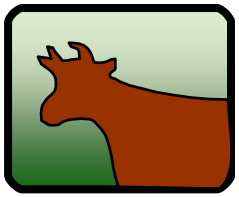
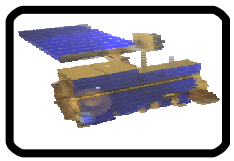
RangeView

RangeView is a web-based information system that allows users to view, animate, and analyze satellite imagery in order to monitor vegetation dynamics through time and across landscapes.

RangeView is designed for use in natural resource decision-making in ways that complement traditional land management procedures, such as field-based inventory and ground monitoring techniques.

Table of Contents

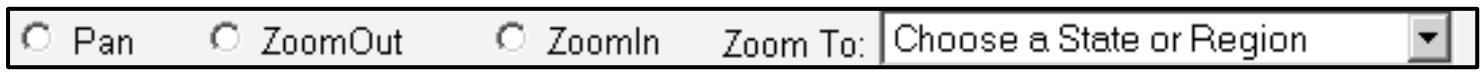




Introduction to RangeView

The RangeView application allows users to zoom in to an area of interest, overlay layers such as roads and cities, select satellite imagery of vegetation greenness, and then animate those images.

1. In your internet browser, go to http://rangeview.arizona.edu.
2. Click on “Dynamic Animation with AVHRR data” in the Tools box. (We will use the MODIS later in the exercise)
3. At the top of the window, you will find navigation tools such as zoom in, zoom out, and pan (move along the image).



   a) Select the “zoom in” button and click in Sonora. Click three more times to zoom in to the interior of the state.

   b) Select the “zoom out” button and click in the center of the image viewer to zoom back out to see all of Sonora.

   c) Select the pan tool and click on the left side of the image viewer to see the Pacific Ocean. Now click on the right side of the image viewer once to center on Sonora and again to see Chihuahua.

   d) From the “Zoom to:” menu, choose the United States to zoom out to the full extent of the map area.

   e) Now choose Sonora in the “Zoom to:” menu.

Introduction to RangeView

1. On the left side, you will see a list of map layers with two check boxes next to each item.

   a) Find the map layer called “Highways” and check the first box to select this map layer for display upon clicking Refresh.

   b) Scroll down to find the layer called “Major Cities” and check both boxes to display the cities and their labels.

   c) Click the Refresh button 

see the map layers and labels you have selected appear in the image viewers.

   d) Click the “ZoomOut” tool once to get a wider view of Sonora.

   e) Notice that after you zoom out, the “Cities” layer has red **X**’s where the check boxes should be. This means that you are zoomed out too far to see that map layer. At this scale, showing the cities in Sonora would make the map too crowded to read.

   f) Use the “ZoomIn” tool to zoom in to Sonora until the **X**'s next to the “Cities” layer disappear. Check the first box next to this layer and click Refresh to view the cities.

Layer Name (Resolution)	Turn on/off Layer	Turn on/off Label
Major Cities	☐	☐
Cities	X	X
Cities/Towns	X	X
Major Urban Areas	☐	☐
Urban Areas	X	X
Populated Areas	X	X
Highways	☐	☐
Roads	X	X
Countries	☐	
States & Provinces	☑	☐
Counties	☐	☐
Rivers & Streams	X	X
Lakes	☐	☐
Water Bndry (Regional)	X	X
Water Bndry (Detailed)	X	X
FS Land	X	X
FS Allot AZ & NM	X	X
FS Pasture AZ & NM	X	X
State Land AZ	X	
Tribal Lands	X	X
BLM Land	X	X

Introduction to RangeView

1. Notice there is a location map in the top left hand corner showing where in North America you are viewing.

   a) Select the “Zoom In” tool and click once. Notice the red box showing your location has changed.

2. Notice also that the map layers you have checked on appear in a legend at the bottom of the page.

3. Now that you know how to use the navigation tools and map layer display, try to reset the page to the way that you had it before. Here is a list of things to do:

   a) Uncheck the map layer called “Highways.”

   b) Uncheck the box for the layer called “Major Cities” and the box for its lables.

