

## GLOBE High School and Middle School Students in Canutillo and El Paso, Texas Study Satellite Images

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### Abstract

Students at Canutillo High School in Canutillo, Texas and Slider Middle School in El Paso, Texas have been involved in the GLOBE (Global Learning and Observations to Benefit the Environment) Program for several years. As part of their GLOBE instruction teachers Joel Gilbert (Canutillo HS) and Sharon Mitchell (Slider MS) introduce their students to the basic concepts of remote sensing. Both Gilbert and Mitchell's courses include the study of satellite imagery. The students are first shown how the images are composed of tiny dots called "pixels", and that a pixel represents the instantaneous field of view of the ground surface imaged. Students are also taught that the ground surface area represented by one pixel in a satellite image is called "ground resolution" and that the greater the number of pixels per inch, the greater the resolution. The students also learn that satellites transmit these pixel images to ground stations as digital signals, which represent the ground surface being imaged. It is through this lesson, ground surface reflectivity and light's behavior as it is sent back to a satellite's sensors, that Gilbert is able to build his course upon the TEKS (Texas Essential Knowledge and Skills) standards with relevant instruction. In this lesson, a grayscale image, which may vary in tone, is presented to the class. Then false color is added to emphasize a particular feature, such as vegetation. The class is then introduced to the electromagnetic spectrum and is shown how different wavelengths of light produce the false color images that appear in satellite imagery. Gilbert's IPC (integrated physics and chemistry) classes study the properties of light as part of their course work, and since satellite sensors operate by picking up the way light is reflected from various surfaces, it is easy for him to incorporate the studying of these images into his lesson plans.

For the last several years, Mitchell has been studying remote sensing with her eighth grade classes at Slider Middle School. Using a set of six Landsat images of El Paso that she received from PACES (Pan American Center for Environmental Studies) at UTEP, for the years 1984, 1988, 1991, 1994, 1997 and 2001, she instructs the students (working in teams of two) to study the changes (urban sprawl) that had taken place over that seventeen-year period. First, she has the students tape transparent sheets over the images and then gives them a list of major streets

and sites e.g. their school to identify and label. They are then asked to study the images to see what year each site first appeared on the image. Through studying and comparing the images the students are able to see how much change has taken place. Both Gilbert and Mitchell end their lessons discussing how urban sprawl puts a strain on area water supplies, and what, given the crisis drought situation in the west, what the future consequences will be.

### Background and Overview

Today's teachers need to learn to integrate technology effectively into the curriculum and NASA technology provides an excellent teaching tool for 21<sup>st</sup> century schools. With the aid of a grant from NASA and JPL we in the GLOBE Program at UTEP have endeavored to provide instruction to a significant number of teachers in image processing at a moderate technical level. Two years ago we finished a pilot program that trained secondary school teachers, and through them their students in state of the art remote sensing methods. Twenty teachers, ten each school year, were selected from the three largest school districts in the El Paso area. These teachers had been introduced to remote sensing during their GLOBE training, however none felt comfortable enough to implement it in their classroom. They needed further instruction. The greatest benefit to the participating teachers continues to be access to NASA's advanced geologic remote sensing methodologies and facilities at UTEP's Pan American Center for Environmental Sciences (PACES) and JPL. The innovative aspect of this program is that it provides a logical, direct and economical way for the transfer of NASA's remote sensing technology to a wide variety of students: most of whom are minorities. At the end of this two-year period, this training had impacted at least 3000 secondary students. To date, because many of these teachers have continued to use remote sensing as part of their classroom curriculum, countless other students have been given the opportunity to experience, manipulate, and interpret image processing. Results of this project include the use of satellite imagery to enhance senior projects, help teachers validate GLOBE land cover, and raise awareness of NASA resources available to teachers and therefore impact the level of knowledge of their students.

## Teacher Applications

Teacher and student projects attempted, have to take into account the unique geographic location of El Paso, Texas. El Paso, with a population of approximately 600,000, sits across the Rio Grande River from its sister city Juarez, Mexico, which has a population of 1.5 million. On the satellite image it looks like one large metropolitan area, but in fact it is an international border that shares two cities, three states (Texas, New Mexico and Chihuahua) and two countries. Urban sprawl is a problem in both cities. Sharon Mitchell, an eighth grade teacher at Slider Middle School in far east El Paso, is making her students aware of this problem by having them compare satellite images taken of the El Paso region over a span of seventeen years. Mitchell, who has been studying remote sensing with her classes since her participation in the NASA grant in 2000, requested and received from PACES, a set of six false color satellite images, with accompanying sets of 18 color copies of each. The images were for the years 1984, 1988, 1991, 1994, 1997 and 2001. Using these copies with her classes, she instructed the students (working in teams of two) to find a list of particular sites relating to the sprawl, clearly identifiable in the images. To begin with, she taped a plastic transparent sheet over each image before each class and instructed the students, using permanent markers, to identify, trace and label the major roads and highways that had been built during that interval e.g. Loop 375, which is a major bypass built around the city of El Paso. In one image the students could see that this now major artery, appeared first merely as a dirt road, and in a later image they could see that it was paved and much wider. They were also required to determine the length of Loop 375 in cm and miles. They were asked to identify and compare the hue of red of the grass on the golf course and to determine in which year the grass had a good growing year. The students also located and marked new parks and new schools that had been built in the area.

Canutillo High School in Canutillo, Texas is located to the west of the city of El Paso. In contrast to the location of Slider Middle School, which is located entirely in an urban setting, Canutillo is a farming community surrounded by pecan groves, and cotton, alfalfa, chili, and onion fields. Gilbert, as well as having his students identify sites on satellite images, has his students concentrate on how urban sprawl is taking over former fields and groves.

## Conclusion

The southwest is in the middle of one of the worst droughts since the "dust bowl days" of the 1930's. Rainfall for the El Paso/Juarez/Canutillo area is half the yearly average of 8 to 10 inches. These cities get their water supply from two sources, water wells and the Rio Grande River. Farmers that

normally got about 5 *acre feet* a year from the Elephant Butte Irrigation District, in 2003 only received 7 *acre inches*. Obviously this is not enough water to grow crops or maintain pecan groves. As a result, farmers have had to either get water for their fields from existing wells on their farms, drill new ones, or let their fields lie fallow. Pecan growers do not have that option. To conserve the water from the Rio Grande River, water is released from Elephant Butte Dam only periodically; when it is time for the farmers to receive their irrigation allotment. This means that the water supply to the Rio Grande has been reduced so much that for most of the year it is nothing but a dry riverbed. Urban sprawl puts a strain on local water supplies: the Rio Grande River, and the Mesilla and Hueco Bolson aquifers. It also takes agricultural land out of production, and destroys Chihuahuan Desert habitats. When students are taught how to interpret satellite images, they not only see the impact that urban sprawl has on a region, they are able to comprehend how that impact will affect them and their future children's lives as well. These students are using data previously only available to research institutions. Now they can use this data to answer their own research questions. Teachers and their students can now perform investigations that lift science classes from the banality of memorization to the illumination of understanding.

GLOBE encourages and fosters this type of learning through the use of scientific protocols in data gathering and free availability of this data to interested individuals and groups. Through the initial distribution of a single Landsat image by GLOBE, remote sensing has gained a place in the curriculum taught by area teachers