

# BAY EDUCATION CENTER Rockport, Texas



## Docent Manual

UNIVERSITY OF TEXAS MARINE SCIENCE INSTITUTE



MISSION ★ ARANSAS NATIONAL ESTUARINE RESEARCH RESERVE



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# INTRODUCTION

## Overview

The Mission-Aransas National Estuarine Research Reserve Visitor Center is part of the Bay Education Center, in Rockport, Texas. The Bay Education Center is a partnership between the Aransas County Navigation District (ACND), the City of Rockport (City), the NERR, the University of Texas Marine Science Institute, the Texas General Land Office (GLO), and the National Oceanic and Atmospheric Administration (NOAA). The ACND provided the land on which to build the Bay Education Center. Construction of the Bay Education Center was made possible by Reserve funds received through a NOAA grant, GLO granted funds, and City funds. NOAA grants provided funding for the Visitor Center exhibits and Science on A Sphere® (SOS).



*Mission-Aransas NERR Visitor Center exhibits at the Bay Education Center.*



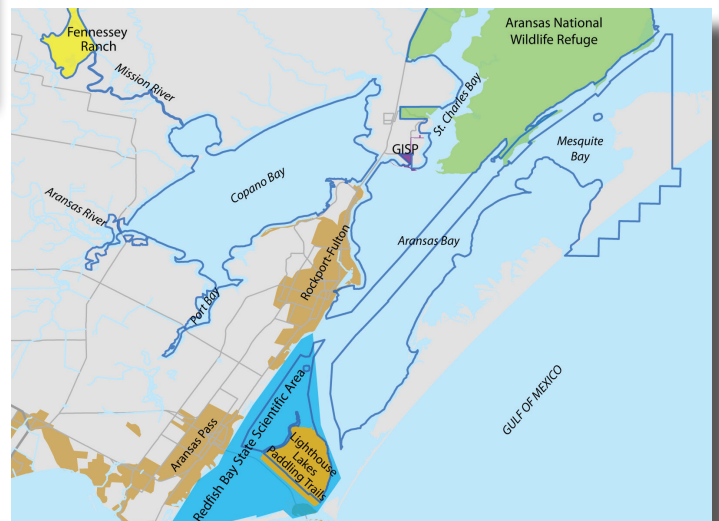
*View of the Bay Education Center from the harbor fishing pier.*

The Visitor Center offers approximately 950 square-feet of interactive exhibits, aimed at enhancing public awareness of the ecological and economic importance of the Mission-Aransas Estuary and the role that the Reserve plays in estuarine research, education, management, and protection. Most of this document manual is devoted to providing background information about the Visitor Center exhibits.

Adjacent to the exhibits, the Visitor Center auditorium houses SOS, a display system created by NOAA to help people learn about Earth and planetary

sciences. SOS uses a computer and four projectors to display satellite images on a six-foot diameter sphere. This technology creates the experience of viewing the Earth and other planetary bodies from space. SOS is a powerful teaching tool because it offers visitors a means to explore environmental data in a visually engaging and fun way. The datasets available for display include satellite images of ocean currents, real-time weather, hurricanes, landforms, commercial airplane traffic, the Earth at night, the sun, planets, moons, and much more.

There are over 350 datasets currently developed for the system and NOAA is constantly creating more. Additional information about SOS may be found at <http://sos.noaa.gov/>.



*Map showing central location of Rockport within the boundary of the Mission-Aransas Reserve. The Reserve boundary is depicted by blue lines on the map.*

## Visitors

Visitors to the Mission-Aransas Reserve Visitor Center include grandparents and grandchildren, families on vacation, public and private school groups, and retired seasonal residents (“winter Texans”), who live in the Texas Coastal Bend during the cooler months of the year. The Visitor Center attracts thousands of visitors and school children each year and it is difficult for Reserve staff to provide a quality experience for all of them. Visitor Center docents extend the educational outreach capabilities of the Reserve education program and allow us to help many more visitors and students appreciate the importance of estuaries.

## Volunteer Job Description

### Objective

Bay Education Center Docents represent the Mission-Aransas National Estuarine Research Reserve and help enhance public knowledge of the importance of estuaries.

### Docent Characteristics and Experience

Docents must be enthusiastic, cheerful, professional, and willing to learn. They should have an interest in working with the general public. Experience in natural history, environmental or marine science and/or education are helpful, but not required.

### Supervision & Training

Docents will complete the required University of Texas compliance training, read, and familiarize themselves with the Bay Education Center docent training manual, and receive personal instruction from a member of the Reserve’s education staff before acting as docents at the Bay Education Center.

### Requirements

- Minimum age of 15 years, 12 with a parent
- Receive direction and work cooperatively with the BEC Education Specialist.
- Work a three hour shift, which requires standing during most of that time

### Activities and Responsibilities

Bay Education Center Docents are responsible for greeting guests as they walk in, encouraging them to sign the guest book, and offering to answer questions, if needed. Docents should make guests feel welcome without overwhelming or pestering guests. Docents who are interested in doing so may assist with visiting school groups and public events, as appropriate.

Docents help to prepare for showings of Science on a Sphere by directing guests to seats or asking guests to wait until a previous program ends. Before SOS programs begin docents turn off lights and close shades. While the program is in progress docents quietly greet and usher late guests into empty seats. Docents who receive special training to operate the SOS system, may open the Visitor Center and present SOS programs when the BEC Education Specialist is absent.



Visitors attending a Science on a Sphere presentation.

## **Mission, Goals, and Objectives**

### **Mission Statement:**

The mission of the Bay Education Visitor Center is to enhance public awareness of the ecological and economic importance of the Mission-Aransas Estuary and the role that the Mission-Aransas Reserve plays in estuarine research, education, management, and protection.

### **Goals:**

The interpretive goals of the Bay Education Visitor Center are:

1. To foster an appreciation of Mission-Aransas estuarine resources and the ecosystem services they provide.
2. To enhance an understanding of human impact on the past, present, and future estuarine environment.
3. To encourage the protection and conservation of the natural and cultural resources within the Mission-Aransas Estuary.
4. To promote awareness of the Mission-Aransas Reserve's existence and mission.

### **Objectives:**

1. The majority of visitors will be able to describe several benefits that healthy estuaries provide for them personally.
2. The majority of visitors will be able to explain how some human activities can negatively impact estuaries.
3. The majority of visitors will be able to list actions that they can take in their everyday lives to maintain healthy estuaries.
4. The majority of visitors will become aware of the existence of the Mission-Aransas Reserve and be able to describe education, stewardship, coastal-training, and research activities that are supported by the Mission-Aransas Reserve.



*High school student interacting with a hands-on exhibit.*

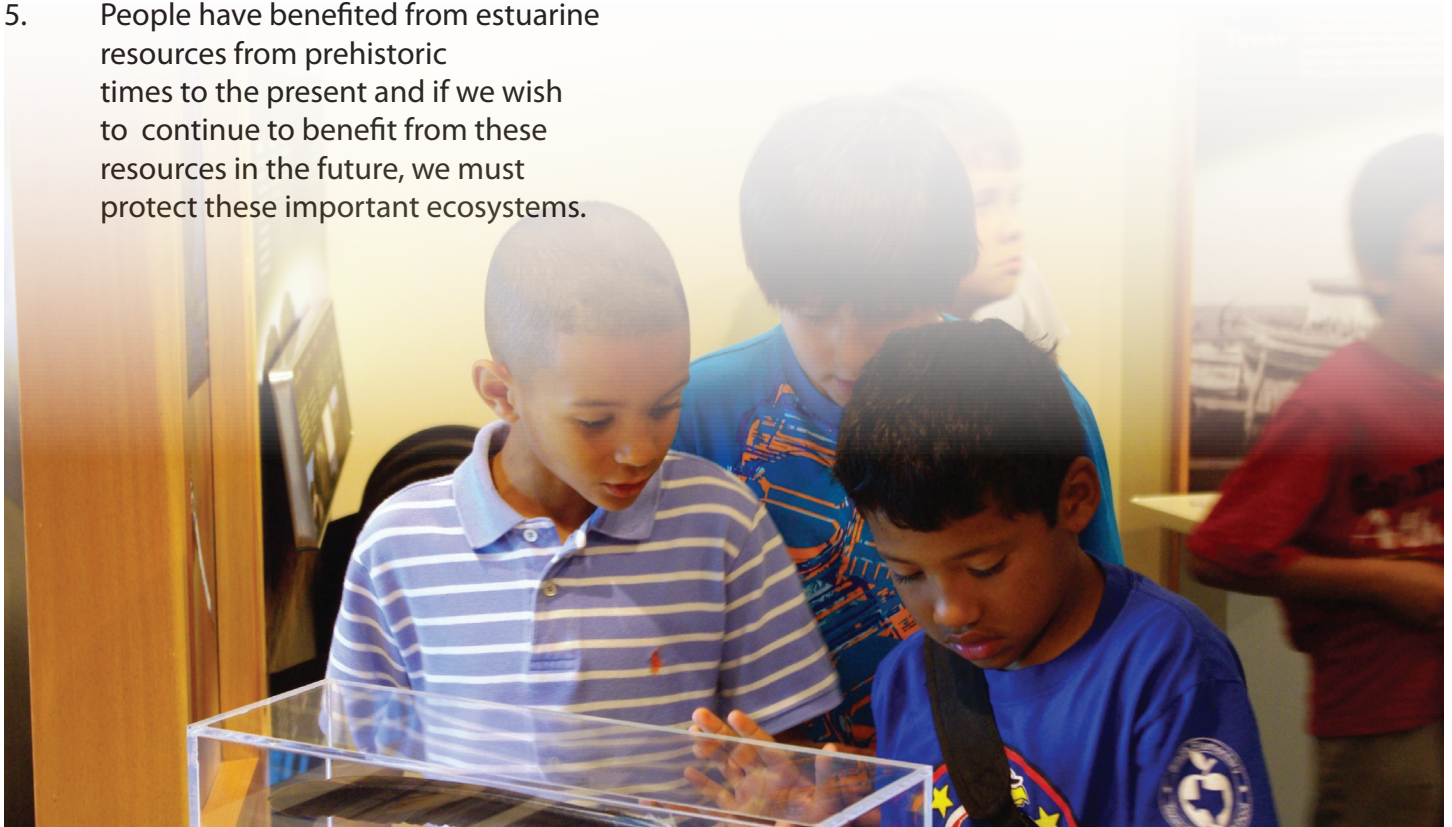
**Interpretive Theme And Subthemes: What message do we want visitors to take home after their visit?**

**We want visitors to know that:**

Estuaries are among the world's most ecologically important ecosystems and the services provided by estuaries significantly benefit people.

**We hope that visitors will remember that:**

1. Estuaries are places where freshwater from streams meets and mixes with salt water from the ocean.
2. Estuaries contain plants and animals that function as living filters to clean and purify our water.
3. Estuaries provide protection from tidal surges, floods, and shoreline erosion.
4. The diversity of the estuarine environment provides habitat for many types of wildlife and several species are critically dependent upon estuaries as nursery grounds.
5. People have benefited from estuarine resources from prehistoric times to the present and if we wish to continue to benefit from these resources in the future, we must protect these important ecosystems.



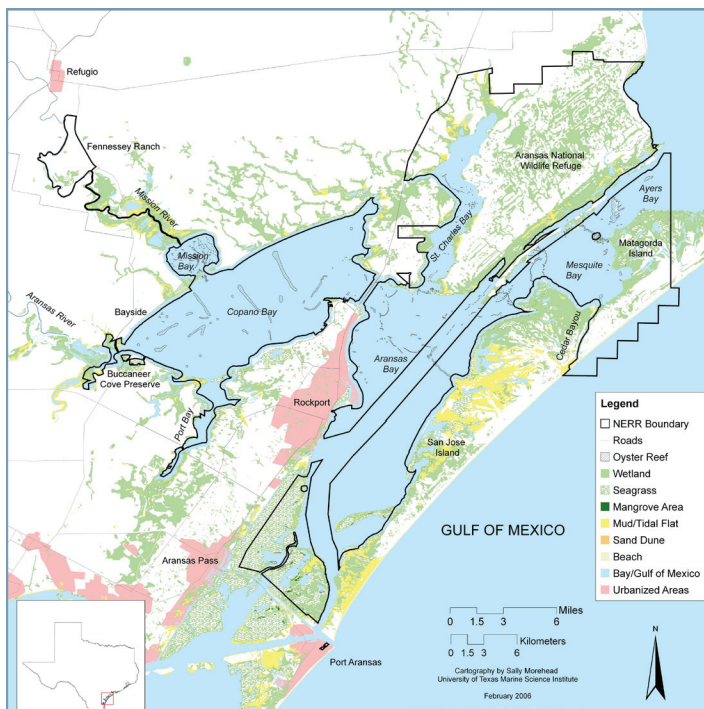
# EXHIBITS

## What is an Estuary?

**Subtheme 1:** Estuaries are places where freshwater from streams meets and mixes with saltwater from the ocean.

**Learning Point 1.1:** Estuaries are often named for the rivers that flow into them. The local estuary is known as the Mission-Aransas Estuary because the Mission and Aransas Rivers are the primary sources of freshwater for the estuary.