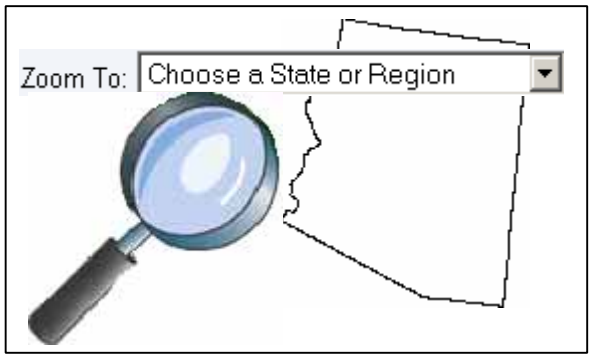
   c) Uncheck the map layer called “Cities.”

   d) Use the “ZoomTo” tool to zoom to Sonora.

   e) Remember: to see the changes you make to the map layer list, you must press the Refresh button.

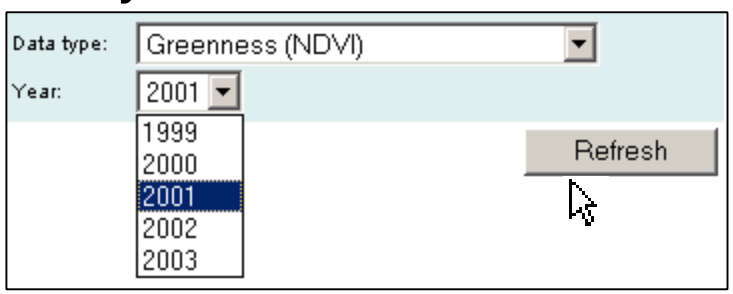
RangeView Reminders

- ✓ The “Zoom to:” menu can zoom directly to U.S. states, Canadian provinces, and Mexican states.

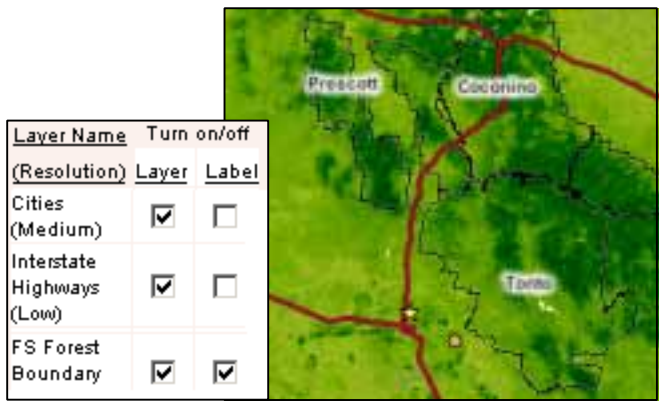


- ✓ You must select the correct navigation tool before using it in the image viewers.

- ✓ Press the Refresh button to see changes to the map layer list, the data type menu, or the year menu.



- ✓ Only one label in the map layer list can be on at a time.

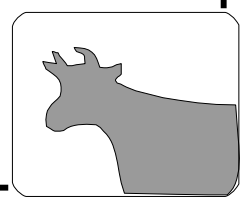


Application 1: Range Monitoring

Persistent drought in the western U.S. and northern Mexico has often necessitated modification of wildlife management practices due to deteriorating vegetation conditions. Given the large and sparsely populated areas being monitored, it is difficult to determine the effects of decreased rainfall in specific regions. However, a proxy for the impact of rainfall is available through the RangeView website in the form of the satellite measured vegetation greenness.

Objectives: To use the RangeView website to…

1. Visualize the vegetation greenness on the Reserva de la Biosfera del Pinacate during a wet year (1998) and a dry year (2002).
2. Evaluate the difference from average greenness on the reserve for 1998 and 2002.



