The Landsat Program and Water Resources Information Needs in the United States

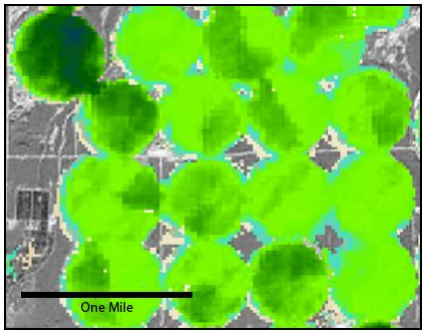
Western States Water Council

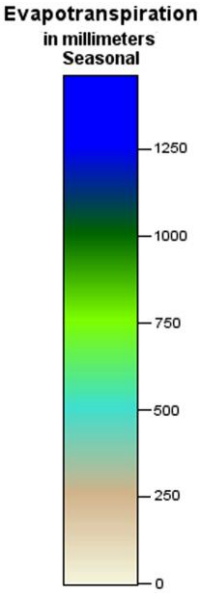
The water resources of the United States are a $200 billion per year economic engine that supports hundreds of thousands of jobs. However, in the West and the Nation water is in short supply, requiring reductions in consumptive uses. Water and water rights are increasingly valuable commodities being bought and sold. Remotely sensed imagery collected by Landsat is essential for determining past and present water use and evapotranspiration (ET) at scales that reveal patterns of land management and water consumption. ET maps derived from Landsat thermal imagery are used operationally by water managers to monitor and manage agricultural and urban water use, administer water rights, evaluate market transfers, negotiate and monitor interstate compacts, estimate water-use by invasive species, and assess and monitor water and food security and sustainability. Landsat is the only operational satellite that combines thermal data with short-wave data at the spatial resolution needed to administer water use and water rights, which is often at the level of the individual agricultural field.

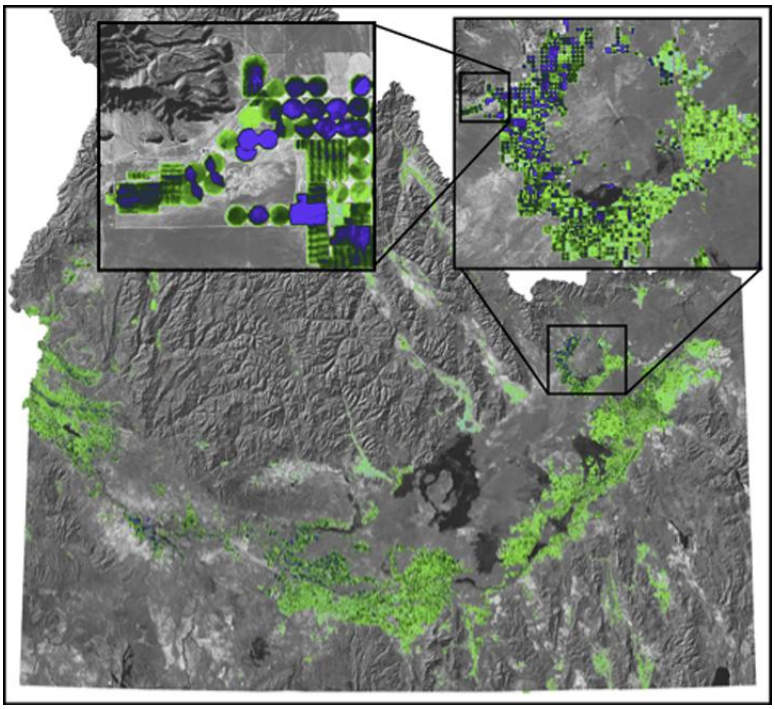
Water Resources Management Needs in the United States for the Landsat program:

