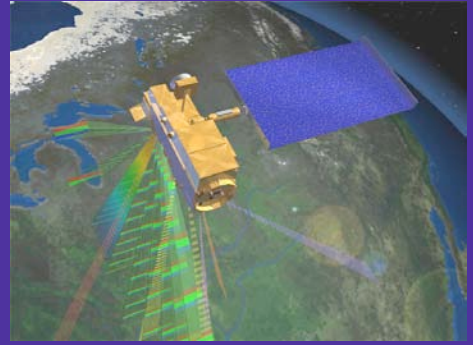


# Using Remote Sensing Imagery



in

# Interpretation



# Perspectives from Space



 Image by [Shedd Nelson, Foster](http://www.nasa.gov)  
Laboratory for Atmospheres  
Goddard Space Flight Center  
<http://rind.gsfc.nasa.gov/rind/>

 Hurricane Linda west of Mexico  
September 9, 1997 17:43 UTC  
Data from: NOAA, NOAA, USGS 

Earth, It's our home. We in interpretation are dedicated to conveying age-old stories and provoking people to think about our surroundings in new ways. In this portion of the session, we will illustrate some ways you might use new tools borne of remote sensing, in your interpretive products-be they programs, exhibits or writing.

# Some Universal Concepts Tied to NASA's Work

- Exploration and discovery
- Survival
- Change
- Home
- Community
- Curiosity
- Search for understanding
- Time
- Mystery
- Death
- Life

If you are familiar with the notion of universal concepts, here's a few that relate to some of NASA's work.



Interpreters can use a wide variety of remote sensing products to augment their presentations and other interpretive products. And, using space-based imagery can be an effective means to reach young minds.

# NASA Remote Sensing Products are Great for Interpreters!

- Help connect local resources with global perspective
- Can address immediate needs for information or graphics
- Show change over time
- Provide unique views of natural disasters
- Help interpreters support management decisions
- Help spark interest among visitors
- Connect today's exploration with themes of historical sites
- Are great sources of information



Just as interpreters work in a broad variety of resources, so too there is a broad variety of remote sensing products which we can use. Some instruments are on aircraft rather than on satellites.

## Assateague Island National Seashore



One example involves Assateague Island, where beach erosion is a critical resource issue.



Aerial view of Assateague Island, from an Airborne NASA LIDAR Mission (Ocean City in distance).

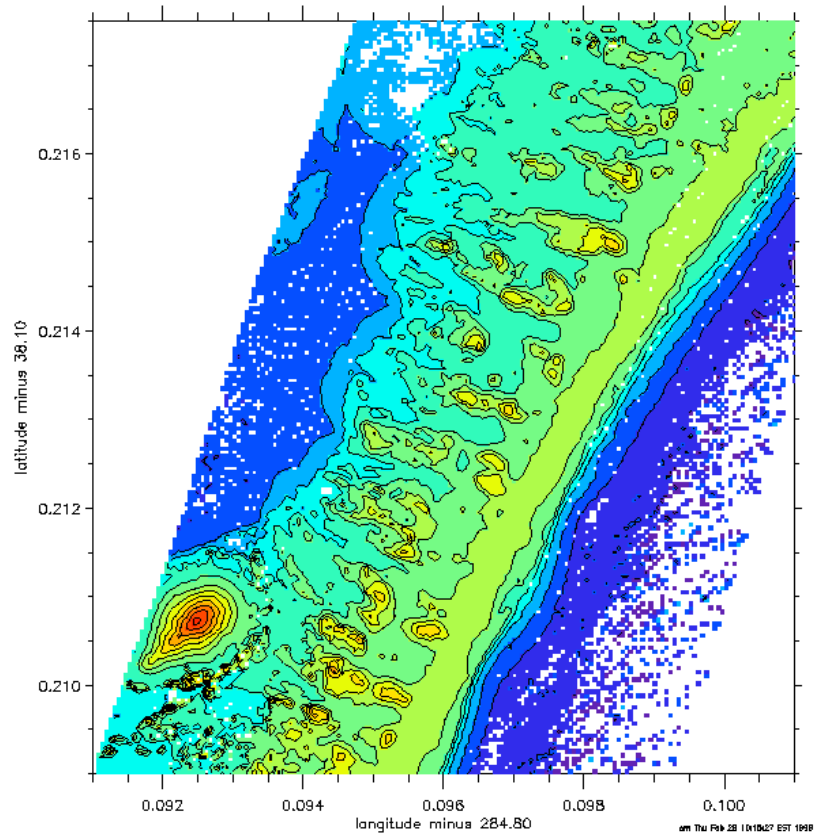
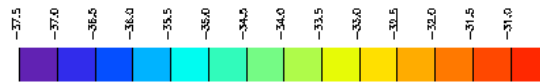
NASA helped out by conducting studies of airborne remote sensors, called LIDAR, over the park. This aerial view was taken during an airborne mission to map the beach using LIDAR.



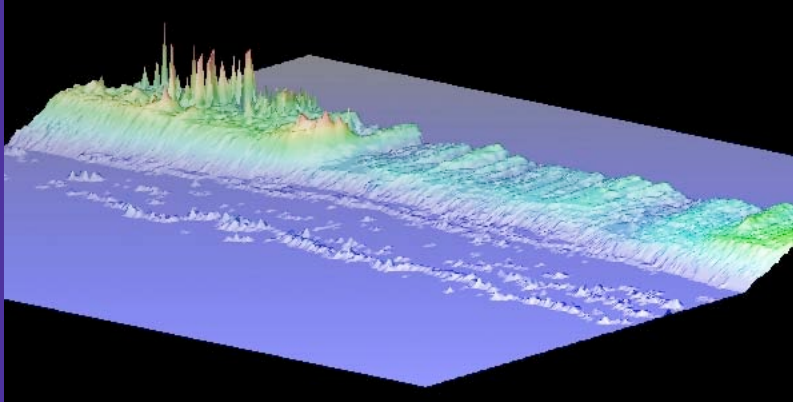
LIDAR imagery can help visitors understand the shifting beach morphology of Assateague Island.

### Airborne Topographic Mapper Survey of Assateague Island

5 meter grid cells, mean elevations (meters), WGS-84 coordinates

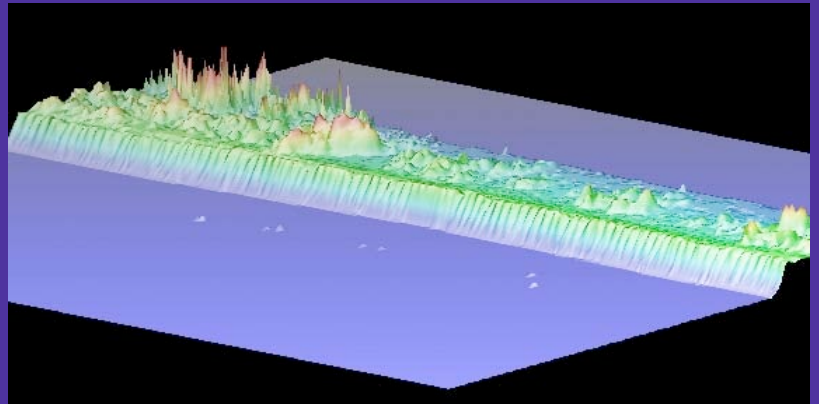


## Assateague Island Before and After Feb. 1998 Nor'Easters (data from LIDAR)



Overwash area *before*  
1998 Nor'Easters

Overwash area *after*  
1998 Nor'Easters



One of the final products of this mapping project was this three-D representation of the beach, showing the effects of storm damage to the island.

