discrepancies were resolved by using the names in the original census documents. Problems in the matching process sometimes identified the need for additions or deletions of boundary lines in the spatial data.

[34] The LSU delineations were used for the decades 1790–1930. The population data for 1940 and 1950 were also linked to the LSU spatial data. The agricultural data for 1940 to the present and population data for 1960 to the present were linked to the CTY2M spatial data using the FIPS code.

[35] The printed census volumes were considered the primary authority for tabular data. The primary authority for many edits to the spatial data was the map guide to the federal censuses, 1790–1920 [*Thorndale and Dollarhide*, 1997].

[36] The match of the spatial data to the tabular data was tested from both directions. When records did not match, some problems were identified beyond issues of spelling. Census data sets sometimes include separate statistics for independent cities, such as Virginia cities, Washington, D. C., and Baltimore. When separate data for cities were present in the census data, delineations for the cities were included in the spatial data for that decade. If separate data for cities were not provided because the counts were

Table 1. Population, Area of Improved Farmland, and Verification Proportion of Improved Farmland[a]

Year: Population Census	Population[b]	Year: Agricultural Census[c]	Improved Farmland[b], km^2	Verification Proportion[d]
1790	3,900,346			
1800	5,265,084			
1810	7,243,517			
1820	9,618,449			
1830	12,859,992			
1840	17,086,491			
1850	23,191,775	1850	457,395	0.99993
1860	31,396,557	1860	659,860	0.99966
1870	38,545,660	1870	764,661	1.00016
1880	50,122,248	1880	1,152,571	1.00012
1890	62,890,686	1890	1,447,521	1.00021
1900	75,997,808	1900	1,677,632	1.00013
1910	91,647,770	1910	1,936,205	0.99999
1920	105,273,049	1920	2,035,864	1.00000
1930	122,354,059	1930	2,114,051	1.00000
1940	130,962,661	1940	2,175,846	1.01421
		1945	1,823,502	0.99978
1950	149,877,932	1949	1,933,382	0.99981
		1954	1,859,856	0.99985
1960	177,922,144	1959	1,811,032	0.99987
		1964	1,755,478	0.99989
1970	198,318,284	1969	1,856,046	0.99998
		1974	1,778,514	0.99958
1980	221,685,733	1978	1,802,205	0.98195
		1982	1,770,817	0.98334
		1987	1,772,426	0.98874
1990	243,672,462	1992	1,731,185	0.98344
		1997	1,720,566	0.98701

[a]By census year, for the conterminous United States.
[b]The population and improved farmland values given here were summed from the county data.
[c]Agricultural land was not inventoried by the census prior to 1850.
[d]The verification proportion is the national total obtained by summing the county data, divided by the equivalent value from published national summaries. A value of 1.00000 is a perfect match.

included with the surrounding counties, the city boundaries were deleted.

[37] After the iterative matching process was completed, the census data were joined to the region table. Census enumerations that were reported in acres were converted to square meters. Ratios of the area of each land-use type, such as ‘‘improved land in farms’’ or ‘‘harvested cropland,’’ and population densities were calculated by dividing by the total area of a county. Although some census records provided a total area for a county, the area computed by the geographic information system was used as the basis for deriving ratios.

[38] Population and agricultural land density maps were created for each variable for each census date to provide a visual check on the matching process and the census numbers. Anomalies were traced and previous steps repeated as needed. If the land in farms for a county exceeded 120% of the county area, the boundary delineations were verified and re-digitized. If a discrepancy was not caused by digitizing, the acreage was verified.

[39] Farms on the edges of counties frequently overlap with one or more other counties. The Bureau of the Census counted all the acres of a farm or ranch in the county of its headquarters. In most areas of the country, the undercounts and overcounts recorded for a given county were most likely equivalent. However, there were extreme cases in which the area in farms exceeded the area of the county. A noticeable example occurs in Texas, where starting in 1900 there are more than 20 counties with large ranches that extend into adjacent counties. This condition also occurs in Grant County, Nebraska, starting in 1920. This agriculture and population database has not been tested for ‘‘undercounts,’’ which could only be done by proof-reading the data purchased from three sources. Blanks and zeros that seemed anomalous were verified with the census volumes.

4. Results

[40] The trend for population over time is given in Table 1 and mapped in Figure 1. Population has increased over the period of the study, with 10-year rates of increase of approximately 35% between 1790 and 1860, rates between 20 and 30% from 1860 to 1910, and rates between 7 and 19% from 1910 to 1990. The uses of land in the conterminous United States are shown in Figure 2. Only some of the data shown in Figure 2 are from the county-level time series; other data are from national summaries. The time series of total land in farms in Figure 2 shows a peak in 1949, followed by a decline. The total area in farmland may be sensitive to definitional changes relating to the inclusion of woodlands and rangeland. Specifically, federal land that is used for grazing by a permit is included in non-farm grazing land, and federal land that is under the control of an operator through a lease is included in ‘‘other pasture,’’ a part of ‘‘land in farms’’ [*U.S. Census*, 1943b].

[41] An indication of disturbance due to plowing, grazing, clearing, and other activities is provided by the record of improved farmland, as shown in Table 1 and Figure 2, as well as the sets of maps in Figures 3 and 4 and the regional analysis

