Thank you for the comments and suggestions. These comments were very helpful for revising and improving our paper. We have responded to the comments point by point.

Reviewer #2:

General comment:

The manuscript reconstructed land use and land cover history during 1630-2020 over the conterminous United States (CONUS). It gathered multiple sources of data including remote sensing-based land cover maps, national inventories and statistics data, meteorological fields, topographical data and others. The resulting dataset has an improved spatial resolution than other global datasets, potentially facilitating regional modeling work. However, the manuscript is not well organized. For example, in the method section, there are missing details about how various sources of input data were combined and adjusted to generate full time series of urban and crop land area. And also, the validation needs more justification on the choice of spatial scale and more discussion about what causes differences between the data from this work and other datasets. For example, this data shows a different trend in areas of urban and pasture in the past two decades compared to others. I have provided detailed comments below.

Response: Thank you for these suggestions. We revise the method for reconstructing historical urban and cropland area with more detail information, including the data used for difference period and harmonization method between different datasets. Please see the section 2.2 (Lines 105-185).

Section 2.2.1

In this study, we used the same definition for the developed land as NLCD for urban land. The developed land in NLCD includes four components: open space, low intensity developed land, medium intensity developed land, and high intensity developed land (Table 2). We used the NLCD developed land area during 2001–2019 as the urban land area baseline. Before 2001, we applied Historical Settlement Data Compilation for the United States (HISDAC-US) (Leyk et al., 2020; Uhl et al., 2021) as input to reconstruct the historical urban land area. The HISDAC-US built-up areas describes the built environment for most of the CONUS from 1810 to 2015 at 5-year temporal and 250 m spatial resolution using built-up property records, locations, and intensity data (Leyk and Uhl, 2018; Uhl et al., 2021). Here, we assumed that the HISDAC built-up areas data could capture the trend of urban land development. Then, the historical urban land can be estimated as follows:

$$HistUrban_{s,t} = HistUrban_{s,t+1} \times \frac{HISDAC_{s,t}}{HISDAC_{s,t+1}} \quad (1)$$

where $HistUrban_{s,t}$ and $HistUrban_{s,t+1}$ are the reconstructed urban land area of state *s* in year *t* and *t*+1; $HISDAC_{s,t}$ and $HISDAC_{s,t+1}$ are the HISDAC built-up area of state *s* in year *t* and *t*+1.

There is no census data on urban land area before 1810. Following Liu et al. (2010), we used population to estimate the urban land area by assuming that urban land expanded at the same rate as total population during 1630–1810. The urban land area of each state can be calculated as follows:

$$HistUrban_{s,t} = HistUrban_{s,t+1} \times \frac{Pop_{s,t}}{Pop_{s,t+1}} \quad (2)$$

where $HistUrban_{s,t}$ and $HistUrban_{s,t+1}$ are the reconstructed urban land area of state *s* in year *t* and *t*+1; $Pop_{s,t}$ and $Pop_{s,t+1}$ are the total population of state *s* in year *t* and *t*+1.

Section 2.2.2

The definition of cropland varies in the existing literature and datasets (Zumkehr and Campbell, 2013; Bigelow and Borchers, 2017; Goldewijk et al., 2017; Homer et al., 2020, Table S5). Cropland, defined by the U.S. Department of Agriculture (USDA) Economic Research Service (ERS), includes five components: cropland harvested, crop failure, cultivated summer fallow, cropland pasture, and idle cropland (Table 2). In this study, we only count the cropland harvested area, which includes row crops and closely sown crops, hay and silage crops, tree fruits, small fruits, berries, and tree nuts, vegetables and melons, and miscellaneous other minor crops (https://www.ers.usda.gov/data-products/major-land-uses/glossary/#cropland). USDA Census of Agriculture Historical Archive (CAHA) recorded state-level cropland harvested areas at 4 to 10 years intervals (Table 1 and Table S5), which was used for historical cropland area reconstruction between 1879 and 2017. The CAHA cropland was interpolated into annual using the linear method first. To subtract the double-cropped area, we applied the annual national cropland harvested area without double-cropped area from ERS Major Land Uses data to adjust the interpolated cropland harvested area. The adjustment can be expressed as follows:

$$HistCrop_{s,t} = \frac{Cropland\ Harvested_{s,t}^{linear}}{Cropland\ Harvested_{conus,t}^{linear}} \times Cropland\ Harvested_{conus,t}^{ERS} \qquad (3)$$

where $HistCrop_{s,t}$ is the reconstructed cropland area of state s in year t; $Cropland\ Harvested_{s,t}^{linear}$ is the linearly interpolated cropland harvested area of state s in year t based on CAHA cropland harvested area; $Cropland\ Harvested_{conus,t}^{ERS}$ is the national total cropland harvested area without double-cropped area in year t. For 2018–2020, the state-level cropland area was calculated based on the state-level area weight in 2017.

For 1879–1910, there was no national-level cropland harvested area without double-cropped area. Therefore, we applied the trend of the CAHA cropland harvested area to reconstruct the historical cropland:

$$HistCrop_{s,t} = HistCrop_{s,t+1} \times \frac{CAHA\_CHA_{s,t}}{CAHA\_CHA_{s,t+1}} \qquad (4)$$

where $HistCrop_{s,t}$ and $HistCrop_{s,t+1}$ are the reconstructed cropland area of state s in year t and t+1; $CAHA\_CHA_{s,t}$ and $CAHA\_CHA_{s,t+1}$ are the cropland harvested area of state s in year t and t+1.