## NASA Studies Coral Reefs



**New Worldwide Coral Reef Library**

[http://www.nasa.gov/vision/earth/lookingatearth/coralreef\\_image.html](http://www.nasa.gov/vision/earth/lookingatearth/coralreef_image.html)

Some of you may be surprised to learn the breadth of the research that NASA does about Earth.

For example did you know that NASA studies coral reefs? Visit [http://www.nasa.gov/vision/earth/lookingatearth/coralreef\\_image.html](http://www.nasa.gov/vision/earth/lookingatearth/coralreef_image.html)

## Some Major Topics of NASA's Remote Sensing Research

- Land Use Change Over Time
- Human/Other Causes of Global Change
- Effects of Natural Disasters
- Effects of Local Events on Regional or Global Processes
- Air Quality
- Species Distribution

How might interpreters use all this wonderful work and imagery to connect visitors with the meanings and significance inherent in their sites' resources?

# Connecting Your Site to the Rest of the World

- Local changes affect your site

## NASA Studies Urban Growth



Ft. Vancouver NHS (arrow) is nearly surrounded by high density urban use.

Repeat observations can show urban encroachment, and help people understand the relationship between local decisions and the park experience.

Here, urban growth between 1986 and 1996 is shown in red. The blue line marks a land use zone boundary.

[local affects local]



In this Landsat image, red areas show vegetation, and blue-grey is buildings or pavement. Ft. McHenry NM appears as a bright red dot on the edge of Baltimore Harbor.

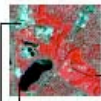
Baltimore, Maryland



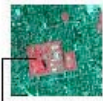
Baltimore Zoo  
Druid Hill Park Lake



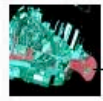
Football Stadium  
Camden Yards  
Inner Harbor



Lake Montebello  
Morgan State Univ.  
Herring Run Park



Patterson Park



Fort McHenry

How much land is set aside for preservation? What is the value of harbor front real estate? These are ideas that might be discussed with this image.

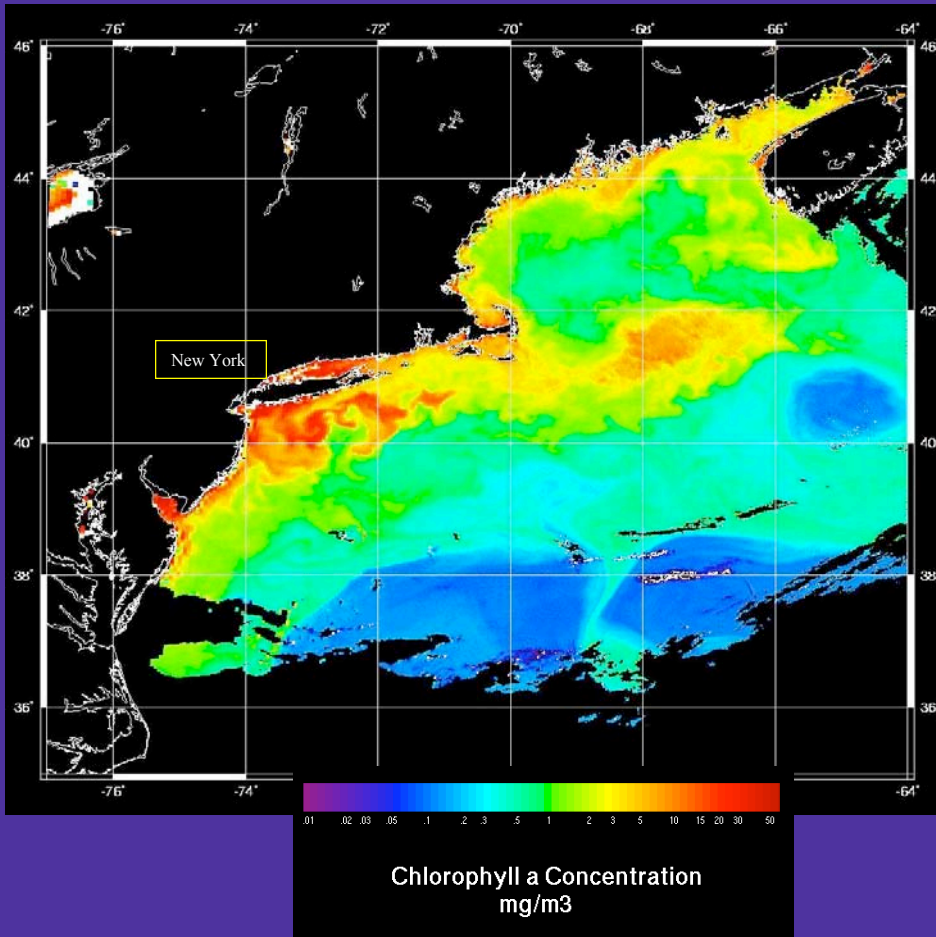
# Connecting Your Site to the Rest of the World

- Local changes affect your site
- Local changes affect the globe

Acting locally and thinking globally is a big leap for many people. It's a difficult thing for us to grasp how our individual actions can shape major changes on Earth.



# Satellites Provide Global Perspectives of Local Events



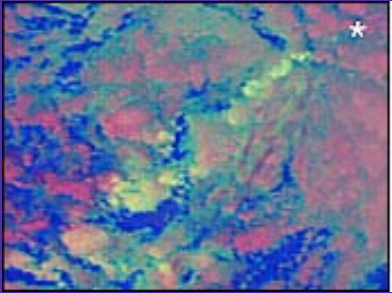
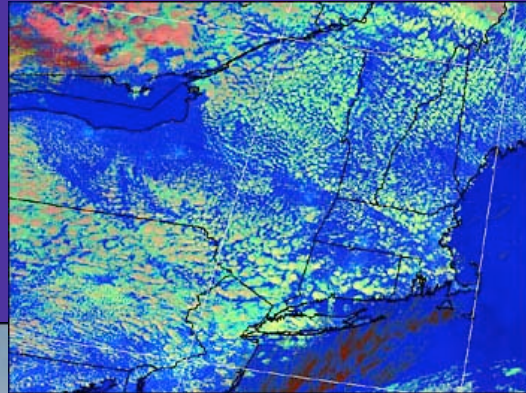
This SeaWiFS image was taken shortly after a nutrient spill in the Hudson River.