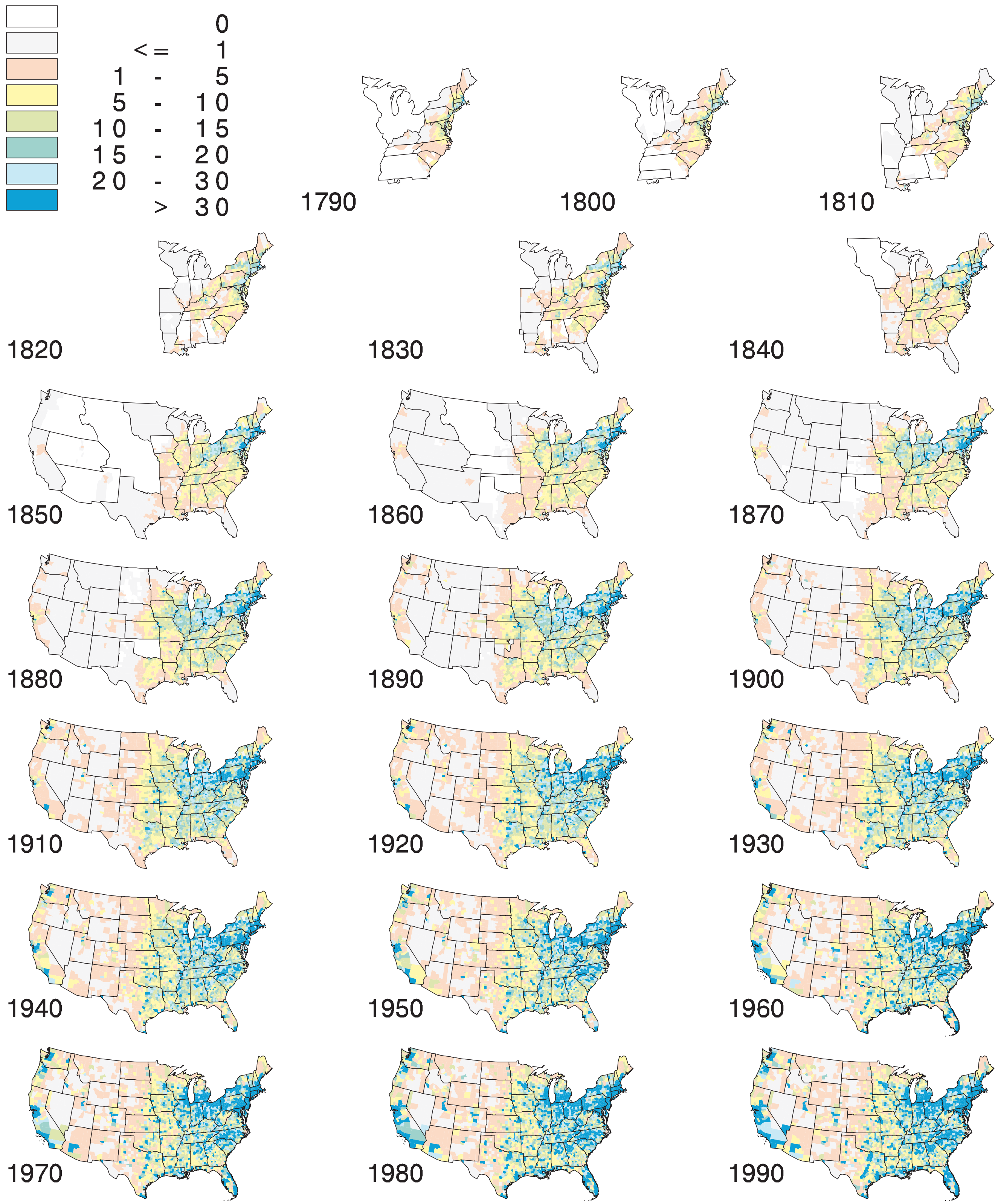

Figure 1. Maps of population density (people per square kilometer) by county, 1790 to 1997, for the conterminous United States.

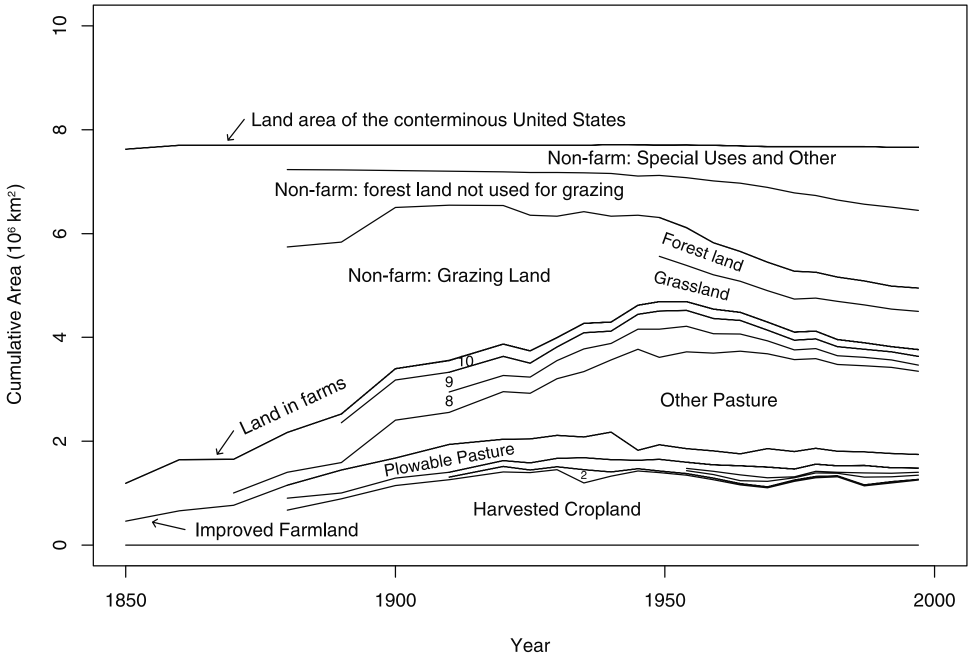

Figure 2. Patterns of land use in the conterminous United States, 1850 to 1997 (cumulative area, km^2). Improved farmland was recorded by the census from 1850 to 1920, and cropland was recorded from 1925 to 1997. Total land in farms has also been recorded since 1850. The categories shown, from bottom to top, are 1: harvested cropland; 2: crop failure; 3: cropland idle; 4: cropland in cover crops; 5: cropland in cultivated summer fallow; 6: plowable pasture (1940 and before) or cropland used for pasture (1945 and after); 7: other pasture; 8: farm woodland pastured; 9: farm woodland not pastured; 10: farm, special uses and other; 11: non-farm grazing on grassland; 12: non-farm grazing on forest land; 13: non-farm forest land not used for grazing; and 14: non-farm special uses and other. The line labeled "improved farmland" is the cumulation of categories 1 through 6 representing cropland and plowable pasture, and is illustrated in the maps in Figures 3 and 4. The line labeled "land in farms" is the cumulation of the first 10 categories, and "land area of the conterminous United States" represents the cumulation of all categories. Multiple U.S. Census sources were used, and not all data are represented by our county-level time series. The non-farm values were derived from *U.S. Census* [1989c] and *Economic Research Service* [*USDA*, 2000]. Some values are interpolated or computed by subtraction.

in Figure 5. Figure 3 shows the county-level detail for 1850. In Figure 4, the data are also at the county level, but county boundaries are not drawn. Areas of improved land, in farms (for 1920 and before) or total cropland (for years 1925 and after), by state for selected years, are given in Table 2.

4.1. Verification of the Time Series

[42] Additional census volumes were used to verify individual entries where there were apparent discrepancies [*U.S. Census*, 1791, 1802, 1811, 1821, 1832, 1841, 1853, 1854, 1864a, 1864b, 1872a, 1872b, 1872c, 1883, 1891, 1894a, 1894b, 1895, 1896, 1901, 1902, 1910, 1913a, 1913b, 1913c, 1913d, 1922, 1923, 1927, 1931, 1932a, 1932b, 1932c, 1932d, 1932e, 1936, 1942, 1943a, 1943b, 1946, 1952, 1956, 1960a, 1960b, 1965, 1972, 1973, 1975, 1981a, 1989d, 1996].

[43] The population, farmland, improved farmland, and cropland national totals summed from the spatial data set were compared with the published totals from the United States Census, and representative results are shown in Table 1. For census years between 1850 and 1920, the totals were compared with the totals given by *Dodd* [1993] for areas of improved farmland. The areas of total farmland were compared with a census volume [*U.S. Census*, 1989b] for census years between 1930 and 1969. The areas of total farmland and cropland were compared with census summary volumes for census years between 1974 and 1997 [*U.S. Census*, 1975, 1981b, 1989a, 1999]. During the years since 1978, the area of total cropland summed from the county data is less than the area reported in national totals by more than 1%. This difference may be due to the impact of disclosure rules, in which the census does not report county values that could identify individual farm operators. As farms become larger, more counties may be affected by these disclosure rules.