Because there was no available cropland census data at the state level before 1879, the HYDE cropland was used. We first estimated the cropland per capita by applying the trend of HYDE cropland per capita. Then, the total cropland area can be calculated by multiplying cropland per capita and total population. The data harmonization process can be expressed as follows:

$$HistCrop_{s,t} = (HistCrop\_p_{s,t+1} \times \frac{HYDE\_Crop\_p_{s,t}}{HYDE\_Crop\_p_{s,t+1}}) \times Pop_{s,t} \qquad (5)$$

where $HistCrop_{s,t}$ is the reconstructed cropland area of state s in year t; $HistCrop\_p_{s,t+1}$ is the reconstructed cropland per capita of state s in year t+1; $HYDE\_Crop\_p_{s,t}$ and $HYDE\_Crop\_p_{s,t+1}$ are HYDE cropland per capita of state s in year t and t+1.

For the data validation/comparison, we add the causes analysis for the differences between the datasets, please see section 3.1.1 (Lines 279-303). Considering the importance of cropland and the census data availability, we add the county level cropland area comparison between our data and USDA census data, please see section

3.1.2 (Lines 304-322). Moreover, we also compare the NLCD and our data at grid level, please see section 3.1.3 (Lines 323-338).

References:

Bigelow, D. P. and Borchers, A.: Major Uses of Land in the United States 2012, U.S. Department of Agriculture, Economic Research Service, 2017.

Goldewijk, K. K., Beusen, A., Doelman, J., and Stehfest, E.: Anthropogenic land use estimates for the Holocene - HYDE 3.2, Earth Syst. Sci. Data, 9, 927-953, https://doi.org/10.5194/essd-9-927-2017, 2017.

Homer, C., Dewitz, J., Jin, S., Xian, G., Costello, C., Danielson, P., Gass, L., Funk, M., Wickham, J., Stehman, S., Auch, R., and Riitters, K.: Conterminous United States land cover change patterns 2001-2016 from the 2016 National Land Cover Database, ISPRS. J. Photogramm. Remote Sens., 162, 184-199, https://doi.org/10.1016/j.isprsjprs.2020.02.019, 2020.

Leyk, S. and Uhl, J. H.: HISDAC-US, historical settlement data compilation for the conterminous United States over 200 years, Sci. Data, 5, 1-14, https://doi.org/10.1038/sdata.2018.175, 2018.

Leyk, S., Uhl, J. H., Connor, D. S., Braswell, A. E., Mietkiewicz, N., Balch, J. K., and Gutmann, M.: Two centuries of settlement and urban development in the United States, Sci. Adv., 6, https://doi.org/10.1126/sciadv.aba2937, 2020.

Liu, M. and Tian, H.: China's land cover and land use change from 1700 to 2005: Estimations from high-resolution satellite data and historical archives, Global Biogeochem. Cy., 24, GB3003, https://doi.org/10.1029/2009gb003687, 2010.

Uhl, J. H., Leyk, S., McShane, C. M., Braswell, A. E., Connor, D. S., and Balk, D.: Fine-grained, spatiotemporal datasets measuring 200 years of land development in the United States, Earth Syst. Sci. Data, 13, 119-153, https://doi.org/10.5194/essd-2020-217, 2021.

Zumkehr, A. and Campbell, J. E.: Historical U.S. Cropland areas and the potential for bioenergy production on abandoned croplands, Environ. Sci. Technol., 47, 3840-3847, https://doi.org/10.1021/es3033132, 2013.

Specific comments

Comment 1: P2, L55, LUH2 has a spatial resolution of 0.25-deg.

Response: Thank you for this suggestion. We revise it. Please see Line 60.

Comment 2: P2, l55, please provide references to the 'substantial uncertainties' statement.

Response: Thank you for this suggestion. We revise the word of "**substantial uncertainties**", and add references describing the spatial uncertainties of LULC data with coarse resolution.

References:

Yu, Z. and Lu, C.: Historical cropland expansion and abandonment in the continental U.S. during 1850 to 2016, Glob. Ecol. Biogeogr., 27, 322-333, http://doi.org/10.1111/geb.12697, 2018.

Lin, S., Zheng, J., and He, F.: Gridding cropland data reconstruction over the agricultural region of China in 1820, J. Geogr. Sci., 19, 36–48, http://doi.org/10.1007/s11442-009-0036-x, 2009.

Comment 3: P5, L95, it would be clearer to split the datasets by the purposes in your model (e.g., input vs validation). And also, there is no temporal resolution for each dataset. Apparently, some of them are not annual.

Response: Thank you for this suggestion. We revise Table 1 and only input datasets is in the Table 1. We add a new table (Table A2) to describe the data used for validation in the appendix.

Comment 4: P6, L100, please clarify if all land cover types of developed land (i.e., Developed, Open Space; Developed, Low Intensity; Developed, Medium Intensity; Developed High Intensity) were regarded as urban land.

Response: Thank you for this suggestion. We clarify the definition of urban land. In this study, the four components (i.e., open space, low intensity, medium intensity, high intensity developed land) in NLCD developed land is regarded as urban land. Please see Lines 107-109.