Here's an example of a local event causing significant regional effects. A nutrient spill caused an algal bloom in the Hudson.

# Local Air Pollution Sources Can Affect Large Areas

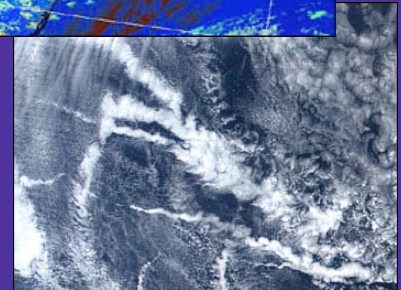
## Clouds of a different color

In this AVHRR image, pink clouds are clean, and yellow indicates pollution. (Aerosols prevent water droplets from becoming large enough to rain.)



## Tracing plumes to the source

Yellow aerosols in Canada can be traced back to this copper smelter, in Flin Flon Manitoba.



## Tracking ships' plumes

This MODIS image shows white plumes of aerosol pollutants from ocean ships.

Local decisions about air pollution can affect other areas! In 2004, NASA scientists tracked a giant, smoggy atmospheric "brown cloud" that formed over South Asia and Indian Ocean and demonstrated its intercontinental reach, and effects around the world. See [http://www.nasa.gov/vision/earth/environment/brown\\_cloud.html](http://www.nasa.gov/vision/earth/environment/brown_cloud.html) for more info.

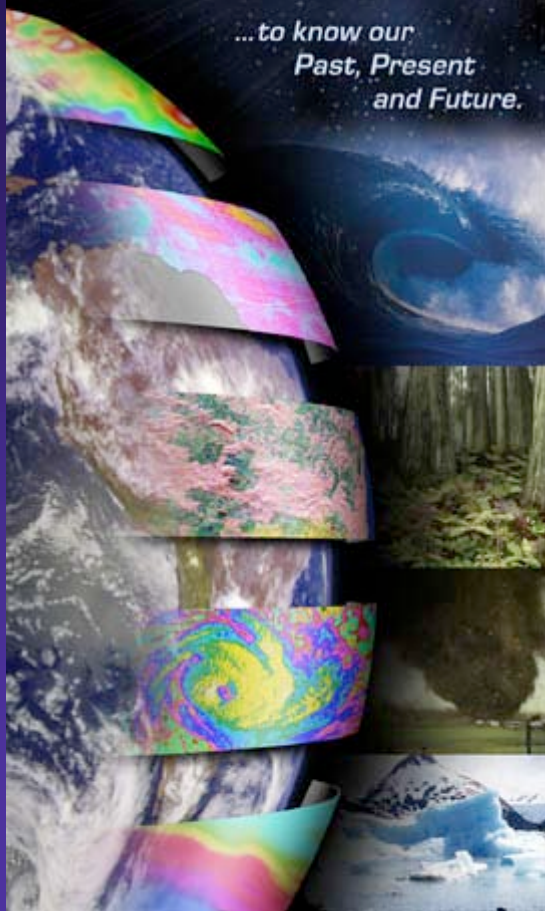
# Connecting Your Site to the Rest of the World

- Local changes affect your site
- Local changes affect the globe
- Global changes affect your site

One challenge interpreters face is making connections between our sites and the rest of the world.

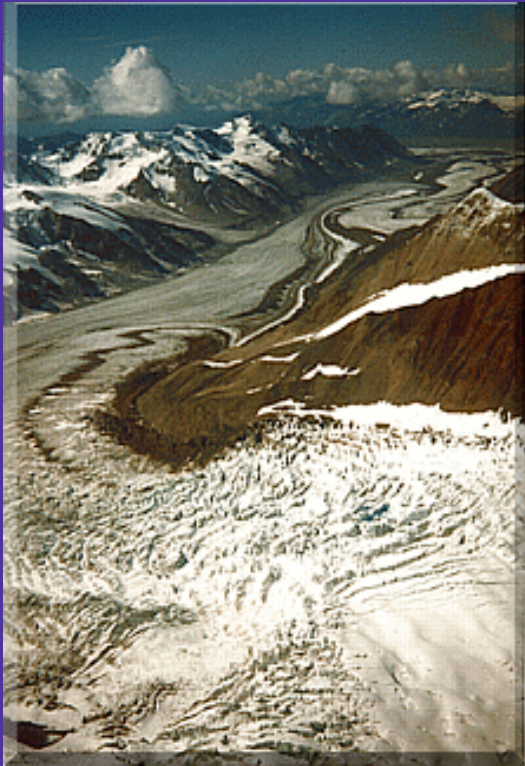
# EARTH SCIENCE

*...to know our  
Past, Present  
and Future.*



**Satellite  
Imagery  
Gives Us  
the Big  
Picture...**

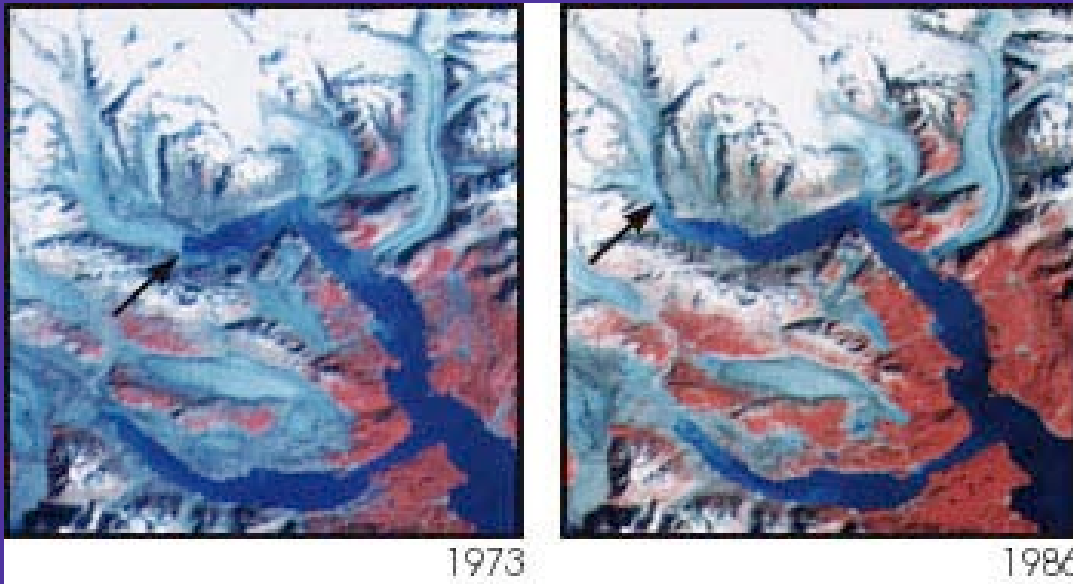
## So Visitors Can Get the Picture Too...



For example, Glaciers in Glacier National Park have been shrinking.



