Maximizing ArcGIS Pro for The Crop Sequence Boundaries (CSB) Project

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Session: Optimize Crop Zoning and Land Planning Boundaries
Date & Time: Thursday, July 13, 2023, at 10:00 am PST
Room: 28B

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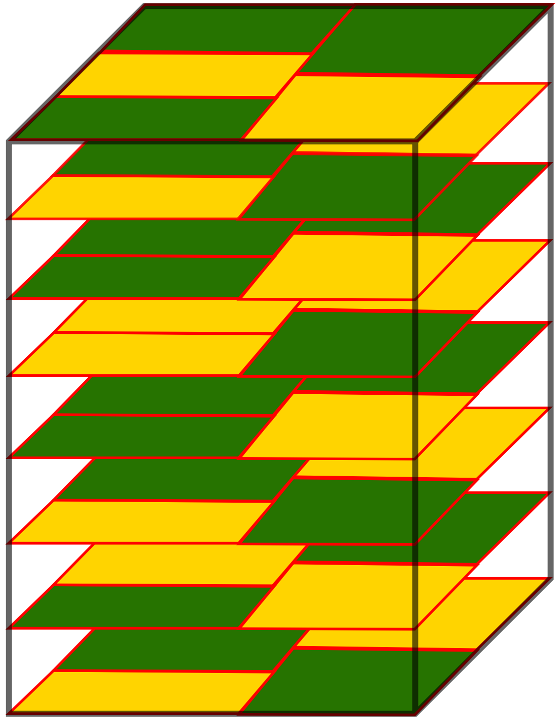
Presentation outline

1. What are Crop Sequence Boundaries (CSB)?
2. Motivation for CSB
3. Study area
4. Methodology
5. Results
6. Conclusion
7. CSB public release information

What are Crop Sequence Boundaries (CSB)?

CSB represent **field-level boundaries** over a **set time frame** in a **homogenously** cropped area.

1. Automatically delineated fields
2. Homogenously cropped areas over a set time frame
3. Physical boundaries and boundaries between different crop types
4. Coverage is complete for the contiguous US



Motivation for CSB

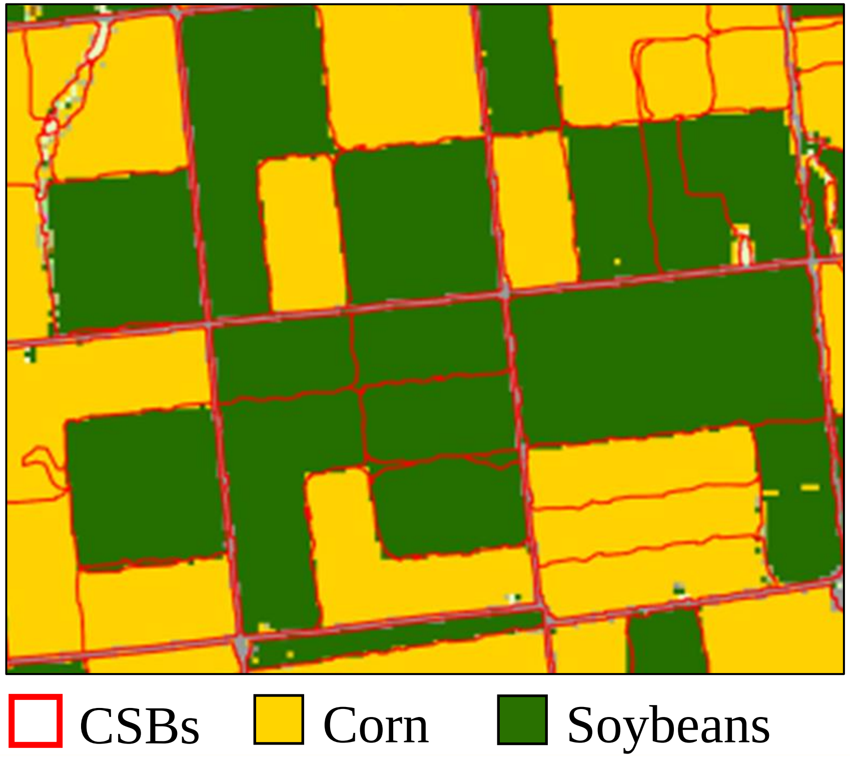
Many automatically delineated field polygons exist