**Learning Point 1.2:** Many bays, lagoons, sounds, and sloughs are estuaries. The Mission and Aransas Rivers flow into Mission and Copano Bays.



Habitat Map of Mission-Aransas Reserve.



These panels define an estuary and introduce the Mission-Aransas Reserve.

## Estuaries: Nature's Kidneys

**Subtheme 2:** Estuaries contain plants and animals that function as living filters to clean and purify our water.

**Learning Point 2.1:** As water moves across the landscape, it picks up sediments, plant debris, chemicals from farm fields and neighborhood lawns, sewage, trash, and other waste materials. Any of these materials can be harmful to the environment, when present in large quantities. Fortunately, nature has developed natural filters that help clean this runoff water before it reaches the ocean. These natural filters are called estuaries. Just as our kidneys remove waste from our bloodstream, estuaries remove debris and chemicals from runoff before it seeps into our groundwater or reaches the ocean.

**Learning Point 2.2:** Runoff from the land can contain many types of chemicals. Estuarine plants take in some of these chemicals, such as nitrogen and phosphorus, and use them as nutrients to support their growth and reproduction. Plants also help keep our water clear by slowing water currents and trapping sediments in their stems and roots.



The containers in the foreground and the smooth cordgrass replica in the rear demonstrate how plants trap sediments to help clean estuarine water.

**Learning Point 2.3:** A single oyster can filter up to 1.3 gallons of water through its body in just one hour. Oysters are filter feeders, meaning that they filter food particles from the water with their gills. Oysters have amazing gills that they use for breathing and trapping food. Their food is mostly phytoplankton (small, plant-like organisms) and debris. Tiny hairs on the oyster's gills make rowing movements, creating a current of water that flows through the oyster. As the water current flows across their gills, oysters trap and remove food particles from the water. Along with their food, oysters also filter out many harmful pollutants, such as bacteria and viruses. They actually clean the water we swim in while they eat.



The periscope viewer shows film loops of oysters filtering debris from the water and the giant oyster model helps visitors understand oyster anatomy.

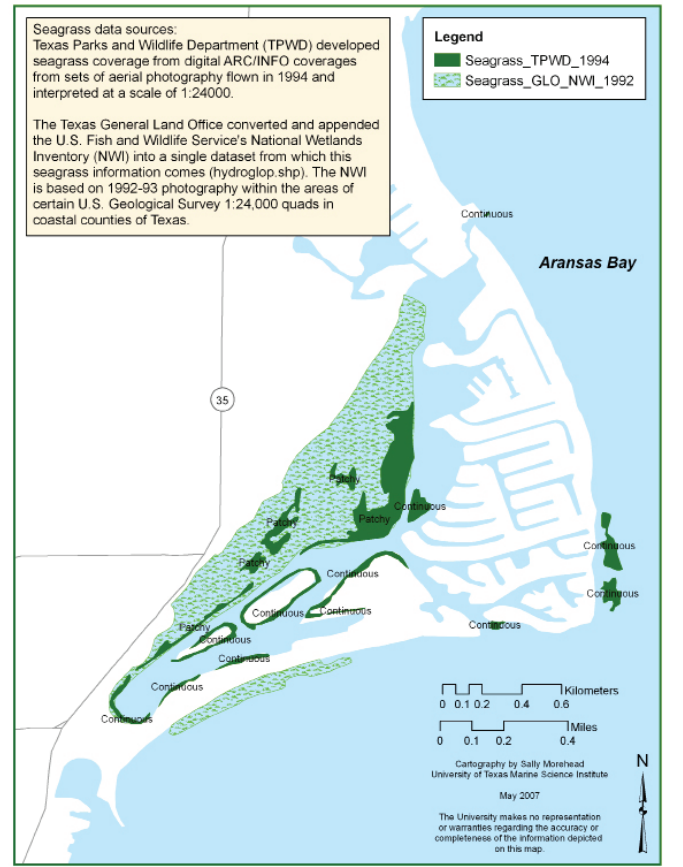


When sediments fall to the estuary bottom, they are stabilized and held in place by seagrass rhizomes and roots. Seagrasses also help filter chemicals, such as nitrogen and phosphorus, from the water and transform these into something that can be eaten by other organisms (i.e., plant tissue). However, if the amount of sediment or chemicals in the water negatively affects water clarity, the health and productivity of seagrasses will deteriorate. Increased sediment decreases water clarity and the amount of sunlight that is able to penetrate the water column. Seagrasses require light to undergo photosynthesis and produce food, but if the plants do not receive enough light, they will not be able to produce enough food to survive and reproduce.



Display showing the five species of seagrasses found in the Estuary.

The amount of nutrients present in the water can also have a negative affect on water clarity and quality. High levels of nutrients stimulate the growth of small, single-celled, plant-like organisms known as phytoplankton. These organisms are capable of forming large mats at the surface of the water and greatly decreasing the amount of light that is able to penetrate to the seagrass beds. When the phytoplankton die and decompose, a large amount of oxygen is used up in the decay process, resulting in low oxygen conditions that may harm fishes, crustaceans, and mollusks.



Seagrass abundance in Little Bay, near the Bay Education Center.

## Storm and Flood Protection

**Subtheme 3:** Estuaries provide protection from tidal surges, floods, and shoreline erosion.

**Learning Point 3.1:** Estuaries help protect us and our property from storms and flooding. Near-shore seagrass beds and shoreline plants baffle or slow down wind and waves, minimizing their ability to erode the shoreline. The dense rhizomes and roots of estuarine plants, such as smooth cordgrass and mangroves, also reduce shoreline erosion by anchoring sediments in place. Marshes act as sponges to absorb flood waters, so coastal towns near marshes often suffer less damage than those in areas where the marshes have been drained and filled.



*Plant replicas demonstrate how estuarine plants hold sediments together and help reduce erosion.*

## Estuarine Diversity

**Subtheme 4:** The diversity of the estuarine environment provides habitat for many types of wildlife and several species are critically dependent upon estuaries as nursery grounds.

**Learning Point 4.1:** Ecosystems containing a high variety of habitats can sustain a higher variety of living things. Our local ecosystem has many different types of habitats, such as freshwater and saltwater marshes, mangroves, beaches, tidal flats, open bays, oak mottes, and coastal prairies. These habitats can support a vast array of wildlife, from tasty blue crabs, shrimp, and oysters to the iconic and endangered Whooping Crane. This variety is a good thing because the more diverse an ecosystem, the better able it is to respond to change or disturbance.

**Learning Point 4.2:** Seagrass beds and oyster reefs act as safe harbors for juvenile fishes, shrimps, and crabs. These habitats provide lots of nooks and crannies for the animals to hide in to escape from predators. They also provide an important source of food because phytoplankton and small prey organisms such as zooplankton (planktonic animals) and small invertebrates live there as well. The larvae and juveniles of some estuarine fishes, shrimps, and

crabs are totally dependent upon seagrass beds for shelter and food early in their life cycles. Seagrass beds are similar to a field of wheat underwater, providing shelter and food to estuarine-dependent species.

**Learning Point 4.3:** The Fennessey Ranch, on the Mission River near Refugio, Texas, is unique among the mostly saline or brackish water habitats contained within the Mission-Aransas Estuary, because it provides numerous freshwater wetlands and terrestrial habitats. These include freshwater marshes, a freshwater lake, riparian forest, dense brush, and coastal prairie. These different habitats support a rich diversity of animals, such as Bald Eagles, mountain lions, deer, turkey and neo-tropical birds.



The habitat turners show the types of wildlife that are supported by various estuarine habitats.



The dioramas along the back wall depict the range of habitats found within the Mission-Aransas Estuary.

## Estuaries and Us

**Subtheme 5:** People have benefited from estuarine resources from prehistoric times to the present and if we wish to continue to benefit from these resources in the future, we must protect these important ecosystems.

**Learning Point 5.1:** Historic Native Americans and their ancestors collected oysters and other shellfishes in the Mission-Aransas Estuary. Although shellfishes primarily provided food for these past people, quality stone for tool-making was scarce on the Texas coast, so they made tools from the shells of oysters, clams, and whelks. Mounds of discarded shells, known as “shell middens,” are commonly found at estuarine archaeological sites along local bay shorelines. Shell artifacts, such as oyster shell fishing-net weights, clam shell scrapers, and whelk shell awls are sometimes recovered as well.

Shells are no longer important for tool-making but we still enjoy eating shellfishes. Commercial fishing for estuarine-dependent shellfish, such as oysters, blue crabs, and shrimp adds millions of dollars to the Texas economy. The annual Texas oyster harvest is among the largest in the United States. Each year, the residents of Fulton and visitors from across Texas celebrate this important estuarine resource at *Oysterfest*, a festival that features carnival rides and games, live music, vendor booths, food, and, most importantly, oyster shucking and eating contests.

Oysters have relatively dense shells that preserve well in archaeological sites, but shrimp “shells” do not preserve well, so their importance in the diets of prehistoric people is unclear. Historically, shrimp did not become a popular human food item on the Texas coast until the 20th century and commercial shrimping was a minor industry in Texas prior to 1920. Shrimp became more important as a protein source when meat rationing went into effect during World War II. By the turn of the 21st century, Texas shrimp landings were valued in excess of 200 million dollars, making shrimping the most valuable commercial fishery on the Texas coast.



The electronic picture frame exhibit shows a series of historical photos of people benefiting from local estuarine resources.

This exhibit displays shell tools recovered from local archeological sites as well as touchable shell tool replicas.

**Learning Point 5.2:** Texas is one of the premier birding destinations in the United States. Around 600 species of birds live in or migrate through the state, giving Texas bragging rights to the most bird species of any state in the United States. Over 75% of the state's bird species have been recorded in the Texas Coastal Bend.

Millions of shore birds, wading birds, and waterfowl spend their winters in the Mission-Aransas Estuary and increasing numbers of birders have discovered the spectacular experience of birding here. The varied habitats within the estuarine ecosystem attract many different types of birds and birders in the Rockport area have been known to record over 200 different species in one day.

The Whooping Crane is one of the more popular species pursued by birders. The Mission-Aransas Estuary is the winter home of the only wild migratory flock of endangered Whooping Cranes in the world. Although the cranes breed in Canada during the summer, they migrate over 2,400 miles each fall to spend the winter in or near the Aransas National Wildlife Refuge.

**Learning Point 5.3:** The shallow bays, seagrass beds, and abundant salt marshes of the Mission-Aransas Estuary provide a rich food source for resident and migratory waterfowl. Large flotillas of Redhead ducks spend their winters in the Estuary, feeding almost exclusively on the rhizomes of one species of seagrass, commonly known as shoalgrass.

Hunting waterfowl is a long-standing tradition in



*Taxidermied redhead shown in feeding pose.*



*Life-sized model of a Whooping Crane, surrounded by a reader rail with information about this endangered species.*

Texas. As early as 1909, the Rockport area hunting clubs drew hunters from across the United States to take advantage of the vast numbers of ducks and geese that wintered in the local bays and marshes. Waterfowl hunters were among the first "conservationists," as they observed the decline of their prey and advocated responsible use policies and restrictions.

Birds and birding are celebrated at several area festivals, including Rockport's annual *Hummer / Bird Celebration*, held each September during the peak of the Ruby-throated Hummingbird migration.

**Learning Point 5.4:** Estuarine-dependent fishes, such as the redfish, black drum, and speckled sea trout, were important food sources for historic and prehistoric people, who inhabited the Mission-Aransas Estuary. Scientists can determine which fish species were eaten by prehistoric people, by examining fish otoliths or “ear stones” that are found at archaeological sites. Otoliths are mineralized structures, located in the heads of bony fishes, which survive well in archaeological sites due to their hardness. Otoliths may be used to identify certain species of fishes, based on their different shapes and sizes. Scientists also use otoliths to identify the bays that fishes lived in, by studying the chemicals present in the otoliths.

Today’s redfish anglers may be surprised to know that when they catch one of these beautiful rust-colored fish, there is a small chance they might not be catching an entirely “wild” fish. As part of the redfish stocking and enhancement program, the Texas Parks and Wildlife Department releases millions of juvenile redfish each year. Researchers are trying to measure the survival rates of these hatchery-reared fish to evaluate the success of this stocking program.