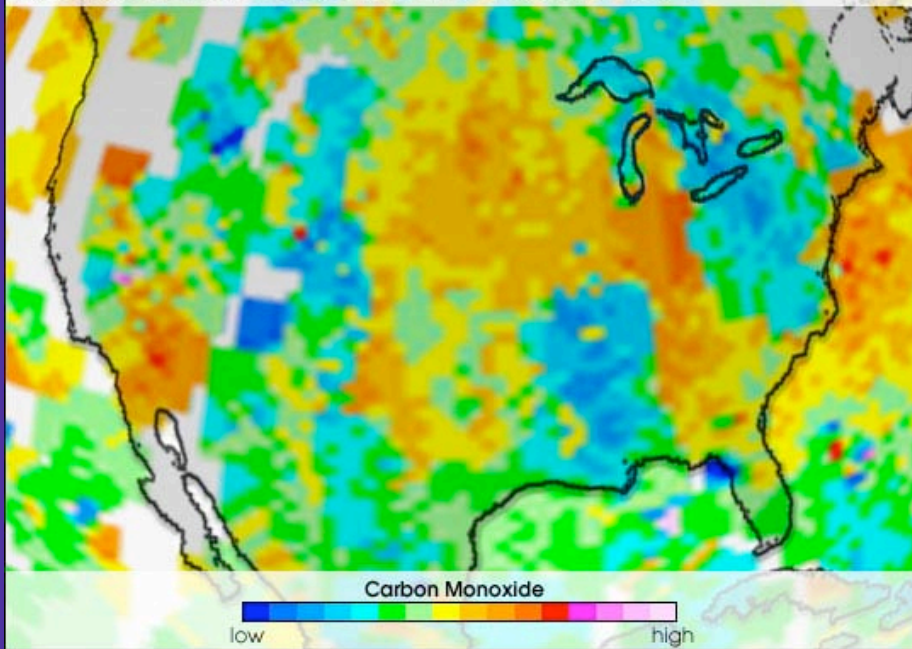
## Landsat Repeat Images Show Glacial Retreat on a Large Scale



Between Sept. 1973 and Sept. 1986, the Muir Glacier retreated more than 7 km.

Global warming is thought to be the cause for glacial retreat in Glacier NP. The scale of this change is difficult to visualize from ground-based observations. But from space, we can clearly see what is happening.

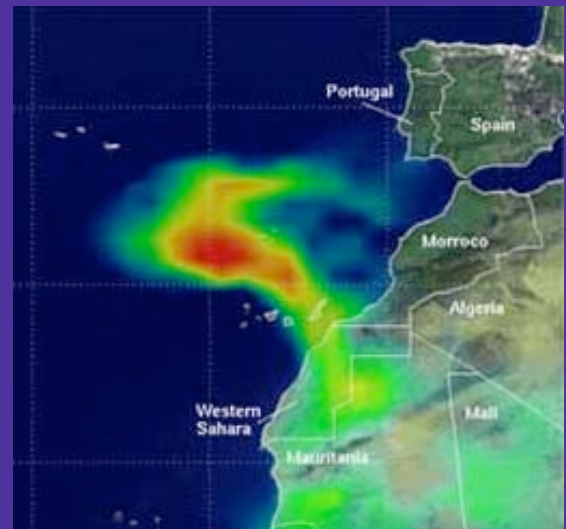
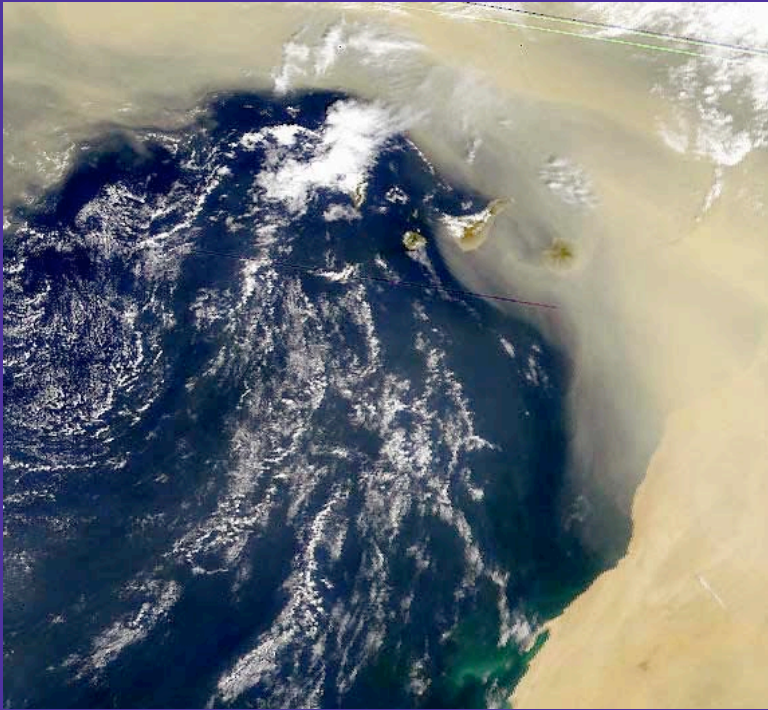
### Measurement of Pollution in the Troposphere



This image from the MOPITT instrument shows the relative amount of CO over North America from March 5-7, 2000.

One concept which is often difficult to convey is the large scale effects of air pollution, and the regional and global distribution of pollutants. What kind of air quality do you have where you live?

## Saharan Dust Storms Affect Coral Reefs



This particular storm reached over 1000 miles into the Atlantic.

*SeaWiFS image taken Saturday, 26 February 2000*

Not all global effects are human-caused. How does your site fit in with major Earth processes?

Satellite observations couple with ground-based studies revealed the effect of Saharan dust storms on Caribbean coral reefs.