Exercise 1: Interpreting Vegetation Greenness

1. Choose Sonora from the “ZoomTo” menu.
2. Select “Greenness (NDVI)” in the “Data type” menu for both image viewers. Select 1998 as the year for the left image viewer and 2002 as the year for right image viewer.

NDVI stands for Normalized Difference Vegetation Index and is one way to measure vegetation greenness. NDVI on the Dynamic Animation tool is measured from a sensor called **AVHRR** (Advanced Very High Resolution Radiometer.)

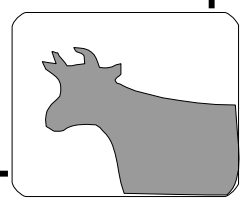
3. In the map layer list, check both the label and layer boxes for “Major Cities” to have reference points. Click Refresh.

4. The image viewers show *vegetation greenness* for the years 1998 and 2002. Notice the legend below the map. The dark to light brown colors represent the least green areas in the scene. The light to dark green colors represent greener areas in the scene.

? Which map shows more overall vegetation greenness? Does the 2002 image appear as you would expect in drought conditions?

Navigating to the Pinacate Reserve

1. Select the “Zoom In” button in the navigation bar and click twice on northwestern Sonora (west of Nogales and south of the Mexico-United States border) to zoom in.
2. In the map layer list, check both boxes to display the layer and the label of the “FS Allot AZ & NM.”
3. Check the layer box next to “FS Pasture AZ & NM.”
4. Uncheck both boxes next to “FS Land”. Click Refresh.
5. Click twice on the Walker Basin allotment to zoom in.
6. If necessary, select the “Pan” button in the navigation bar, and click in the image viewer to center the Walker Basin pasture in the viewer.
   (Click just to the right of center if the right side of the allotment is cut off and to the left of center if the left side of the allotment is cut off.)
7. Uncheck the **label** box for “FS Allot AZ & NM”. Add or remove layers to the image viewers to display the information you feel is most relevant.



Animating the Images

1. To see the greenness of this area through time, press the Animate button. The images for each year will be displayed for the area with the layers that you selected.

2. When the images are available, you will be directed to the animation window which has buttons that allow you to play, stop, and browse through the images.

3. Notice the map layer list and navigation tools are no longer available.

4. If the images are playing through, press the stop button . Then press the “Skip to Beginning” button to see the first image.

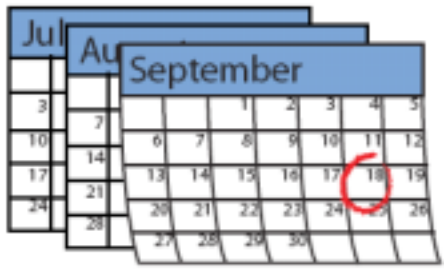
5. The date at the top of the image is the last day of a *compositing period*. To minimize cloud and snow cover, the day with the most greenness during the compositing period is chosen to create the images you are viewing.

? How many days are in the compositing period?
(Hint: Use the Step Forward and Step Backward buttons to switch between the images.)

RangeView Reminders

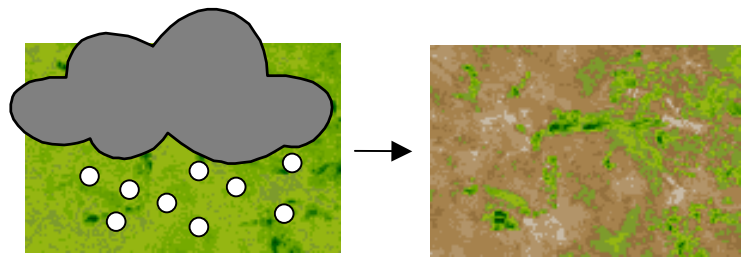
- ✓ In a “Greenness” image, areas that are dark to light green are more green than areas that are light to dark brown.

- ✓ AVHRR greenness images show the maximum greenness during its 14-day compositing period.



- ✓ **NDVI** stands for Normalized Difference Vegetation Index and is a measurement of vegetation greenness.