- Almost all are **small area pilot studies**

Need for a contiguous US product that is derived from the NASS Cropland Data Layer (CDL)

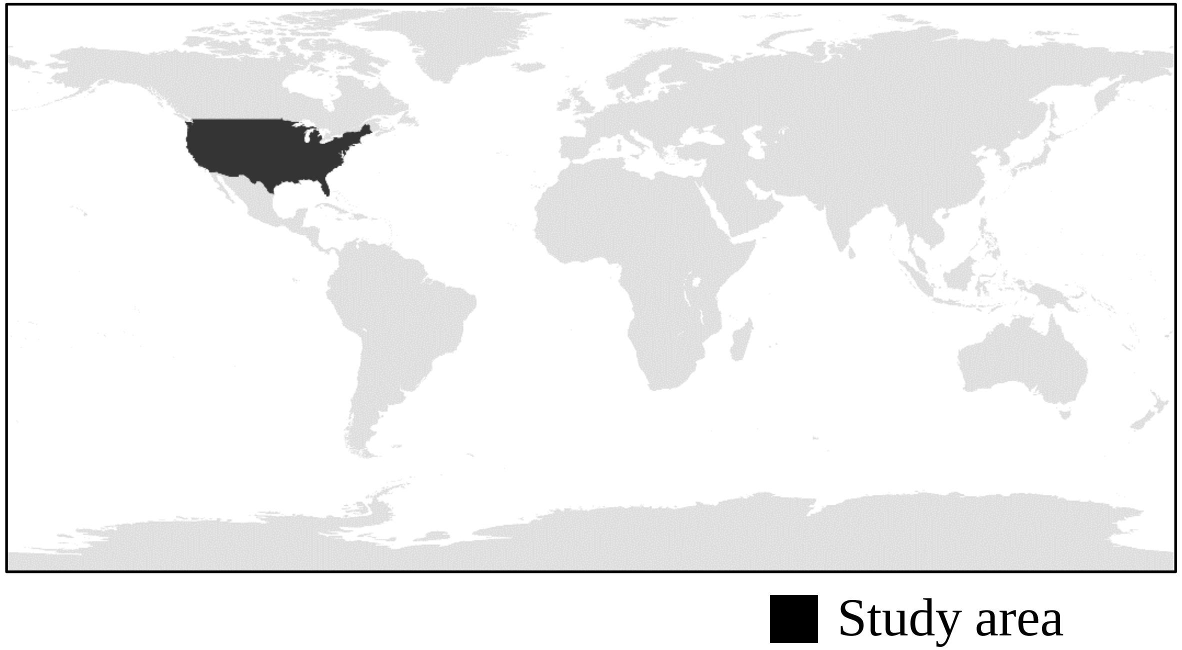
- Can be used as a **standard foundation for crop field level** geospatial analysis
- That is **publicly available** for download

