Tracking soil loss trends on ag lands

Remote sensing that indicates crop residue, cover crops is the latest tool from University of Minnesota researchers and BWSR in soil erosion data collection

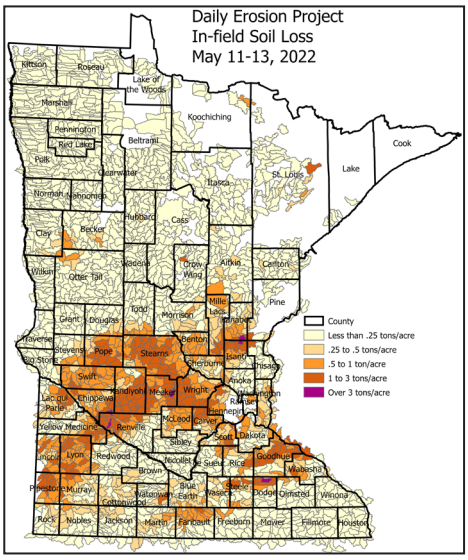
Financial support for the Daily Erosion Project web application comes from a direct legislative appropriation to BWSR from the Legacy Amendment's Clean Water Fund.

Soil erosion by water and wind is common across all of Minnesota's diverse landscapes, but preventing excessive erosion is critical to ensure the long-term productivity of the state's rich soils and to keep its surface waters clean and clear for future generations.

One of the Minnesota Board of Water and Soil Resources' (BWSR) roles is to track annual soil erosion on agricultural lands.

Today, we don't see the catastrophic soil loss of the 1930s Dust Bowl, when wind erosion carried away inches, sometimes feet, of topsoil. Nor have we seen towns buried by sediment, as they were after heavy rains in southeastern Minnesota's Whitewater River valley during the same period. Those events spurred the development of what today is the USDA's Natural Resources Conservation Service (NRCS), and the formation of soil and water conservation districts in Minnesota.

Improvements to agricultural and forestry management practices have curbed such widescale soil loss. But soil losses



greater than tolerable limits still occur. BWSR works with its many federal, state and local conservation partners to track, mitigate and prevent soil loss.

Researchers, lawmakers and BWSR's partners identified the need to modernize the state's approach to tracking long-term soil-loss trends and land cover changes

Above: *The heavy rains on May 11 that caused widespread damage throughout Central Minnesota also caused field erosion, including in Stearns County's Lake George Township west of Highway 71.* **Photo Credit:** Stearns County SWCD

Left: *DEP mapping depicts the results of the intense storms May 11-13 in Central Minnesota. Many watersheds this spring posted record in-field soil loss on May 12. Such a storm would have resulted in very little erosion or runoff in August with full crop canopy and drier conditions. But with little cover and saturated soils in May, the DEP model predicted high erosion rates.* **Map Credit:** BWSR, University of Minnesota

that help to reduce the impacts of wind and water erosion.

Since 2016, BWSR has partnered with the University of Minnesota's Department of Soil, Water, and Climate; Iowa State University; and soil and water conservation districts to track spring crop residue levels, fall cover crop emergence and in-field soil loss through the Daily Erosion Project (DEP) web application.

Financial support comes from a direct legislative appropriation to BWSR from the Legacy Amendment's Clean Water Fund.

University of Minnesota researchers have developed sophisticated remote-sensing techniques to distinguish cover crops from crop residue, and to view that data by county, watershed and agro-ecoregion boundaries. In recent years, additional satellites launched from NASA's Landsat and the European Space Agency's Sentinel programs have enabled remote sensing to be used as a viable method of processing this information.