- ✓ Clouds or snow can make an area appear less green than it actually is.



Exercise 2: Using Difference from Average to Make Comparisons

1. Use the Step Forward button to navigate to the August 13, 1998 image. Consider the climate during this time of the year. Why do you think it is suddenly more green in the 1998 image at this date?

   _____

2. Which year (1998 or 2002) appears to have more vegetation?

   _____

3. Is this what you would expect considering that 1998 was a relatively wet year and 2002 was dry? _____

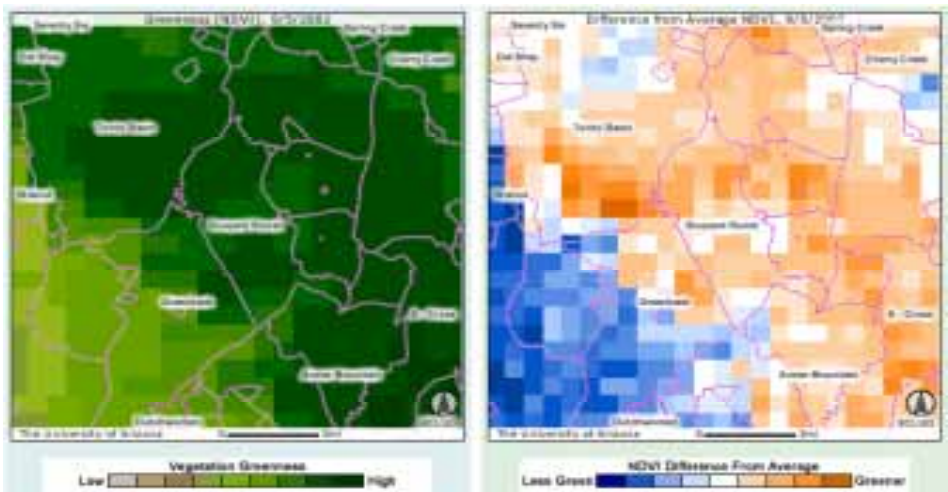
4. Considering vegetation, what sort of vegetation do you think is present in the areas least affected by climate? _____

5. Excluding cloud cover, in what month do you think the greatest difference between 2002 and 1998 in greenness? _____

Difference from Average

ALWAYS USE THIS BACK BUTTON ON THE PAGE TO GO BACK→ Back

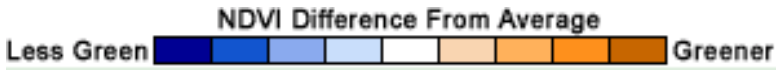
1. To make a new animation for comparing 2002 greenness to the average, press the yellow Back button in the top right corner of the page.
2. The image viewers are still zoomed in to the Pinacate Reserve, but the layers have been turned off. Check the layer box for “Major Cities” and for “Highways.” Click Refresh.
3. Set the data type of the both viewers to “Difference from Average NDVI.” Leave the year of the right viewer as 1998 and the year of the left viewer as 2002. Click Refresh.



This comparison shows the left viewer diplaying NDVI data (greenness) and the right viewer displaying the difference from average.

2002 and 1998 Greenness Compared to Average

1. To see an animation of this imagery, press the Animate button.
2. Stop the animation and use the "Skip to beginning" button to go to the first image of the year. Play through each image using the Step Forward and Step Backward buttons.
3. Notice the legend below the viewers. Areas that are orange are more green than average for that time of the year. Areas that are blue are less green than average for that time of the year.



? Since 2002 was a dry year, what color do you expect to see? Can an area ever be exactly average?

Questions for Consideration

there any period of time in the Pinacate area when the greenness in 1998 is less n average? Is there any time period in 2002 when it is above average?