Comment 5: P6, L100, did you take an average of urban land area during 2001-2016 and use it as the baseline? Or you did make use of the time series of urban land areas. I wonder about the temporal variation of urban land per capita and its impacts on estimation of historical urban areas. It would be better to include this information in supplements.

Response: Thank you for this suggestion. We take an average of urban land area during 2001-2016 and use it as the baseline for urban land per capita. In fact, the real urban land per capita is not stable especially for such long-term study period.

We revise the urban land estimation method by applying the trend of HISDAC built-up areas between 1810 and 2001. The description about the method please see Lines 106-123.

Figure R1 shows the urban land per capita change derived from the newly developed urban land and HISDAC built-up areas during 1810–2010. The figure shows that the urban land per capita gradually increase over the past 200 years, which means that our previous data overestimated the urban land area in the early years.

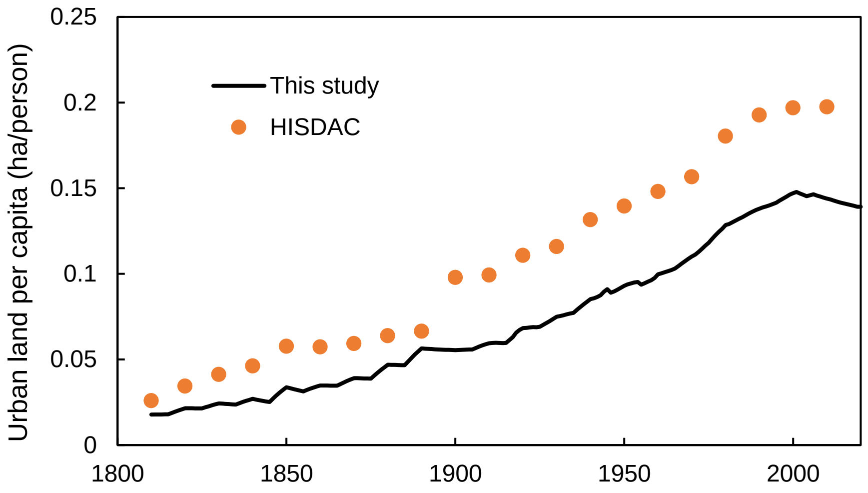


Figure R1. Urban land per capita change between 1810 and 2020. The value indicated by the orange dot is the urban land per capita derived from HISDAC built-up areas; the value indicated by the black line is the urban land per capita derived from the newly developed urban land.

Comment 6: P6, L106-108, which dataset were these criteria applied to? CPHR, CAHA, or other?

Response: Thank you for this suggestion. The cropland harvested area from CAHA is used for historical cropland reconstruction.

Comment 7: P6, L112, I could not find the CPHR dataset in Table 1. Please make sure the product name and time period is consistent between the table and manuscript.

Response: Thank you for this suggestion. The cropland planted area in Table 1 is the CPHR data. The cropland planted area was used to establish the relationship with cropland harvested area.

Referee 1 thinks that converting cropland harvested area with an unchanged linear equation is not reasonable and dangerous. So, we change the cropland reconstruction method, and the cropland planted area is not used in the new method. Please see section 2.2.2 (Lines 124-153).

Comment 8: P6, L117, 1975-2020, right? If not, please list this dataset clearly in Table 1. Please add more details about how the adjustment was done to make 'the inter-annual variation more reasonable'. For example, was this adjustment done at national scale then disaggregated to state scale?

Response: Thank you for this suggestion. The period of cropland planted area used before is 1975-2020. In the new method, the cropland planted area data is not used. In the revised method, we also conduct an adjustment to subtract the double-cropped area, and the national cropland harvested area was disaggregated to state-scale. Please see Lines 132-140.

Comment 9: P6, L125-126, what causes this difference? Due to the CAHA crop harvested area?

Response: Thank you for this suggestion. We assumed that there should be a large difference between the cropland harvest area between 1879 and 1889. However, we found that the cropland harvested area in South Dakota, Nebraska, and Kansas increased rapidly between 1879 and 1889 (Figure R2). Thus, we thought the cropland harvested area in 1879 is not correct before.

We rechecked the changes in cropland harvested area between 1879 and 1889 and total population (Figure R3) during 1850-1890. The rapidly increase of cropland area resulted from the population growth. we think the cropland harvested area should be right and can be used for cropland reconstruction.