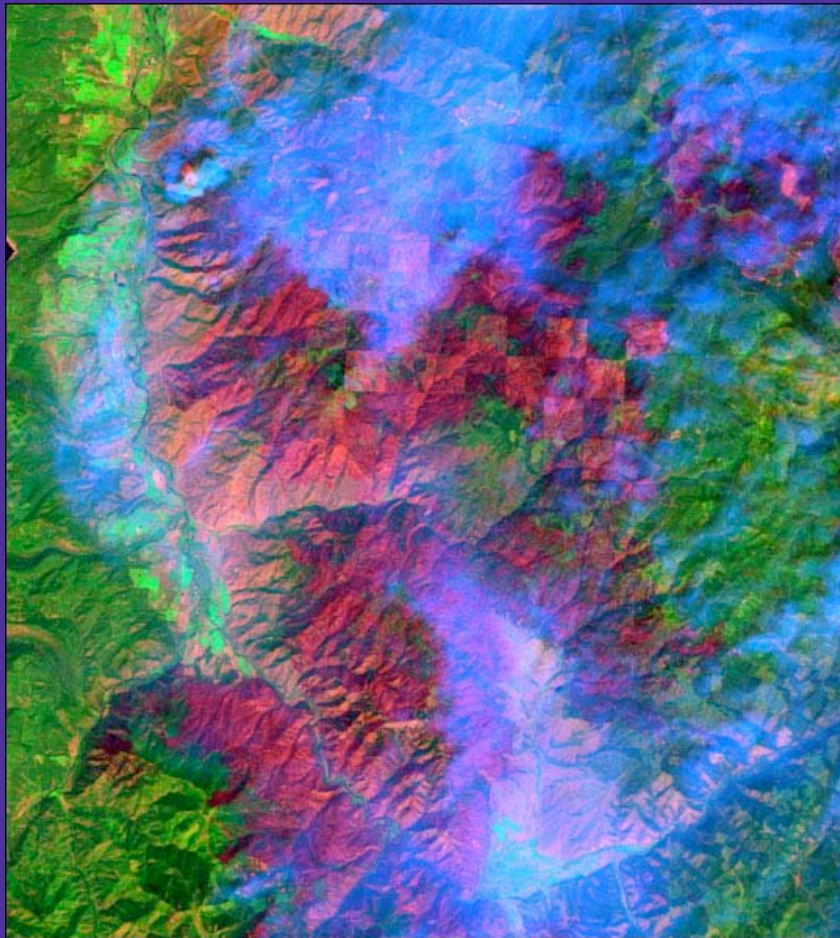
# Interpretation Must be Up to Date

In the midst of large scale events, the timeliness of interpreters' information for the public can be critical.



Image from SeaWIFS August 7, 2000, (smoke/aerosols from the Montana fires eventually ended up in Florida)

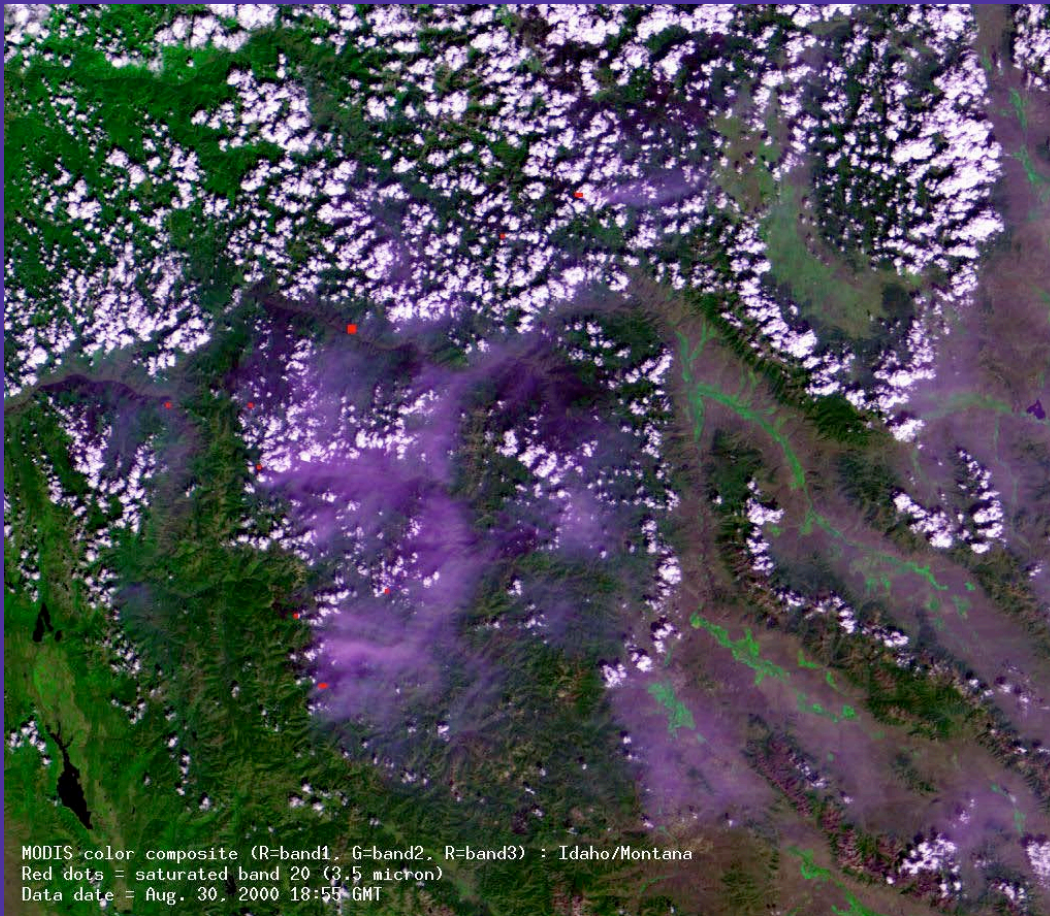
Some imagery is available in “near-real time,” which can provide you with useful products for ongoing or recent events, such as wildland fire.



## Landsat 7 ETM+ Image of Montana fires, August 14, 2000

Dull red pixels show recent burn scars, bright red pixels depict the flaming portions of the burn. Green pixels depict unburned vegetation.

In summer of 2000, NASA picked up on newsworthy fire events in our country. As a result, many spectacular images were created of the wildland fires. These were available on the web as the event was happening. You can get these kinds of images too.

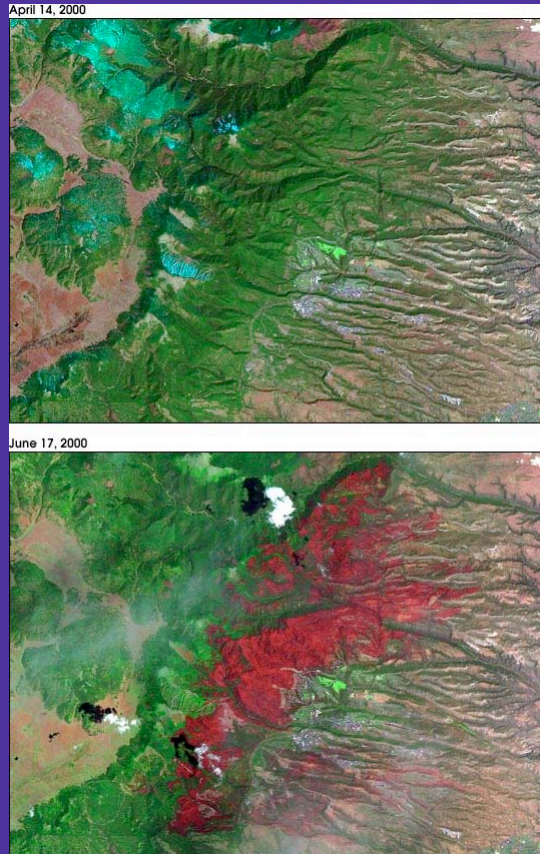


**In this Aug. 30, 2000 MODIS image, fires seen by thermal infrared detectors appear as red dots. Burned areas show up as black areas underneath the purple smoke.**

Here, satellite imagery is being used to discern the location of the fire's hot spots.

