

Studying Midwest soil erosion from space

April 20 2018, by Isaac Larsen



The agricultural landscape south of Clear Lake, Iowa, where UMass Amherst geoscientist Isaac Larsen grew up. The light-colored patches in plowed fields are areas where dark-colored, organic-rich topsoil has been lost to erosion. Larsen has a new grant from NASA to use satellite images to study soils in the Midwest. Credit: Google Earth

Geologist and geochemist Isaac Larsen at the University of Massachusetts Amherst is used to tramping around in the dirt to conduct his soil research, but satellite photos of the Iowa farmhouse where he grew up have added a new dimension to the work, and he now has a grant from NASA to study soils in a whole new way, from space.

An expert in soil production, erosion, human impact and the evolution of the agricultural landscape, Larsen has been awarded a three-year, \$265,000 New Investigator Program grant from NASA's Earth Science Division, which supports innovative research by earth scientists early in their careers.

Erosion reduces soil fertility, Larsen points out, resulting in diminished agricultural production. The cost in the U.S. reaches tens of billions of dollars a year and while many recognize the need to conserve soil, uncertainties remain about how big the problem is.

He says that developing [soil loss](#) estimates on large spatial scales is a daunting challenge. "There has been a lot of work on [soil erosion](#) on much smaller plots, but taking that information across the landscape is difficult," he notes. "Using remote sensing as a way to look at the broad scale is promising. We'll know in very fine detail where soil has been lost."

Many hilltops around Larsen's childhood home in Clear Lake, Iowa, have lost all their [topsoil](#) and are worn down to glacial till. As he explains, "I could see the erosion from the ground, but it wasn't until after I'd been trained as a geomorphologist in graduate school that I was able to interpret the patterns of soil color as topsoil loss. I then wondered if the effects of erosion could be seen from space. They can, and looking at the pictures from space shows just how extensive the loss of topsoil is. Once you start looking, you see it all throughout the Midwest."

"I think we'll be able to produce robust estimates of the degree of topsoil loss throughout the Midwestern U.S.," he says. "These are some of the most fertile soils in the world, but we don't have a good measure of the extent of topsoil loss at present."

Most of this work will use existing images, Larsen says. He and a

graduate student will come up with creative ways to use space-based data to study Earth's soils not only using public NASA data, but also high-resolution commercial images that NASA and the National Geospatial-Intelligence Agency can make available for research by agreement with private companies.

One goal is to estimate how much topsoil has been lost in the former tallgrass prairie since European settlement in the 1800s, from western Illinois to eastern Nebraska and from Missouri and Kansas north to Iowa, Minnesota and the eastern Dakotas. The researchers will create a map and regional analysis that farmers, extension agents and others can use to identify which areas might benefit from changing farm practices.

Larsen proposes to use high-resolution images to map out the presence and absence of topsoil in areas where images are available from the right time of year - either after fall harvest and before it snows, or after the snow melts and before spring planting. "Because of those narrow windows, we don't have high resolution images everywhere, but we've been able to link the extent of soil loss with high-resolution topographic information from Lidar," another remote-sensing technique, he adds.

Topsoil loss is reversible, as home gardeners know from adding compost and other soil amendments to their plots. Reversing topsoil loss on the farm- to county-scale requires different approaches, Larsen says, but is well worth the effort.

"If we were to restore the organic, carbon-rich part of the topsoil that is the key to soil fertility and productivity, it would represent a large economic advantage to farmers. Something can definitely be done about it. With very aggressive management you can build the [soil](#) back up, and studies suggest you can bring topsoil back in less than a decade using such methods as adopting no-till farming, crop rotations, and planting cover crops," he adds.

Provided by University of Massachusetts Amherst

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