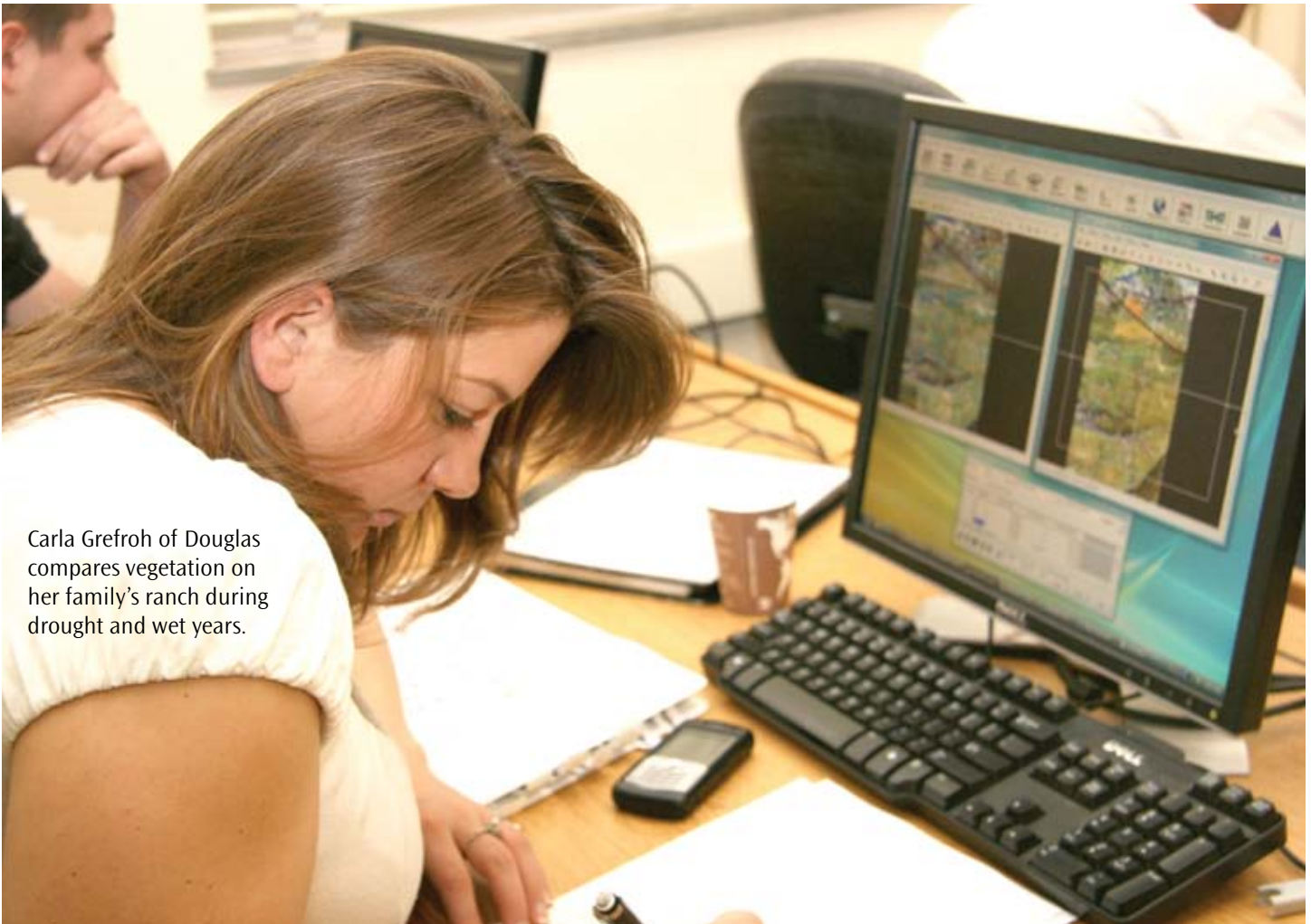


COLLEGE OF AGRICULTURE AND NATURAL RESOURCES

REFLECTIONS

2010

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Carla Grefroh of Douglas compares vegetation on her family's ranch during drought and wet years.