**Learning Point 5.5:** Texas’s abundant estuaries also form natural harbors and many of the state’s shipping ports are located in bays. These ports have provided transfer points for people and cargo from Spanish colonial times through the present.

El Copano was a historically significant port, located on the northwest shore of Copano Bay. Established by the Spanish in 1785, it became the main supply port for the Spanish settlements at Refugio, Goliad, and San Antonio. Early 19th century Texas colonists from Ireland and Mexico passed through the Port of El Copano. The port was used by Mexicans and those fighting for Texas independence during the Texas Revolution and by blockade runners during the Civil War. The Port of El Copano and the town that grew up around it declined as railroads gained prominence and they were abandoned in 1880.



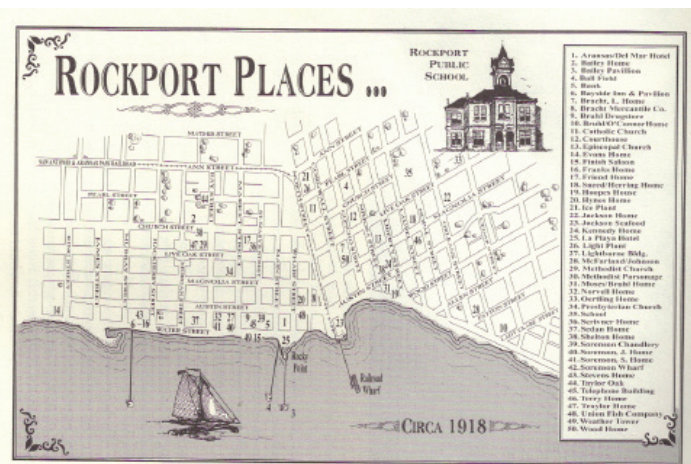
*These magnifying canisters hold otoliths of locally important recreational fish species.*

Presently, over 95% of the important recreational and commercial fishes that live in the Gulf of Mexico rely on estuaries as nursery grounds. The redfish, black drum, and speckled sea trout that were caught by prehistoric Texans are still favorite recreational species. Other estuarine-dependent fishes, such as the southern flounder, are important commercial species, contributing millions of dollars to the Texas economy each year.



*Shellcrete, such as this piece from a local historic structure, was used to build many of the structures at the port and town of El C3pano.*

Rockport is named for the rocky point upon which General Zachary Taylor and his Third Infantry landed in 1845, en route to defend the western border of Texas during the Mexican-American War. General Taylor's description of the rocky point upon which he and his troops had landed gave local ranchers the idea that it would be a fine site for a cattle shipping port. The ranchers built a wharf on the rocky point and herded cattle down the wharf, directly onto waiting ships. Following the Civil War, Rockport became an important shipping port for cattle, hides, and beef tallow, but shipping cattle by sea ended with the arrival of the San Antonio and Aransas Pass Railroad in 1888. By the late 1920's, bay shrimpers and fishermen filled the harbor with shrimp trawlers and fishing boats and Rockport became an important fishing port on the Texas coast.



Map showing the rocky point upon which Zachary Taylor landed in 1845.

From: Allen, W. A. and S. H. Taylor. 1997. Aransas: The life of a Texas Coastal Community. Eakin Press, Austin.

**Learning Point 5.6:** The Mission-Aransas National Estuarine Research Reserve is one of 28 sites in the National Estuarine Research Reserve System. These reserves operate as partnerships between the National Oceanic and Atmospheric Administration (NOAA) and the coastal states. The University of Texas Marine Science Institute, in Port Aransas, Texas, administers the Mission-Aransas Reserve. The Mission-Aransas Reserve provides a venue for scientific research and outreach education to foster a deeper understanding and appreciation of the Mission-Aransas Estuary among scientists, policy-makers, and the general public and to encourage the protection of this precious resource.

The three primary goals of the Mission-Aransas Reserve are to: 1) improve understanding of Texas coastal zone ecosystems structure and function, 2) Increase understanding of coastal ecosystems by diverse audiences, and 3) promote public appreciation and support for stewardship of coastal resources. The Mission-Aransas Reserve develops and facilitates partnerships that enhance coastal decision making through an integrated program of research, education, and stewardship.

The Mission-Aransas Reserve's *System-Wide Monitoring Program (SWMP)* collects data on short-term variability and long term changes in water quality parameters, weather, and nutrient concentrations throughout the Reserve.



Replica of a System Wide Monitoring Station with interactive computer touch screen.

## Exhibits

The Mission-Aransas Reserve's *Education Program* uses formal and informal approaches to educate a variety of audiences about the estuarine environment. A unique asset of the Reserve's education program is its access to scientists and scientific data collected through the SWMP program. Recognizing the educational potential of these data, the Reserves have developed effective programs and products that bring this information to the K-12 educators/students and the general public.

The Mission-Aransas Reserve's *Stewardship Program*



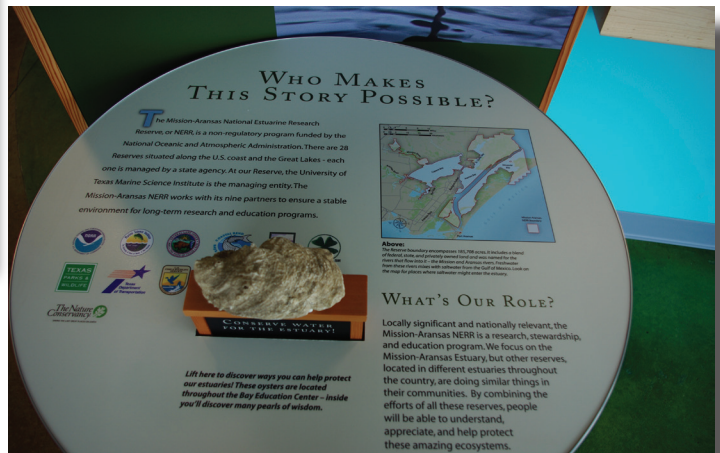
Volunteers and Reserve staff picking up trash along the shoreline of the Aransas National Wildlife Refuge, as part of National Estuaries Day.



Students from Aransas County ISD studying salt marsh plants at the Mission-Aransas Reserve Wetlands Education Center.

is responsible for promoting public appreciation and support for the protection of natural resources. Responsibilities of the Stewardship Program include: 1) monitoring land management practices among reserve partners, 2) supporting existing clean-up and recycling programs, 3) characterizing the reserve through habitat mapping, 4) promoting reserve initiatives at public events, fairs, and expositions, 5) initiating restoration and mitigation projects with appropriate partners, and 6) identifying potential areas for land acquisition.

The Mission-Aransas Reserve's *Coastal Training Program* provides coastal decision-makers with the knowledge and tools they need to address critical resource management issues in their local communities. The program provides training opportunities related to a variety of issues that include coastal habitat conservation, restoration, mitigation, energy resource development, and sustainable resource management.



Animal Rehabilitation Keep staff releasing a rehabilitated green sea turtle.



**Learning Point 5.8:** We have the ability to help protect estuaries through simple actions that we can take in our everyday lives. Some of these actions include:

- 1) reducing the amounts of herbicides, pesticides, and fertilizers that we use in our yards, so that they do not run off into our estuaries and pollute the water;
- 2) properly disposing of household chemicals so that they are not washed into storm drains and eventually into our estuaries;
- 3) maintaining our automobiles and boats to prevent oil and gas leaks;
- 4) properly disposing of fishing line and other trash, so that it does not ensnare and injure wildlife;
- 5) conserving water in our homes and yards;
- 6) participating in one of the Texas General Land Office Adopt-a-Beach Clean-ups;
- 7) volunteering to help with research, education, or stewardship programs at the Mission-Aransas Reserve.

People can also help protect estuaries by learning more about them. Knowledgeable people make better decision-makers and everyone who uses the estuary is a decision-maker.

To learn more about the Mission-Aransas Estuary, participate in local educational events such as the University of Texas Marine Science Institute's Public Lecture Series, the *Hummer / Bird Celebration* in Rockport, the *Celebration of Whooping Cranes* in Port Aransas, and the *Earth Day Bay Day* festival in Corpus Christi.

Experience and share the wonders of the Mission-Aransas Estuary by kayaking, fishing, or birding in our local bays or swimming at the Rockport Beach Park with family and friends.



*Visitors enjoying a summer afternoon at Rockport Beach Park.*

## SCIENCE ON A SPHERE ©

The best resource for information about Science on A Sphere© (SOS) is NOAA's website: <http://sos.noaa.gov/>.

There, you can follow links to find:

The SOS dataset catalog: <http://sos.noaa.gov/datasets/>

SOS datasets for Google Earth: <http://sos.noaa.gov/kml/>

Sample scripts for presentations: <http://sos.noaa.gov/docs/scripts.html>

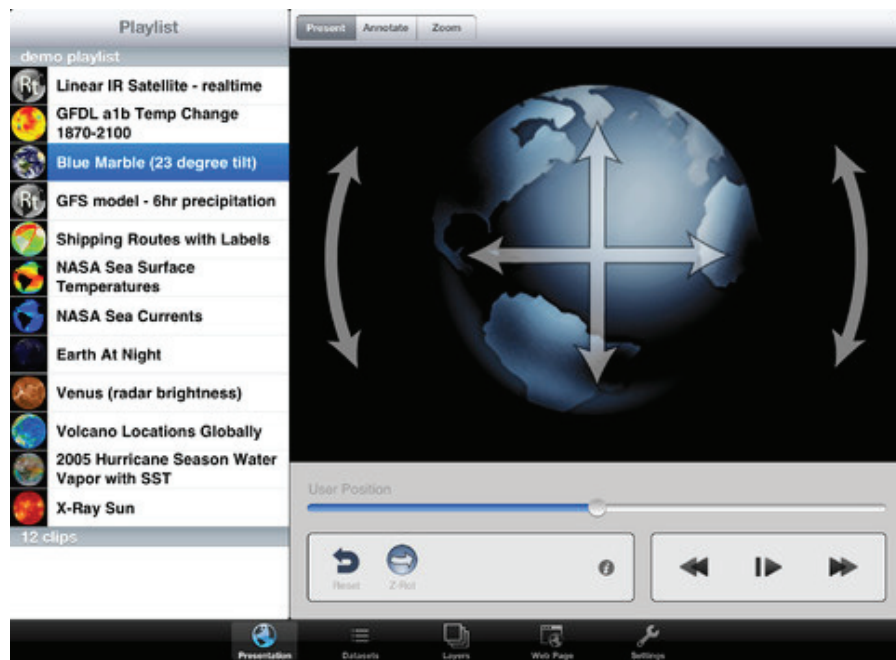
Lesson Plans: <http://sos.noaa.gov/docs/teacher.html>

Dataset movies: [http://sos.noaa.gov/download/dataset\\_table.html](http://sos.noaa.gov/download/dataset_table.html)

... and much more.

### SOS Operation

1. The iPad, remote control, and laser pointer are located in the cabinet to the left of the main computer in the NERR office.
2. Start SOS by double clicking the icon on the main computer. Remember to always leave this computer on and leave the doors to the cabinet open.
3. Use the grey remote control to power on all four SOS projectors in the auditorium. You only need to use the POWER button on the remote control... you will not use the other functions.
4. Use the iPad to choose a playlist, advance the datasets, and control the sphere.
5. Unless the remote application is already open, touch the SOS Remote icon on the iPad to open it.
6. Select your playlist by touching "datasets" at the bottom of the screen and then "load playlist" on the upper left of the screen.
7. Touch "presentation" on the lower left of the screen in order to control image movement on the sphere.
8. In presentation mode, always keep the red "user position" ball centered below the sphere image.
9. Turn off all the projectors by hitting the power button on the remote control two times.
10. Close the SOS program on the main computer by clicking the red X button. Do not turn off the main computer.
11. When finished, return the remote control, iPad, and laser pointer to the locked storage cabinet in the NERR office.



Screen shot of the SOS Remote application on the iPad.

## SOS Information for Docents

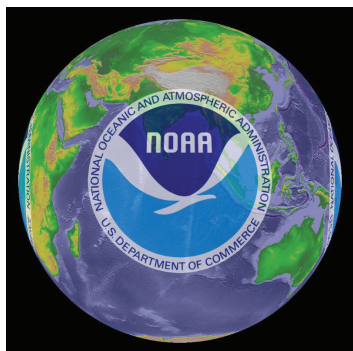
### Greeting

Welcome guests to the Bay Education Center and introduce yourself as a volunteer for the Mission-Aransas National Estuarine Research Reserve (Reserve). Use the following information to briefly describe the connections among the Reserve, the University of Texas Marine Science Institute, the National Oceanic and Atmospheric Administration, the Bay Education Center, the City of Rockport, and the Aransas County Navigation District:

- The Mission-Aransas Reserve is a federal and state partnership that is managed by the University of Texas Marine Science Institute, in Port Aransas. Federal funding for the Reserve comes from the National Oceanic and Atmospheric Administration (NOAA).
- The Reserve partnered with the City of Rockport and the Aransas County Navigation District to create the Bay Education Center.
- NOAA provided the funding for SOS and the exhibits.