# Satellite Imagery Helps Explain Change Over Time

Landsat 7 provided clear images of the Cerro Grande Fire area before and after the burn. Here, the extent of the fire can be clearly seen (red area was burned).



One of those universal concepts we mentioned is *change*...

Because satellites just keep on going round the globe, they take repeat images which can be very helpful in explaining change over time.

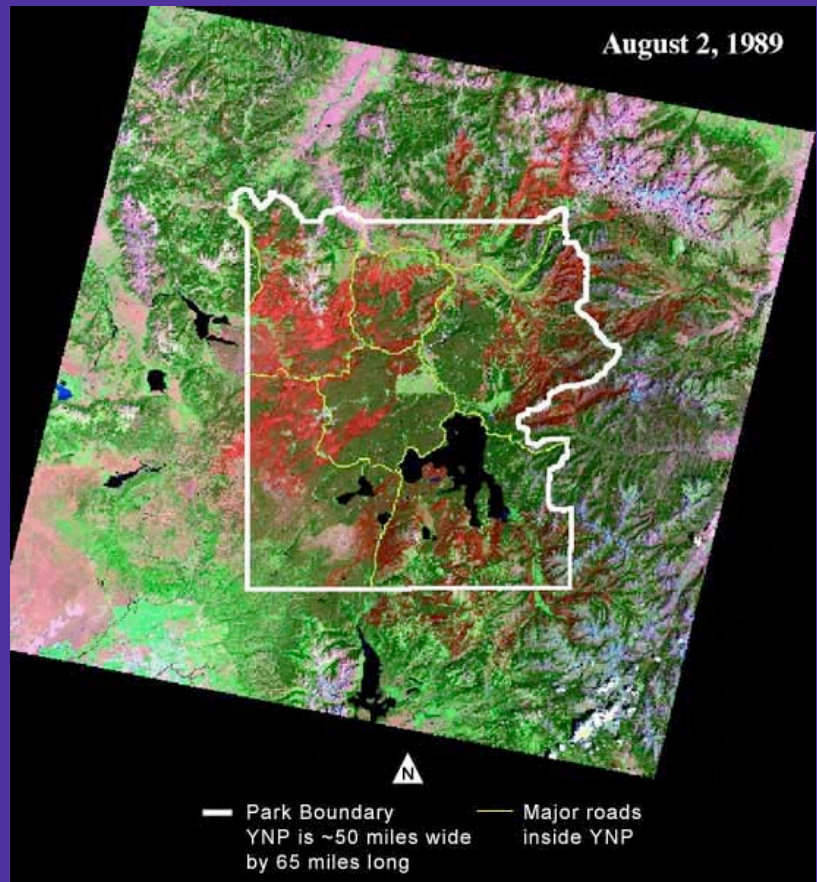


In the spring of 1988, lightning-sparked fires burned more than 800,000 acres inside Yellowstone National Park, and 600,000 acres outside the park were burned.

Remember the Yellowstone fires of 1988?

# Yellowstone One Year After the Fires

In this Landsat  
image, burned  
areas are shown  
in bright red.



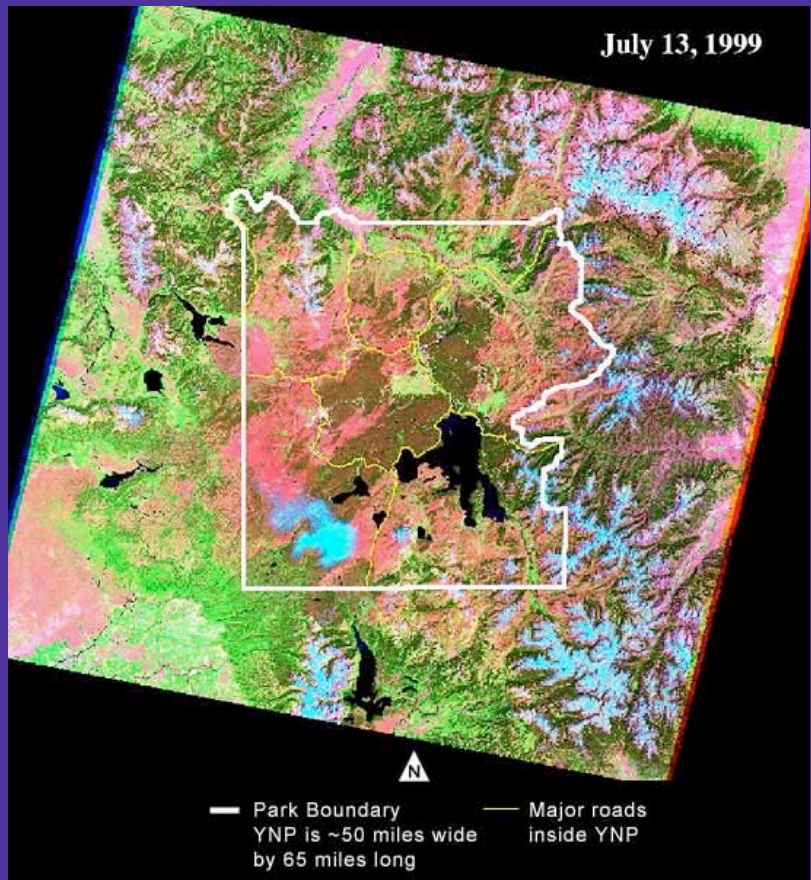
Landsat Thematic Mapper (TM) False Color Image  
*Image Processing by Janet Chien*

At first it seemed devastating...



# Ten Years Later...

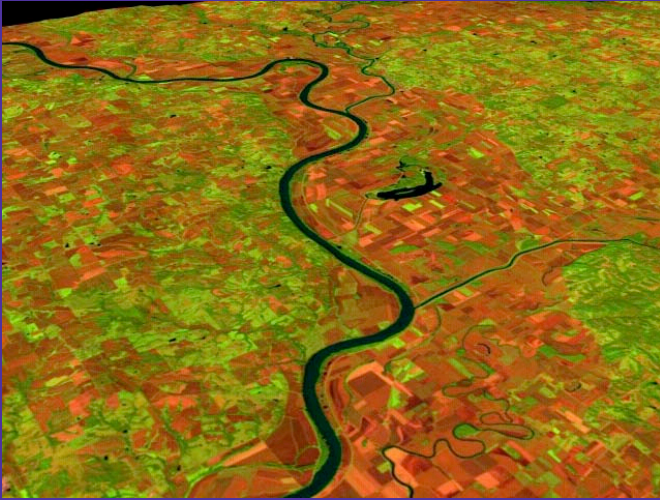
Forest and brush areas that burned in 1988 appear pinkish-green. Grassy areas and meadows appear as bright green.



