FORUM

Getting the Lowdown From High Up

ARS has an exceptionally broad program in remote sensing that involves more than 20 laboratories around the country, often in cooperation with other agencies in this country and abroad.

Most of the research takes advantage of remote sensing's ability to view entire regions to monitor, assess, and manage farmland, rangeland, and forests—including effects on the nation's waters.

The story that begins on page 4 highlights the work of the ARS Hydrology and Remote Sensing Laboratory, in Beltsville, Maryland, working with the National Aeronautics and Space Administration and other agencies. This includes aerial and satellite monitoring of soil moisture as part of the global water cycle and in relationship to global warming, tillage techniques, and pest infestations. It also includes predictions of such things as flooding, drought, crop yields, and soil carbon storage.

Similar work is done by other ARS labs throughout the country. Much of the research is directed at watersheds—areas drained by streams—because they have a major effect on ecosystems. Groups of watersheds drain into basins that in turn drain into large bodies of water.

From studies of one watershed in El Reno, Oklahoma, ARS hydrology engineer Jurgen D. Garbrecht has developed computer software that uses digital landscape technology to solve environmental problems. Garbrecht worked with Canada's University of Saskatchewan in developing TOPAZ. Short for topographic parameterization of the landscape, TOPAZ is a computer-based evaluation tool that defines and analyzes land-surface characteristics, watershed configurations, and drainage features.

TOPAZ has already gone global. Researchers, engineers, and educators in Europe and the Middle East are using it. USDA is using it to generate drainage path information for water quality models. Canadian researchers use it in their Global Energy and Water Cycle Experiment, a study of the Mackenzie River Basin, to better understand the role of cold regions in the global climate system.

TOPAZ creates data files from which images can be generated by most commercial geographic information system packages. Scientists are now working with colleagues in Tucson, Arizona, to add new features to TOPAZ for use in combination with another ARS model that predicts runoff and erosion.

While protection of water quality at the watershed scale is an important part of ARS' remote-sensing work, there are many other aspects of managing lands at the watershed, basin, regional, or local level. For example, biologist Norman C. Elliott and entomologist S. Dean Kindler in Stillwater, Oklahoma, are cooperating with researchers at Oklahoma State (OSU) and Texas A&M Universities to quickly, accurately, and cheaply map greenbug infestations on wheat fields over entire regions. Greenbugs are a serious pest of grain and sorghum in the Southern Plains. During severe outbreaks, wheat farmers lose more than $250 million a year.

So far, the Stillwater team has done some field and greenhouse work with the same sensors used on satellites. They can detect the unique light reflectance characteristics of greenbug-damaged fields.

As part of a cooperative research and development agreement, Elliott is also working with OSU and Site Specific Technology Development Group, Inc., to develop a computer model to give farmers and consultants advice on controlling greenbugs in wheat.

And precision agriculture would have no future without remote-sensing research. ARS scientists across the country contribute to development of sensors and techniques. Precision agriculture began with use of global positioning system sensors to give farmers a square-foot-by-square-foot accounting of crop yields.

ARS scientists are expanding remote sensing to include live monitoring of such things as crop growth, soil conditions, and plant water and fertilizer needs—down to each square foot of land, over entire regions. This type of work is being done from Beltsville to Phoenix, Arizona, to Weslaco, Texas.

Whether for precision farming or environmental monitoring, remote sensing is done from 220 miles in space down to ground and water levels and below.

For example, researchers in New Orleans designed a submersible sensor to monitor harmful algal species, such as those responsible for red tide and dead zones. They are testing a prototype in the St. John's River in collaboration with regional, state, and federal researchers.

The New Orleans research epitomizes the depth and breadth of ARS' remote-sensing work—using the eyes of sensors at many different altitudes to monitor the health of the Earth's farmland, rangeland, forest lands, and bodies of water.

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