Anne Reich

CHALLENGE

Discover how global environmental changes are influencing ecosystems around the world and how, in turn, changes in ecosystems modify earth's chemical and climate systems.

SOLUTION

JMP® statistical discovery software from SAS analyzes years' worth of data produced in experiments that manipulate atmospheric and climate conditions to simulate the future.

RESULTS

Gaining a better understanding of how environmental changes are affecting our ecosystems, and of how such changes influence the global carbon cycle and future climate, allows global leaders to make more-informed policy decisions regarding the environment.

The Capacity to Change

A prominent ecologist helps shape a more environmentally sound future

When Peter Reich talks about the environment, those in the know take notice. So it arrives as encouraging news when Reich, one of the world's leading forest ecologists, says he's guardedly optimistic about the future of our planet.

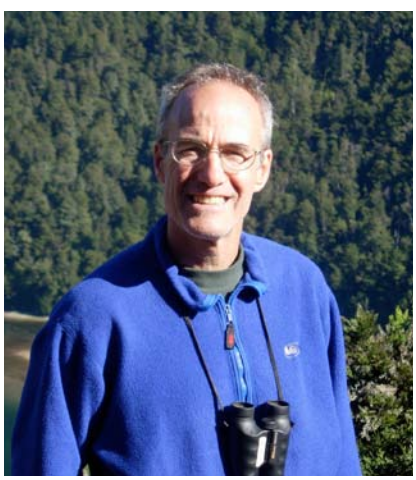
"We're not going to solve things overnight," says Reich, "but I think we have the capacity, and we have the resources, to fix what we're doing. Whether our political systems are too dysfunctional to make the right choices in time is the big unknown."

Reich holds an endowed professorship in the Department of Forest Resources at the University of Minnesota, where he is a Regents Professor and Distinguished McKnight University Professor. In the realms of ecological, environmental and plant sciences, Reich's research is cited more frequently than that of almost any other scientist in the world, and his faculty colleagues have extolled him as a "truly exceptional teacher and mentor," to boot.

Reich is among the cadre of scientists who have dedicated their professional lives to helping ensure a more environmentally sound future. He's a terrestrial ecosystem ecologist who examines the ways global environmental change is influencing ecosystems around the world and the impact of those changes on things such as global carbon cycles and climate systems.

"The world has to get the notion that it's in our interest, both economically and culturally, to take care of the environment," he says. "We need the environment to be healthy to maintain a healthy, sustainable society."

He's conducting some revolutionary research in Minnesota. And JMP® statistical discovery software is playing a critical role.



Anne Reich

Peter Reich
Regents Professor and Distinguished McKnight University Professor, University of Minnesota

"When you've used a system for a long time, you're loath to change. But almost everyone we've exposed to JMP has ended up using it. In my view, it's far and away the most satisfying system we use."

Peter Reich

Ever-greater challenges

A major impetus of Reich's work is the desire to better understand the ways in which changes in climate, carbon dioxide (CO_2) and ozone pollution, as well as deforestation and other land uses, influence the functioning of terrestrial ecosystems. He studies, among other characteristics, the diversity of species for which a grassland or forest provides a home, the amount of carbon it stores and its continued health in the face of changes we humans put it through.

Reich has been doing this work since the late '70s. He's witnessed advances and setbacks.

"The world is very dynamic and ever changing," he says, "changing all the time in amazing ways."

New technologies and geopolitical cooperation offer opportunities for people to be better stewards of the planet, but he warns that the challenges grow greater as we continue to assault the land, oceans and atmosphere.

Thus Reich and his colleagues at the University of Minnesota are making haste. They're currently conducting two state-of-the-art experiments in which they're manipulating atmospheric conditions to simulate the future to see how ecosystems might respond to these theoretical future realities.

One long-term project involves exposing grasslands to the concentrations of CO_2 that are expected in the future. The other raises the temperature of soils and plants in the forest to projected future levels. The objective of both projects is to gather knowledge of how our physical world is changing and to better prepare for what's to come.

In the year 2050

In the grasslands project, Reich and his colleagues are exposing outdoor plots to either ambient air (meaning natural conditions) or to CO_2 levels elevated to what might be expected in the future. His team is using a high-tech engineering system called Free-Air CO_2 Enrichment, or FACE, which allows the growing of plants in the field without chambers, thus maintaining conditions that are as natural as possible.

"We use these grassland plots as a model system to test hypotheses about how terrestrial ecosystems will interact with elevated CO_2," Reich explains.

The team is also manipulating plant diversity, nitrogen and water levels.

"Every living entity needs more than one thing," Reich says. "We can't just eat eggs or lettuce; we need a balanced diet. Plants need carbon, nitrogen, water, etc. You can give them all the CO_2 you want, but if they don't have enough nitrogen or water, they're likely not going to be as responsive to the added CO_2."

