Operational Tillage Information System

USING REMOTE SENSING DATA TO MAP CONSERVATION AGRICULTURE PRACTICES

This no-till soybean crop is off to a great start with high organic matter from last year's corn. © Paige Buck, USDA-NRCS Illinois

Agriculture's footprint in the U.S. spans all 50 states and accounts for more than half of the U.S. land base—1.2 billion acres, including more than 200 million acres of row crops like corn, soybeans, wheat, cotton and rice. Tillage practices and winter cover crops on these row crops have a significant impact on productivity and environmental outcomes, including soil erosion, water quality, carbon sequestration and soil health.

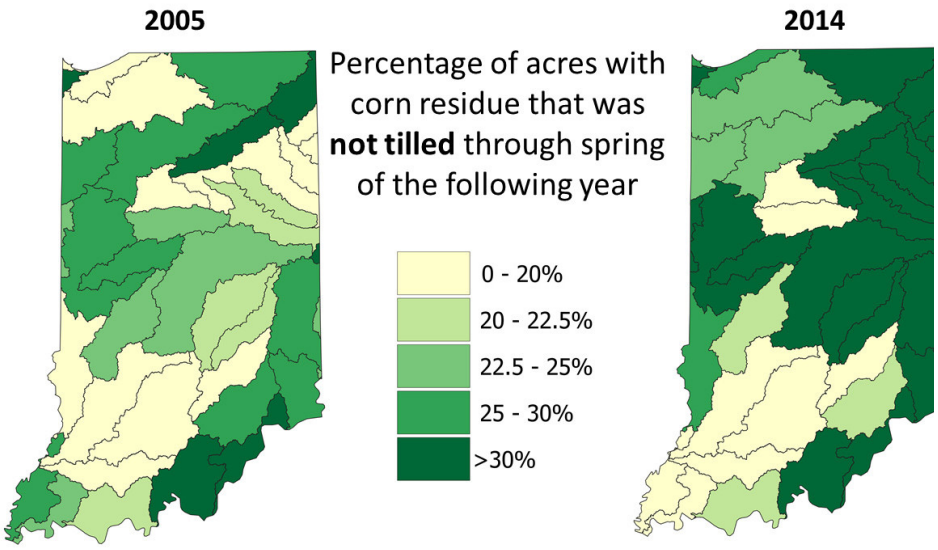
Applied GeoSolutions (AGS) has developed an **automated system to monitor the usage trends of tillage and cover crop practices over large agricultural areas.** Called the Operational Tillage Informational System (OpTIS), this system produces accurate, timely and spatially comprehensive maps of crop emergence, crop residue cover and winter cover crops annually using information from multiple earth-observing satellites. Taken together, this will lead to an accurate estimate of the area being farmed to promote soil health.

In collaboration with the Conservation Technology Information Center (CTIC) and The Nature Conservancy, AGS is applying OpTIS technology and the DeNitrification-DeComposition (DNDC) model—a computer simulation model of carbon and nitrogen biogeochemistry in agroecosystems—to map trends in soil health management practice adoption and to estimate the associated nitrous oxide emissions, nitrate loss, soil organic carbon, and water holding capacity benefits associated with these trends.

While OpTIS calculations are performed and validated at the farm-field scale using publicly available remotely sensed data, the privacy of individual producers is fully protected by reporting only spatially-aggregated results at much larger scales (i.e., HUC 8 watershed and USDA Crop Reporting District).

Multiple cover crop species help to improve soil health and overall production capacity. © Ron Nichols, USDA-NRCS

An aerial-applied rye grass cover crop grows between harvested corn rows in southwest Iowa. © Jason Johnson, USDA-NRCS Iowa



Remote sensing technology, combined with computer analytics, has proven to be a cost-effective, accurate method to gain valuable insight into the adoption of conservation practices across America's croplands, including those practices related to improved water quality and soil health. © CTIC

OpTIS Benefits Conservation and Business Stakeholders

Maps produced by OpTIS and DNDC will fill critical gaps in understanding recent trends in conservation practices and soil health, as well as set a baseline of adoption against which future progress can be tracked. The application of this information is vitally important to multiple private and public stakeholders.

For instance, OpTIS can help:

- **Soil and Water Conservation Districts** establish program priorities and evaluate progress in achieving county or statewide goals.
- The **U.S. Environmental Protection Agency** and state governments to track progress and better focus efforts to meet the Gulf of Mexico Hypoxia Task Force goals.
- Stakeholders throughout the **agri-food system supply chain** better understand market trends that impact environmental sustainability.
- **Conservation organizations** better focus efforts to improve soil health and water quality.
- **Regional and national agriculture agency offices** evaluate and compare the effectiveness of conservation programs across large regions.
- **Academic researchers** model water quality and the carbon cycle.

Historical Perspective and Next Steps

Starting in the late 1980s, CTIC compiled and distributed Crop Residue Management survey data collected by federal, state, county and conservation district personnel in extensive transect programs across the row-cropping regions of the U.S. While the data from this effort was integral to the nation's understanding of conservation tillage trends, data collection efforts at the federal level ended in 2004.

During the intervening years, CTIC has championed efforts to re-start the collection and dissemination of data, leading to the collaboration with AGS and the Conservancy on OpTIS. Given the scale and importance of these data to stakeholders in government, industry, and academia, it is clear that even greater levels of public and private collaboration will be required to operationalize and sustain this effort at the national scale. AGS, CTIC, and the Conservancy are committed to making this vision a reality.

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Field measurements help to validate remote sensing data. © AGS

Documenting OpTIS Success

Applied GeoSolutions (AGS), in collaboration with Conservation Technology Information Center (CTIC), conducted a pilot project to test, ground-truth and document the capability of the Operational Tillage Information System (OpTIS) to consistently map tillage practices and cover crops in Indiana from 2006 to 2015.

Funded as a collaborative public-private partnership, the pilot project produced county and watershed level maps of conservation tillage and cover cropping at an annual time step, as well as a comprehensive report outlining the performance of the system.

Building on the success of the Indiana pilot project, **AGS and CTIC are now collaborating with The Nature Conservancy and other partners to apply OpTIS across the U.S. Corn Belt** for the years 2005-2017, with plans to expand the application to all U.S. agricultural regions.

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