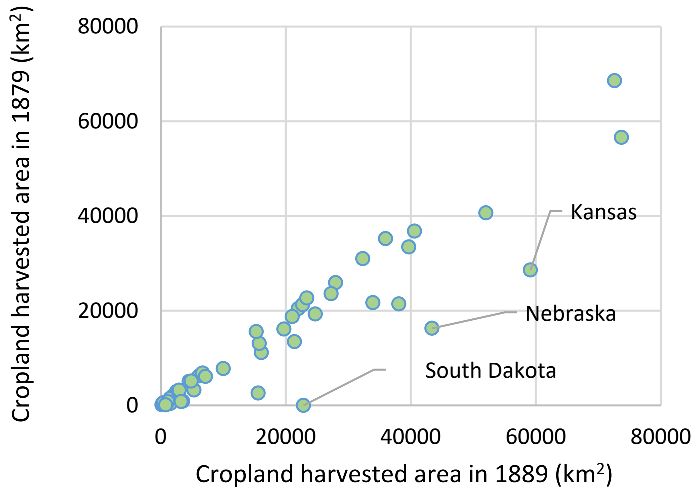


Figure R2: Comparison between cropland harvested area in 1889 and 1879

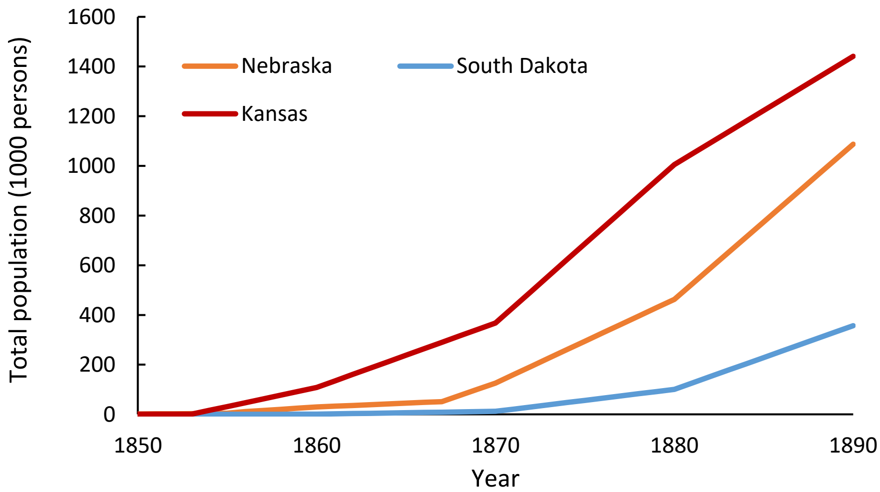


Figure R3: Total population change in Nebraska, Kansas, and South Dakota between 1850 and 1890.

Comment 10: P6, L127, please justify why the cropland per capita was calculated at national level instead of state level like the urban area per capita. This could avoid any potential confusions about the following assumption you made.

Response: Thank you for this suggestion. Considering that HYDE is reconstructed based on the country level data, so the national level cropland per capita was used before. We agree that applying the state level cropland area per capita to estimate the total cropland area should be more reasonable. In the new method, the HYDE cropland per capita for each state was used in the harmonization process. Please see Lines 145-152.

Comment 11: P7, L130-134, was there a harmonization process applied to connect cropland area during 1630-1880 derived from the HYDE and cropland area during 1889-2020 derived from the CAHA? If not, please add time-series plots of derived cropland areas that show such harmonization is not needed.

Response: Thank you for this suggestion. There was a harmonization process to connect cropland area derived from HYDE and reconstructed historical cropland area. Please see Lines 145-152.

Because there was no available cropland census data at the state level before 1879, the HYDE cropland was used. We first estimated the cropland per capita by applying the trend of HYDE cropland per capita. Then, the total cropland area can be calculated by multiplying cropland per capita and total population. The data harmonization process can be expressed as follows:

$$HistCrop_{s,t} = (HistCrop\_p_{s,t+1} \times \frac{HYDE\_Crop\_p_{s,t}}{HYDE\_Crop\_p_{s,t+1}}) \times Pop_{s,t} \quad (5)$$

where $HistCrop_{s,t}$ is the reconstructed cropland area of state *s* in year t; $HistCrop\_p_{s,t+1}$ is the reconstructed cropland per capita of state s in year t+1; $HYDE\_Crop\_p_{s,t}$ and $HYDE\_Crop\_p_{s,t+1}$ are HYDE cropland per capita of state *s* in year *t* and *t*+1.

Comment 12: P7, L141-L143, please clarify how the pasture per capita during 1630–1982 was estimated from pasture per capita at the state level (NRI data-based) in 1982 and the national level (HYDE data-based).

Response: Thank you for the suggestions. Same as the cropland area estimation, we agree that applying the state level pasture per capita to estimate the total pasture area should be more reasonable. In the new method, the HYDE cropland per capita for each state was used in the harmonization process. Please see Lines 154-166.

Because there was no available pasture census data at the state level before 1982, the HYDE pasture was applied. We first estimated the pasture per capita by applying the trend of HYDE pasture per capita. Then, the total cropland area can be calculated by multiplying pasture per capita and total population. The data harmonization process can be expressed as follows:

$$HistPasture_{s,t} = (HistPasture\_p_{s,t+1} \times \frac{HYDE\_Pasture\_p_{s,t}}{HYDE\_Pasture\_p_{s,t+1}}) \times Pop_{s,t} \quad (6)$$

where $HistPasture_{s,t}$ is the reconstructed pasture area of state *s* in year *t*; $HistPasture\_p_{s,t+1}$ is pasture area per capita of state *s* in year *t*+1; $HYDE\_Pasture\_p_{s,t}$ and $HYDE\_Pasture\_p_{s,t+1}$ are the HYDE pasture per capita of state *s* in year *t* and *t*+1.

Comment 13: P7, L157, "... then multiplied the forest area from USDA-FR to generate …". What is the time period of USDA-FR forest area used here? 1630?

Response: Thank you for this suggestion. We revise it. …then multiplied the forest area from USDA-FR in 1630.

Comment 14: P8, L170, why is there no scaling factor for TA_t_r (s) < TLA(s) ? How was the difference/residual between TA_t_r (s) and TLA(s) dealt in your following analysis? And also, what is the source of the state's total land area (TLA)?