_____

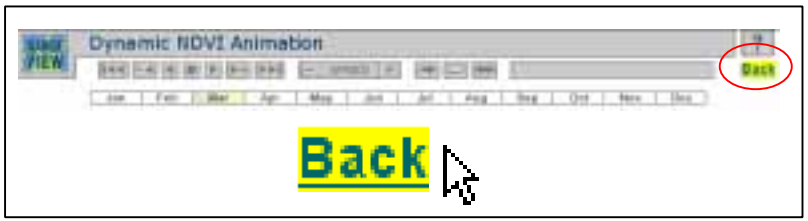
re there portions of Sonora that experience less than average greenness in 1998 higher than average greenness in 2002?

_____

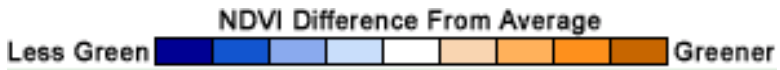
o you think that this means that the Pinacate region received more rainfall than rest of Hermosillo in 1998, or could it be a reflection of Pinacate's generally low erage rainfall? _____

RangeView Reminders

- ✓ Always use Back button on the page to get back to the navigation page.

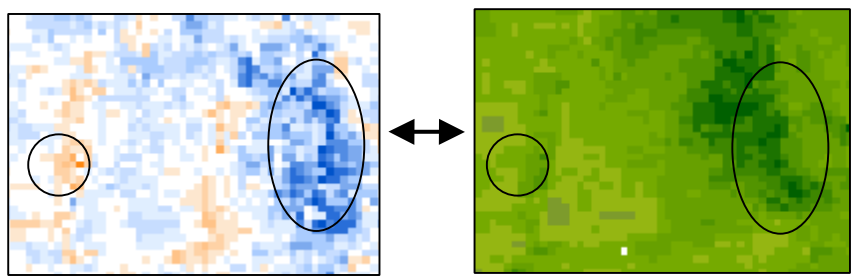


- ✓ In a "Difference from Average" image, areas that are orange are more green than average, and areas that are blue are less green than average.



- ✓ The "Average" is a calculated mean of greenness images. Therefore, an area can never be truly "average."

- ✓ In a "Difference" image, an area that is blue is not necessarily more green than an area that is orange.



Application 2: Introduction to MODIS

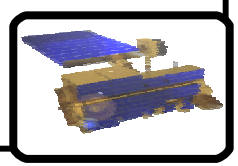
MODIS (Moderate Resolution Imaging Spectroradiometer) is the newest addition to the RangeView data products. Like AVHRR, MODIS is a sensor that collects greenness data, but MODIS offers us some different capabilities. Among these is the ability to get data at a resolution of 250 meters, compared to the 1000 meter resolution of AVHRR.

Comparing AVHRR and MODIS

	AVHRR	**MODIS**
Spatial Resolution	1 kilometer	1 kilometer; 250 meters
Passes over Earth	every day	every day
Historic Coverage	1989 to present	2000 to present
Vegetation Indices	NDVI	NDVI; EVI

EVI stands for Enhanced Vegetation Index and is another measure of vegetation greenness.

Remember, both **EVI** and **NDVI** (Normalized Difference Vegetation Index) **= Greenness**

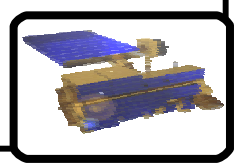


Exercise 1: Exploring the MODIS Data Tool

1. If you are not at the homepage, click the RangeView button 

in the upper left corner of the screen.
2. Click on “Dynamic Animation with MODIS Data” in the Tools box.
3. Notice that the window looks the same as the AVHRR window. All the reference layers on the left side of the screen are still available for use.
4. In the “Data type” menu notice there are different data layers available. NDVI is now available in both 1000 meters and 250 meters. Notice also that the difference data (Difference from Average NDVI, from Last Period’s NDVI and from Last Year’s NDVI) are not available.
5. Under the “Year” menu notice the years of availability for MODIS compared to AVHRR. MODIS is a newer sensor and has only been collecting data since 2000.

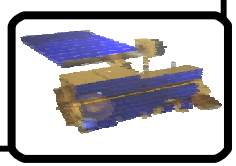
LAI stands for Leaf Area Index, and is another satellite measure of vegetation.



