Conservation Technology Information Center

Viridis View Methodology Details for Iowa State University

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About Iowa State University

Iowa State University has tracked site-specific conservation practices as GIS records for many years for the state of Iowa and the INRS. The Daily Erosion Project uses BMP maps in addition to remote sensing of tillage, cash crops, and cover crops to estimate erosion daily across hundreds of thousands of hillslopes across the Corn Belt. These records are combined with other climate and soil property files to create daily Water Erosion Prediction Project files. Online at www.dailyerosion.org/map.

The history and evolution of our **Tillage** estimation methodology

Tillage and residue cover estimates are made using a methodology refined over the last couple decades for the Daily Erosion Project (dailyerosion.org). Recent estimates use the methodology detailed in Williams et al. 2024 and detailed on our Github page. This approach uses Google Earth Engine to search multiple Landsat images for the lowest Normalized Difference Tillage Index out of at least 3 during the spring tillage season. Images are removed from consideration by NDVI and NDMI thresholds to remove too green and too wet raster cells. A regression between NDTI and observed residue cover in a few hundred fields across Iowa was developed and found to predict residue cover with reasonable accuracy. Tillage index values were compared across other Midwestern states on corn and soybeans and found to be similar to Iowa values.

The history and evolution of our **Cover Crop** estimation methodology

Our cover crop detection began 2 years ago, focusing on manually digitized training points each season, which worked but didn't scale well across years or new geography. The current methodology replaces that manual step with automated, image-derived endmember extraction grounded in recent remote sensing literature: each year we mine representative cover crop, residue, soil, and non-ag green signatures directly from that season's Sentinel-2 imagery, then feed them into a pixel-wise spectral unmixing model (MESMA-lite) that estimates fractional cover crop cover per pixel rather than a binary presence/absence call. This shift was driven by the need for a system that scales across years and geography without re-digitizing training data

each growing season. The next major step is refining these products with more ground-truthed data and testing.

Row crop lands included in our estimates

Corn (maize), Soybeans

Our imagery source(s), bands, filters, indices, and date ranges

We use Google Earth Engine with Sentinel-2 Surface Reflectance (10 spectral bands, QA60/SCL cloud masking) to derive NDVI, NDRE, NDTI, and a SWIR ratio for calibration and gating. We build fall (Nov 15-Jan 15) and spring (Apr 15-May 30) composites each year, with a Sentinel-1 radar gate (Jul-Oct) flagging harvest timing. Cropland extent comes from USDA NASS CDL (2-year corn/soy union). A 5-year bare-soil Sentinel-2 composite (low-NDVI, low-NBR2) supports our soil endmember.

How we classify the presence or absence of **Cover Crops**

We classify cover crop presence using a spectral unmixing approach (MESMA-lite), where each pixel is treated as a blend of a small set of reference spectral signatures — residue, cover crop, soil, and in spring, non-ag green vegetation. These reference signatures aren't static; we re-derive them each year directly from the imagery by sampling thousands of points across known corn/soy fields and pulling representative percentile signatures from the highest-scoring candidates. For every pixel, we test all plausible combinations of these signatures and keep whichever one best reconstructs the pixel's actual spectrum. The resulting cover crop fraction is gated by NDVI/NDRE thresholds and cropland masking, then spatially filtered to reduce noise. Fields are marked as present and recorded when both time frames have detection results. This method is applied uniformly across our full project.

How we categorize **Tillage**

We categorize tillage using the residue fraction output of a pixel-wise spectral unmixing model (MESMA-lite), the same approach used for cover crop detection. For each pixel, we test combinations of residue, cover crop, and soil endmember signatures and keep whichever reconstructs the observed spectrum with the lowest error, yielding a continuous residue percentage rather than a binary class. Our tillage section focuses only on corn and soybean fields. That percentage is then binned using after-planting residue-cover thresholds consistent with CTIC conventions: 0-15% residue as Conventional till, 15.1-30% as Reduced till, and above 30% as No-till. We derive these residue values from our spring composite (April 15-May 30), the window that best approximates post-planting field conditions. These cutoffs are applied uniformly to fields across our full project area — they do not vary by region.

Our efforts to quantify estimate accuracy

Formal accuracy quantification against independent field observations or an external tillage/cover crop survey has not yet been completed; that is the next planned step for this methodology. In the meantime, our only built-in quality check is internal to the unmixing process itself: for each pixel, we evaluate the reconstruction error between the predicted and observed spectrum, which flags where the selected endmember combination fits poorly. Rather than deriving thresholds from scratch, our broader literature review spans nearly 40 recent peer-

reviewed articles on cover crop and residue remote sensing, from which we drew the methodological approaches best suited to this pipeline. We would characterize this cycle's results as a first-pass computational estimate rather than a field-validated product.

Published references describing our estimation methodology

Ph.D. research underway, publications forthcoming

Other conservation-related datasets that we could potentially make available to interested parties

The Iowa State University GIS Facility has developed 2010 and 2020 vintage datasets delineating edge-of-field Best Management Practices for the state of Iowa. BMPs were analyst derived using lidar and aerial imagery.

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