4.2. Regional Trends

[44] Figure 5 shows the improved farmland or cropland time series for the conterminous United States and for three subregions, chosen to capture regional differences in the timing and intensity of agricultural development. The subregions were defined for the Northeast, the Southeast, and the Midwest-Great Plains, as shown in the inset map in Figure 5. The trend shown in Figures 2

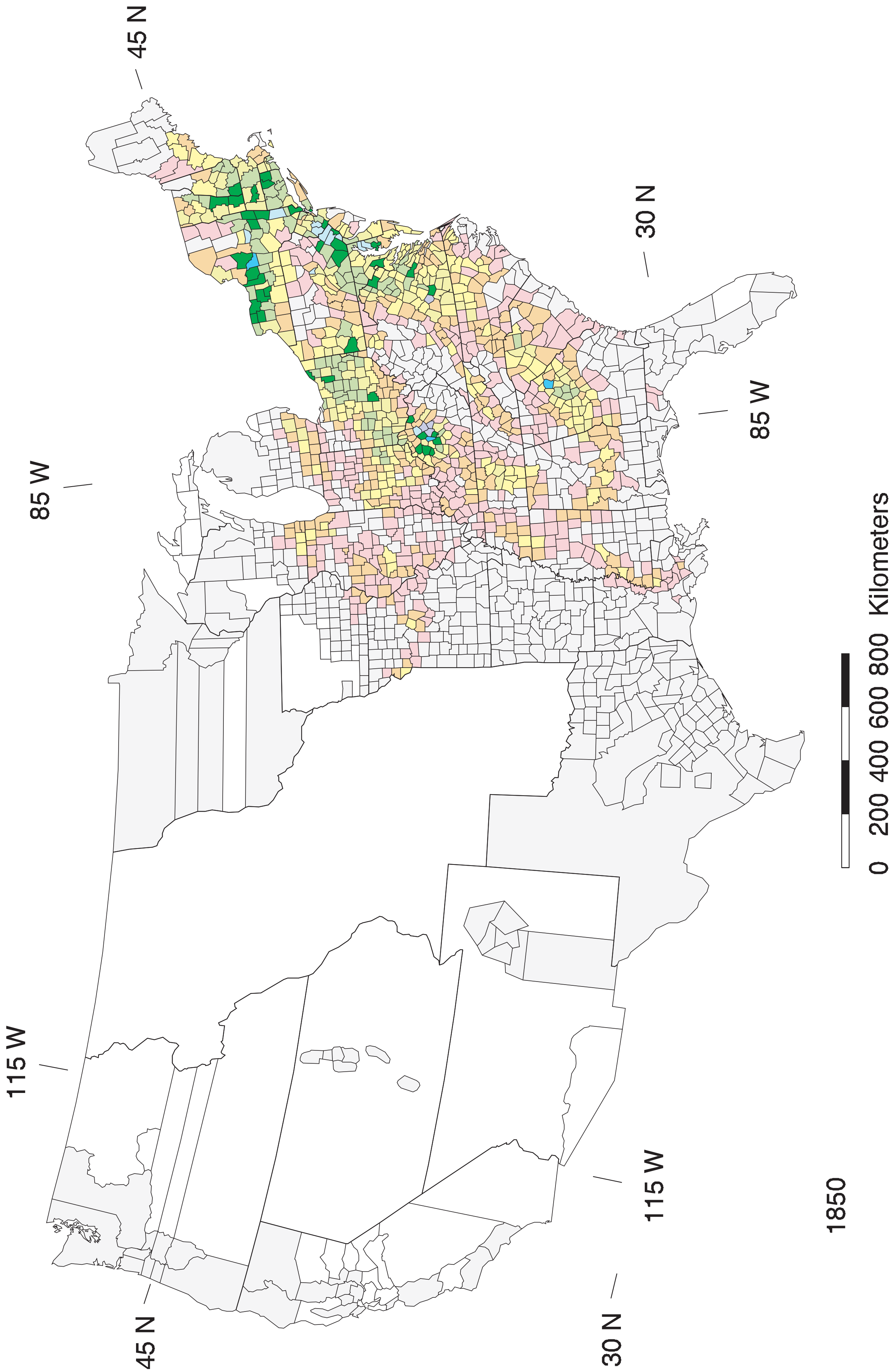

Figure 3. Map of the proportion of improved farmland by county, 1850, for the conterminous United States. See Figure 4 for the legend.

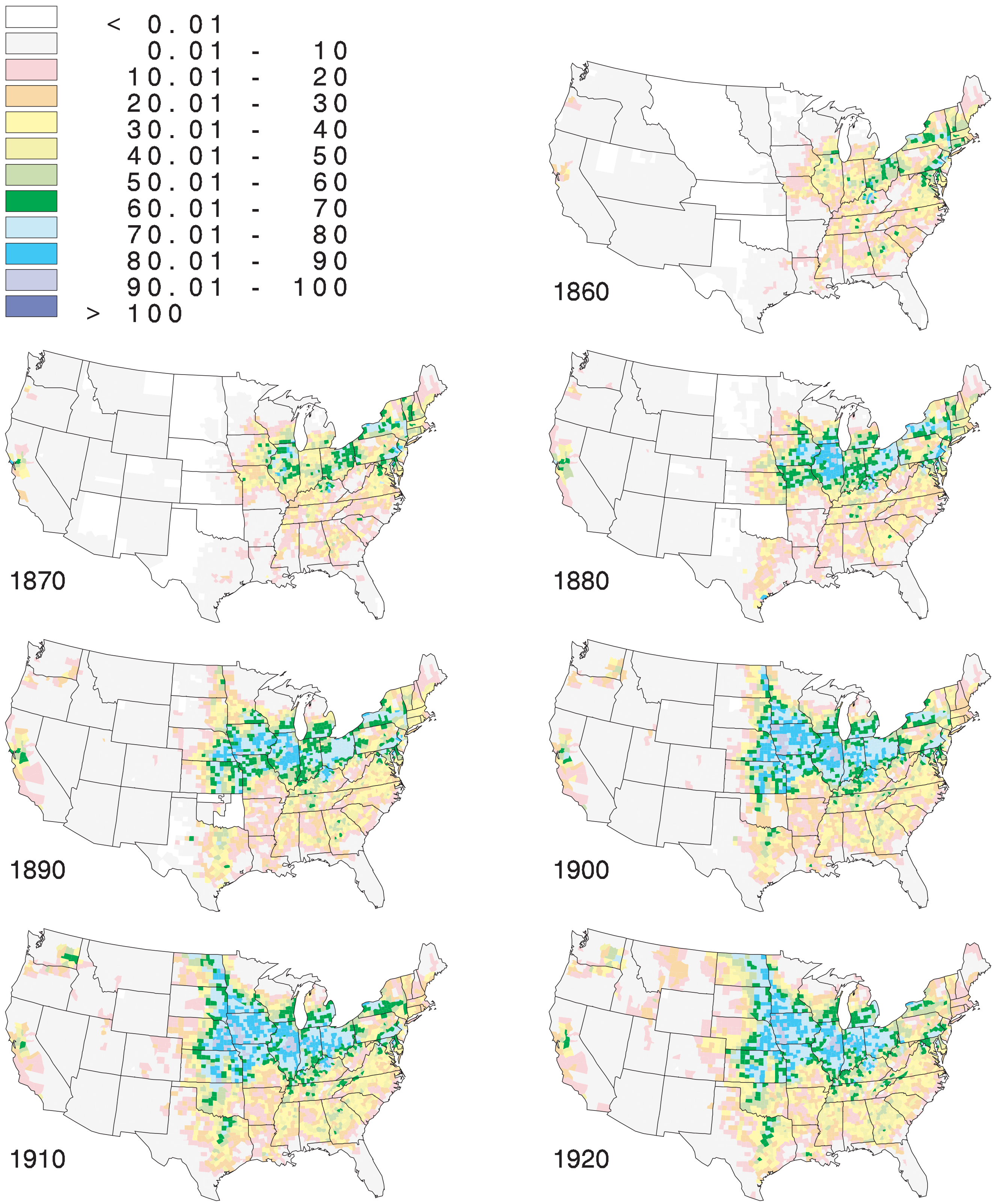

Figure 4. Maps of the proportion of improved farmland by county for census years 1860 to 1997 for the conterminous United States.