2013-2020 CSB layer (red outline) in McLean County, IL, overlaid onto CDL



Study area

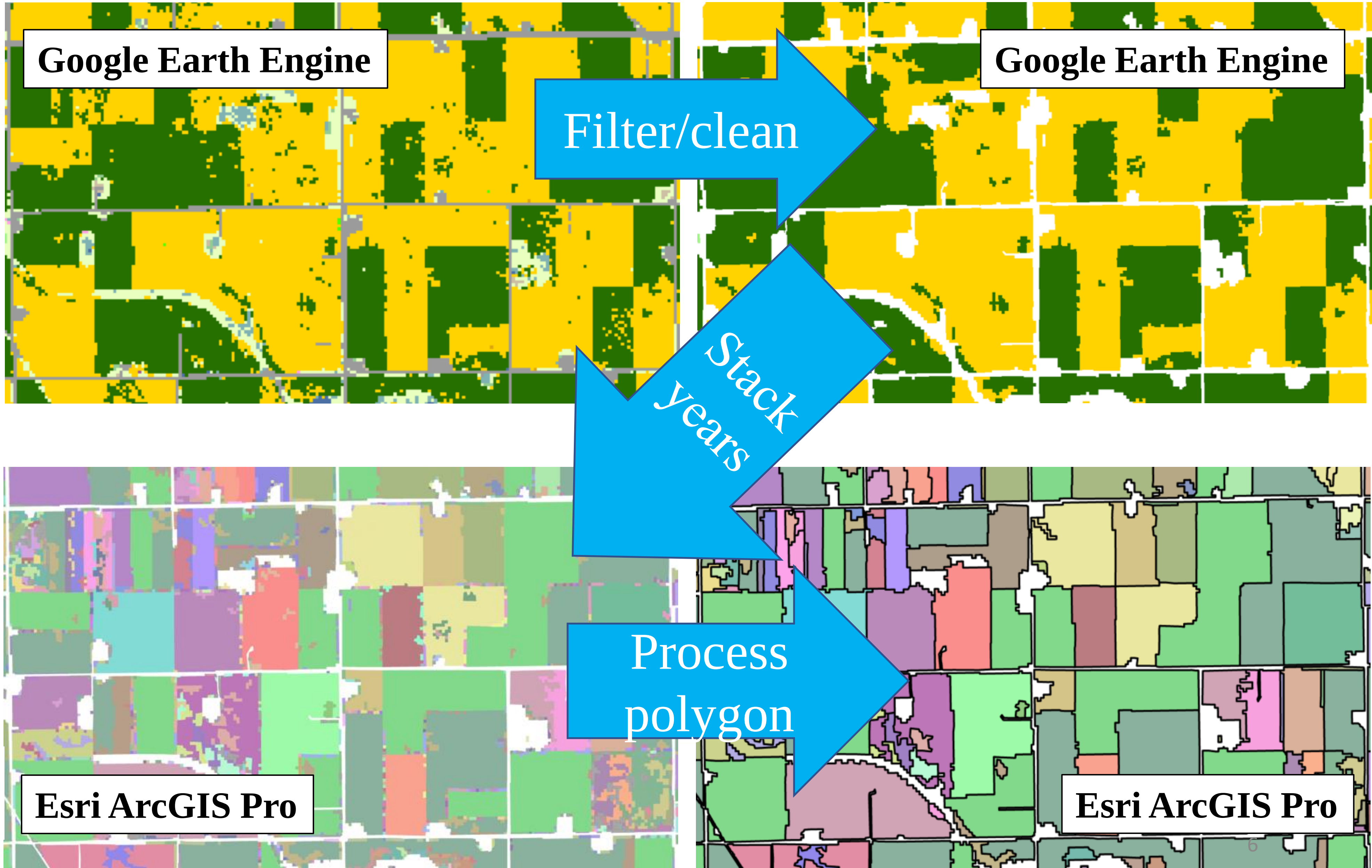
- The CSB project began in 2020
- Piloted for Illinois, US and expanded to the contiguous US
- CSBs are created for all years between 2008 to 2022 using 8-year time frames (i.e., 2015-2022)
- CSB areas compared to estimated corn and soybean planted acres



Methodology overview

Basic geospatial-processing steps for creating polygons from the CDL:

High performance cloud computing



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Methodology

CDL Processing In Google Earth Engine

1. Resample CDL to 10m
2. Reclassify CDL to Simple Classes
3. Filter Multiple Times (focal-mode)
4. Re-impose Road / Rail Network
5. Export Desired Years and Extent