1) Establish an Operational Land Observation program having spatial resolution at land and water management scales to build on the 30-year global archive of Landsat data
2) Maintain continuity of Landsat resolution data in visible, near infrared, short-wave infrared and thermal bands
3) Spatial resolution sufficient to observe land and water at field scale: 30 to 60 meter pixels
4) An ideal image procurement process with satellite passes each 4 days (*4-day return cycle*), 16 days maximum.
5) Continuous Scene Acquisition around the globe with no data gaps in any future year
6) A policy of and funding for building multiple satellites under a long term program to assure no future data gaps
7) Continuation of the existing policy of no-cost data access for all archived and future scenes
8) Absolute radiometric uncertainty < 5%, 1-sigma, for VNIR/SWIR bands and < 2%, 1-sigma, for the thermal band.
9) Necessary Federal funding:

    1) $ 40 million in FY 2012
    2) $125 million in FY 2013
    3) $250 million in FY 2014
    4) $250 million in FY 2015
    5) $265 million in FY 2016
    6) $250 million in FY 2017
    7) $200 million in FY 2018







ET maps showing depths of water evaporated from irrigated fields of Idaho during the April - October growing season-- derived from Landsat.

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http://www.idwr.idaho.gov/GeographicInfo/METRIC/et.htm and http://www.kimberly.uidaho.edu/water/metric/index.html
http://www.westernstatesetworkshop.com/past-events/boise-2011/ and http://wmp.gsfc.nasa.gov/workshops/ET_workshop.php
April 6, 2012.

Why Landsat is an Essential Earth Imaging Program
and Why it Requires Federal Support

1. The pixel resolution of Landsat -- 30 m reflected data and coincident 60-120 m thermal data -- is ideal for monitoring land use change and water consumption of human-related features -- agricultural fields, riparian systems, forest clearings, vegetation disease outbreaks, etc..

2. Landsat fits a critical niche between the high resolution commercial satellites and the 'daily' low-resolution satellites like MODIS, NPOESS-VIIRS and AVHRR , which cannot resolve most human-related land features.

3. Landsat has a 16 day return time (8 days with 2 Landsats) that provides the high-frequency coverage required to monitor the dynamic evolution of vegetation and water consumption. High-resolution, sub-meter systems can not cover the US every 8 or 16 days.

4. Landsat's view angle of less than 8 degrees assures high data-accuracy and fidelity.

5. Landsat data are optimal for operational natural-resource models. The models are fundamental to promoting economic growth and efficiency, food production and security, and natural resources management, planning and projection. Imagery from low-resolution satellites such as MODIS is generally too coarse to be used exclusively, while imagery from high resolution systems (IKONOS, QuickBird, etc.) is too infrequent[1]. Small-sat systems may not have necessary spectral bands and coverage and are currently not capable of carrying thermal imagers having Landsat-type coverage and accuracy.

6. Approximately 80% of Landsat data are used in natural-resource applications. A majority of Landsat data users work in government and do not have the budgets to support high prices for images. Experience has shown that the 30 m Landsat pixel, while ideal for natural resources, is too coarse to command the high prices afforded high-resolution imagery. As a consequence, Landsat must remain publically financed. America's investment in Landsat reduces costs for essential resources management products from low-cost or no-cost Landsat imagery.

7. The long, continuous archive of Landsat imagery dating from 1972 for short-wave and from 1982 for thermal data provides a time machine for viewing land surface temperature and conditions over the entire US. Western water-resource applications depend on the Landsat thermal data archive to map and quantify historical water use. No other satellite system comes close to this permanent heritage of data.

8. ET data can be interpolated to cumulative monthly and growing season estimates by coupling ET images from Landsat with weather-based measurements of potential ET. This capability will continue to increase as gridded weather data systems evolve.

9. The enormous advances in the use of Landsat data for natural resources management, including water, have come because Landsat data are free to users. The user community will continue to develop valuable Landsat-based applications as long as Landsat data are provided at no-cost or at minimal cost.

This page produced by Richard G. Allen, Univ. Idaho and Tony Morse, Spatial Analysis Group, April 9, 2012.

[1] QuickBird and GeoEye, for example, can cover every point of the US approximately only every 160 days and IKONOS every 250 days.