Navigating to the Pinacate Reserve

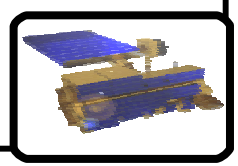
1. In the “Zoom To” menu choose Sonora. Select 1000m NDVI for one viewer and 250m NDVI for the other viewer. Select 2003 for both viewers. Click the Refresh button.
2. Because the MODIS 250m resolution footprint only covers the northernmost part of Mexico, the rest of the country displays no MODIS data.
3. In the map layers turn on the layer for Highways. Click Refresh.

4. Select the “Zoom In” tool
   the
   ear
   and Highway
   2).
5. Zoom in until your map viewer window
   e .



Exercise 2: Exploring Data at 250 Meters

1. Do not Animate the images yet. Look carefully. What differences do you see between the 1000m and 250m?
2. In the 250m image can you see the faint green line running parallel to the highway? What do you think this might be?
3. Open a new browser window and enter the following web address: www.maps-of-mexico.com. Scroll down and click "State maps." Move your mouse on the map to the state of Sonora and click.
4. Click on the Sonoran grid that is on the top row of the map, and is the second grid from the left.
5. Can you identify the feature on this map which is the same feature shown by the faint green line in the MODIS data? It is the Sonoyta River.
6. Is the Sonoyta River drainage clearly visible in the 1000m image?
7. You may compare these images further by zooming in more if you wish.

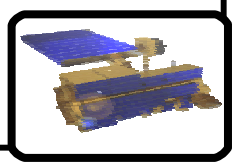


Animating the Images

1. Click the Animate button to start the animation. Remember you can use the animation toolbar 

to browse through the images at your leisure.
2. In what month is the Sonoyta drainage area the most visible? Is it also visible in the 1000m image at this time? Are there dates when it is not visible in the 1000m image?
3. Can you see any other riparian areas in the 250m image?
4. Over all which image did you find more helpful in exploring vegetation dynamics on the ground?

A riparian area is the area directly surrounding the bank of a river.



Introduction to MODIS: Exercise 2

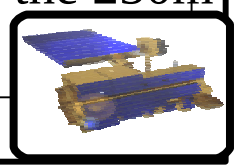
Oftentimes we find that allotments are small enough that the 1km AVHRR pixels give us a very “blurred” image of what is happening on the ground. MODIS data gives us the ability to look with more detail at these smaller allotments.

Keep one map viewer on Greenness 250m and one on Greenness 1000m, but change the year to 2002. Press the animate button.

In the February 17, 2002 image the 1000m shows a relatively homogenous picture of vegetation greenness. The 250m image, however, shows significant variation within this allotment. Why does the 1000m not show the same greenness variation that the 250m does?

Would the 250m image effect your decision making on this allotment differently than the 1000m image?

As you view the animation remember that the 250m image is also made by “averaging” the greenness over an area. If we could see what was “inside” the 250m pixels we would see even greater variation.



Exploration

Rangeland Monitoring: Your own area of interest

1. Now is the chance to explore your own area of interest with the RangeView tools you've learned how to use. Perhaps you have an allotment that is of particular interest to you.
2. Return to the main RangeView page by clicking the RangeView button in the upper left corner of the screen.
3. Before you begin exploring your area you will have to make a few decisions. Which dataset will you use (AVHRR and MODIS). Remember if you choose MODIS there are no difference images and the data is only available from 2000. Maybe you will choose to look at your area first in AVHRR and then in MODIS.
4. Think about which years you will look at. Why? Think about what layers will be useful in finding your area of interest. Maybe you will put cities on first to zoom into a general area. If you are looking for a forest service allotment this layer may be helpful.
5. Can you relate what you see on RangeView to what you have experienced in a certain area on the ground. If you see anything interesting or strange in the animations ask yourself what this be.

Application 3: Precipitation and Climate

There are several factors which affect vegetation greenness, including the vegetation type, soil type, and geographic location. Some of the most significant factors are **precipitation** and **climate**.