ArcGIS Pro Raster Prep In Cloud

1. Split Raster by Sub-Regions
2. Stack Years into Unique Raster
3. Remove Non-Cropland (n-n, n-1)

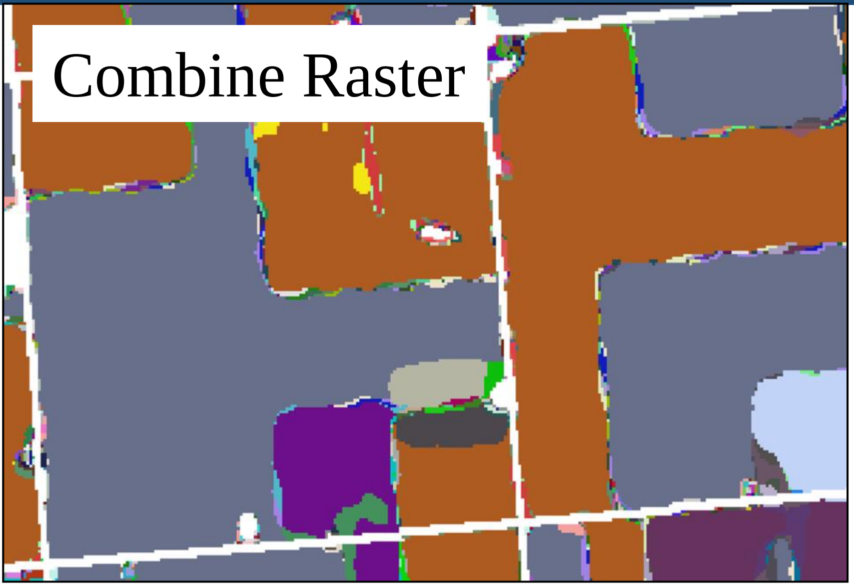
ArcGIS Pro Vector Processing In Cloud

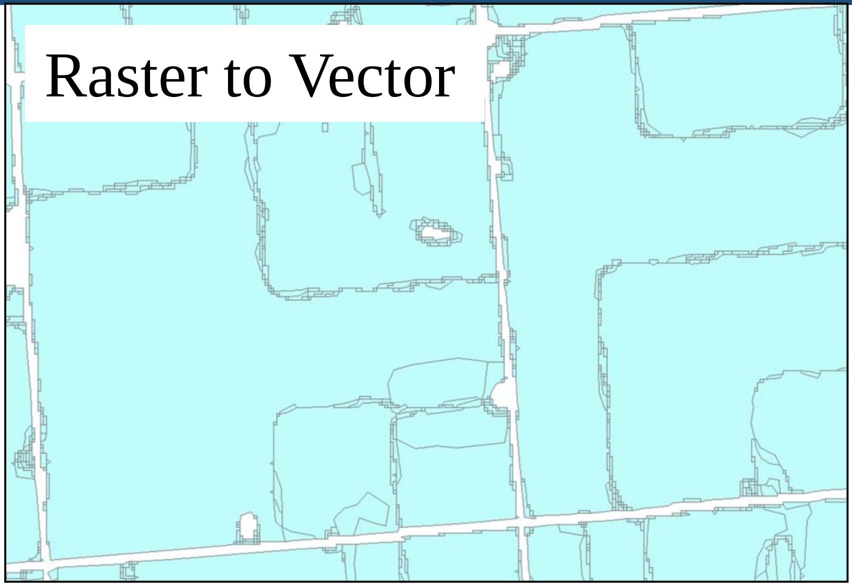
1. Convert Raster to Polygons
2. Project to Albers Conical
3. Eliminate under 1 ha into Neighbor
4. Export Polygons Over 1 Hectare

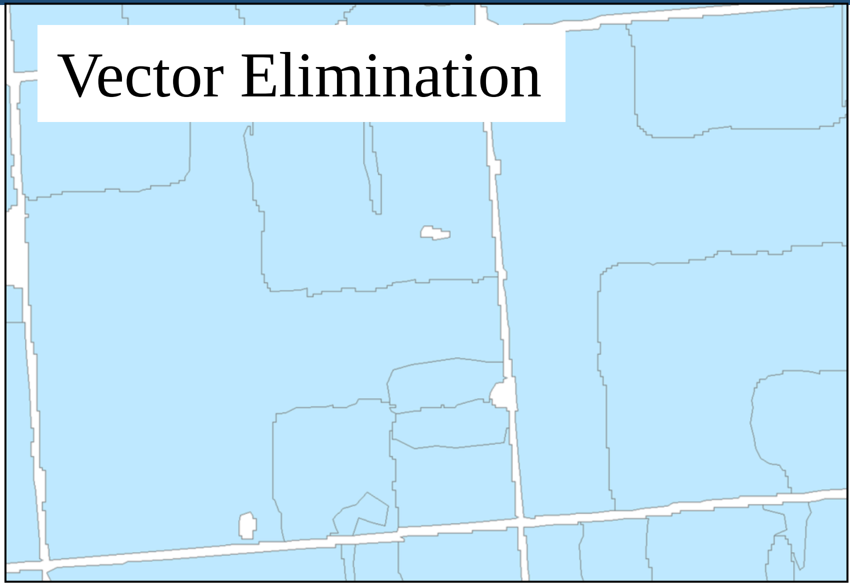
ArcGIS Pro Post-Processing In Cloud

1. Merge to State or contiguous US
2. Create Unique Identifying Code
3. Populate Attribute Table
4. Package for Distribution