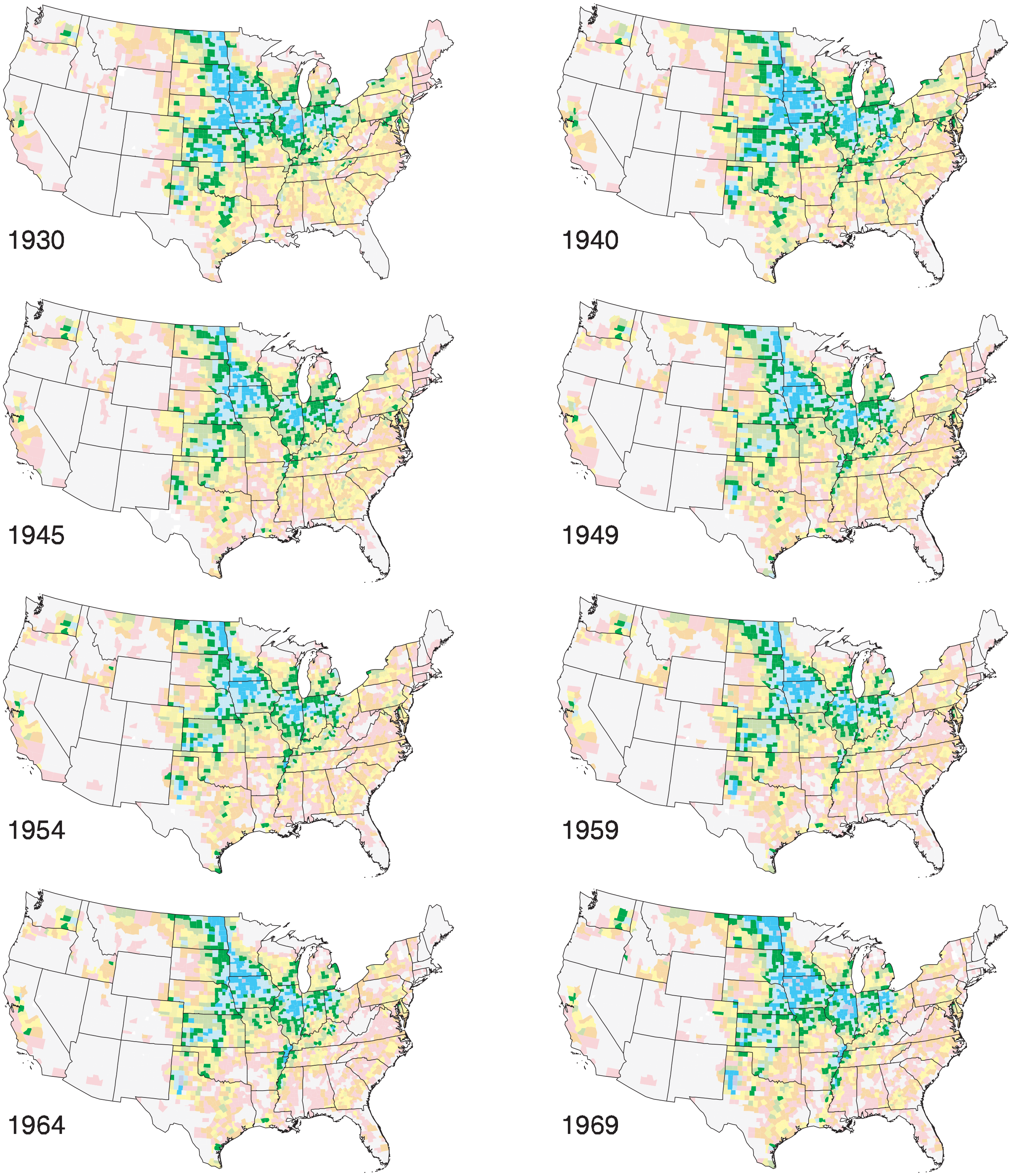

Figure 4. (continued)

and 5 for the conterminous United States generally illustrates an increase in improved farmland and cropland from 1850 to 1940 and then a slight decline through 1997. On a regional basis, the trend in the Northeast is a stronger increase until a peak in 1880, and then a stronger decline than in the other regions. The Southeast has a broad peak in the period from 1920 to 1940 and then also declines substantially. The increase in trend in the Midwest and

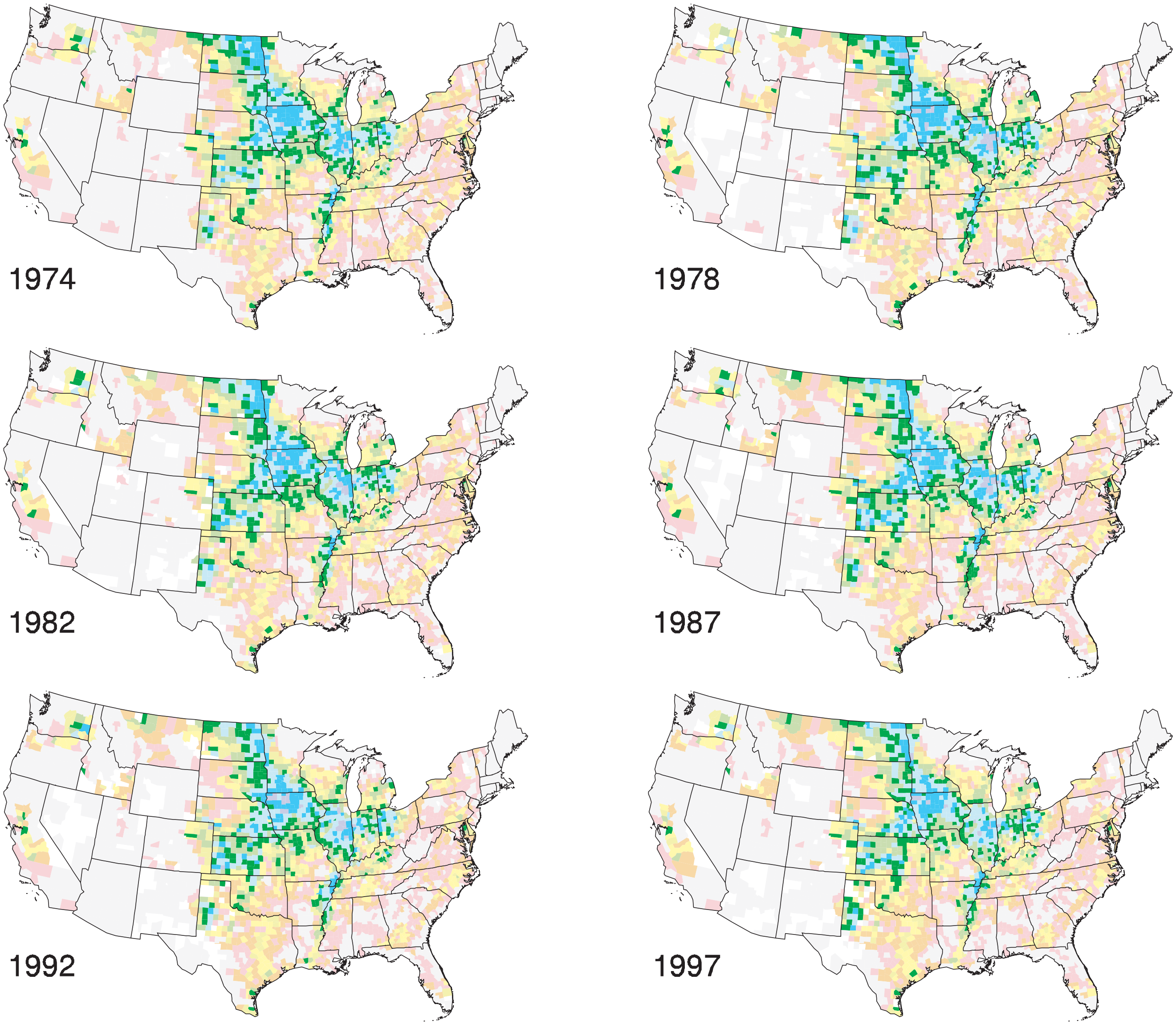

Figure 4. (continued)

Great Plains begins around 1850, peaks in 1940, and then has a slight decline.