Climate Event: monsoon
Definition: The onset of summer rainfall and thunderstorms, bringing an abrupt end to a dry period from April to June.

Climate Event: ENSO (El Niño Southern Oscillation)

Definition: a see-saw in tropical sea level pressure between the eastern and western hemispheres

Locations Affected: worldwide

Southwestern US Response:

El Niño: El Niño causes wetter than normal conditions during the late summer and winter.

La Niña: La Niña causes drier than normal conditions from late summer through the winter.

Vegetation Greenness and Precipitation

In portions of Arizona and Mexico, the months from April to June are characterized by extreme dryness. This period usually ends abruptly with the onset of summer rainfall and thunderstorms, known as the monsoon.

- **Objectives:** To use the RangeView website to…
  1. Choose appropriate images for viewing precipitation effects on greenness.
  2. Identify the start of the monsoon in 1999 and 2000
  3. Determine the relationship between greenness and precipitation as seen in satellite imagery

Exercise 1: Choosing Appropriate Images

- Go to http://rangeview.arizona.edu → Dynamic Animation with AVHRR Data Tool.
- Choose Sonora from the "Zoom to" menu.
- Choose a data type that will highlight the effect of precipitation on vegetation greenness and allow you to compare Sonora's monsoon seasons for 1999 and 2000. The available image types are:
  - Greenness: shows vegetation greenness and can be used to compare greenness from one place to another.
  - Difference from Average: shows whether an area is more (*orange*) or less (*blue*) green than average.
  - Difference from Previous Period: shows whether an area has increased (*orange*) or decreased (*blue*) in greenness from one period to the next.
  - Difference from Previous Year: shows whether an area has more (*orange*) or less (*blue*) greenness than last year
- Select one year for each viewer to look at the monsoon seasons one at a time or select a different year for each viewer to compare the monsoon seasons.

Exercise 2: Identifying the Monsoon

1. Using the tools of your choice, compare Sonora's monsoon seasons for 1999 and 2000. Note that the monsoon usually occurs in the months between June and September.
2. Below are some questions to consider. Your animation may not be able to address all of the questions. If the animation you selected cannot answer the question, think about why it cannot.
3. When do you think the monsoon started – at the beginning, middle, or end of which month?
   1999 _____ 2000 _____
4. Which year had the most rain during the monsoon season? _____
5. Is this a normal amount of rain for this season?
   1999 _____ 2000 _____
6. How significant is the monsoon's effect on vegetation greenness over several months? _____

Exercise 3: Vegetation Greenness and Precipitation

Exploring Monsoon Patterns in Arizona

–Return to the Dynamic Animation tool page. (Go to http://rangeview.arizona.edu → Dynamic Animation with AVHRR Data Tool.)

–Choose Arizona from the "Zoom to" menu.

–Turn on the layers and labels for Major Cities.

–Zoom in to the Tucson area.

–Once again, select a data type that will allow you to compare the monsoon seasons for 1999 and 2000.

–Animate your data sets.

–When does the monsoon appear to affect vegetation greenness? How does this relate to the monsoon season in Sonora? Are the timing and affects of the monsoon seasons more similar or different in Arizo and Sonora?

Comparing NDVI to Numeric Data Values

Year	Start	Month by month rainfall				
		June	July	August	September	Total
2000	June 17	1.56”	1.59”	1.70”	0.02”	4.87”
1999	June 26	0.16”	4.15”	3.05”	0.97”	8.33”

Source: www.nws.noaa.gov

- Does this correspond with what you have seen?
- Look at the amount of rainfall for each month. In which month do you expect to see the highest vegetation greenness values?
  - 1999? _____
  - 2000? _____
- Look at the animations again. Does there appear to be a lag in the effects of precipitation on vegetation greenness?