Methodology







Tuning methods:

- Using too many years- split fields too much
- Using too few years- does not divide fields enough
- Filtering too much – soften edges
- Filtering too little – leaves islands
- Many choices for fixing edge noise

Contiguous US has about 19.5 million unique polygons

National results for corn and soybean

	Corn			Soybean		
Year	Published* (planted acres)	CSB (acres)	Error (%)	Published* (planted acres)	CSB (acres)	Error (%)
2015	88,019,000	89,888,422	2.1%	82,660,000	87,120,721	5.4%
2016	94,004,000	96,665,222	2.8%	83,453,000	87,644,495	5.0%
2017	90,167,000	93,440,276	3.6%	90,162,000	96,119,359	6.6%
2018	88,871,000	92,904,634	4.5%	89,167,000	95,515,323	7.1%
2019	89,745,000	93,459,732	4.1%	76,100,000	80,548,849	5.8%
2020	90,652,000	95,060,605	4.9%	83,354,000	88,401,544	6.1%
2021	93,252,000	97,139,581	4.2%	87,195,000	93,138,351	6.8%
2022	88,579,000	93,071,290	5.1%	87,450,000	94,088,968	7.6%

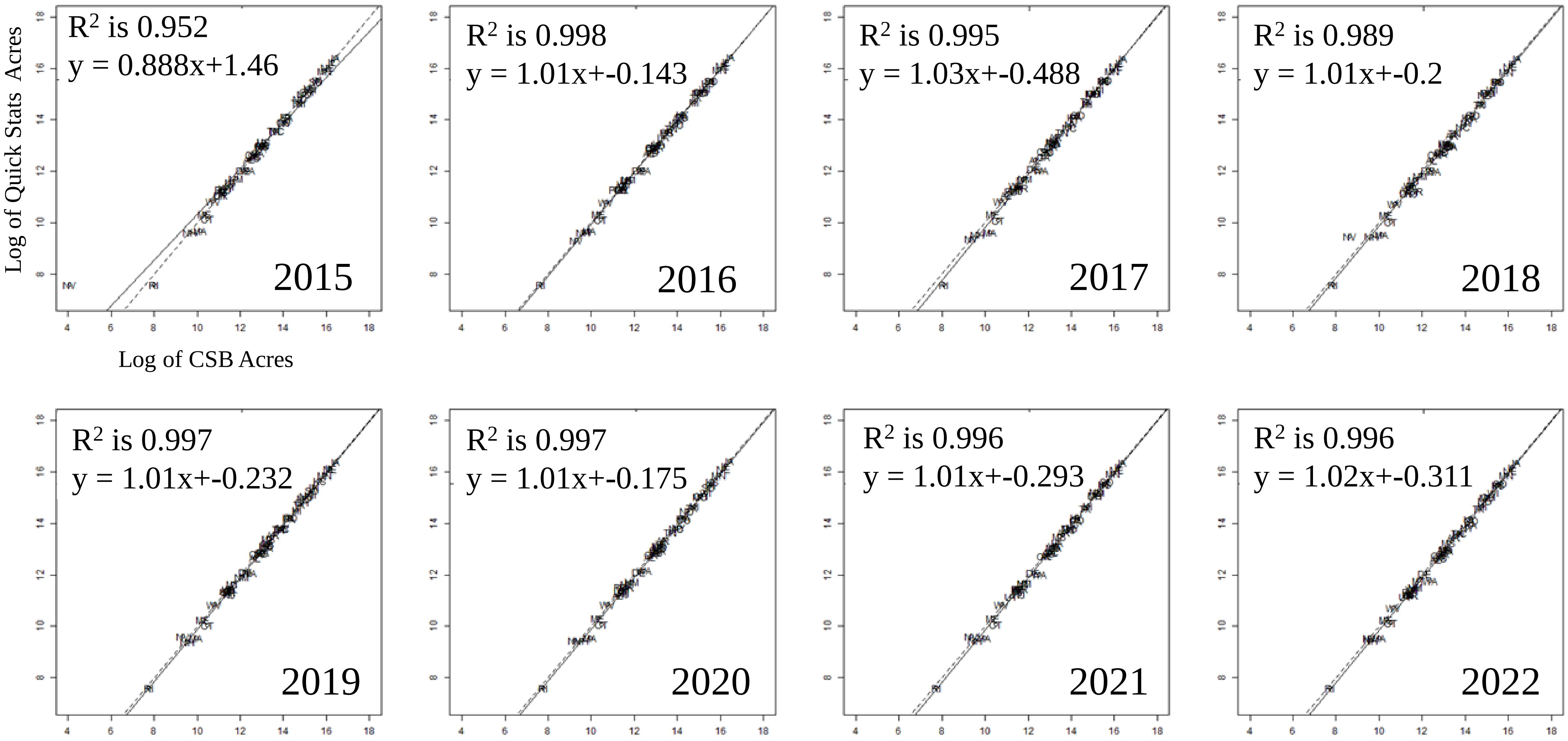
*Official estimates published by USDA-NASS
https://quickstats.nass.usda.gov/