William Eddy

Warming equipment melts an early-autumn dusting of snow in a forest research site.

In other words, the plants are not going to soak up as much CO_2 if they're receiving inadequate supplies of nitrogen and water. And lower carbon absorption rates could affect projections by the Intergovernmental Panel on Climate Change, a consortium of climate scientists from around the world, of how much climate protection forest and grassland ecosystems will provide in the future.

"They're projecting the future of how carbon dioxide levels are increasing in the atmosphere to 2030, 2050, and beyond, and their models assume that the production of the world's terrestrial ecosystems will continue to be more and more stimulated by CO_2. But those models assume that plants will have all the nitrogen, phosphorous, water and other things they want.

"Our study is one of only three that can address this issue. This is our 12th year, and the time span of the experiment is important. In the first three years the response to CO_2 was not influenced by how much nitrogen was available. But in the following years, we did see that the plants that had access only to the ambient nitrogen were less responsive to the elevated CO_2 than those that had some extra nitrogen as well.

"So we need long-term experiments because ecosystems are complex systems that have time lags and require a few years or more to see what's actually happening."

Anne Reich

Reich's work takes him into forests around the globe, including this one in Argentina.

Reich explains that roughly one third of the CO_2 we emit today stays in the atmosphere, a third is soaked up by the oceans, and the remaining third is absorbed by terrestrial ecosystems. "What this means is that climate is probably going to change faster than anticipated; because even if we keep emitting the same amount of CO_2, if less of it is absorbed by trees and soils, the change in the amount that stays in the atmosphere will be accelerated."

B4WARMED

The second project, called B4WARMED, began in 2009. It involves heating soils and plants in the forest to see how a temperature increase of 2 to 4 degrees Celsius will affect the nature of the forests in northern Minnesota, which are on the frontier between the boreal forests and the more temperate systems.

Reich and his research team of professors, postdocs and graduate students are using infrared lamps and soil heating cables to warm 96 forested plots. This experiment is unique in that the plants are grown in a natural, outdoor environment, with both soils and above-ground parts of plants experimentally warmed.

"We're looking at a variety of hypotheses about how warming-induced changes in soil moisture will probably have negative impacts on the boreal species, and perhaps also on more southerly species. All things being equal, when it gets warmer, plants lose more water. So if you get exactly the same amount of rain but it gets 3 degrees warmer, you've made your world drier."

'We swear by it'

Reich says he uses JMP because of its ability to easily manipulate data: "Its ability to sort and resort data by various elements of the data set is, in my view, unparalleled.

"Let's say you have a thousand observations and they came from different dates and different counties. You can very easily sort those. You can say, 'I only want to know what happened in 1999 versus 2009.' Or, 'I only want to know what happened on Thursdays versus Sundays, but only if your name is Sanchez and not Rodriguez.' That may seem relatively simple. But most spreadsheets do a really bad job of that – and with JMP it's very easy.

"We use JMP to do everything from first looks at our data, to working through the exploratory, to the final analysis, and then we use it in papers.

"It's just a phenomenal tool because it's so straightforward, it's fast – I can run analyses in a matter of seconds or minutes – and it's easy to learn."

Reich says he uses a number of JMP tools on a regular basis – multiple regression, contingency models, ANOVAs, survival analysis – depending on the experiment.

"We swear by it. We've made lots of converts over the years. When you've used a system for a long time, you're loath to change. But almost everyone we've exposed to JMP has ended up using it.

"In my view, it's far and away the most satisfying system we use."

'In our own best interest'

Saving the planet also makes good financial sense, Reich believes. "People say it's too expensive to take care of the environment and we have to take care of the economy first. But the cost of environmental degradation is not just the cost to clean it up later, but also the lost 'revenues' from services that nature provides and which have considerable economic value."

For example, he explains, forests and wetlands store and clean water and regulate its flow. Vegetation prevents flooding of roadways, farmland and even municipal sewage plants. Bees pollinate almost all of our agricultural crops.

"Forests and oceans have soaked up three of every five extra molecules of carbon dioxide that humans have put into the atmosphere by burning fossil fuels. Without those services, the pace of climate change to date would have been much faster – perhaps even 3.5 times more change than we have observed – and we would have in 2009 the kind of climate that we anticipate having in about 2090," Reich said. "What is the dollar value of preventing that much climate change? No one can really do a good job of estimating, but it likely would add up to trillions of dollars per year."

We have the capacity to save our environment, says Reich, and the resources. We just need the will.

"We can solve this problem," he says. "It's really a question of getting the political will around the planet to recognize that this is both our ethical duty and it's in our own best interest. With education, we can help people see that."

Reich is doing his part to get us there.