  _____

Application 4: Wildfire Monitoring

In the twelve years between 1988 and 2000, a total of 376 fires have occurred in Sonora. This is an average of 31 fires per year. In particular, the year 1989 was a critical time for our region, with 83 fires which affected 66,025 hectáreas - Horacio Liñeiro Astiazaran; IMADES

Wildfire: Aspen Fire

Started: June 17, 2003

Ended: June 30, 2003

Location: Mount Lemmon, northeast of Tucson, Arizona

Extent: 84,750 acres

Fact: The fire destroyed 333 structures.

Exercise 1: The Aspen Fire

1. In your internet browser, go to http://rangeview.arizona.edu. Click on “Dynamic Animation” in the Tools box.
2. Choose Arizona from the “Zoom to” menu.
3. Select “Greenness” for the data type of the left viewer and “Difference from Last Period’s NDVI” for the data type of the right viewer. Select 2003 as the year for both viewers. Click Refresh.

? Knowing that orange areas have increased in greenness since the previous period and blue areas have decreased in greenness, what color do you expect the fire area to appear after the fire occurs? blue

1. Check on the Interstate Highway layer and labels. Click Refresh.
2. Select the “Zoom In” tool and click twice where the I-10 and the I-19 intersect to zoom in.
3. Northeast of the intersection, Mt. Lemmon appears as a triangular-shaped, highly vegetated area.
4. Click twice to zoom in on Mt. Lemmon. Add any appropriate layers to the image viewers. Click Animate.

Viewing the Effects of the Aspen fire

- If the fire started on June 17, 2003, why do you not see evidence of the fire in the June 24, 2003 image? (Hint: Consider the length of the compositing period.
  Only the highest greenness values are chosen for a composite; low greenness values caused by the fire would be removed
- When did you first see evidence of the fire? 7/8/2003
- Which animation best showed the smoke from the fire? Which animation best showed the extent of the fire? Why? Diff. from Last Period; It shows sudden changes in greenness.
  The extent of the fire is much clear in this data
- In the July 8th image, what is the length and width of the fire?
  Length: 12-15 1km pixels Width: 7-9 1km pixels

A **pixel** (picture element), seen as squares in the AVHRR greenness images, represents 1 km^2.

– Use the “Step Forward,” or “Step Backward” buttons to alternate between the image with the fire and the previous image to see the dramatic change in vegetation greenness. Which dataset would highlight this change well? Difference from Previous Period

Exercise 2: Identifying Wildfire in Sonora

According to Horacio Liñeiro Astiazaran of IMADES, “[Las regiones mas vulnerables de quemarse en el estado de Sonora] son: Yecora, Álamos, Cananea, Huchinera, Nacori Chico, Bacanora y Nogales. Estas regiones se ven afectadas debido a su topografía, tipo de combustible y activida socioeconomica. Son áreas que están permanentemente evaluadas en función de sus recursos forestales que año con año son afectados por los incendios.”

Wildfires Recorded in Sonora

Año	Incendios	Hectáreas
1988	26	23,915
1989	83	66,025
1990	10	3,840
1991	23	9,860
1992	14	205
1993	22	6,241
1994	29	2,663
1995	29	5,009
1996	48	8,017
1997	26	1,667
1998	26	1,667
1999	76	12,509

Exploration

What local wildfires do you remember? This is a good time to explore the effects these wildfires had on the vegetation where they occurred.
If you cannot remember any recent wildfire locations, try exploring this website for reminders: http://maps.geog.umd.edu/activefire_html/checkboxes/us_checkbox.htm -Select "MODIS Active Fire Detections" and click "Open Map"
-Use the zoom tool to select the state of Sonora.
-Under Date Query, enter the dates you want to review.
-When you have a feel for the area and the date when the fire occurred, see if you can locate the fire using RangeView.

- Here are some questions for thought:
- Is it easier to see your wildfire using Difference from Average or Greenness?
- How could you use Difference from Last Period or Difference from Last Year as tools in examining the burn area?
- What factors do you think play a role in the greenness' return to average around your burnt area?
- Does the data you see on RangeView indicate that the area around your fire has now recovered? What information are you using to make that decision?