Enhanced learning through student-selected agricultural **REMOTE SENSING PROJECTS**

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Students utilize high-tech opportunities to examine Wyoming crop, ranch, and forest areas

Images from earth observation satellites provide valuable information for students and researchers interested in monitoring natural resources. These remotely sensed images provide a birds-eye view of the earth's surface and enable monitoring of rangelands, shrublands, and forests.

Many remote sensing satellites collect images at regular intervals, giving researchers an opportunity to monitor changes on the earth's surface. They can also be used to characterize

variability in vegetation conditions within an agricultural field, ranch, or forest. Vegetation growth stage (emergent vs. full canopy) and condition (healthy vs. stressed) can be determined by examining reflected infrared light, which is measured by many remote sensing satellites.

In general, remotely sensed images contain a wealth of information about the Earth's surface and are valuable for a wide range of users.

Remotely sensed satellites divide the surface into a uniform grid of pixels and record the amount of reflected visible and infrared light coming to the satellite sensor from each pixel. Analysts examine the pattern of reflected light across a range of wavelengths to extract information about places in an image. For example, a farmer can monitor changes in crop growth during the growing season using a series of Landsat images (see story at right). A rancher can map forage conditions on a ranch and also identify areas of poor or no vegetation growth.

Increasing Student Employment Potential

Changes introduced by natural disturbances, such as wildfires and droughts, and anthropogenic (caused by human) activities, such as land conversion, are creating new applications of remotely sensed imagery. Because the imagery is so valuable, several countries have launched remotely sensed satellites to collect earth observation data. In the U.S., federal government agencies, as well as private companies, are launching and operating remote sensing satellites. Students who learn image processing and interpretation skills as part of their academic training often increase their employment potential.

Ag Remote Sensing Projects

UW students are learning to implement many of the applications described above in the applied remote sensing for agricultural management course (BOT/RNEW 4130/5130 and AECL4130). One requirement of this course is that students complete a class project using imagery to answer questions about a real-world agricultural issue. For example, some students use images of their parents' farms or ranches to better

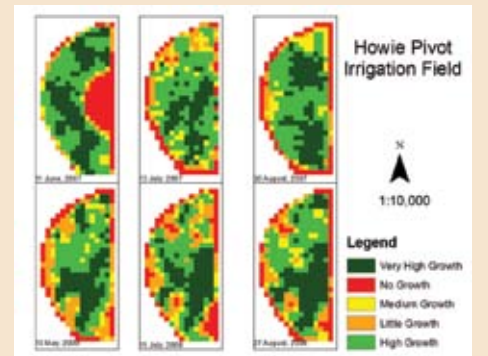
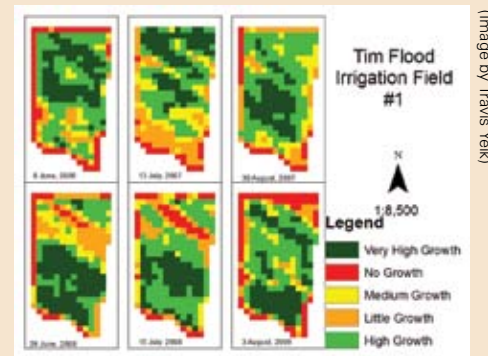
understand crop growth patterns by comparing the images to conditions observed on the ground.

Students associate areas of poor growth (often characterized by low infrared reflectance) identified in the image to problems such as soil alkalinity or poor water drainage. Similarly, several students obtained images acquired in normal and drought years for rangelands and mapped changes in vegetation condition. Students enhanced their learning experience by selecting images for areas of interest to them rather than working on pre-defined laboratory exercises.

Mapping Crop Growth in Big Horn River Basin

Garret Klein, Pavillion, and Laramie Wiginton, Kinnear, (rangeland ecology majors); Chris Heil, Elkhart, Texas, (agroecology and rangeland ecology major); and Travis Yeik, Veteran (geography major and soil science minor), used Landsat images for monitoring crop growth in agricultural fields in Fremont and Washakie counties. Klein and Wiginton mapped crop growth by computing a vegetation index derived from the amount of reflected red and infrared light. Based on their research, they concluded Landsat images could be used to accurately identify areas of poor and medium growth for different crops; however, they noticed some weed-infested areas also had high infrared reflectance due to dense canopy, thereby reducing the utility of Landsat data under these circumstances.