4.3. Data Availability

[45] A time series for population and the combined time series for improved land in farms and cropland are available for download from the EROS Data Center. They have been spatially interpolated into the modern county boundaries. Some restrictions may apply to some of the original spatial and tabular data that would require users to obtain permissions from other sources.

5. Discussion

5.1. Economic and Technological Forces of Change

[46] The patterns of agricultural development and decline that are reflected in Figures 2–5 are the result of complex interactions between the capabilities of the land, climate, population growth and migration, energy sources, transportation, general economic conditions, agricultural technologies, and agricultural policy.

[47] A useful framework for grouping the driving forces is provided by *Borchert* [1967, 1991], who summarized major epochs as the Sail-Wagon Epoch (1790–1830), the Steamboat and Iron Horse Epoch (1830–1870), the Steel Rail Epoch (1870–1920), the Auto-Air-Cheap Oil Epoch (1920–1970), and the Satellite-Electronic-Jet Propulsion Epoch (1970 to the time of writing).

[48] The migration of Europeans into port cities and the diffusion of agriculture by conversion of Eastern forests to cropland were dominant in the early years. A forced migration of slaves from Africa also contributed to population growth and the expansion of plantation agriculture in the South. The Appalachian Mountains were generally unsuitable for agriculture and represented a physical barrier to western expansion. The development of canals and inland

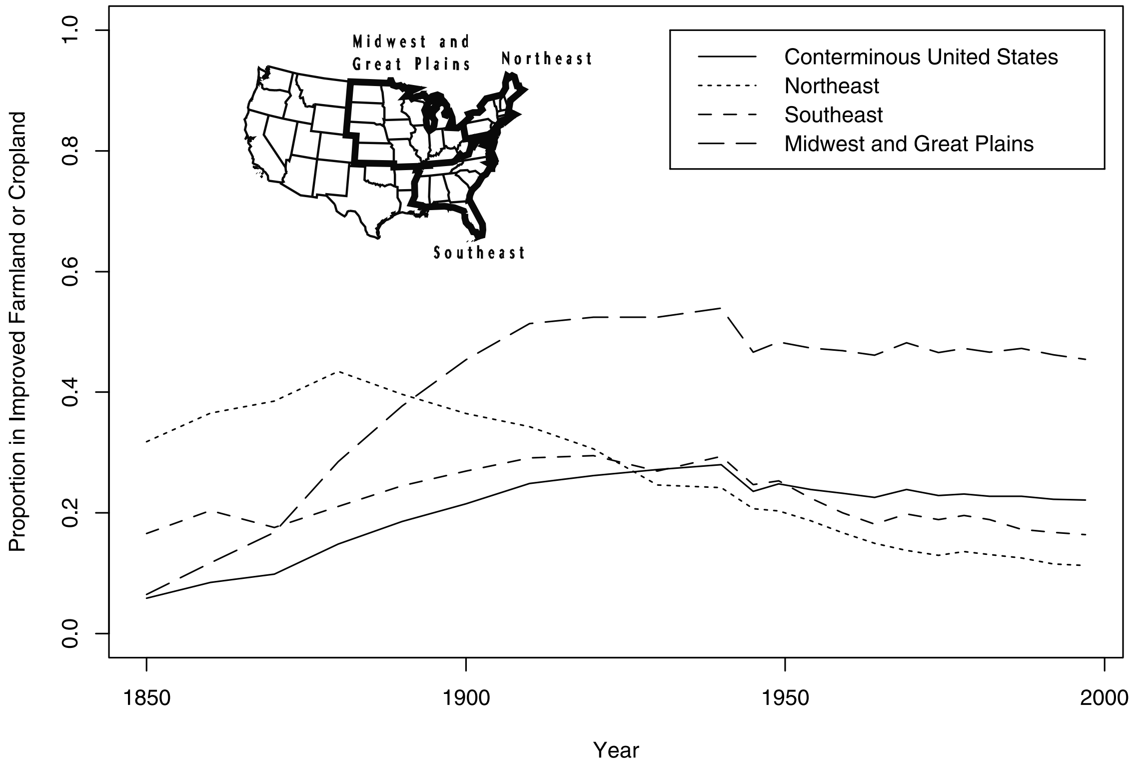

Figure 5. Proportion of improved farmland or cropland, 1850 to 1997, for the conterminous United States and three subregions.

waterways from 1810 through 1840 allowed farmlands developed west of the Appalachians to serve markets in the East, with steamboats becoming important after 1830 [*Meinig*, 1993]. Railroads began to surpass waterways for transport in the 1860s and railroad ton-miles peaked between 1885 and 1920, with a progression of fuels from wood to anthracite to bituminous coal [*Borchert*, 1967]. The proportion of improved farmland in the farm-dominated counties of the Northeast region peaked in 1880 (Figure 5) as the transportation system allowed the Eastern markets to be served by agriculture on the better soils of the Ohio Valley and areas west of the Appalachians [*Meyer*, 1987]. The development of tile drainage allowed wetland areas near the Great Lakes and in Iowa, Minnesota, and the Mississippi Delta to be cropped [*Dahl and Allord*, 1996; *Prince*, 1997]. The proportion of improved farmland in the Midwest and Great Plains reached a high level in 1910 and remained fairly steady through its peak in 1940, after which it stabilized with a slight decline through 1997 (Figure 5). Major droughts around 1860, 1890, and 1930, as well as pest infestations, influenced these patterns. The proportion of improved farmland or cropland developed more slowly in the Southeast compared to the nation as a whole, with a peak in 1920 being repeated in 1940, after which the proportion declined sharply (Figure 5). The boll weevil had decimated the cotton crop between 1909 and 1921, and erosion and nutrient withdrawal had depleted the soils [*Hart*, 1967]. Many of the southern croplands were abandoned following the disintegration of the post-bellum sharecropping system, and often later converted to plantations of trees [*Hart*, 1968, 1991; *Earle*, 1992; *Danbom*, 1995]. In the 20th century, motorized tractors, automobiles, rural electricity, and the development of federal highways influenced farming practices. Improvements in yields resulted from fertilization, pesticides, and crop genetics, guided by research funded by state and federal governments through the land grant universities [*Edmond*, 1978]. The federal government also attempted to stabilize economic cycles through controls on production linked to farm subsidies [*Schertz et al.*, 1980; *Hallberg*, 2001], provided agricultural agencies [*Lewis*, 1987], and stimulated the development of irrigation in the western states [*Meyer*, 1995]. Some variations in the time series may be due to other governmental policies, such as international agreements for foreign agricultural trade, embargoes restricting trade, and the introduction of the Conservation Reserve Program and Wetland Reserve Program.

5.2. Consistency of the Time Series

[49] Our primary purpose was to assess disturbances on the landscape that would affect the carbon content of soils. The most consistent time series from these data are the connected trends of improved farmland (1850–1920) and cropland (1925–1997). The patterns of the time series may be influenced by definition and terminology changes in the census data. For example, land in the plowable pasture category may have never been plowed, whereas the "cropland used for pasture" category implies that plowing had been previously done. These data cannot be used to consistently identify the portions of these pasture categories that were actually plowed prior to a given census year.

