SOIL, WATER & ENVIRONMENTAL PHYSICS

Healthy soils enhance agricultural and environmental sustainability by storing and supplying water, energy, organic materials, and nutrients. Nationwide, soils are being stressed by increasing food and energy demands, land-use shifts, and climate change. Understanding soil, water, and environmental physics is key to developing solutions that protect our life-supporting soil resources.

For sixty years, researchers from 24+ State Agricultural Experiment Stations have worked together to better understand how water, energy, and nutrients move through and interact with soil. Since its inception, the team has made considerable scientific advances and helped state and federal agencies develop best management practices and policies.

Multistate Research Fund IMPACTS

Research is improving soil models and monitoring systems. Over the years, project members have developed, tested, and used new mathematical and statistical models and methods. For example, researchers developed and used the HYDRUS software to assess hydraulic, thermal, biogeochemical, microbial, and gaseous processes in soils. HYDRUS has been downloaded 45,100 times and cited more than 10,000 times since 2016. It is now an essential part of soil physics, hydrology, and environmental science courses taught worldwide. Project members have also designed new sensors, data loggers, and other products for agricultural and environmental monitoring at a wide range of scales. Many of these products are sold worldwide to farmers, scientists, and other users by well-known companies, some of which were created by project members.

The team's data and tools have been used in many ways. Project findings have been shared widely with stakeholders through academic journals, book chapters, field days, conferences, presentations, and other outlets. New sensors and monitoring systems have been used to improve the efficiency of irrigation practices, decrease leaching and runoff of nutrients and hormones from agricultural land, and enhance our understanding of processes that improve soil health. Information on soil physics and hydrology has been used to design infrastructure that reduces flood risks, identify ways to safely store nuclear waste, and develop techniques that minimize dust and contaminated water drainage from mine tailings. Project members also worked closely and shared information with concerned Navajo farmers after the Gold King Mine Spill. Global climate modelers have used project findings to better understand the role of soil processes in weather and climate patterns. State and federal agencies and municipalities have used data on water quality and quantity to predict drought, manage wildfire risk, and guide conservation initiatives. The team has also collaborated with NASA to find ways to grow plants in space, where soil, water, and nutrients interact in unique ways.

Multistate leadership enhances research capacity. The multistate structure is a convenient and efficient platform for establishing research collaborations, validating approaches, pooling data, sharing equipment, creating rigorous peer reviews, and educating the next generation of scientists and engineers. The project has led to new collaborative research facilities, which have reduced duplication and enhanced the capacity for and quality of field and laboratory analyses. Lecture and laboratory materials created by project members are used in courses nationwide. Over the past five years, project members have trained more than 200 graduate students and post-doctoral scholars. Members have also played vital roles in bringing together soil scientists and stakeholders through national and international networks like the National Ecological Observatory Network and International Soil Modeling Consortium.

W4188 Soil, Water, and Environmental Physics to Sustain Agriculture and Natural Resources (2019-2024) was funded in part by the Hatch Multistate Research Fund through USDA-NIFA and by grants to project members at participating institutions. Over the last 5 years, this project has leveraged an estimated $50 million from federal and state competitive awards. Participating institutions include: University of Arizona, University of California-Berkeley, University of California-Davis, University of California-Riverside, Colorado State University, University of Delaware, University of Idaho, Iowa State University, University of Kentucky, Michigan State University, University of Minnesota, Montana State University, University of Nevada-Reno, University of Nevada-Las Vegas, Desert Research Institute, New Mexico State University, North Carolina State University, North Dakota State University, Oklahoma State University, Oregon State University, Pennsylvania State University, University of Tennessee, University of Texas at Austin, Texas A&M University, Texas Tech University, Utah State University, Virginia Tech, Washington State University, University of Wisconsin, University of Wyoming, USDA-ARS/California and USDA-ARS/Texas. **Learn more:** bit.ly/W-4188