



AUG 25, 2021

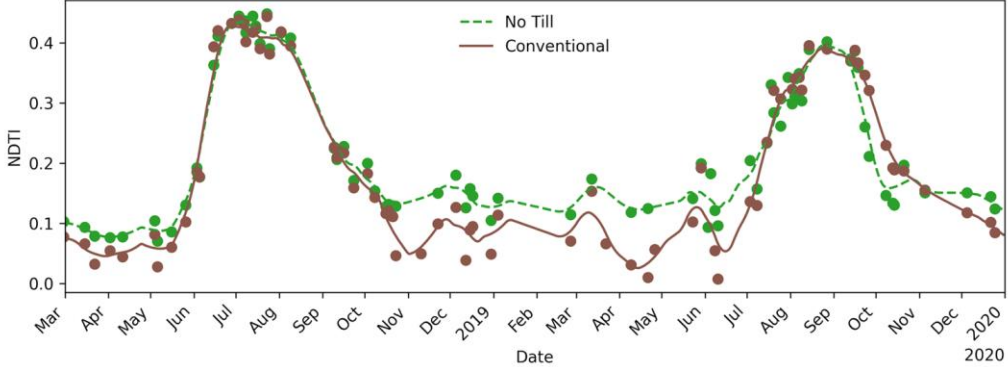
# Ground-truth data for remote sensing of tillage and cover crop practices

 indigo™

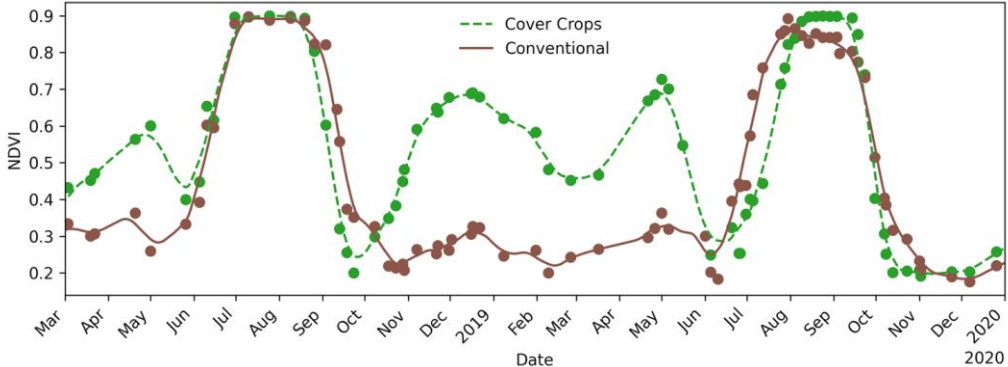
# Indigo Atlas is a suite of remote sensing products for agriculture

Indigo has developed remote sensing tools for monitoring cover crops, tillage practices, and crop identification

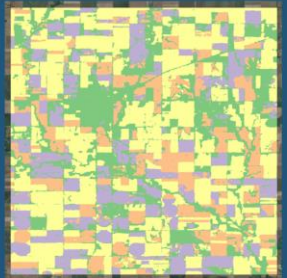
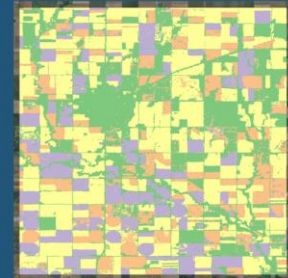
Tillage Practices



Cover Crops



Crop Identification





Predicted - 2018

Actual - 2018

- Wheat
- Soybean
- Corn
- Not Crop

# There are two types of ground truth data with distinct value

	Event Data	Direct Observation Data																								
Example	<p>Tabular record of events</p> <table border="1"> <thead> <tr> <th></th> <th>Date</th> <th>Area applied</th> <th>Detail 1</th> <th>Detail 2</th> <th>...</th> </tr> </thead> <tbody> <tr> <td>Event 1</td> <td>X</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Event 2</td> <td>X</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>...</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		Date	Area applied	Detail 1	Detail 2	...	Event 1	X					Event 2	X					...						<p>Downward facing picture with time and location</p> <div style="display: flex; justify-content: space-around;">   </div>
	Date	Area applied	Detail 1	Detail 2	...																					
Event 1	X																									
Event 2	X																									
...																										
Pros	<ul style="list-style-type: none"> <li>- Records of actions that farmers have or have not done</li> <li>- Useful for validation of detection, inventories, etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Quantitative - More directly tied to the artifact being detected by imagery</li> <li>- Useful for calibration to tune remote sensing models</li> <li>- Can allow for standardization across sources</li> </ul>																								
Cons	<ul style="list-style-type: none"> <li>- Qualitative – can be ambiguous</li> <li>- Obscures significant detail; if cover crop planted, how robust was the stand? If reduced tillage, what was the % residue?</li> </ul>	<ul style="list-style-type: none"> <li>- Without the event data, can be challenging to interpret without significant expertise</li> <li>- Observation can vary significantly across days</li> </ul>																								
Advice	<p>If possible, ask growers to share both!</p>																									



# Ground truth from “uncalibrated” sources

Standardization in language and aids (examples, visual rubrics, etc.) play an important role in ensuring data is comparable across sources

- Example – Tillage
  - Tillage method may not be specific enough – variables of interest are area and depth of disturbance, residue coverage
- Example – Cover crops
  - Capturing that cover crops planted may not be enough – variables of interest may be emergence ratings, important to discriminate between cover crops, weeds and winter cash crops (especially during early growth stages)
- Accuracy
  - Consider if supporting evidence/information is worth capturing
    - i.e., for a planting date, confirm with dates from planter machine data or records in FMS



# Capture variability in time and space

- Temporal variables
  - Within season
    - Capture externalities that impact biomass or field coverage
  - Between season
    - Multiple seasons on same field are helpful to parse out weather driven variables
- Spatial variables
  - Need sufficient coverage of soil types, microclimates, topographies, to accurately project across the entire area



Date of peak winter greenness on ARS LTAR farm in Caroline Co., MD – 2021 (top) vs. 2019 (bottom)  
(from: [phenocam.sr.unh.edu](http://phenocam.sr.unh.edu))