New technique highlights the most important details in land-use analysis

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A new analysis technique developed at PNNL will promote understanding of model results for potential changes in land-use practices, including for agriculture and forestry. Photo courtesy of the National Resource Conservation Service.

Models to help understand land use range from highly detailed local scenarios to massive, integrated systems that link energy, agriculture, and the economy over areas as large as the continent of Africa. But more sophisticated land-use modeling yields a complicated set of results when translated to regional or global analyses. Ways to analyze and visualize results must keep pace with the vast amount of data produced. To tackle this issue, researchers at Pacific Northwest National Laboratory developed a new analysis technique to improve land-use model results to simultaneously address the most important variables needed for regional and global analyses.

"Previous studies either highlighted a single land-use type or presented many figures that were difficult to assemble into a coherent whole," said PNNL modeling expert Page Kyle, who led the study. "Our work showcases a method that can assist with the interpretation of model output, particularly when comparing output across regions, land-cover types, and scenarios."

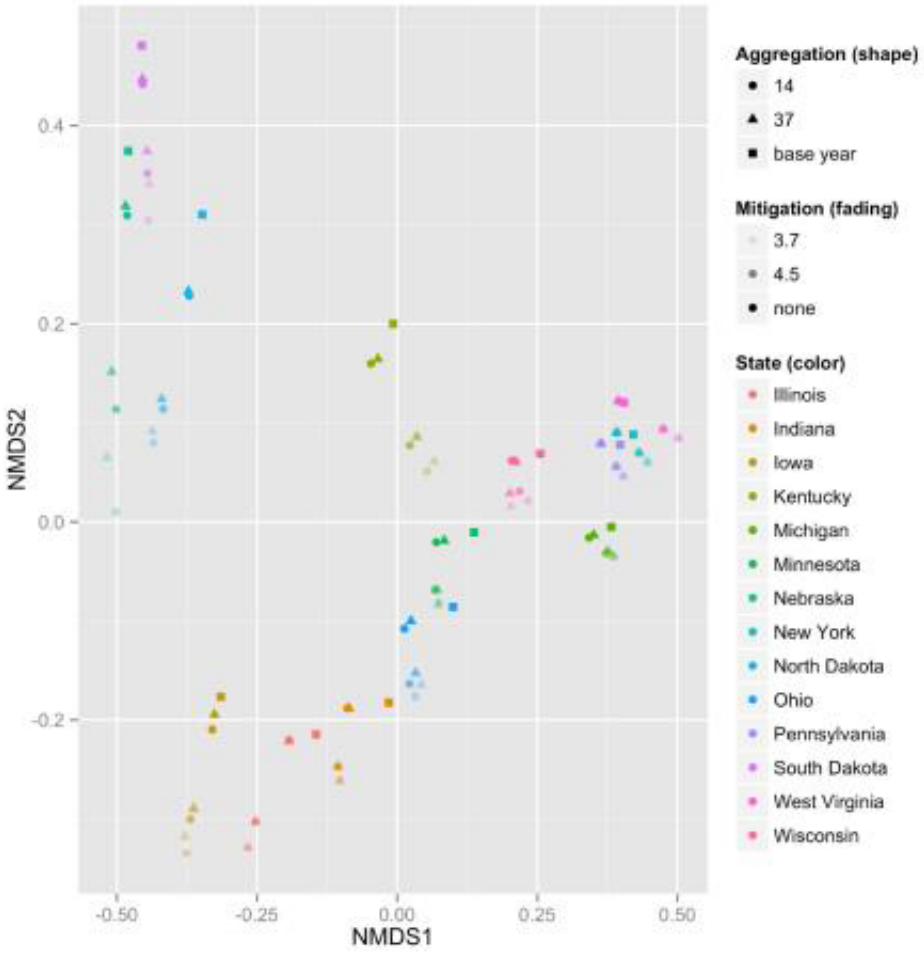
Land-use modeling variables can include details as diverse as current economic stresses and future climate change. Many times, the sheer amount of data makes zeroing in on the appropriate variables next to impossible. The results of this study ultimately make land-use modeling information more useful in studies that address regional and global climate questions.

Starting with a statistical approach originally developed for ecosystem analysis, PNNL scientists reviewed land-use data from 14 Midwestern and mid-Atlantic states. The 2.2-million-square-kilometer region is important for agriculture, producing 80 percent of U.S. corn and soybeans and 40 percent of the wheat. Most of the agriculture production lies in the central and western portion of the region, while the Eastern states are mostly forested. Including this land-use diversity helped the scientists determine an approach that would work across a

broader group of circumstances.

The team constructed scenarios directly relevant to land-use decisions based on possible future greenhouse gas emissions over a 90-year period starting with a base year of 2005. They looked at how land use might change across the region, in each of the 14 states, and within 37 agricultural areas in the region. Even with the large amount of data generated, the team found that the statistical approach could make eight different land-use classes easily visible on a single graphic, allowing researchers to more clearly understand key changes in the scenarios.

Global models generally sub-divide the world into between 10 and 100 regions. However, the assignment of countries (or sub-national geographic units) to these regions is inherently arbitrary. To the extent that this choice has consequences for model results, these effects must be understood to allow decision makers to make sense of results. Scientists will use the statistical methods developed in this study to explore the importance of these regional constructions in global modeling.



A new analysis technique developed at PNNL can collapse the vast amount of data resulting from land-use scenarios (such as differences in land allocation by 8 land-use types, 14 states, and any number of scenarios or time periods) onto easy-to-read graphs to improve understanding of complex systems.

More information: Page Kyle et al. Assessment of the importance of spatial scale in long-term land use modeling of the Midwestern United States, *Environmental Modelling & Software* (2015). DOI: 10.1016/j.envsoft.2015.06.006

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