Response: Thank you for this suggestion. The purpose of this section is to check whether the total area of urban, cropland, pasture, and forest is larger than the state land area. If the area is lower than the state land area, we will not modify the reconstructed area of each LULC class. Thus, there is no scaling factor for TA_t_r (s) < TLA(s). We don't do consider the difference/residual between TA_t_r (s) and TLA(s) dealt in the following analysis. In the updated version, we check the reconstructed area of each LULC class, the total area of urban, cropland, pasture, and forest at each state and each year stratify the condition "TA_t_r (s) < TLA(s)", so we remove this section.

For the state's total land area, we derive the area information from state boundary file. The file can be download in the following links:
https://www.nass.usda.gov/Publications/AgCensus/2017/index.php#highlights

Comment 15: P9, L182-184, please add references to how ANN can be used to solve the nonlinear geographical problems.

Response: Thank you for this suggestion. We add related references. Please see Lines 212-213.

Comment 16: P9, L184-185, please add more details about how land use probability was generated from ANN and NLCD. And also, NLCD is supposed to be an independent variable used in the modeling, right? However, NLCD is a land cover data, how can it be useful for modeling of land use probability? Please keep in mind that land use and land cover are usually used interchangeably but are actually different terms. If you regard them as the same terms, why do you refer to it as land use probability instead of land use and land cover probability?

Response: Thank you for this suggestion. In this study, we used the ANN tool in Future Land Use Simulation (FLUS) software to estimate the probability of occurrence. The FLUS model is a land-use change simulation model that combines Cell Automata (CA) model and artificial neural networks (ANN) (Liu et al., 2017). The independent variables for the ANN model include elevation, slope, annual mean temperature, annual precipitation, annual maximum temperature (July), annual minimum temperature (January), crop productivity index, population density, distance to the city, distance to the road, distance to the railway, distance to the river, soil organic carbon, soil sand, soil clay. The purpose of ANN training is to establish the relationship between each LUCC type and the independent variables, and the NLCD Boolean type will be the dependent variable.

We agree that land use and land cover are usually used interchangeably but are different terms. In this study, we regard them as the same terms change the 'land use probability' as 'LULC probability'.

References:

Liu, X., Liang, X., Li, X., Xu, X., Ou, J., Chen, Y., Li, S., Wang, S., and Pei, F.: A future land use simulation model (FLUS) for simulating multiple land use scenarios by coupling human and natural effects, Landsc. Urban Plan., 168, 94-116, https://doi.org/10.1016/j.landurbplan.2017.09.019, 2017.

Comment 17: P9, L200, what are the difference between ES_weight_t and SE_weight_t in Eq. 4 and 6.

Response: Thank you for this suggestion. We revise it. Eq.4 should be SE_weight_t.

Comment 18: P9, L200, what are the values of t1 and t0 in Eq. 7? Are they the starting and ending year of each subperiod?

Response: Thank you for this suggestion. Yes, t0 and t1 are the starting and ending year of each subperiod.

Comment 19: P10, L216, what does 'Boolean type' mean? Categorical type like NLCD that each grid (i.e, 30 m) has a single land use and land cover type?

Response: Thank you for this suggestion. Yes, categorical type.

Comment 20: P10, L217-218, please elaborate more on "the total number of potential pixels or the land use demand was determined based on the reconstruction results in Section 2.2. Then, the area difference of land use type k between the target and current map was calculated." The resulting data from section 2.2 is the state level total area of urban, crop, pasture and forest, right? So, such 'area difference' is at the state level, right?

Response: Thank you for this suggestion. We implement the spatial allocation algorithm at state level, so the resulting data from section 2.2 is the state level total area of urban, crop, pasture and forest and the 'area difference' is also at the state level. We rewrite the spatial allocation process for both fractional LULC type and category type, please see Lines 235-266.

Comment 21: P10, L228-236, the LUH2 used for validation, but it was not mentioned in section 2.1 and Table 1.

Response: Thank you for this suggestion. We revised the material and methods section and add the description of LUH2. Please see Table A2.

Comment 22: P10 L229, please justify why the validation against NLCD was at state-level. As you highlighted that your land use data is at 1 km, a finer spatial resolution than most other data, so the validation at 1 km will be more informative about the value of this dataset. A good agreement on state-level total land use area does not necessarily indicate the spatial allocation of total area to 1 km is good as well.

Response: Thank you for this suggestion. The lack of actual spatial explicit reference data made a complete formal validation impractical. Though the LULC definitions in this study are different from other LULC datasets, data comparison is a way to access the accuracy of the reconstructed LULC area and spatial pattern. Thus, we conducted three data comparisons to increase the confidence of the newly developed LULC datasets. First, the state-level LULC area derived from the multisource datasets was used for comparison. Considering the differences in the cover period of multiple LULC datasets, we derived the average state-level statistics area for urban, cropland, pasture, and forest from 2000 to 2020 for comparison. Second, we collected the USDA county-level cropland area between 1840 and 2012 and compared the cropland proportion with that derived from our data in four selected years (1850, 1920, 1960, and 2002). Third, we compared urban, cropland, pasture, and forest from the newly developed LULC dataset with the NLCD during 2001–2019 at the grid level. Please see Section 3.1 (Lines 278-338).