Inform visitors about other SOS programs and Reserve programs:

- SOS programs are offered Tuesday through Saturday at 2 and 3 p.m.
- SOS program topics change each day as follows:
  - o Tuesday – Astronomy
  - o Wednesday – Atmosphere
  - o Thursday – Land
  - o Friday – Oceans
  - o Saturday – All Topics
- Information about other Reserve programs may be found on flyers and rack cards at the Bay Education Center. They include, but are not limited to Bay Talks, Habitat Hikes, and Estuary Explorer programs.



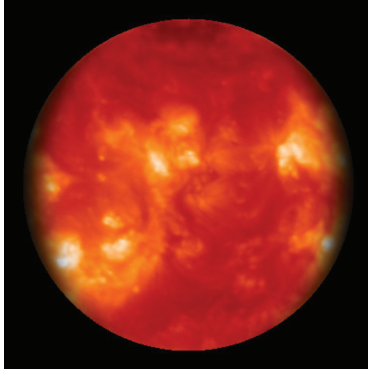
#### NOAA Logo Over EC

This dataset highlights the fact that SOS is a NOAA product. The NOAA logo or any image can be shown on the sphere. Many datasets have been created by utilizing the ETOPO2 dataset, which was generated from digital data bases of seafloor and land elevations. The ETOPO2 is a combination of satellite altimetry observations, shipboard echo-sounding measurements, data from the Digital Bathymetric Data Base Variable Resolution and data from the GLOBE project. Earth Color Enhanced uses green, yellow, orange, red and white to denote increasing elevation of the land.

### Wrap Up

Remind visitors that the Bay Education Center is open Tuesday through Saturday, from 1 to 4 pm. Different topics are presented each day, as follows: Tuesday - Astronomy, Wednesday - Atmosphere, Thursday - Land, Friday - Ocean, and Saturday - Best of the Rest. The programs are always free but there is a donation box by the door if you would like to help promote our education programs. Wetlands Education Center Tours at UTMSI in Port Aransas are offered on Tuesday, Thursday, and Saturday at 10 am. Visitors are welcome to take photos of themselves “holding up the Earth” after presentations. Remember to thank the guests for visiting the Bay Education Center.

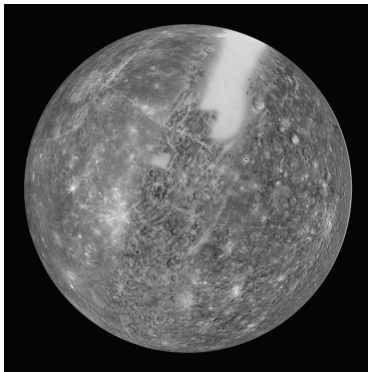
## Astronomy



### X-Ray Sun

The sun is a giant ball of burning gas and the closest star to Earth. The matter in the sun comprises about 99.8% of all the matter in the solar system. The remaining .2% goes to all the other planets and moons and the asteroid belt. The Sun is an astonishing 861,800 miles in diameter. Since the sun is not a solid object, the equator, or center, actually rotates faster than the polar areas by about 10 days. What you see here is the corona, or the outer layer, of the sun. You never want to look directly at the real Sun, but it's okay to look at this video of it. While the sun's brilliant surface is about 10,000°F, the thin outer corona is much hotter at about 1,000,000°F. The bright yellow flashes of light you see

are actually solar flares. These are storms on the surface of the sun. Scientists at NOAA watch for these flares because they can create problems here on Earth. The high-energy particles and radiation from the solar flares excite the upper atmosphere of Earth. This can interfere with communications like cell phones and satellites. The high-energy particles and radiation also create the Aurora Borealis, or Northern Lights.

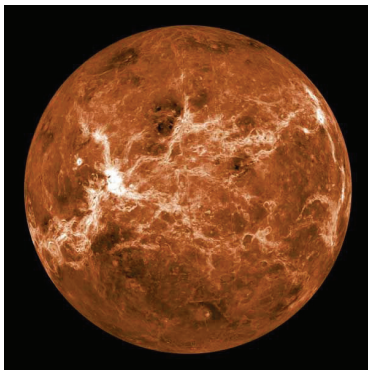


### Mercury

Mercury is the planet closest to the sun. This dataset is only half of Mercury. Humans have only seen one side of the planet because it rotates very slowly, and spacecraft so far have always flown by at similar vantage points. Mercury rotates three times for every two orbits around the sun. And since it's only 36 million miles from the Sun, it's too hot for us to send a spacecraft to the sunny side of Mercury. Mercury is so close to the sun that its orbit is only 88 days. Mercury looks a lot like the moon. That's because it doesn't have an atmosphere, just like the moon. One thing an atmosphere does for a planet is provide protection from meteors and rocks. Without an atmosphere to protect Mercury, it has become covered with craters. Another result of not having

an atmosphere is a sharp temperature contrast. Surprisingly Mercury is not the hottest planet in the solar system, the sunny side of Mercury is about 750°F, while the cool side, or the side facing away from the Sun is a much colder 350°F below zero; a sharp contrast of about 1100°F. These pictures of Mercury were taken by the Mariner Spacecraft in 1974 and 75.

Mercury may not seem like a comfortable place to visit but one perk is that it has less gravity than the earth because it is smaller; if you weigh 100lbs on earth you would only weigh 37lbs on Mercury!



### Venus

Venus is the hottest planet in our solar system at 900°F. The atmospheric pressure is really high on Venus. It's about 92 times as much as our air pressure on earth. This is about the pressure a deep sea diver would encounter at a depth of 3000 feet underwater. So if you were on Venus you'd be compressed to about the size of a toothbrush. Hot and squished, not a fun place to live. At one point, Venus may have had oceans, but they've since evaporated and been lost to outer space. Its orbit is 225 days, and its distance from the sun is about 67 million miles. Because Venus is the brightest planet, it is often the evening star in the sky. Of course, it's not really a star.



### Earth (Blue Marble)

Our planet is around 4.5 billion years old. The Earth's tilt is 23.5° and spins at 663,000 mph, which gives us our seasons. During the summer (in the Northern Hemisphere), we are tilted toward the sun, causing temperatures to rise. The Earth is about 8,000 miles wide. All of the Earth's weather is caused by what we call differential heating, which just means that some parts of the Earth, such as the equator, get more heat from the sun than others. This temperature imbalance has to be worked out by wind and weather patterns. We're 93 million miles from the Sun, and the Earth is 71% water, about 29% land. They should have called the planet "Ocean". Notice that the Earth is not covered in craters

because there is an atmosphere to provide protection.

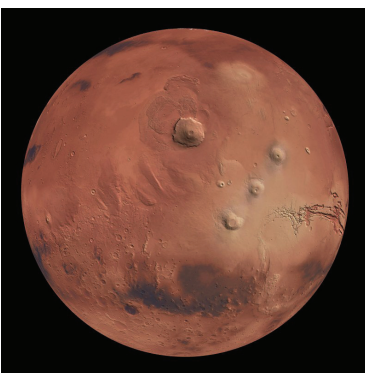


### Earth's Moon

The moon, however, does not have an atmosphere to protect the surface from meteors and rocks. This is the cause of the marked up surface. The Moon doesn't shine with its own light. It reflects sunlight, so it's like a big mirror in the sky. The moon is about 1/4th the diameter of Earth, and 1/80th of the mass. The temperature range is pretty great; the side of the Moon that always faces us, the sunny side, is 253°F while the dark side is -387°F, making a difference of over 600°F!

The Moon is mainly responsible for the tides of the oceans, and it goes through its phases from full to new, and back to full again in about 28 days. Neil Armstrong was the first person to walk on the moon, on July 21 (the Apollo

11 landed on the moon on July 20), 1969. The moon's a pretty dusty, rocky, plain place. The astronauts said the dirt felt like snow, but smelled like spent gunpowder. That's because it's made of a silicate rock, which apparently made the command module return flight a little smelly. We may get to go back to the moon, and maybe we'll have our first girl walk on the moon. In 2004, President Bush signed an initiative for NASA to go back for longer missions to the moon.



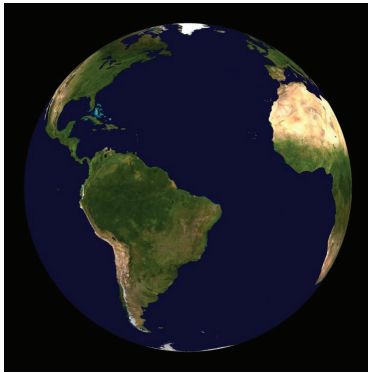
### Red Mars

The Red Planet, Mars. It is red because of the iron oxide dust on its surface, it's just a big rust bucket. We are exploring Mars currently more than any other planet. Mars has polar ice caps; the northern one is larger. They're made of frozen water and carbon dioxide.

Mars has a couple of very interesting features. This deep long scar is the Valles Marineris. It is the biggest canyon known in the Solar System. Its 2500 miles across, that's as wide as the US, and it is 5.7 miles deep. The Grand Canyon, for comparison, is only 1 mile deep.

Another record-breaking feature of Mars is Olympus Mons. It is the largest mountain (and volcano) known in the Solar System. Its over 85,000 feet high!

The highest point on Earth is Mt. Everest, which is about 29,000 feet, so Olympus Mons is almost three times that height.



### Earth with Vegetation

Earth with Vegetation shows the Earth without cloud cover so that the vegetation can be clearly seen. It is a mosaic image therefore it doesn't represent any particular season. The background image of the land and oceans was created using data from June through September of 2001. This could not be done in a single day or even a week because on any given day clouds are blocking a significant portion of the surface.

The shading is true color with the oceans shades of blue, the lands varying from green to brown. The brown areas are the sands of the deserts. The shading of the land was done using a dataset compiled by the U.S. Geological Survey's Earth Resources Observation and Science Data Center.



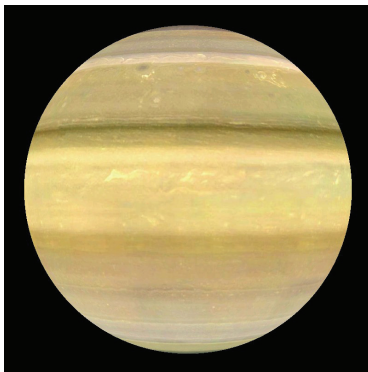
### Jupiter Storm Animation

Jupiter, the largest planet has a diameter 11 times that of Earth. If you took all the other planets and smashed them together, Jupiter would still be larger. Jupiter is 482 million miles from the Sun. This video of Jupiter is based on photographs from the Cassini spacecraft that flew there in 2000. It may have a solid core about the size of Earth, but mostly it's a gas giant.

Its motion is very fast (though slower than the inner planets). It travels around the sun in only 12 years, which is pretty quick. And it rotates at an incredible speed, completing one rotation in just 9 hours and 50 minutes. In fact, Jupiter, which has the fastest rotation rate in the solar system, bulges at the equator

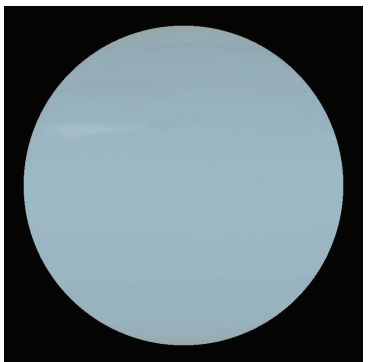
and flattens at the poles due to its rapid rotation. For something that large, that's quite a spin. Since it is primarily gas, there's some pretty wicked weather on Jupiter. That's what formed the GREAT RED SPOT. It is a huge storm. It's similar to a hurricane that is the size of the Earth! And it has been going on for over 325 years!

Jupiter has 63 moons that all have different orbits.



### Saturn without Rings

This planet might look unfamiliar to you without its rings. Saturn, known for its rings, is the 6th planet from the sun and the 2nd largest. The rings of Saturn are made of ice, dust, and rock, with about 60 moons embedded within them. There are 3 main bands of the rings, which extend between 4,000 and 100,000 miles outward from the equator. Saturn also rotates really fast, spinning around in about 10 hours. It has wind speeds up to 1,100 miles per hour. It's a gas giant, made of hydrogen and helium making it the lightest planet. Saturn's core has a temperature of 21,400°F and it radiates more heat and energy out to space than it receives from the Sun. The Cassini spacecraft has been studying Saturn since 2004, and in 2008 it made its 70th trip around it! In all of these trips we have found out something fascinating about Saturn that we never knew before! At the North Pole, there is a gigantic hexagon! This is a 6 sided vortex with winds of 200 miles per hour. On the South Pole, a storm with a well-defined eyewall was discovered. This is the first known eyewall to exist outside of Earth.



