# Wisconsin, Argentina face complementary challenges in ecohydrology

March 31 2015, by Scott Gordon

Steve Loheide, right, leads group of Argentine grad students in a fieldwork exercise in the mountains near San Luis, Argentina.

Argentina might seem a long way to go for an environmental engineer seeking to better understand land use in Wisconsin. But on his Fulbright Scholar Program-supported journey to Argentina in 2014, Civil and Environmental Engineering Associate Professor Steve Loheide sought to learn from the surprising parallels between Argentina and Wisconsin's histories of land use and ecohydrology.

Take the lowland Pampas region, which extends across southeastern Argentina, all of neighboring Uruguay, and a bit of southern Brazil. People associate the area with images of cattle grazing in fertile pastures,

but in the past few decades, the area's farmers have increasingly turned to corn, soybean and other row crops. That will sound familiar to anyone acquainted with Wisconsin's agricultural history.

For Loheide, the crucial similarity is what happens below the surface, as natural and managed ecosystems exert different influences on groundwater. "The main thing that I'm looking at is the lateral exchanges of groundwater between ecosystems," says Loheide, who is also affiliated with the UW-Madison Geological Engineering Program, Freshwater and Marine Sciences program and the Gaylord Nelson Institute for Environmental Studies "We live in an increasingly human-dominated landscape, in which we have patches of managed land with remnant ecosystems interspersed."

In the Pampas and Chaco regions of Argentina, Loheide and his collaborators at the Universidad Nacional de San Luis are looking at areas where patches of forest have been converted for corn farming. The corn's roots run shallower than those of forest trees, which means water percolating downward has more of a chance to recharge the groundwater below, and to potentially "subsidize" neighboring forest areas' water supply providing the ecosystem with a backup groundwater supply in a period of drought. Conversely, if too much groundwater builds up, this could eventually cause a lack of oxygen in the soil and kill the crops.

The solution, Loheide believes, is to incorporate extensive groundwater and soil data into computer models that can help farmers and officials make land-use decisions that will manipulate groundwater changes to the advantage of agriculture and natural ecosystems. "What's really interesting is the interplay between natural ecosystems and managed ecosystems, and what balance of those provides us with the highest level of ecosystem services—crop yield, clean water, and healthy ecosystems," Loheide says.

For his Fulbright project, Loheide combined his computer-modeling experience and with Argentine researcher Esteban Jobaggy's deep knowledge of agronomy and ecology. Drawing on field data that Jobaggy's group has been gathering for years, Loheide built models to simulate groundwater transfer between cropland and neighboring natural ecosystems in the Pampas and in the Chaco region of northern Argentina. Loheide says that ultimately, decision-makers can use the model results to predict future shortages and excesses of groundwater in cropland, and then optimize management strategies, such as planting new forests and all manner of variations in what farmers plant and when.

"The expertise about what's important to these ecosystems is already known from fieldwork and the research that's been done here for the last 15 years in this group. And I can then transfer that knowledge into a model to ask, 'Can we really predict how this system functions? If so, then we do have that quantitative understanding of the ecohydrologic processes, but if not, we need to look for which processes we're missing?'" Loheide says. "And then we have a predictive framework for decision making—what if we convert 10 percent of the landscape? What if we convert 90 percent? How do those two choices differ?"

Loheide is able to bring back some insights for tackling similar problems in Wisconsin, and the experience of international collaboration helped him to look at his approach to research in new ways. "I was able to bring my modeling expertise and say, 'This is how I would envision the system,' and they would say, 'Yeah, but you're forgetting about this," he says.

Because Jobaggy's group has been studying ecosystems in Argentina for 15 years, the Argentine researchers challenged him to incorporate new factors that wouldn't be much of a concern in Wisconsin—especially poorly developed drainage systems and the accumulation of salts in the soil.

During the trip, Loheide and Jobaggy also taught an intensive graduate course in quantitative ecohydrology, which proved just as eye-opening as the research. "It brought together graduate students from across the country," Loheide says. "Some were in meteorology, geology, hydrology, botany—a whole range of disciplines."

Throughout a packed two-week course schedule of lectures, field exercises, and computer modeling exercises, Loheide found himself learning from the grad students as much as teaching them. "It was one of the most interactive classes I've had the pleasure of being involved in as either a student or instructor," Loheide says.

As he prepares to return to the UW-Madison campus, Loheide says the Fulbright experience—which aims to stimulate international cooperation through scholarship—has given him a broader view that will greatly benefit his future research and teaching.

"It's brought up a lot of new research questions," he says. "I think that's one of the great things about a sabbatical or an exchange. You start to study a different system and add more things into your way of thinking, which for me, translates into more processes in my modeling."

Provided by University of Wisconsin-Madison