Section 3.1.2

An accurate cropland map is quite critical for historical LULC reconstruction. We compared our data with county-level census data to assess the accuracy. This study's spatial pattern of cropland proportion (i.e., cropland area/county area) is close to the census data in 1850, 1920, 1959, and 2002 (Figure R5). In 1850, both the newly developed cropland and census data showed high cropland density in the BlackBelt, New England, and the North Central. In contrast, our data was higher in North Central, the east of Virginia and North Carolina, and the south of Georgia (Figure R5). Cropland derived from this study was higher than the census data in the Atlantic coast, the Mississippi Alluvial Plain, the northwest of Texas, the west of Oklahoma, and California in 1920, 1959, and 2002. However, the cropland proportion in the Appalachian Mountains and the south of the Great Plains was lower than the census data (Figure R5). This underestimation may result from the low cropland fraction in satellite data because it is difficult for satellite data to identify the small area cropland patch in the mountain region and classify the pasture or grassland with cropland in the south of the Great Plains. Moreover, both datasets showed the cropland expansion in the North Central, the Great Plains, the Mississippi Alluvial Plain, and California between 1850 and 2002. The cropland abandonment can also be found in the Appalachian Mountains between 1920 and 2002. The statistical comparison also shows that our data fits well with the census data in 1920 (R^2 = 0.68), 1960 (R^2 = 0.89), and (R^2 = 0.91) (Figure A2). Overall, the newly developed cropland has a relatively accurate spatial pattern and proportion.

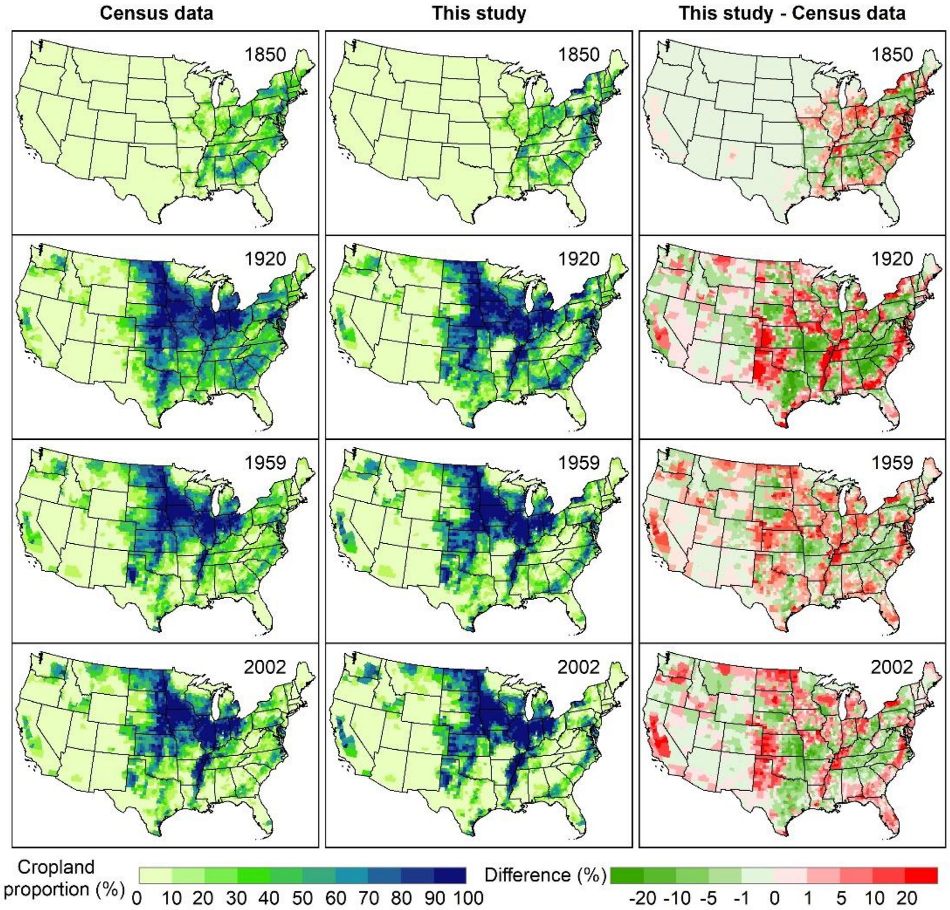


Figure R5. Spatial comparison of county-level cropland proportion between our reconstruction and census data in 1850, 1920, 1959, and 2002. First column: cropland proportion from census data; Second column: cropland proportion derived from this study; Third column: cropland proportion between this study and census data.

Section 3.1.3

The spatial patterns of urban, cropland, pasture, and forest in this study are close to the satellite-based data from NLCD, and most grid cells have a relatively small difference between 2001 and 2019 (Figure R6). Our results have a higher urban land fraction in the NLCD low urban density area, but the difference in 87% of urban grids is smaller than 10%. Cropland with a positive difference is mainly distributed in the Northeast, Alabama, and Missouri, in which 65.95% of grids have slight differences with less than 10% (Figure R6). 37.19% of grids have negative difference values and are mainly located in states with high cropland proportions. Moreover, most states in our data have a lower pasture fraction than NLCD data except in Oklahoma, Arkansas, Texas, and Georgia, and the grid cells with negative differences account for 39.82%. The reconstructed forest shows a higher density than NLCD in the South, Pacific coast, and

Great Lakes. It underestimates the forest fraction in the central states, such as Missouri, Kentucky, and Ohio. There are 58.80% grids whose differences are relatively small and with a range from -10% to 20% (Figure R6).