### Uranus

The next two planets are the blue planets. This first one is Uranus. It's blue (or greenish) because of methane in its atmosphere. William Herschel discovered

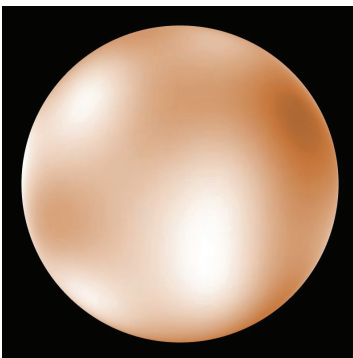
it in relatively recent times in 1781. It has a very high mass and density, and is made of frozen water, ammonia, and methane. Uranus is 2 billion miles from the Sun, so the temperature is a very chilly  $-323^{\circ}\text{F}$ . It has an 84-year orbit around the Sun. What makes Uranus so unique is that while most of the other planets revolve around their axis and spin like a top in just about the same plane as they orbit the Sun, Uranus has a 98-degree tilt. So it rolls over and over itself as it travels around the Sun earning the name “the lazy planet”.



### Neptune

Neptune is also blue from methane in its atmosphere, along with a lot of hydrogen and helium. When this picture was taken by the Voyager spacecraft, Neptune had a dark spot caused by a storm, like Jupiter’s Great Red Spot. Unlike Jupiter’s Great Red Spot, the storm on Neptune is not persistent or stationary. The storm was first discovered in the Southern Hemisphere, but when the Hubble Telescope photographed the planet later, the Southern Hemisphere storm was gone and a new storm had formed in the Northern Hemisphere. Neptune is also a very unpleasant place to live. Its temperature is  $353^{\circ}\text{F}$  below zero. And it has winds of up to 1200 miles per hour. There is a

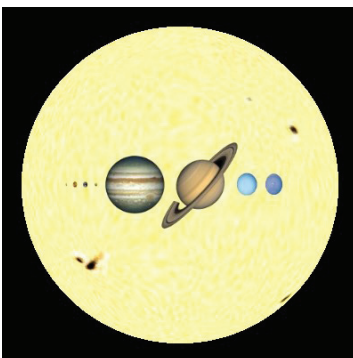
group of white clouds referred to as “The Scooter” which races around the planet every 16 hours. It’s a very windy place, though the theories about what powers the winds are all somewhat speculative. It is thought that the very hot core of Neptune might play a part in the strong surface winds. Researchers are trying to learn more about its hot core, and the cause of the winds.



### Pluto (a.k.a. 134340)

Pluto is no longer a planet, it’s a dwarf planet. Unfortunately, this is currently our best picture of Pluto. Because Pluto is over 3 billion miles from the sun, it is hard to get close enough to get a good picture. This picture was taken by the Hubble Telescope (with some Earth-based color information added). We’re going to get a better look at Pluto with the New Horizons spacecraft, which will pass Pluto in 2015. It’s made of rock and ice, and is 1,400 miles wide. Until 2006, it was the 9th planet. But in that year, the International Astronomical Union set up new guidelines for what it takes to be a planet. There are 3 things you need:

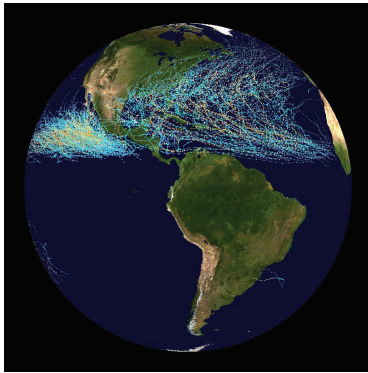
1. You have to be in orbit about the Sun, which Pluto is.
2. Next, you have to have enough gravitational pull of your own to retain a spherical shape, whether you’re made of gas or solid. And Pluto does do that.
3. But, it does not pass the third test. You have to have swept out everything else within your path around the Sun. Pluto is not dominant enough to have done that, for 20 years Neptune and Pluto switch places every 248 Earth years.



### Yellow Sun with Solar System to Scale

This dataset has the Sun as the background and then has a picture of the solar system drawn to scale. See how Earth and Venus are the “twin planets”.

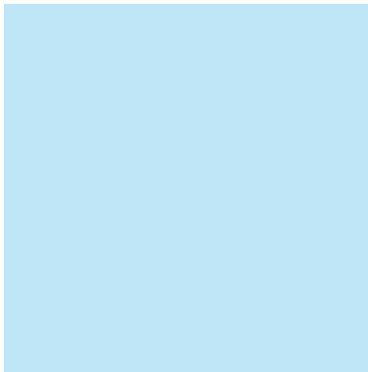
# Atmosphere



## Accumulative Hurricane Tracks 1950-2005

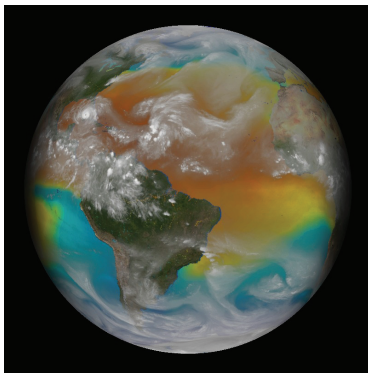
This dataset consists of all the hurricanes that occurred worldwide between 1950 and 2005. By tracking storms from the past we are able to better predict storms in the future. It's important to remember that our estuaries here on the Texas Coastal Bend protect us from large storm surges pushed in by hurricanes. The dots here show the locations of the tropical storms at six hour intervals and are shaded according to the Saffir-Simpson Scale using the provided color bar. Notice that no hurricanes cross the equator; this is because hurricanes spin in opposite directions in the Northern and Southern hemispheres.

In Japan hurricanes are called typhoons, in the southern hemisphere they are cyclones and in Australia they are Willy Willies. All of the hurricanes that hit the Gulf of Mexico form off the coast of Africa in the Gulf of Guinea; this is where cool moist air from the ocean is combining with hot dry air from the Sahara Desert and mixing causing tropical depressions.



## Forecast: Hurricane Names by Location (Image missing)

This is a dataset of the blue marble with shaded areas where storms are called hurricanes in pink, typhoons in red, cyclones in blue. The dataset shows the names if the storms in the different areas.



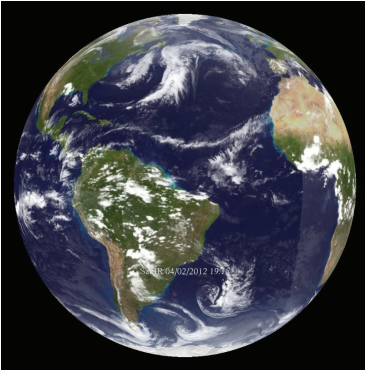
## 2005 Hurricane Season Water Vapor with SST

The 2005 hurricane season shattered records that have stood for decades - with 28 named storms, 15 hurricanes, seven major hurricanes, and four category 5 hurricanes. It was also the first season in which four major hurricanes hit the U.S. The season started early and ended late with two tropical storms in June (which hadn't happened since 1986) and three tropical storms in November with one that formed in December and dissipated in January. The season also included the most rapid intensification of a hurricane in 24 hours in the Atlantic Ocean, a record held by Wilma (third and fourth most intense hurricanes ever recorded in the Atlantic). The 2005 hurricane season is most remembered for

Hurricane Katrina, which devastated parts of Mississippi, Louisiana and in particular, New Orleans. Over 1600 people died during the storm and an estimated cost for all the damage, \$75 billion, making Katrina the costliest hurricane ever.

Irene Track (Image and Description of dataset missing)





#### Real-Time :Linear IR Satellite

Geostationary infrared satellite images are used by meteorologists to determine where clouds are, but more importantly, how the clouds are moving. The infrared, IR, satellites work by measuring the infrared radiation that is emitted. Because the emitted radiation is proportional to temperature, the data are converted to temperature values, which can be useful for meteorologists. In comparison to clouds, the Earth's surface, even on very cold nights, is warm. When there are clouds, they absorb the radiation emitted by the Earth below and emit their own radiation at a much cooler temperature. Any area that has clouds shows up cooler than the ground, allowing meteorologists to detect the locations of the clouds. The height of clouds is inversely proportional to temperature, meaning that the tallest clouds are the coldest. It is often the tallest clouds that bring the most severe weather.

The satellites that collect these data are geostationary, meaning that they rotate at the same rate as the Earth so that the satellites are over the same spot on Earth all the time. This allows them to collect a continuous stream of data for one location so that "movies" of the data can be made. This real-time dataset is shaded on a gray scale, meaning that the lowest clouds are a very light gray and the highest clouds are bright white. The "Blue Marble" is the background image for this dataset. Data for this visualization is available for the past thirty days.

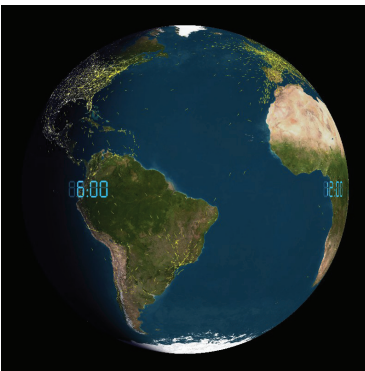
20121019 EarthNow: U.S Precipitation Outlook (Image and Description of dataset missing)

20121019 EarthNow: U.S. Temperature Outlook (Image and Description of dataset missing)



#### Facebook Friendships

This dataset was created by an intern at Facebook who plotted 10 million pairs of friends on Facebook. The result is a stunning map that shows the connections between people and highlights the regions with readily available access to the internet. Africa, with limited internet access is rather dim, while China, with many internet users is dim due to the use of a popular Chinese social networking site and government restrictions.



#### Air Traffic with Day/Night Terminator

"On any given day, more than 87,000 flights are in the skies in the United States. Only one-third are commercial carriers, like American, United or Southwest. On an average day, air traffic controllers handle 28,537 commercial flights (major and regional airlines), 27,178 general aviation flights (private planes), 24,548 air taxi flights (planes for hire), 5,260 military flights and 2,148 air cargo flights (Federal Express, UPS, etc.). At any given moment, roughly 5,000 planes are in the skies above the United States. In one year, controllers handle an average of 64 million takeoffs and landings." - From the National Air Traffic Controllers

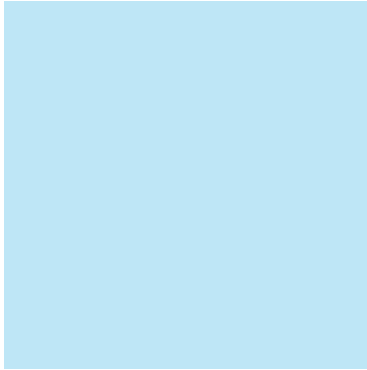
Association webpage

This dataset tracks commercial flights from the approximately 9000 civil airports worldwide. The day/night terminator is included as a time reference. Flight traffic picks up noticeably during daylight hours and drops off through the night. Each yellow tail is one plane in this visualization

Europe has sound ordinances controlling when flights can land early in the day, watch as daylight

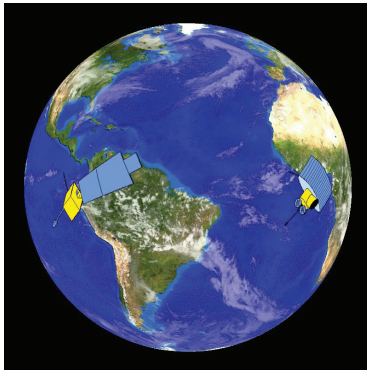
approaches. Watch the air traffic increasing as the sun crosses over the US.

Previously used datasets:



#### 2010 Hurricane Season (Image missing)

2010 was the 3rd busiest hurricane season in history. Fortunately for us the Jet Stream was staying in place along our eastern coast and pushing most of the storms out to sea. The only hurricane that affected Rockport was Alex, he was a category 2 hurricane and was extremely large taking up the entire Gulf of Mexico.



#### Geostationary Satellite Positions and Polar Orbiting Satellite Tracks

Satellites are a key tool for scientists to monitor and observe the Earth's atmosphere from space. The NERR uses satellites to collect data from all of the SWMP or water quality monitoring stations in the US and upload the information to the internet. Geostationary satellites orbit around the Earth at the same rate as the Earth rotates so that the satellites are over the same spot on Earth all the time. This allows them to collect a continuous stream of data for one location so that "movies" of the data can be made.

The satellites are positioned 22,300 miles above the Earth's surface in order to view the Earth's full disk and to maintain their geostationary orbit.

Geostationary satellites travel at about 7000mph in order to maintain their geostationary orbit.

