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NASA

Mapping Water Use—Landsat and Water Resources in the United States

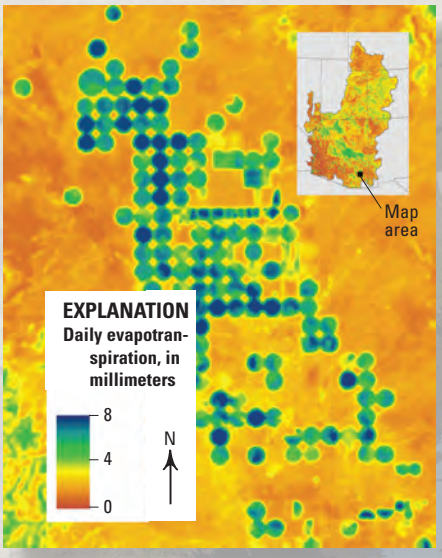
"A vision to observe Earth for the benefit of all..."

Interior Secretary
Stewart Udall, 1966

Water is one of our Nation's most important natural resources, a resource that has long been considered inexhaustible. Yet changes in land use, climate, and population demographics are placing unprecedented demands on water supplies in the United States. As the frequency of droughts increases and water levels in aquifers and reservoirs decline, people are wondering:

Is there enough water to meet all of our needs?

Landsat satellites are helping to answer that question.



Water-Use Mapping

Using Landsat satellite data, scientists with the U.S. Geological Survey (USGS) have helped to refine a technique called evapotranspiration (ET) mapping to measure how much water crops are using across landscapes and through time. These water-use maps are created using a computer model that integrates Landsat and weather data.

Crucial to the process is the thermal (infrared) band from Landsat. Using the Landsat thermal band with its 100-meter resolution, water-use maps can be created at a scale detailed enough to show how much water crops are using at the level of individual fields anywhere in the world. The map on the left shows the amount of water used in a single day by crops in irrigated fields in southern Arizona.

U.S. Department of the Interior
U.S. Geological Survey

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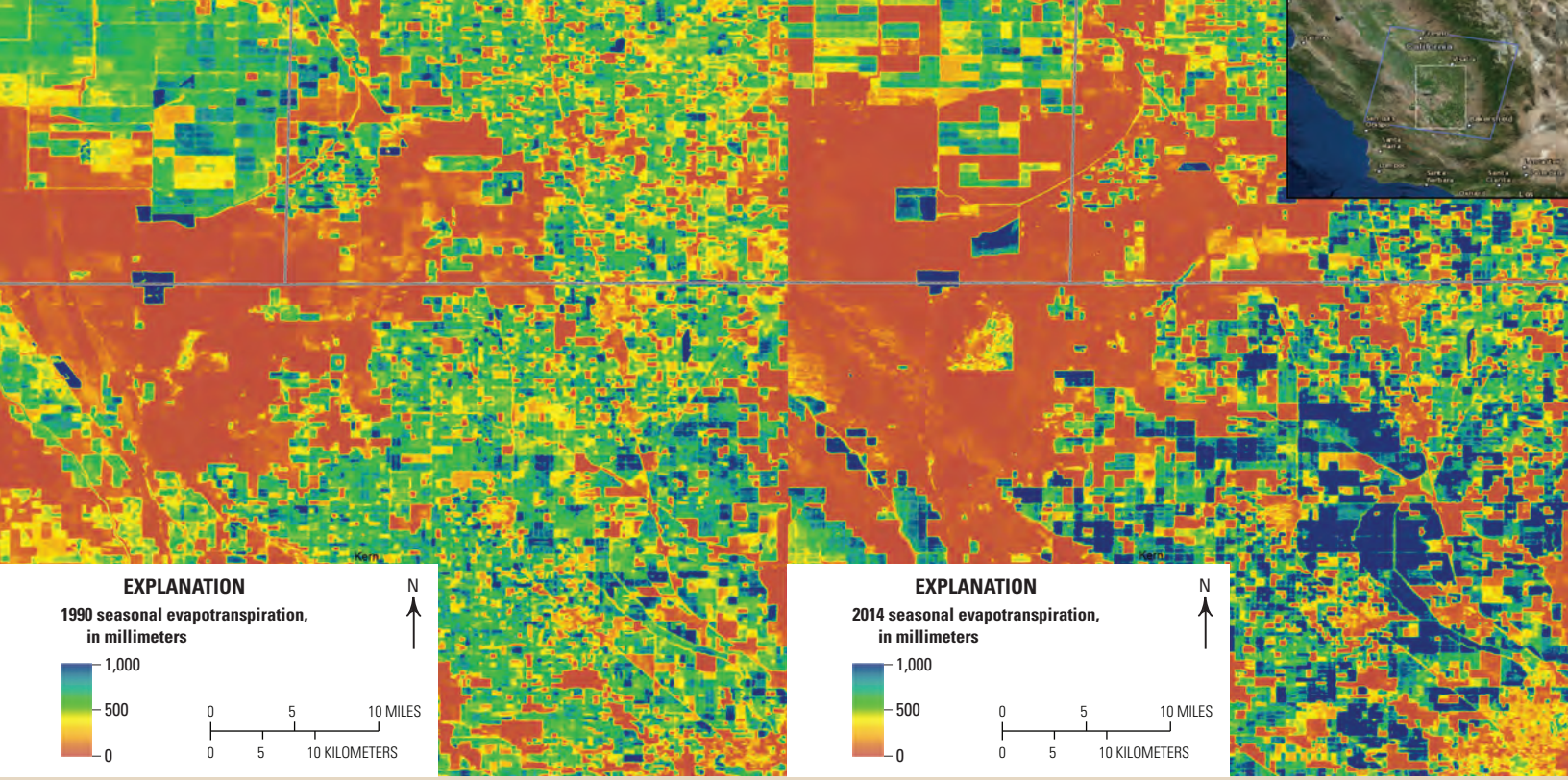