[50] The definition of a farm has changed nine times since 1850 and, although this can affect whether a particular

Table 2. Area of Improved Land in Farms (for Years 1920 and Earlier) or Total Cropland (for Years 1925 and Later)[a]

	Improved Land in Farms or Cropland, 1000 km^2						
State	1850	1880	1910	1940	1969	1997	Total Area, 1000 km^2
Connecticut	7.0	6.5	3.9	2.6	1.0	0.7	12.8
Maine	8.3	14.1	9.6	6.4	2.9	2.2	83.8
Massachusetts	8.7	8.7	4.7	3.2	1.1	0.9	21.1
New Hampshire	9.1	9.3	3.8	2.4	0.8	0.5	24.0
New Jersey	7.1	8.5	7.3	4.7	2.9	2.4	19.7
New York	50.4	71.9	60.2	41.5	24.6	19.1	126.0
Pennsylvania	35.0	54.5	51.5	37.5	22.7	20.4	117.4
Rhode Island	1.4	1.2	0.7	0.4	0.1	0.1	2.8
Vermont	10.4	13.2	6.5	6.0	3.4	2.5	24.9
Subtotal, Northeast	*137.5*	*187.9*	*148.2*	*104.6*	*59.4*	*48.8*	*432.4*
Alabama	18.1	25.9	39.4	46.1	23.4	17.0	134.0
Delaware	2.3	3.0	2.8	2.3	2.0	2.0	5.2
District of Columbia	0.1	0.1	0.0	0.0	0.0	0.0	0.2
Florida	1.4	3.8	7.3	11.6	15.3	14.7	146.1
Georgia	25.8	33.1	49.7	47.3	27.7	21.7	151.9
Maryland	11.2	13.4	13.5	10.5	7.4	6.5	25.6
Mississippi	13.9	21.1	36.4	43.3	33.1	24.1	123.4
North Carolina	22.2	26.3	35.8	34.1	24.1	22.7	127.8
South Carolina	16.4	16.7	24.6	22.4	13.9	10.0	80.1
Tennessee	20.8	34.3	44.0	46.0	34.0	28.6	109.0
Virginia	34.5	34.4	39.8	32.2	18.6	17.4	103.5
Subtotal, Southeast	*166.7*	*212.0*	*293.2*	*295.8*	*199.6*	*164.7*	*1006.7*
Illinois	20.4	105.6	113.4	101.6	100.5	96.8	145.8
Indiana	20.5	56.6	68.9	59.4	54.8	52.0	94.2
Iowa	3.4	80.7	119.8	111.9	112.3	108.5	145.7
Kansas	0.0	43.4	120.9	138.4	128.6	121.5	212.9
Kentucky	24.0	43.1	57.7	53.5	38.2	34.6	104.4
Michigan	7.9	33.8	52.2	48.2	34.7	31.9	150.7
Minnesota	0.0	29.5	80.2	104.1	90.3	87.0	218.8
Missouri	11.8	67.4	98.9	93.1	84.8	77.8	180.9
Nebraska	0.0	22.4	98.8	113.0	89.9	89.4	200.3
North Dakota	0.0	1.0	82.7	109.6	119.2	107.7	183.4
Ohio	39.9	73.2	77.9	63.4	50.4	45.9	106.8
South Dakota	0.0	3.5	63.5	95.4	80.3	78.3	199.9
West Virginia	7.3	15.2	22.2	15.6	6.3	5.4	62.7
Wisconsin	4.3	37.3	48.3	53.3	46.8	41.9	145.5
Subtotal, Midwest and GP	*139.4*	*612.6*	*1105.5*	*1160.4*	*1037.0*	*978.7*	*2152.1*
Arizona	0.0	0.2	1.4	4.0	6.6	3.1	294.6
Arkansas	3.2	14.5	32.5	41.2	40.4	40.7	137.0
California	0.1	43.2	46.1	52.2	45.5	43.6	408.7
Colorado	0.0	2.5	17.4	52.2	43.6	40.0	269.7
Idaho	0.0	0.8	11.3	19.0	25.0	23.4	215.8
Louisiana	6.5	11.1	21.3	24.4	23.6	21.6	119.3
Montana	0.0	1.1	14.7	59.8	65.2	71.3	381.3
Nevada	0.0	1.4	3.0	3.5	3.0	3.4	286.5
New Mexico	0.7	1.0	6.0	17.1	9.2	8.1	315.3
Oklahoma	0.0	0.2	71.2	79.6	63.4	60.1	181.3
Oregon	0.5	8.9	17.3	21.3	21.0	21.4	251.2
Texas	2.7	51.1	110.6	190.7	160.9	144.7	684.9
Utah	0.1	1.7	5.5	7.1	7.9	8.4	219.8
Washington	0.1	2.0	25.7	29.1	33.3	28.7	174.7
Wyoming	0.0	0.4	5.1	14.2	11.3	9.7	253.3
Subtotal, West	*13.7*	*139.9*	*389.3*	*615.5*	*559.9*	*528.3*	*4193.5*
Total, Conterminous US	457.4	1152.5	1936.1	2176.4	1856.0	1720.5	7784.7

[a]By state for selected dates.

cropland parcel is counted, in most cases this most likely has only a small influence on the national results. For example, starting in 1978, the threshold for defining a farm increased to $1000 of farm products sold. Prior to 1978, a farm was defined as "any place with less than ten acres from which $250 or more of agricultural products were sold or normally would have been sold during the census year, or any place of ten acres or more from which $50 or more of agricultural products were sold or normally would have been sold during the census year" [*Hallberg*, 2001]. This definitional change would result in a reduction in the number of farms enumerated by the census and would also tend to reduce the area of land in farms enumerated by the census. Yet, between 1974 and 1978, there was an increase in the area of land in farms, so that the impact of the definitional changes seems to be masked by the changes in land management.

[51] Short-term disturbances occurring between census years may not be reflected in these data. The census focused on farmlands, but there are no comparable county-level data on lands that are not in farms.

[52] Corrections to census data for a given year may be included in tables published with later censuses. *Dodd* [1993] states that the published counts are most accurate when farthest away from the decade of the count. We used the most recent source when we keyed data, but did not verify if this was consistently done in existing digital data sources.

[53] Independent cities in Virginia are sometimes included in census data and sometimes not included, depending on the decade and the source. We matched the spatial data with the census source for each census year, but the result is not a smooth time series for some of these areas.

6. Conclusions

[54] We developed a database of changes in population and agricultural land, primarily from digital sources, to which we added some revisions and corrections. The county-level data provide more spatial detail than was previously available. For the conterminous United States, the area in total cropland peaked in 1940, but this is a synthesis of underlying regional trends. The total cropland area in the Northeast peaked in 1880, after which transportation of agricultural goods from the better soils of the Midwest and Great Plains became competitive. The Midwest and Great Plains total cropland area peaked in 1940 at 53.9% of the entire land and then declined slightly to 45.5% in 1997. In the Southeast, the cropland area peaked in 1920 at 29.5% of the land and then decreased to 16.4% in 1997; pine tree plantations have been developed on many areas that were formerly cropland.

[55] Although the database was developed to meet the needs of our carbon modeling work, we expect that it may be useful for other disciplines too. For the physical sciences, the data may be useful for studies of hydrology, biogeography, and climate. For the social sciences, it may be useful for studies of patterns of settlement, migration, and the interactions of humans and the environment. Many other census attributes could be attached to the spatial data for studies of ethnicity, religion, and demographics.

[56] Future work in the MBCP will use these data to model the carbon dynamics on the landscape as influenced by land-use change. Although a full land-use history at the county level would be highly desirable, including forests, grasslands, wetlands, and urban areas, its development will require sources of data other than the census.