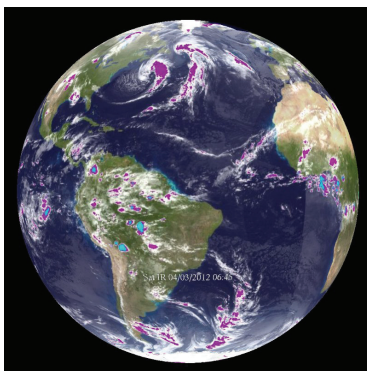
In addition to geostationary satellites, scientists also use polar orbiting satellites. These satellites circle the Earth, crossing the poles on each orbit. Typically, polar orbiting satellites are about 500 miles above the Earth's surface. The satellites travel at almost 17,000mph, allowing them to orbit the Earth in roughly 100 minutes. A polar orbiting satellite is able to cover the whole Earth in less than one day.

There are hundreds of scientific satellites orbiting the Earth. Each of the polar orbiting satellites travel at slightly different heights this allows them to pass by one another without crashing. This dataset shows the positions of seven geostationary satellites and the tracks of several polar orbiting satellites, plus the location of the International Space Station over one day, February 15, 2007. Each color represents a different type of satellite.

Blue - NOAA-17 and NOAA-18,

Yellow - Defense Meteorological Satellite Program,

Red - NASA, large ones are Terra and Aqua, small one is TRMM (notice the different orbit type), and White- is the International Space Station.



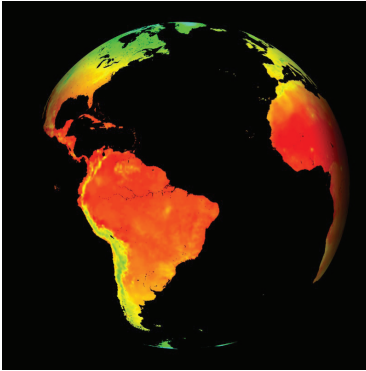
#### Real-time Color Enhanced Infrared Satellite

Infrared satellite images are used by meteorologists to determine where clouds are, but more importantly, how the clouds are moving. The infrared or IR satellites work by measuring the infrared radiation that is emitted and then converted to temperature data.

In comparison to clouds, the Earth's surface, even on very cold nights, is warm. When there are clouds, they absorb the radiation emitted by the Earth below and emit their own radiation at a much cooler temperature. Any area that has clouds shows up cooler than the ground, allowing meteorologists to detect the locations of the clouds. The tallest clouds are the coldest. It is often the tallest

clouds that bring the most severe weather.

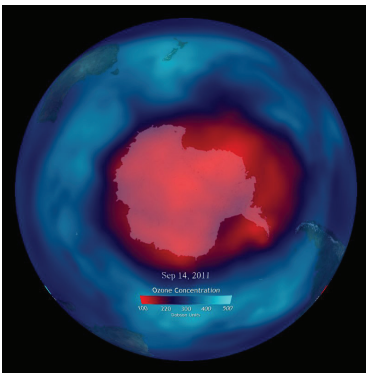
The satellites that collect these data are geostationary, meaning that they rotate at the same rate as the Earth so that the satellites are over the same spot on Earth all the time. This allows them to collect a continuous stream of data for one location so that “movies” of the data can be made. This real-time, color enhanced dataset is shaded so that the significant clouds are brightly colored in order to stand out from the surface. The lowest clouds are white, medium level clouds are shades of purple, and the highest clouds are teal. The background of this image is the “Blue Marble.” The data is constantly updated so that the past thirty days of data are available.



#### NCDC Monthly Land Surface Temperature (1950 - 1999)

The temperature of the air varies dramatically in both time and space. Because the Earth’s rotational axis is at a 23° tilt, the Northern Hemisphere and Southern Hemisphere simultaneously experience opposite seasons. This dataset displays the gridded, monthly, historical terrestrial air temperature from 1950 - 1999. This sequence clearly illustrates the annual cycle of climate variability across the world through the seasons. Besides displaying how the hemispheres experience opposite seasons simultaneously, this dataset also reveals the effect of significant elevation changes. The mountainous regions tend to be cooler than the surrounding areas.

Temperature responses over land to significant El Niño/La Niña events can also be measured as well as global warming trends in many regions.



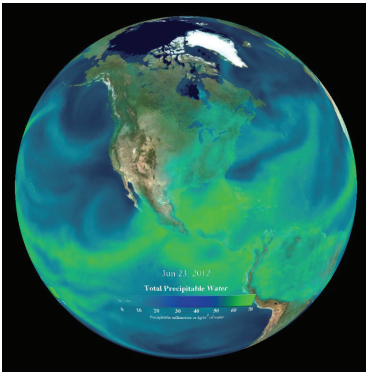
#### Real-time Stratospheric Ozone

Ozone is a gas made of three oxygen atoms, and just like any other gas it circulates in the atmosphere. The stratospheric ozone layer is critical because it protects Earth from harmful ultraviolet solar radiation. Areas with ozone concentrations less than 220 Dobson Units are called “holes” in the layer. The Antarctic ozone hole is formed each year in the Southern Hemisphere spring (September-November) when there is a sharp decline in the total ozone over most of Antarctica. During the cold dark Antarctic winter, stratospheric ice clouds form when temperatures drop below -78C. These very cold clouds are responsible for chemical changes that promote production of chemically active

chlorine and bromine. When sunlight is combined with the chlorine and bromine in the Antarctic Spring, there is an activation that leads to a rapid ozone loss, which results in the Antarctic ozone hole.

Although some ozone depletion also occurs in the Arctic during the Northern Hemisphere spring (March-May), wintertime temperatures in the Arctic stratosphere are not persistently low for as many weeks which results in less ozone depletion. The production of ozone is high near the equator, but due to atmospheric circulation transporting the ozone to the poles, the equator tends to be a region of relatively low ozone through the year.

Scientific evidence, accumulated over more than two decades of study by the international research community, has shown that human-produced chemicals are responsible for the observed depletions of the ozone layer. Through an international agreement known as the Montreal Protocol on Substances that Deplete the Ozone Layer, governments have decided to eventually discontinue production of CFCs, halons, carbon tetrachloride, and methyl chloroform, and industry has developed more “ozone-friendly” substitutes. With adherence to the international agreements, the ozone layer is expected to recover over the next 50 years or so. NOAA’s polar orbiting satellites are used to monitor the ozone hole and the data taken from the POES satellites is processed and made available on a daily basis in near real-time.



### Real-time Total Precipitable Water

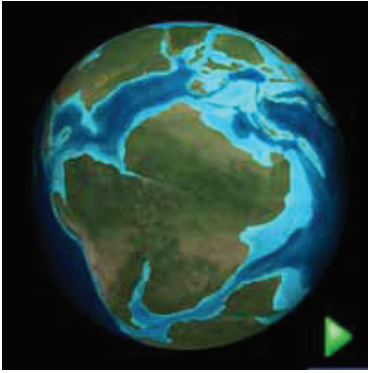
The atmosphere contains an enormous amount of moisture that circulates around the globe. However, not all of it actually condenses into rain, sleet, or snow since the right balance of pressure and temperature are needed to create precipitation.

Total precipitable water (TPW) in the atmosphere is the amount of water that can be obtained from the surface to the “top” of the atmosphere if all of the water and water vapor were condensed to a liquid phase. Significant features that can be identified in TPW data are the atmospheric rivers that flow off the oceans and onto coastal land areas. A famous example is the Pineapple Express

that forms in the Northeast Pacific and impacts the Northwest United States. Also notice how TPW values are much greater over the equator and ocean. High levels of evaporation in these areas are one of the primary drivers of atmospheric circulation.

The land, ocean, and atmosphere all emit microwave radiation which can be measured by sensors on satellites, allowing scientists to study various aspects of the Earth. Microwave sounders are able to measure very low levels of microwave radiation naturally emitted by the Earth at different frequencies. Even water vapor emits microwave radiation that can be measured by microwave sounders. The AMSU and the Special Sensor Microwave Imager, SSM/I, which is carried on Defense Meteorological Satellite Program satellites, the AMSU/SSM/I combined dataset is updated daily.

# Land



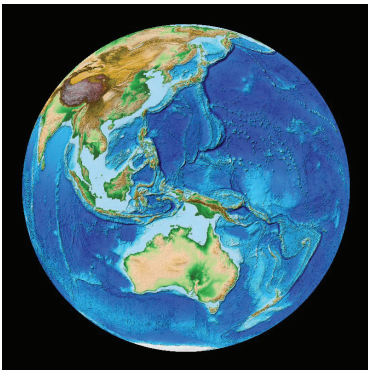
Paleo Geographic movie July 8, 2009 (Plate Tectonics)

This dataset is from the ARC Science Center. It is a time-elased frame set of approximately 4000 high-resolution images with original artwork visualizing the evolution of the Earth's surface due to plate tectonics over the past 600 million years. The theory of tectonic plates is that there are sections of rocky crust floating on the surface of the earth.

This shows the large southern landmass called Pannotia, which began to break apart into several small pieces as well as Gondwana 550 million years ago, which eventually became the cores of North America, Northern Europe, and Siberia. The smaller pieces from the break up of Pannotia drifted together to form Laurasia. Gondwana and Laurasia drifted for more than 200 million

years, and then came back together again, pushing up a great mountain range of which the Appalachian Mountains are one remnant.

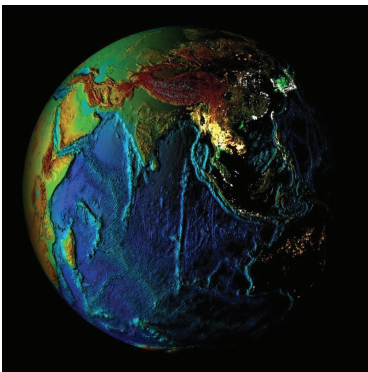
This new super continent, Pangaea, then began its break up around 300 million years ago into what became the present day world. During the Jurassic period, 140-180 million years ago, the North Atlantic opened up, followed by South America and Africa pulling apart to create the South Atlantic, and then the final break up of Gondwana into India, Australia, and Antarctica. When India broke free from other landmasses, it traveled with great speed toward current day Asia. The collision between the two land masses caused the Himalayas to form. Also during this time, several mass extinctions occurred due to various warming and cooling events.



Etopo 1

ETOPO1 is a 1 arc-minute global relief model of Earth's surface that integrates land topography and ocean bathymetry. It was built from numerous global and regional data sets, and is available in "Ice Surface" (top of Antarctic and Greenland ice sheets) and "Bedrock" (base of the ice sheets) versions. The "Ice Surface" version is available for Science On a Sphere®. This dataset is a higher resolution version of ETOPO2, which is a 2 arc-minute global relief model of Earth's surface. An arc-minute is 1/60 of a degree. Scientists use high resolution maps like ETOPO1 to improve accuracy in tsunami forecasting, modeling, and warnings, and also to enhance ocean circulation modeling and Earth

visualization.



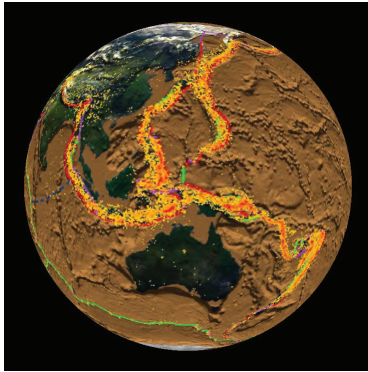
Surface of the Earth and Nighttime Lights

This planet Earth visualization shows a rotating planet in order to display both a nighttime and daytime view. The daytime side of the visualization shows the bathymetry and topography of the globe.

Color coding is used to distinguish between the elevations. Red and gray represent the highest terrain on the land, green and yellow represent the lowest. In the ocean, the darker colors are the deeper ocean floors while the lighter colors indicate shallower areas as well as mountain ranges on the sea floor. The very light blue shading in the ocean, near the land forms, is generally the shallow continental shelf.

Some interesting features that can be seen are the mountain ranges in the oceans, such as the mid-Atlantic Ridge in the middle of the Atlantic Ocean, which is spreading. Also in the ocean is the Marianas Trench, which is south of Japan. This trench is the deepest location in the ocean with an amazing depth of 36,201 feet, almost 7 miles. On land, the Himalayas are a noteworthy feature, as they are the home of Mount Everest, the tallest point on earth at a height of 29,035 feet, almost 5.5 miles.

The nighttime side of this visualization shows lights of the world over a one-year period. The white represents lights generated from electricity. Areas of high population and economic development are generally covered with white lights. Also, areas along coasts tend to be well populated. The Nile River can be easily traced from the string of lights that outline it. Major interstates in the United States can be traced out from the lights of the towns along the roads.