$$PE_{crop} = \frac{A_{crop} - T_{crop}}{A_{crop}} \text{ x } 100$$

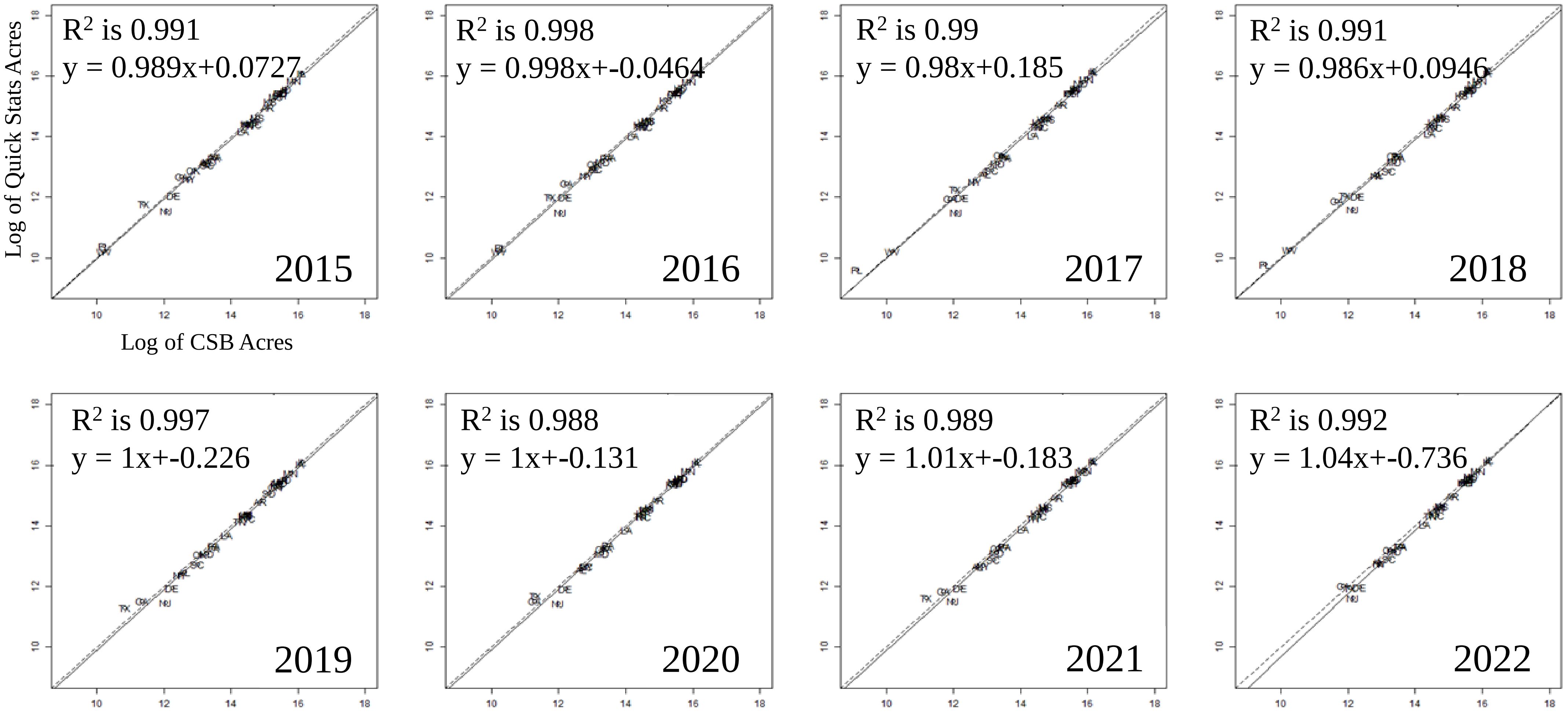
PE is the percent error, A_{crop} is the CSB acres, and T_{crop} is the Quick Stats planted acres