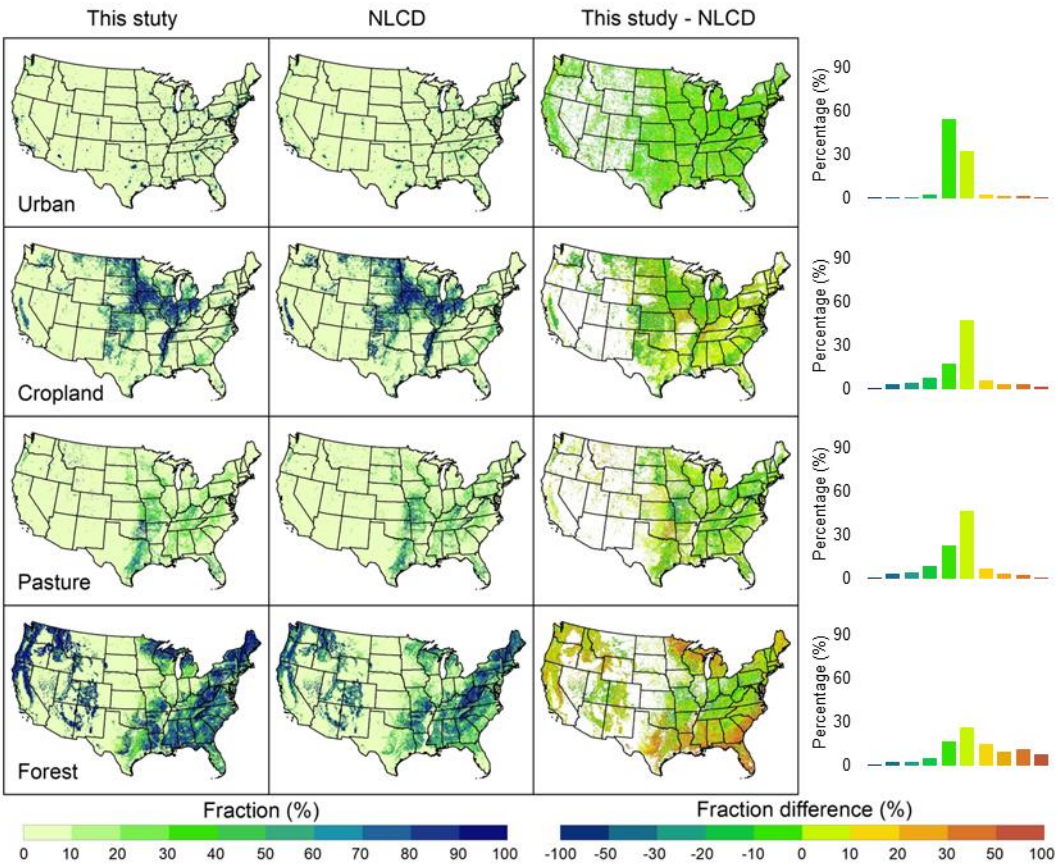


Figure R6: Spatial comparison between our reconstruction and satellite-based urban, cropland, pasture, and forest. First column: Reconstructed data in this study (average between 2001 and 2019); Second column: Satellite-based data (average between 2001 and 2019); Third column: Difference between first column and second column; Fourth column: Distributions of fraction difference between our reconstructed database and satellite-based data.

Comment 23: P11, Figure 4. Such comparisons to different datasets are very important and informative. However, I would suggest more discussion on the ‘outlier’ states in figure 4a and 4b. For example, please dig into which states your estimates of urban land area is lower than HISDAC? And what are the potential causes?

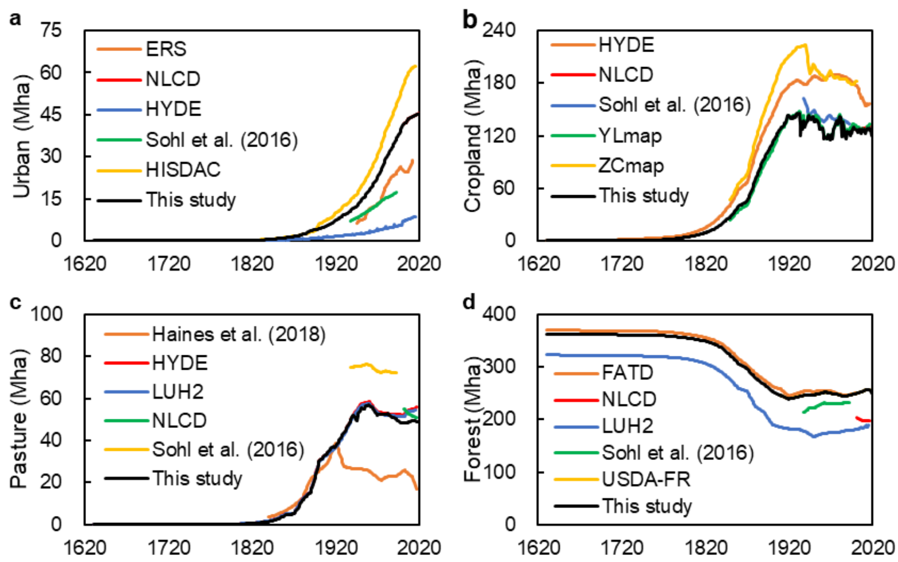
Response: Thank you for this suggestion. We revised this section and added more analysis about the differences between multiple datasets, please see Lines 279-296.