Yeik analyzed growth patterns in sugar beets and alfalfa crops near Worland using Landsat images acquired from 2006, 2007, and 2008 (see upper right). This multi-year analysis of crop growth patterns was



(Image by Travis Yeik)

LANDSAT IMAGES

Landsat images have been collected by a series of remote sensing satellites operated by the U.S. government since the early 1970s (<http://landsat.usgs.gov>) and represent an extensive civilian archive in terms of duration (more than 36 years) and geographic coverage. Landsat collects a new image every 16 days (except Landsat 7, which collects an image every 14 days) for every place on Earth. Each image covers a relatively large geographic area (approximately 90 miles by 90 miles). Landsat records information from the visible and infrared regions of the spectrum, which is useful for monitoring vegetation condition and a wide variety of other applications. Countless studies have demonstrated the value of Landsat data for monitoring changes in croplands, rangelands, and forests. Landsat images are useful when monitoring rangelands and croplands through conventional field surveys not feasible due to cost or access issues.



Cody Tully of Sinclair helped fight the 2006 Isabelle Fire that burned near Lake Owen in southeast Wyoming. He is examining satellite images of the burn.

necessary for identifying areas of poor and high growth and for devising appropriate management plans to help improve crop yields.

Assessing Wildfire Damage to Forest Vegetation

Using Landsat images, Cody Tully of Sinclair estimated wildfire burn severity of a fire in the Medicine Bow National Forest; Brice Stanton of Newcastle, and Adam Stephens of Rapid City, South Dakota, for a fire in the Black Hills National Forest; and Anne Morabito, Chicago Park, California, for a fire in Southern California. Stanton and Tully worked on firefighting teams and had firsthand knowledge of the effects of fire on forest vegetation. This knowledge was valuable for interpreting the information from Landsat images about burn severity patterns.

Tully helped fight the 2006 Isabelle Fire that burned 1 mile south of Lake Owen in southeast Wyoming. Burn ratio indices derived from the Landsat images acquired before and after the wildfire enabled him to distinctly

classify the burned areas and also group them by severity classes.

Using the same method, Morabito generated burn severity maps depicting various levels of damage caused by the Station Fire near Los Angeles in Southern California during August 2009. Methodology used by these students is identical to the methods used by federal and state land management agencies tasked with fighting wildfires and monitoring vegetation establishment in burned areas.

Monitoring Wyoming Rangelands

Many students used Landsat images for monitoring rangelands throughout Wyoming. Students compared vegetation condition during drought years to normal years and estimated the differences in spectral reflectance in different regions of the electromagnetic spectrum. For example, Carla Gefroh of Douglas (rangeland ecology major) compared the vegetation condition for her family ranch using images acquired in June 2002 and 2009, representing drought and

wet years, respectively. Landsat images highlighted changes in vegetation condition during drought and wet years.

Monitoring vegetation response to drought was one topic in the class. Other projects included monitoring vegetation condition in a growing season for estimating forage availability and areas of overgrazing. The synoptic view provided by Landsat images was invaluable for gaining insights about vegetation condition in rangelands, and repeat coverage helped students map those changes.

USGS Offers Free Landsat Satellite Images

In December 2008, the entire Landsat satellite image archive was made available for free through the U.S. Geological Survey. Previously, images had to be purchased (terrain corrected images could cost as much as \$800) unless they were archived by programs like AmericaView (www.americaview.org) or on dedicated public Web sites like that of the Global Land Cover Facility (<http://glcf.umiacs.umd.edu>).

The recent availability of free Landsat images has created opportunities and enhanced learning experiences for students. When fewer no-cost Landsat images were available, students had to modify the scope of their projects to match data availability. Now, students can download any number of images for anywhere on Earth.

UW students enrolled in the applied remote sensing for agricultural management course are taking advantage of this valuable opportunity and are using these images for monitoring and mapping Wyoming croplands, rangelands, and forests.

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