Figure 1. This pair of seasonal evapotranspiration (ET) maps (May–September) shows crop water use in the San Joaquin Valley, California, in 1990 (left) and in 2014 (right). Comparing the maps reveals changes in irrigation patterns during this period. Notice, for example, that water use intensified in many places (increase in blue areas) and some irrigated lands (green in 1990) transitioned out of agricultural production (reddish brown) by 2014.

From Daily Glimpses to Long-Term Trends

Evapotranspiration (ET) maps can show how much water crops are using in a single day or during an entire growing season. Drawing on the vast Landsat satellite image archive, it is also possible to create maps that span decades to reveal long-term trends in water use (fig. 1). The Landsat archive—invaluable to water-use mapping and so much more—might never have become a reality without the visionary support given to Earth observation from space by Interior Secretary Stewart Udall during the 1960s.

How Water-Use Maps Help

U.S. Geological Survey scientists can map water use at different scales to address different water resource questions and concerns. Field-scale maps, for example, are powerful tools for estimating and managing water consumption on irrigated croplands. Field-scale maps can help answer questions such as the following:

- Where is water being used, how much, and by whom?
- Which types of crops are using the most, or least, water?
- Can water be used more efficiently without impacting crop yields?

Basin-scale water-use maps assist in understanding water balance and availability in river basins and watersheds. Basin-scale maps are large-area maps and are useful for the following:

- Estimating water use by different sectors within a watershed.
- Resolving disputes regarding water rights and allocations.
- Evaluating aquifer depletions and quantifying net groundwater pumping.

Planning Today for Water Demand Tomorrow

According to a recent Government Accountability Office report (GAO, 2014), 40 of 50 state water managers expect water shortages in their states between now and 2023. Addressing concerns about water resources in the United States begins with a clearer understanding of water availability and water-use trends. Mapping water use based on Landsat satellite data has demonstrated immense potential at local and regional scales (Senay and others, 2016), and could become the basis for planning, monitoring, and assessing water use across the Nation.

References Cited

Senay, G.B., Friedrichs, M., Singh, R.K., and Velpuri, M.N., 2016, Evaluating Landsat 8 evapotranspiration for water use mapping in the Colorado River Basin. Remote Sensing of Environment, *in press*, accessed May 19, 2016, at http://dx.doi.org/10.1016/j.rse.2015.12.043.

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