Appendix A: Spatial Edits (1949–1997)

[57] Copies of the CTY2M data set were created, and minor edits were made to account for changes in county boundaries or names. This resulted in the following four spatial data sets, designed to match the census data for each period:

1. For 1987 to 1997, the CTY2M spatial data were used without modification from the *National Atlas* source.
2. In 1983, La Paz County, Arizona, was established from part of Yuma County. For the 1982 data set, the boundary was removed, and the entire area was labeled Yuma.
3. In 1979, the FIPS code for Sainte Genevieve, Missouri, was changed. In 1981, Cibola County, New Mexico, was established from part of Valencia County. For the 1978 data set, the Cibola boundary was removed, and the entire area was labeled Valencia.
4. In the mid-1970s, Washabaugh County, South Dakota, was merged into Jackson County, and Nansemond County, Virginia, was renamed Suffolk County. For the 1949–1974 data set, a boundary delineation was added to provide for Washabaugh County, South Dakota.

Appendix B: Geographic and Definitional Changes

[58] Changes in geographic boundaries and census definitions that influence data interpretation are given here by decade.

B1. 1790

[59] The United States consisted of the 13 original states plus the Southwest Territory (now Tennessee), the Northwest Territory (now Ohio, Indiana, Illinois, Michigan, Wisconsin, and part of Minnesota), and the districts of Kentucky, Maine, and Vermont. Some data exist for the Southwest Territory, but none for the Northwest Territory. Georgia covers what is now a three-state area, but there are data for the eastern part only. South Carolina contains two counties with no data (Cheraws and Orangeburg), and North Carolina also contains a parcel of Indian land with no data. Slaves were enumerated as whole persons.

B2. 1800

[60] Georgia included most of modern-day Mississippi and Alabama. There was also a Mississippi Territory in the southern part of Mississippi and Alabama, with population recorded in three counties. Florida and the coastline of the Gulf of Mexico belonged to Spain, as did the entire western part of mid-America. The Indiana Territory surrounded the western Great Lakes, and the Northwest Territory covered the eastern half of the current Michigan and all of what is now Ohio.

B3. 1810

[61] The Louisiana Purchase was made in 1803, and data were included in the 1810 census only for the parts of the area that had been organized into territories. The census did not include the coastal parts of the present states of Mississippi and Alabama, which were claimed by both Spain and the United States and were known as "Spanish West Florida." Florida was also under Spanish jurisdiction.

B4. 1820

[62] The purchase of Florida was not ratified until 1821, so it still belonged to Spain at the time of the 1820 census.

B5. 1830

[63] The Northwestern states were jointly occupied by the United States and Britain. Both countries also claimed parts of Vermont, Maine, and an area north of Maine in what is now Canada. Florida was included in the census of 1830 as a territory.

B6. 1840

[64] The census included inventories of farm animals and crop production but not agricultural land areas.

B7. 1850

[65] For the first time, "acres of land in farms" were recorded. The census included a category for improved land, defined as "cleared and used for grazing, grass, or tillage, or which is now fallow, connected with or belonging to the farm." The "unimproved land" was defined as [*U.S. Census*, 1853] ". . .land connected with the farm. It is not necessary that it should be contiguous to the improved land; but may be a wood lot, or other land at some distance, but owned in connexion (sic) with the farm, the timber or range of which is used for farm purpose." We summed the areas of improved and unimproved land in farms to calculate the total farm area.

B8. 1860

[66] Modern-day Oklahoma was "Indian Territory," and no census was taken there. The census taken in 1860 included improved and unimproved land in farms, as in 1850.

B9. 1870

[67] The state of West Virginia was created from the northwestern part of Virginia in 1863. In the aftermath of the Civil War, the 1870 census was underfunded and disorganized. The data are probably less reliable than those for prior and subsequent censuses. For example, "a correct census in 1870 would have reported at least 1,000,000 more acres" for land in farms in the region including Pennsylvania, New Jersey, and states to the north and east [*U.S. Census*, 1902, p. xix]. The 1870 census categories included improved land, unimproved woodland, other unimproved land, and population.

B10. 1880

[68] The regular census omitted Indians not taxed, and therefore Indian reservations in all of Oklahoma and parts of the Dakota Territory show zero values for population and farmland. *Dodd* [1993, p. xviii] refers to "special Indian schedules" dated October 1880. In decades prior to 1890, the locations of the tribes are not well documented by the census. Much additional research would be required to properly account for American Indian population and agriculture. In Texas, Kansas, South Dakota, and North Dakota, enumerators reported "no population" in some counties. Table B1 shows the categories of farmlands, which were inventoried in acres.

[69] In 1880, farmland and improved land in Pennsylvania, New Jersey, and states to the north and east exceeded those of the surrounding decades. This peak is questioned in a volume of the 1900 census [*U.S. Census*, 1902].

B11. 1890

[70] The census categories included acres of improved and unimproved land, as in 1850 and 1860. The definitions were clarified, stating "no farm of less than 3 acres was enumerated unless at least $500 worth of product had been actually sold from the same during the calendar year preceding the census year. The improved acreage includes entire land once cultivated, unless afterward abandoned, and all permanent meadows and pastures" [*U.S Census*, 1896].

Table B1. Land Use Variables Used in 1880[a]

Aggregate Level	Land Use Variable
1	land in farms
2	improved land in farms
3	tilled, including fallow and grass in rotation (whether pasture or meadow)
3	permanent meadows, permanent pastures, orchards, and vineyards in improved meadows, pastures
2	unimproved land in farms
3	unimproved woodland and forest
3	other unimproved, including "old fields" not growing wood

[a]Aggregation level 1 represents the total area under consideration. Elements of aggregation level n sum to the preceding level n − 1 for n > 1.

[71] Population counts of Native Americans were available for most counties and reservations. We keyed data for territories and Indian populations that were included in census tables for minor civil divisions and other documents [*U.S. Census*, 1891, 1895], but were not included in the county census tables or the ICPSR data set. In the 1890 and 1900 timeframe, some of the Indian reservations were being moved, and it was not always clear how to associate reservation names to counties. The low counts for area of farmland on some reservations could be due either to an undercount or to a lack of farming.

B12. 1900

[72] The census counted total farm acres and improved farm acres. We calculated the unimproved farmland area by subtracting improved acres from total farm acres.

[73] The county census tables accounted for more than half of the Native American population and agricultural land on reservations [*U.S. Census*, 1902; Tables 4, 12, and 19]. Additional data were found in another census chapter, Agriculture on Indian Reservations [*U.S. Census*, 1902, pp. 718–741] that provides numbers for most tribes, listing the reservations and tribes by county or counties. We substituted the data from this chapter for the original county data only when the numbers were larger, because it was sometimes unclear whether the Native American numbers were included with the county data.

[74] In approximately 20 Texas counties, the unimproved farmland acreage exceeded by 20% of the total county area calculated by the geographic information system, which we attribute to enumerating the area of multicounty ranches in the county of the ranch headquarters.

B13. 1910

[75] The 1910 census tables included a complete set of information for Native American populations and agricultural lands.

[76] Inventories of farmland were split by ownership, so we summed the land in farms for owners, tenants, and managers to calculate total land in farms. Similarly, the improved lands were summed over the ownership categories.