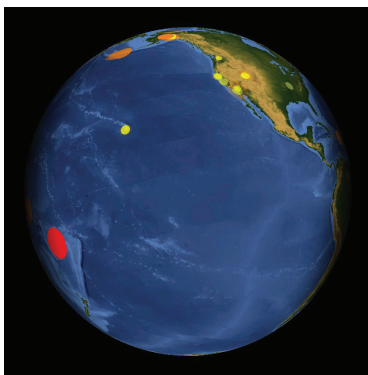


### Cumulative Earthquakes 1980-1995

It is estimated that there are 500,000 detectable earthquakes in the world each year. Of those, 100,000 can be felt and 100 of them cause damage. Anything that causes seismic waves to radiate throughout the Earth is an earthquake. The cause of earthquakes can be natural, such as one tectonic plate slipping below another, or anthropogenic (cause by humans), such as drilling for fossil fuels, extraction of minerals, huge explosions, and the collapse of large buildings. Because most natural earthquakes occur due to slipping plates, the boundaries between tectonic plates are "hot spots" for earthquakes. In the Pacific Ocean, the Pacific Plate is referred to as the "Ring of Fire" because this is one of the most active plates where earthquakes and volcanoes

frequently occur.

This dataset highlights especially well the location of the ring of fire. The cumulative earthquake events from 1980 through 1995 are plotted on a world map with ocean bathymetry. Only earthquakes with a magnitude greater than 4.2 have been plotted. A yellow dot represents 1 or 2 earthquakes, an orange dot represents about 10 earthquakes and a red dot represents 50 to 200 earthquakes. The colored lines represent tectonic plate boundaries. It is clear to see that earthquakes occur most frequently along the plate boundaries. The red lines are convergent boundaries, the green lines are divergent boundaries, the blue dashed lines are diffuse boundaries and the purple lines are transform boundaries.



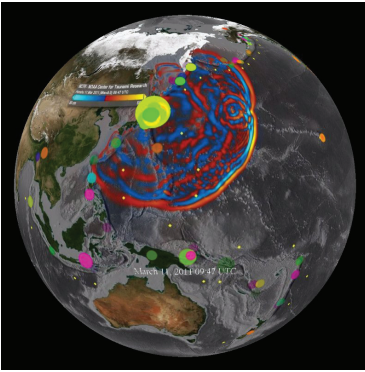
### Earthquakes

We now know the surface of the Earth is composed of a mosaic of tectonic plates moving with respect to each other. When two plates glide past one another, a stress builds up at the boundary. When that stress reaches a critical level, the boundary slips and the result is an earthquake. The traces of repeated slips are known as fault lines. Can you see some earthquakes that are not occurring on fault lines? This could be that they are located on weak points in the plate that were ancient fault lines from when pannotia broke up.

Most earthquakes are small enough to hardly be noticed; however, some can be very powerful causing widespread death and destruction and can

even trigger tsunamis. The Richter magnitude scale was created to rate the strength and magnitude of earthquakes. It is a base-10 logarithm scale of ground motion 100km from the epicenter. Each increase of 1 magnitude means 10 times greater ground motion. To measure the amount of energy that was released during an Earthquake, a base 32 logarithm scale is used.

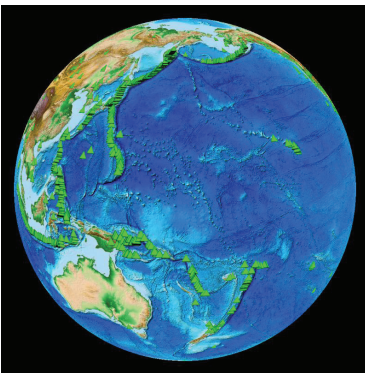
This real-time dataset shows the earthquakes that daily happen around the world that are greater than 2.5 on the Richter scale. With the current database from the USGS, many earthquakes outside of the United States under 4-5 magnitude on the Richter scale are not reported. The size of the circle is proportional to the magnitude of the earthquake, with bigger values on the Richter scale represented by bigger circles. The coloring of the circles is based on the depth of the earthquake below the surface according to the provided color bar. After an earthquake occurs, the representing circle fades out over a seven day period. This dataset is updated hourly.



### Japan Earthquake, Tsunami Propagation, and Height Vombo

On March 11, 2011 at 2:45 local time, a 9.0 magnitude earthquake occurred 81 miles (130 km) off the east coast of Sendai, Japan, triggering a massive tsunami. It is estimated that the initial tsunami wave took 10 to 30 minutes to make its first landfall. Forecasted wave heights were up to 33 ft (10 m) and there were many reports of tsunami waves three stories high in parts of Japan. Across the Pacific Ocean, many countries issued evacuations along the coasts because of the predicted tsunami waves.

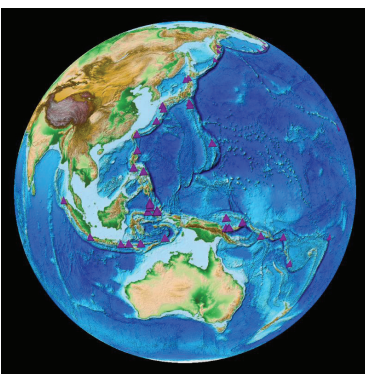
There are several datasets related to this event. The first is a model run of predicted tsunami wave heights from the Center for Tsunami Research at the NOAA Pacific Marine Environmental Laboratory. It shows the predicted wave heights of the tsunami as it travels across the Pacific basin. The largest wave heights are near the earthquake epicenter, off Japan. The wave decreases in height as it travels across the deep Pacific but grows taller as it encounters shallow waters near coastal areas. In general, the energy of the wave decreases with distance, causing the maximum height of the waves at the coasts to decrease. This explains why coastal Hawaii does not see the heights that were encountered in coastal Japan. Out in the open ocean, areas of low wave height correspond to deeper areas in the ocean.



### Volcano Locations Globally

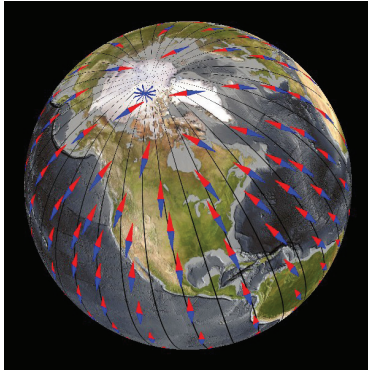
According to the Smithsonian Institute's Global Volcanism Program, there are probably about 20 volcanoes erupting right now, and about 550 volcanoes have had historically documented eruptions. A volcano is an opening, or rupture, in the Earth's crust through which molten lava, ash, and gases are ejected.

Volcanoes typically form in three different settings. The first is divergent plate boundaries, where tectonic plates are pulling apart from one another, such as the Mid-Atlantic Ocean Ridge. Most of these volcanoes are on the bottom of the ocean floor and are responsible for creating new sea floor. The second location is convergent plate boundaries, where two plates, typically an oceanic and continental plate, are colliding. The volcanoes along the Pacific Ring of Fire are from convergent plate boundaries. The third location is over hotspots, which are typically in the middle of tectonic plates and caused by hot magma rising to the surface. The volcanoes on Hawaii are the result of hotspots, they are in the form of a chain because the Pacific plate was moving as the lava broke through the crust. This dataset shows the locations of significant eruptions, of which there are over 400. An eruption is considered significant if there are any fatalities linked to it, the cost of the damage is over one million dollars, it causes a tsunami or there is a major earthquake associated with it. The final dataset shows the locations of all eruptions that have caused tsunamis.



### Volcano Eruptions causing Tsunamis (description missing)

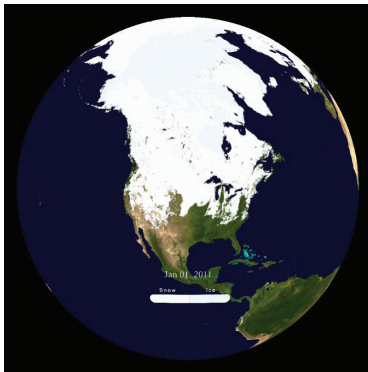
Previously Used Datasets:



Magnets 1590-2010

Earth is like a giant magnet with a North and South Pole. However, the magnetic North and South Pole are not aligned with the Geographic North and South Pole. The Geographic North Pole is defined by the latitude 90° N and is the axis of the Earth's rotation. The Magnetic North Pole is where the Earth's magnetic field points vertically downward. The Earth creates its own magnetic field from the electric currents created in the liquid iron-nickel core, fluctuations in the liquid iron can cause the magnetic field to shift. This dataset shows the changes in the magnetic field from 1590 - 2010. The magnetic poles are indicated by stars.

Compass needles point in the direction of the magnetic field lines, which is generally different from the direction to the Geographic North Pole. The dataset shows the compass pointing directions around the world. The black lines (meridians) indicate the direction of True North. The angle between the compass pointing direction and True North is called magnetic declination. It is important to know the magnetic declination when using a compass to navigate so that the direction of True North can be determined. Since the 1970's the movement of the Magnetic North Pole has accelerated, which is noticeable in all three datasets. The strength of the magnetic field has also decreased by 10% this could be an indication that the poles are in the process of switching, this has been known to happen in the past found from evidence in the orientation of iron in rock cores.

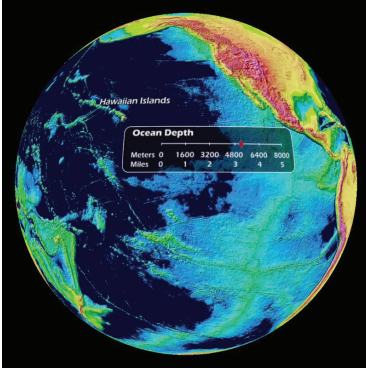


Real Time Snow and Ice

The cryosphere (areas covered by ice, snow, glaciers, or permafrost) is an extremely dynamic part of the global system. Changes in the seasons and climate bring great changes to the extent of Earth's cryosphere. Using satellite data allows scientists to keep a continual eye on these areas. Infrared and microwave data from multiple satellites including the NOAA's GOES Imager and POES AVHRR, US Air Force DMSP/SSMI, and EUMETSAT MSG/SEVIRI sensors is combined to create these daily maps of global snow and ice cover of the planet. Using multiple datasets provides relatively high spatial resolution (about 4 km/pixel) daily maps in all weather conditions. Light blue areas indicate sea ice extent, whereas white colors indicate all other areas of the cryosphere. This SOS dataset is updated on a daily basis in near real-time.



# Ocean



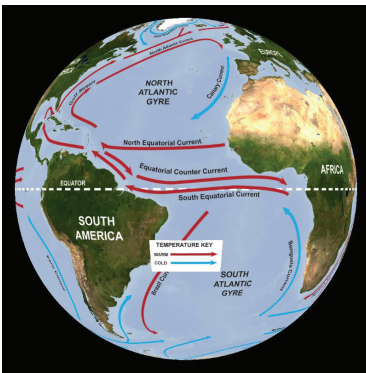
## Ocean Drain with Etopo Background

Beneath the sea surface is an amazing sea floor that contains mountain ranges, trenches and plains. The ocean covers 71% of the Earth's surface, has an area of 139,400,000 square miles and an average depth of 2.3 miles. Due to this vast size, only a few percent the sea floor has been mapped by ships. Maps of the sea floor are created by combining soundings from ships, sonar scans from ships, and gravity anomalies in the sea surface detected by satellites.

This dataset gradually reveals the sea floor as the ocean is "drained". The scale in the dataset shows the distance below sea level in meters and miles. As selected features are revealed, a label appears. For this animation, the labeled

areas include Mariana Trench, Tonga Trench, Puerto Rico Trench, Hawaiian Islands, Grand Banks, Mid-Atlantic Ridge and Ninety East Ridge. The deepest area in the ocean is the Mariana Trench, which is 6.86 miles (11,033 meters) deep. The longest mountain range in the world is the Mid-Atlantic Ridge, which runs through the middle of the Atlantic Ocean.

## Real-time GLAPS Weather Model

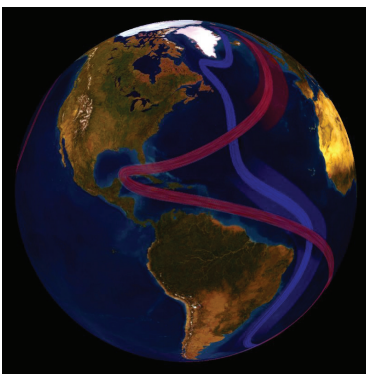


## Ocean Circulation & Ocean Conveyor Belts

The ocean is not a still body of water. There is constant motion in the ocean in the form of a global ocean conveyor belt due to thermohaline currents.