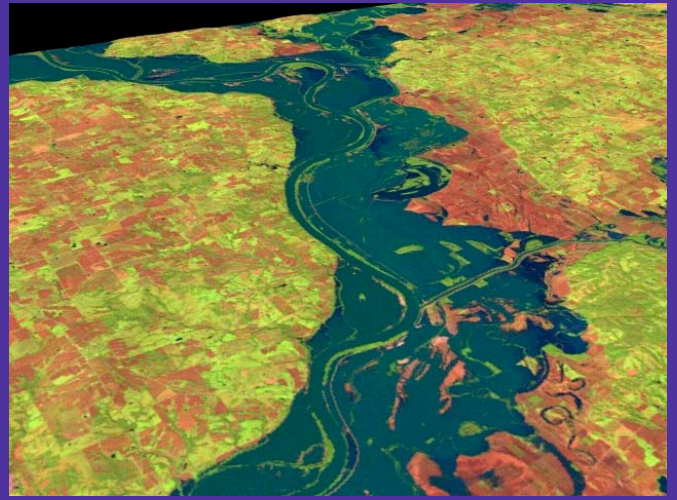
Landsat Thematic Mapper (TM) False Color  
Image  
*Image Processing by Janet Chien*

But in just 10 years we can see a significant change on a large scale.

# Satellite Imagery Helps People Understand Natural Disasters



September 1992



September 1993

**These Landsat scenes are of the confluence of the Missouri and Grand Rivers.** Notice the farmland in the river flood plain. Bare soil and plowed land appears red, vegetation appears green, and water is dark blue.

Views from space can also help us to better understand large-scale natural disasters, such as floods. Understanding helps us cope with the feeling of helplessness that often comes when we experience these events, and can help convey messages about how we might live more harmoniously with the natural rhythms of our planet.

This Landsat 7 image shows the enormity of the ecological disaster caused by Hurricane Floyd.

Note the silt and sediments in the rivers. (Sept.23,1999)



Outer Banks, North Carolina

When you are on the ground, it is hard to grasp the size of some of these events.

# Remote Sensing Supports Interpretation in Other Ways

- Helps explain and support management decisions regarding critical resource issues

Interpreters often must explain the reasoning behind management decisions limiting access to certain areas.



*Mojave Desert photos by USGS*

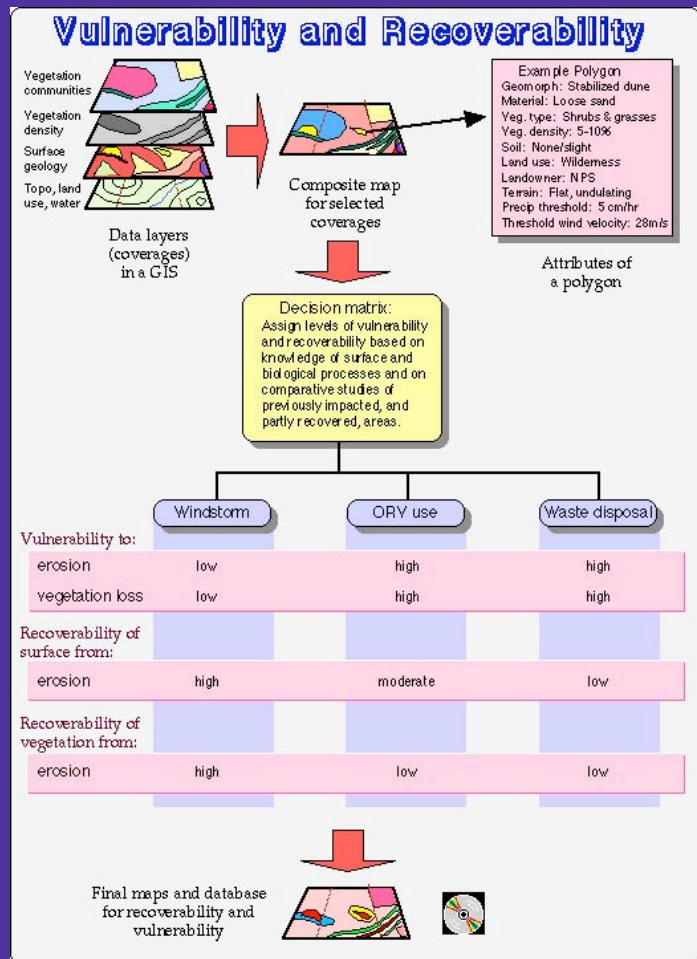
As you are well aware, some issues, such as off road vehicle use can become quite contentious. Sometimes, interpreters can feel as though they are caught in the cross-fire.



The USGS Recoverability and Vulnerability of Desert Ecosystems project uses information from satellite images plus other data to produce surface geology maps like this.

Resource managers and site managers are beginning to use remote sensing techniques in assessing the impacts of visitor use. Interpreters can use this information to help support their interpretive programs that address management decisions.

These maps are added to the information which produces a decision matrix to help land managers decide what recreational activities to allow.







This results in management decisions that make it possible for everyone to enjoy the desert landscape.

# Remote Sensing Supports Interpretation in Other Ways

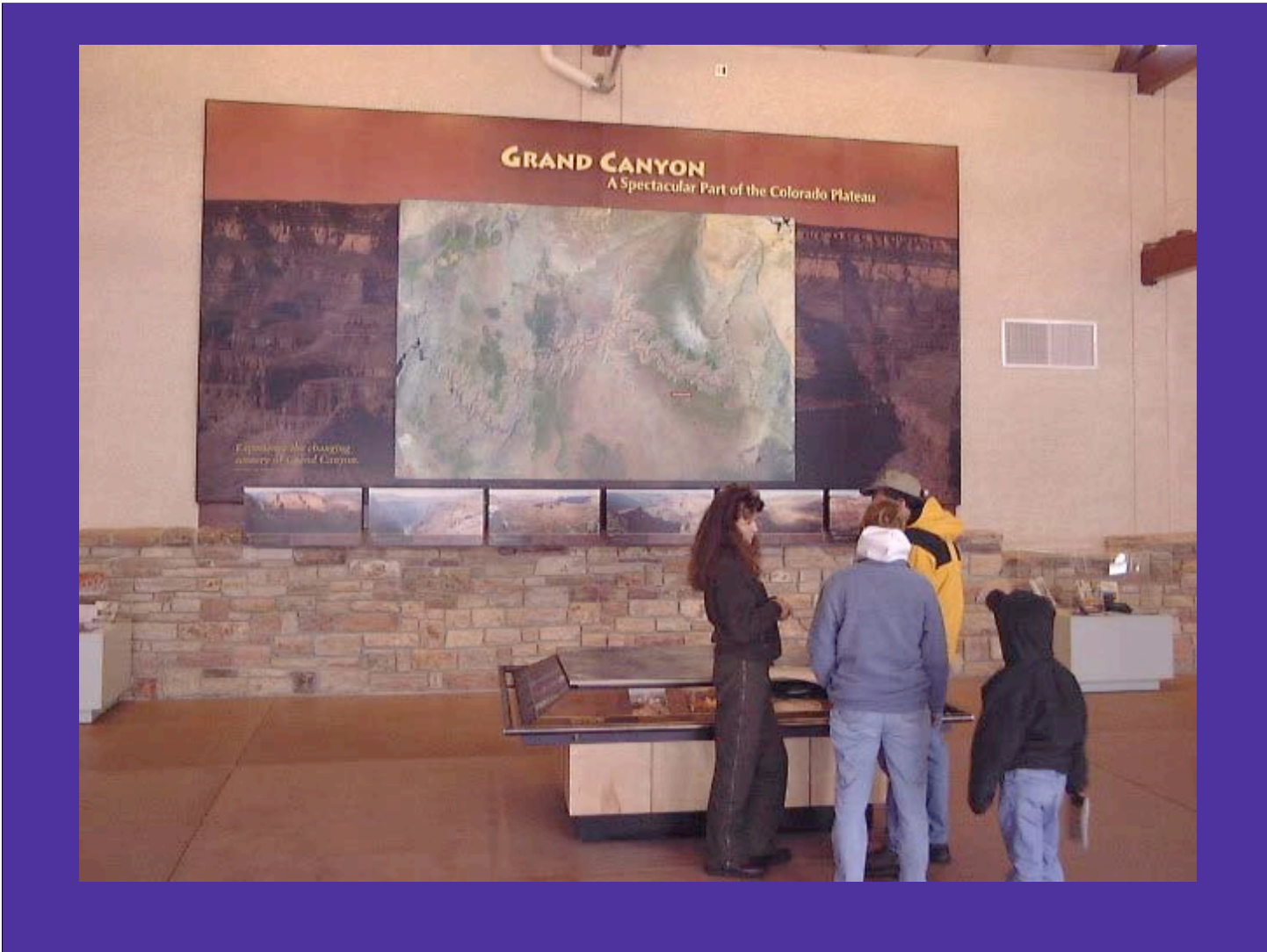
- Helps explain and support management decisions regarding critical resource issues
- Space studies represent today's pioneer spirit and can bring new approach for interpreting historical/archeological sites
- Can be source of content for interpretive products