United States Department of Agriculture
National Agricultural Statistics Service

State results for corn



State results for soybean



Conclusions

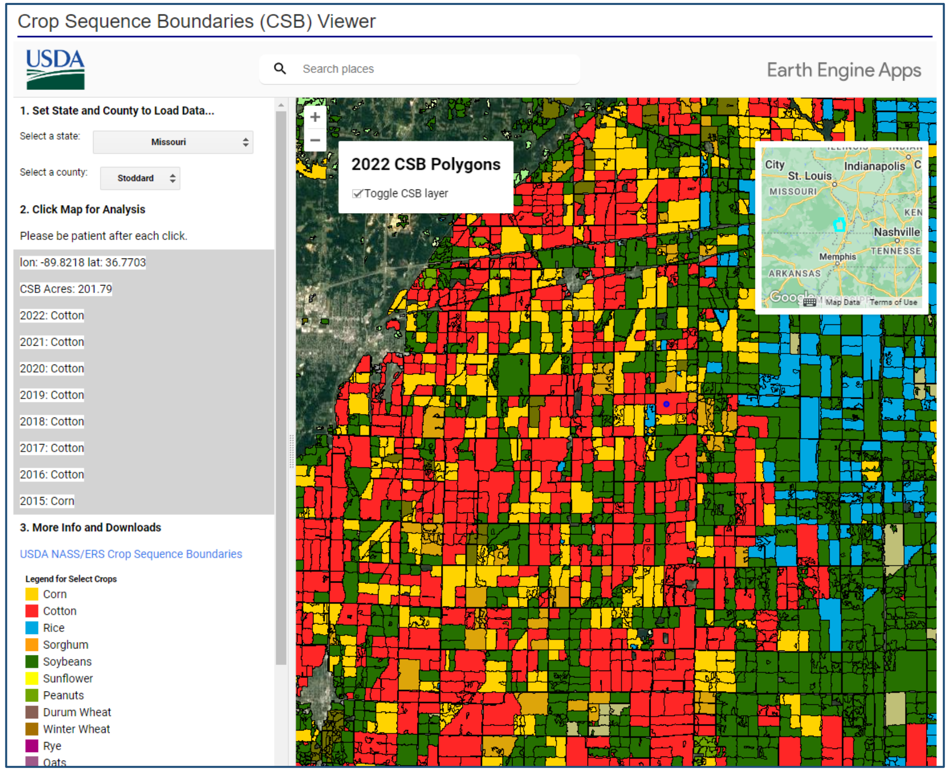
- A **repeatable automated process** for building crop field polygons
- Now **producing large area products** because of advancements in cloud computing
- Prioritizing a **uniform spatial and temporal methodology** which produces a streamlined product but likely at the cost of accuracy
- Future versions need to account for **local variability** and may have to incorporate new considerations and advancements in the research
- Extremely useful **applications** including aggregating gridded data, improving satellite-based estimates of tillage, cover crops and other practices, predicting preseason planted acreage and providing a standard for field-level research

CSB public release information

Link - **https://www.nass.usda.gov/Research_and_Science/Crop-Sequence-Boundaries/**

- Interactive map to explore data
- GDB datasets are available for download
- On GitHub algorithm is available

Released this July!



Example of CSB interactive map

Thank you

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