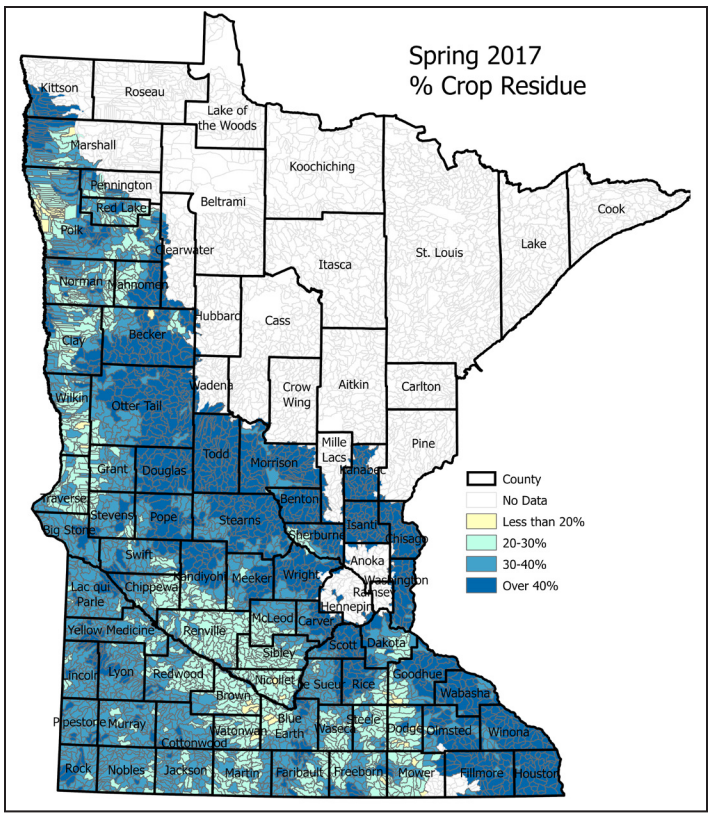
"Utilizing remote sensing techniques allows for efficient and consistent collection of data over time that will enable us to develop long-term trends in changes in crop residue management, tillage practices and adoption of cover crops by farmers," said Matt Drewitz, who coordinates the effort as part of his role as BWSR's measures and outcomes coordinator and project manager.

This summer, BWSR and the University of Minnesota plan to publish the geospatial data layers for crop residue cover and cover crop emergence on the MnGEO Commons.

The methods Iowa State developed for measuring in-field soil erosion in the 2000s have been updated. Minnesota and other neighboring states have begun to adopt the DEP application as their means to track daily and annual soil loss. Tracking annual soil loss through the DEP involves incorporating remote sensing data from crop residue. A wide range of inputs such as elevation models, soils, precipitation and land use are brought into this model to predict runoff and in-field soil loss.

The model is updated daily. With results from 10-plus years available, users can quickly see the effects of a single storm or the effects of soil loss over many years.

"We're mostly measuring the larger impacts over time, so then we can see trends in erosion, or see what parts of the state have the greatest amount of erosion," Drewitz said. The DEP captures a 25,000- to 30,000-acre watershed scale. "The tools that we're looking at here look at the big picture, but it's still going to come down to our local partners to work on the field-scale with the farmers, our SWCD and watershed folks."



Data from 2017 depicts crop residue levels from a relatively average year with good spring planting conditions. In years with very wet falls and/or challenging spring planting conditions, crop residue levels have trended higher. **Map Credit:** BWSR, University of Minnesota

It's one more piece of scientific information decision-makers can use to guide watershed implementation and planning. The map format clearly, concisely and instantly relays information.

In the case of storms such as those Central Minnesota experienced May 11-13, data will provide a more immediate and consistent picture of the location and extent of soil loss. Previously, BWSR collected that data from a host of sources — including visual surveys by SWCD staff members who might have different methods and interpretations.

"Three years ago, we couldn't have shown that map. We (would) know something happened, we just (wouldn't) know the extent. For us at BWSR, it's a way to scientifically track and know for certain what the impact area is," Drewitz said. "It makes it more consistent across the state. (Before), we knew anecdotally, or we'd have pictures, but we didn't have this way to measure the soil loss impacts of a major storm across a wide area."

DEP updates planned for the next year include daily wind erosion and wind speed readings. Wind erosion events are not as common, but they can be significant. The derecho windstorm that swept through Nebraska, South Dakota, Iowa and parts of southwestern Minnesota this spring affected not only soil loss but also the health and safety of those in its path.

"New capabilities such as the ability to predict wind erosion are being added to DEP to increase the utility of the tool for users from state and local agencies, conservation groups and agricultural commodity groups and their producer members," said David Mulla, a University of Minnesota Soil, Water, and Climate Department professor involved with the research.

Management practices that help prevent the loss of soil by wind and water continue to improve and evolve. Direct investments by landowners and assistance from federal and state conservation and clean water programs have made significant strides to curb the effects of soil erosion. The data collected and measured are foundational to tracking long-term trends for future generations.