<http://earthobservatory.nasa.gov/>

There is a bewildering array of NASA websites dealing with national programs, NASA Center programs, various missions, satellite instruments, and research.

We've selected this website to get you started. Here you will find article in plain English, on a variety of topics of great relevance to interpreters. These articles might well add substantially to the content of your programs, or even help you come up with new ideas. There are links to other sites as well.

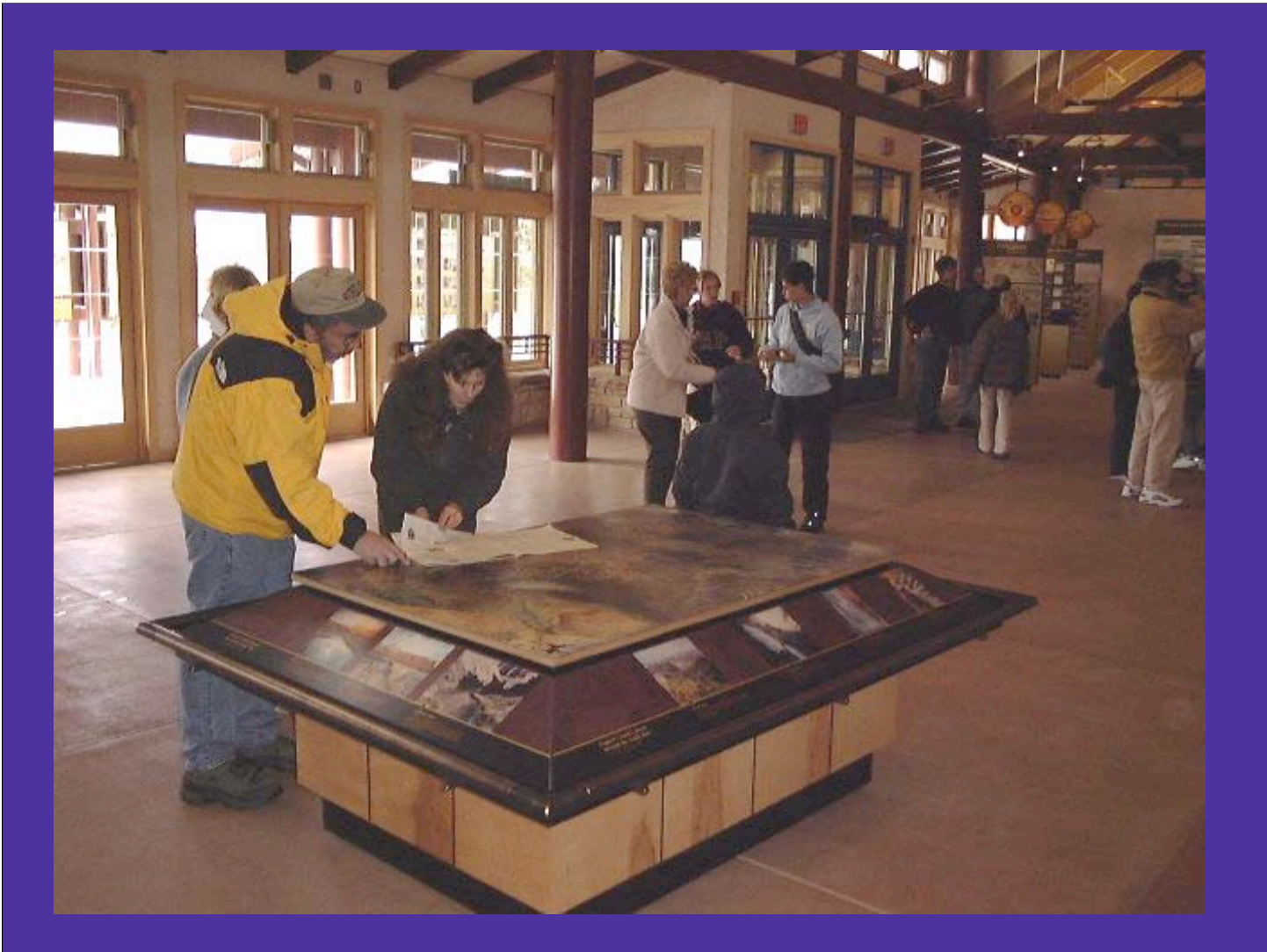
NASA Remote Sensing Products  
are Great for Interpreters!



Here is an example of use of Landsat imagery in a National Park setting. This is the interior of Grand Canyon National Park's visitor center.



Here is an example of use of Landsat imagery in a National Park setting. This is the interior of Grand Canyon National Park's visitor center. Rangers chose Landsat imagery to convey the enormity and the grandeur of the Canyon. Images below the satellite image depict ground-based views keyed to locations on the satellite map.



The same image is used on this table top, so visitors and rangers can readily access the canyon from all angles.

*“The first day or so we all pointed to our countries. The third or fourth day we were pointing to our continents. By the fifth day we were aware of only one Earth.”*

*- Sultan Bin Salman al-Saud  
(Saudi Arabia), Astronaut*



Remote sensing is one tool for interpreters that effectively communicate a truly global perspective on stewardship.