[77] Large Texas ranches were again counted in the county of the headquarters, although acreage was included for land in unnamed adjacent counties. This causes the acres of farmland (for seven counties) and unimproved land (for

Table B2. Land Use Variables Used in 1930[a]

Aggregate Level	Land Use Variable
1	total farmland (split by ownership in ICPSR data)
2	cropland
3	cropland harvested
3	crop failure
3	idle or fallow land
2	pasture land
3	plowable pasture (we keyed from Census volumes)
3	woodland pasture (we keyed from Census volumes)
3	other pasture (we keyed from Census volumes)
2	woodland not pastured
2	all other land in farms

[a]See Table B1 footnote.

Table B3. Land Use Variables Used in 1940[a]

Aggregate Level	Land Use Variable
1	all land in farms[c]
2	cropland harvested[b,c]
2	crop failure[c]
2	cropland idle or fallow[c]
2	plowable pasture[b,c]
2	woodland
2	all other land

[a]See Table B1 footnote.
[b]Subsets of these categories for irrigated cropland harvested and irrigated pasture were reported. The digital files purchased from the ICPSR contained land in farms and harvested croplands, and both categories were split by ownership.
[c]Categories were keyed from the 1945 census county tables [*U.S. Census*, 1946].

six counties) to exceed the area calculated by the geographic information system.

B14. 1920

[78] The census inventoried the following: approximate land area; total land in farms; improved land in farms; woodland in farms; and other unimproved land in farms. We summed the woodland and "other unimproved lands" categories to calculate total unimproved lands. As with some Texas counties, the farm acreages for Grant County, Nebraska, included areas for adjacent counties.

B15. 1925

[79] The Census tabulated county data for 1925, but we did not find a source in digital form and did not key them. The "improved farmland" category was discontinued and "cropland" was first enumerated in 1925 [*U.S. Census*, 1927].

B16. 1930

[80] The census inventoried farmland acres using categories listed in Table B2. We added the plowable pasture data [*U.S. Census*, 1932a] as a component of cropland, in order to be consistent with definitions of cropland in prior and later years.

B17. 1935

[81] As with 1925, the county data for 1935 were tabulated, but we did not find a source in digital form and did not key them. The national summary numbers for 1935 are included in Figure 2 [*U.S. Census*, 1936].

B18. 1940

[82] The original 1940 census county tables [*U.S. Census*, 1942] include the categories shown in Table B3. The category referenced as "cropland used only for pasture" in the 1945 volume uses the numerical values designated as "plowable pasture" in the 1940 volume. The 1940 category "plowable pasture" represents pasture that either has been or could potentially be used for cropland, whereas the 1945 "category cropland used only for pasture" indicates land that has been plowed within the last 7 years and was used as pasture at the time of the census. The pasture, woodland, and "all other land" categories in the 1945 volume [*U.S. Census*, 1946] were footnoted as "not available" for 1940, even though they are included in the original 1940 data [*U.S. Census*, 1942].

B19. 1945

[83] We keyed the categories [*U.S. Census*, 1946] shown in Table B4 because we were unable to locate a county-level digital source. The change in definition from plowable pasture in 1940 to cropland used for pasture in 1945 introduces a change in the time series for improved farmland (1850–1920) and the variables that sum to an equivalent measure (1925 and later). The magnitude of the change cannot be calculated precisely. The change is on the order of 341,000 km^2, calculated by subtracting the 1945 cropland used for pasture from the 1940 plowable pasture.

B20. 1949 Through 1974

[84] The ICPSR provided agricultural land data for 1949 and population information for 1950. We attached the ICPSR population data for 1950 and 1960 to the LSU delineations.

[85] Agricultural land data from the *Economic Research Service* [1999] were available for 1949, 1954, 1959, 1964, 1969, and 1974. We attached these data to the CTY2M spatial data using the FIPS code. Both the ICPSR and the Economic Research Service provided agricultural land data for 1949, so we compared the data to validate the accuracy of both data sets. Minor differences were found, and we used the Economic Research Service source. Table B5 shows the agricultural classifications attached to the spatial data.

[86] The *Economic Research Service* CD-ROM included fields of Class IV farm data for 1964, 1969, and 1974 that are sometimes populated. A Class IV farm is defined as a

Table B4. Land Use Variables Used in 1945[a]

Aggregate Level	Land Use Variable
1	all land in farms
2	cropland harvested
2	crop failure
2	cropland idle or fallow
2	cropland used only for pasture
2	woodland pastured
2	woodland not pastured
2	other land pastured
2	all other land

[a]See Table B1 footnote.

Table B5. Land Use Variables Used in 1949 Through 1974[a]

Aggregate Level	Land Use Variable
1	total surface area
2	water area (over 40 acres)
2	approximate land area
3	land in farms
4	total cropland
5	harvested cropland
5	cropland used only for pasture or grazing
5	all other cropland (not harvested and not pastured)
6	cropland in cover crops, legumes, and soil improvement grasses
6	cropland on which all crops failed
6	cropland in cultivated summer fallow
6	cropland idle
4	total woodland
5	woodland pastured
5	woodland not pastured
4	all other land
5	pastureland and rangeland (other than cropland and woodland pasture)
6	improved pastureland and rangeland
6	not improved pastureland and rangeland
5	other land (not pastureland and rangeland)

[a]See Table B1 footnote.

farm earning more than $2500 in agricultural sales. The total farm data include the Class IV farm data. Also, areas of irrigated land, drained land, and the other miscellaneous categories listed above are already included in the hierarchy of cropland categories under "land in farms." Although Hawaii and Alaska became states in 1959, they are not included in our study area.

B21. 1978 and 1982

[87] Separate versions of the CTY2M spatial data set were used for 1978 and 1982 because there were county boundary and FIPS code changes. Table B6 shows the agricultural variables that were loaded (in acres) for 1978 and 1982.

B22. 1987, 1992, and 1997

[88] The 1987, 1992, and 1997 data are available digitally from the National Agricultural Statistics Service. Data for land under the conservation reserve or wetlands reserve programs were included. There were no changes in county delineations or FIPS codes between 1987 and 1997. Data for the area in acres for each of the following agricultural categories were attached to the CTY2M spatial data set. The categories are shown in Table B7.

Table B6. Land Use Variables Used in 1978 and 1982[a]

Aggregate Level	Land Use Variable
1	total farmland
2	cropland
3	harvested cropland
3	cropland, only pasture or grazing
3	other cropland
4	cropland, in cover crops, etc.
4	cropland, all crops failed
4	cropland in cultivated summer fallow
4	cropland idle
2	total woodland
3	woodland pastured
3	woodland not pastured
2	other land
3	pasture and rangeland, not cropland and woodland
3	land in house lots, wasteland, etc.

[a]See Table B1 footnote.

Table B7. Land Use Variables Used in 1987, 1992, and 1997[a]

Aggregate Level	Land Use Variable
1	land in farms
2	total cropland
3	harvested cropland
3	cropland used only for pasture or grazing
3	other cropland
4	other cropland (in legumes or soil improving grasses, not harvested or pastured)
4	other cropland, cropland on which all crops failed
4	other cropland, cropland in cultivated summer fallow
4	other cropland, cropland idle
2	total woodland
3	woodland pastured
3	woodland not pastured
2	other land
3	pasture and rangeland other than cropland and woodland pastured
3	land in house lots, ponds, roads, wasteland, etc.

[a]Note: Not all data are available for all years 1949, 1954, 1959, 1964, 1969, and 1974. For some years, only Class IV farms (farms with sales of $2500 and over) were inventoried/are available.

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N. B. Bliss, U.S. Geological Survey EROS Data Center, SAIC, Sioux Falls, SD 57198, USA. (bliss@usgs.gov)

P. J. Waisanen, U.S. Geological Survey EROS Data Center, 47914 252nd Street, Sioux Falls, SD 57198, USA. (waisanen@usgs.gov)