Comment 24: P14, L290-L300, is the transition in figure 7 the gross transition or net transition? Please clarify this somewhere because their magnitude and impacts on climate and carbon modeling are quite different. For example, 30% deforestation and 30% reforestation have zero transition on forest, but the biophysical effects could not be ignored.

Response: Thank you for this suggestion. We agree that the effects of LULC gross transition and net transition are quite different. Figure 7 shows the LULC net transition, that is the LULC difference in 1630, 1850, 1920 and 2020.

Comment 25: P17, Figure 9d, the black line stops at near 1920.

Response: Thank you for this suggestion. We revise the Figure 9.



Revised Figure 9: Comparison with other datasets for the conterminous United States: urban land (a); cropland (b); pasture (c); forest (d). NLCD: National Land Cover Database; HYDE: History Database of the Global Environment; HISDAC: Historical Settlement Data Compilation; ERS: Economic Research Service; YLmap: Yu and Lu (2018) cropland density; ZCmap: Zumkehr and Campbell (2013) historical fractional cropland areas; LUH2: Land Use Harmonization; FATD: Forest Area Trend Data; USDA-FR: USDA Forest Resources of the United States of 2017.

References:

Yu, Z. and Lu, C.: Historical cropland of the continental U.S. from 1850 to 2016, PANGAEA, https://doi.org/10.1594/PANGAEA.881801, 2017.

Zumkehr, A. and Campbell, J. E.: Historical U.S. Cropland areas and the potential for bioenergy production on abandoned croplands, Environ. Sci. Technol., 47, 3840-3847, https://doi.org/10.1021/es3033132, 2013.

Comment 26: P17, Figure 9a and 9c, even though NLCD is the input of urban land area to your method, there is a difference in temporal trend in urban area between NLCD and your dataset. Please discuss more about what assumptions cause such trend difference, and how it affects the reconstruction before the 2000s. Same discussion is needed for the pasture as the trend is even opposite.

Response: Thank you for this suggestion. We estimated the historical urban land area by multiplying the urban land per capita (average between 2001 and 2016) and state total population. The area difference between NLCD and our estimation was induced by the increase rate difference between urban land and total population. In the new method, the NLCD developed land area during 2001-2019 was set as the baseline. Considering the possible underestimation as you said in Comment 5, we revise the urban land estimation method by applying the HISDAC built-up area between 1810 and 2001. The new estimation method can be found in the response of Comment 5.

For the pasture, we compared the state level NRI and NLCD data. The definitions of pasture in NRI and NLCD are different. In NLCD, pasture/hay areas is land of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle. But pasture includes land that has a vegetative cover of grasses, legumes, and/or forbs, regardless of whether it is being grazed by livestock in NRI.

Comment 27: P20, L382-383, please explain why inventory-based data is more reliable than the satellite-based forest (NLCD) and biomass density-based forest (LUH2). Forests could have different definitions by various sources, and forest areas are subject to the definition, thus I could see which definition/data source is more reliable than others.

Response: Thank you for this suggestion. Exactly, it’s hard to say which forest data is more reliable because of the differences between forest definitions (Please see Table R1). In LUH2, the biomass density (BD) map is used to identify the potential forest

(BD > 2 kg C m^{-2}) and non-forest at 0.25° × 0.25° resolution (Hurtt et al., 2020), which underestimates the forest in the Rocky Mountain region and Northwest. NLCD is produced by using Landsat images and a comprehensive method and provides nationwide data on land cover and land cover change at a 30 m resolution. So, it can provide a more accurate spatial pattern than the LUH2. The FIA data provides critical status and trend information through a system of annual resource inventory that covers both public and private forest lands across the United States (https://www.fs.usda.gov/research/inventory/FIA), and it can provide a forest trend data back to 1630. Thus, we think that the forest area from FIA is more credible and consistent for long-term LULC change study.

Table R1. Forest definitions from different data sources.

Data source	Definition
FIA	Land at least 10 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for non-forest uses, with a minimum area classification of 1 acre (https://www.fia.fs.fed.us/tools-data/maps/2007/descr/yfor_land.php).
NLCD	Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover (https://www.mrlc.gov/data/legends/national-land-cover-database-class-legend-and-description).
LUH2	Forest was defined using a single tree canopy cover threshold to match the global forest extent provided by the FAO FRA report (Hurtt et al., 2020).

References:

Hurtt, G. C., Chini, L., Sahajpal, R., Frolking, S., Bodirsky, B. L., Calvin, K., Doelman, J. C., Fisk, J., Fujimori, S., Goldewijk, K. K., Hasegawa, T., Havlik, P., Heinimann, A., Humpenoder, F., Jungclaus, J., Kaplan, J. O., Kennedy, J., Krisztin, T., Lawrence, D., Lawrence, P., Ma, L., Mertz, O., Pongratz, J., Popp, A., Poulter, B., Riahi, K., Shevliakova, E., Stehfest, E., Thornton, P., Tubiello, F. N., van Vuuren, D. P., and Zhang, X.: Harmonization of global land use change and management for the period 850-2100 (LUH2) for CMIP6, Geosci. Model Dev., 13, 5425-5464, https://doi.org/10.5194/gmd-13-5425-2020, 2020.