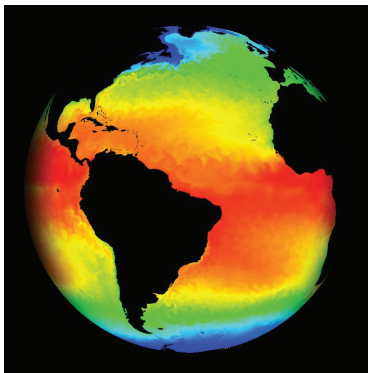
These currents are density driven, which are affected by both temperature and salinity. Cold, salty water is dense and sinks to the bottom of the ocean while warm water is less dense and rises to the surface. The "start" of the ocean conveyor belt is in the Norwegian Sea. Warm water is transported to the Norwegian Sea by the Gulf Stream. The warm water provides heat for the atmosphere in the northern latitudes that gets particularly cold during the winter. This loss of heat to the atmosphere makes the water cooler and denser,

causing it to sink to the bottom of the ocean. As more warm water is transported north, the cooler water sinks and moves south to make room for the incoming warm water. This cold bottom water flows south of the equator all the way down to Antarctica. Eventually, the cold bottom waters are able to warm and rise to the surface, continuing the conveyor belt that encircles the global. It takes water almost 1000 years to move through the whole conveyor belt.



There are two datasets that illustrate the ocean circulation. The first dataset is an animation that shows the movement of the ocean conveyor belt and the second dataset is a still image that has the major ocean currents labeled. In both datasets, surface waters are the red lines and cold, bottom waters are the blue lines. Changes in ocean circulation could have drastic impacts on the climate. The transport of heat associated with the ocean conveyor belt partially moderates the cold temperatures in the North. As the poles warm due to climate change, melt water from ice and glaciers enters the ocean. This fresh melt water has the potential to slow or even shut off the ocean circulation, which is dependent on temperature and salinity. The density of the fresh melt

water is less than that of salty ocean water. This causes the fresh melt water to form a layer on the surface that can block the warm, salty ocean water from transporting heat to the atmosphere. The effect would be a cooling of the higher latitudes. If the warm water is not able to give off heat, it can not cool and sink to the bottom of the ocean. This would disturb the circulation of the entire ocean conveyor belt and have a noticeable impact on the climate in the northern latitudes.

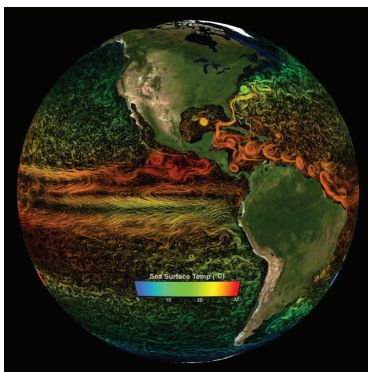


### NASA Sea Surface Temperatures

Sea surface temperature, much like the atmosphere's temperature, is constantly changing. The interaction between the ocean and the atmosphere is one that scientists are constantly researching, especially in light of climate change.

Water warms up and cools down at a slower rate than air, so diurnal variations (heating during the day and cooling during the night) seen in the atmosphere are hard to observe in the ocean. The seasons, however, can be seen as the warmest water near the equator expands toward the United States during the summer months and withdraws again during the winter months.

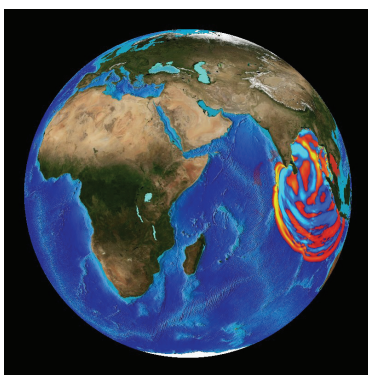
Sea surface temperature data is available in three different formats. The first is available daily from April 13, 2005 through October 31, 2006. The temperature range for the sea surface temperature is indicated on the color bar in degrees Celsius below. 0° is equivalent to 32°F and 30°C is equivalent to 86°F.



### Sea Surface Currents and Temperature with Veg Land

The water in the ocean is constantly moving. Ocean currents are typically driven by surface wind and can have a huge impact on climate. Northwest Europe is moderately temperate considering its latitude because the Gulf Stream off of the eastern coast of the United States transports warm water north to those areas. In fact, the Atlantic Ocean along the U.S. coast is much warmer than the Pacific Ocean along the U.S. coast because of the warm water transported in the Gulf Stream. In this visualization, a model created by NASA, the color variations denote speed. The lighter green areas are moving faster than the blue areas.

Along most of the coasts, where the water faces an obstacle, the water's velocity increases and eddies form. Eddies (small whirlpools) are most readily seen in streams, where they form behind rocks as the water flows around them. The eddies in the ocean follow the same principle, but are so large that they are hard to detect. Eddies can also spin off at the edges of currents as they travel through the oceans. An almost constant string of eddies is visible off of the northern coast of South America as an equatorial current from Africa crashes into South America. Eddies are also visible off of many islands around the world.



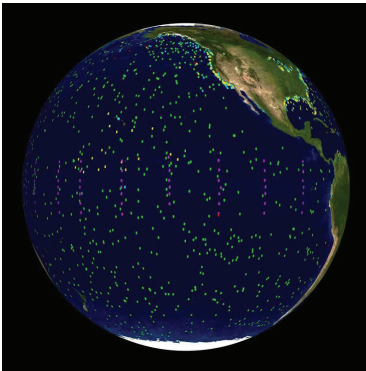
### Indian Ocean Tsunami (new)

This dataset is a model put together by the Pacific Marine Environmental Laboratory that simulates the waves of the December 26, 2004 tsunami the first thirty-six hours after it occurred.

A tsunami is a series of waves generated when a body of water, such as an ocean, is rapidly displaced on a massive scale. Historically tsunamis have been referred to as tidal waves, but that name is discouraged by oceanographers because tides have little effect on tsunamis. The color ranges from light blue for troughs 50cm below sea level and yellow for ridges 50cm above sea level. A color bar is included for this version.

The infamous Sumatra Tsunami on December 26, 2004 was the result of a massive earthquake that occurred when the India tectonic plate subducted beneath the Burma plate, causing an earthquake with a magnitude of at least 9.0 on the Richter scale which displaced a huge amount of water. Out in the depths of the ocean, the wave heights do not increase dramatically. But as the waves travel inland, the depth of the ocean gets shallower causing the waves to build up. Waves with heights of 35.5 feet were reported during the Sumatra Tsunami. The speed of the waves depends on the ocean depth rather than the distance from the source of the wave. The waves travel faster over deep waters and slower over shallow waters as they build up. This allowed the Sumatra Tsunami to propagate worldwide in just one day.

An estimated 230,000 people were killed as a result of the tsunami, 168,000 in Indonesia alone. One reason for the widespread devastation was the lack of a warning system. Previously thought unnecessary in the Indian Ocean because the last major tsunami was in 1883, efforts are underway by the NOAA Center for Tsunami Research to make a worldwide tsunami detection system a reality.



#### Worldwide Buoy Locations

Buoys with the ability to collect data are scattered throughout the world's oceans in order to gain a better understanding of how the oceans work and how they are changing. The data is being used for monitoring chemical levels in the oceans, garnering accurate ocean temperatures and change in temperature, and many other endless uses. Each dot on this visualization represents a buoy, and each color indicates the use of the buoy. The buoy network is still expanding past what can be seen on this visualization.

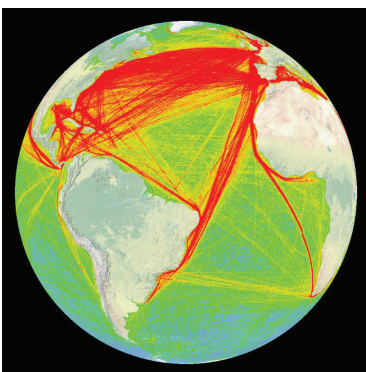
The green colored dots are buoys in the Argo network. By the end of 2006, 3000 Argo buoys were scheduled to be located worldwide. These are deep-

water buoys that record continuous data from over 6500ft below sea level up to the surface.

The yellow and blue dots are maintained by NOAA. These include both traditional buoys, but also C-MAN (Coastal-Marine Automated Network) stations. Most of the buoys are located off of the shores of the United States and provide data for the NOAA Marine Environmental Buoy Database. The C-MAN stations are located on piers, offshore towers, lighthouses, and beaches. These buoys and stations record parameters such as wind speed and direction, wave height, pressure, air temperature, and sea surface temperature. The Mission Aransas National Estuarine Research Reserve has data collection buoys, there is a replica of a buoy in our exhibit room, you can use the touch screen to access the data that is currently being collected from our buoys. You can also access the data from our buoys as well as the entire System Wide Monitoring System online at [nerrsdata.org](http://nerrsdata.org) if you'd like to see water quality parameters from all over the coastal US.

The red dots are buoys in the Deep Ocean Assessment and Reporting of Tsunamis (DART) Project, which is an ongoing effort to maintain and improve the capability for the early detection and real-time reporting of tsunamis in the open ocean.

Finally, the purple dots are buoys used in the Tropical Atmosphere Ocean, TAO/TRITON, project. This project is dedicated to El Nino and La Nina. Notice that the buoys are arranged in parallel lines in the ocean where this phenomenon tends to occur.

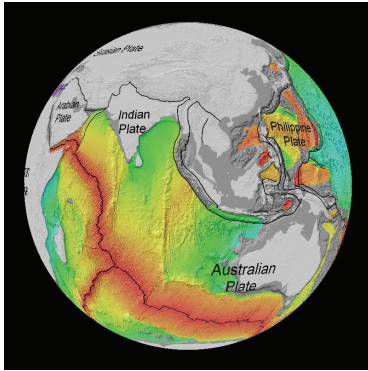


#### Shipping Routes with Labels Oct. 2004 - Oct. 2005

There were more than 30,000 merchant ships greater than 1000 gross tonnage at sea in 2005. The World Meteorological Organization has a Voluntary Observing Ships Scheme that equips ships with weather instruments in order to provide observations for weather models and forecasters. In addition to observing the weather, the location of the ships is also recorded through GPS. From October 2004 through October of 2005 1,189,127 mobile ship data points were collected from 3,374 commercial and research vessels, which is about 11% of all ships at sea in 2005. By connecting the data points for each vessel, shipping routes over the course of one year were plotted. The National Center for Ecological Analysis and Synthesis compiled this data to include in their

Global Map of Human Impacts to Marine Ecosystems.

Previously Used Datasets:

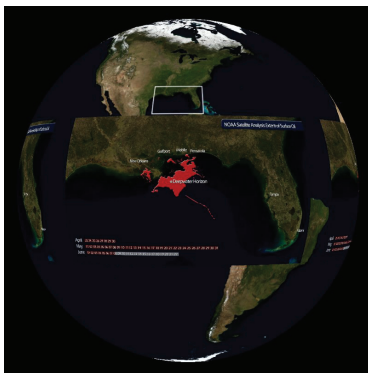


### Age of the Sea Floor

The surface of the Earth is composed of a mosaic tectonic plates moving with respect to each other. The Earth is made of seven major plates and several smaller plates. As the plates move, new sea floor can be created. The plates form three different kinds of boundaries: convergent, divergent, and transform. Convergent boundaries are also called collision boundaries because they are areas where two plates collide. At transform boundaries, the plates slide and grind past one another. The divergent boundaries are the areas where plates are moving apart from one another. Where plates move apart, new crustal material is formed from molten magma from below the Earth's surface. Because of this, the youngest sea floor can be found along divergent boundaries, such

as the Mid-Atlantic Ocean Ridge. The spreading, however, is generally not uniform causing linear features perpendicular to the divergent boundaries.

This dataset shows the age of the ocean floor along with the labeled tectonic plates and boundaries.



### Deepwater Horizon Oil Spill

Oil started gushing into the Gulf of Mexico after the BP Deepwater Horizon caught fire on April 20th, 2010, exploded, and sank. The leaking well was finally capped on July 15, 2010. The subsequent oil loss threatens the health of the Gulf and coastal ecosystems in the region. Starting April 23rd, NOAA's Satellite Analysis Branch used data from a variety of high resolution visible and synthetic aperture radar satellites from NOAA's partners in Earth observations to document the extent of the surface oil.

This animation used a picture in picture (pip) on SOS, shows the daily change in the satellite analysis of surface oil extents. The background map highlights the area of detail shown in the pip. It should be noted that the observed extents

may in some cases not reflect the actual extents due to the difficulty in identifying oil slicks from space. For instance, medium resolution visible images are taken using sunglint data, whereby the sun's angle creates a glare off the surface of the ocean. If the glare is not wide enough, not all of the plume will be seen. Oil-like sheens from algal blooms also complicate the matter. Very high resolution visible and synthetic aperture radar satellites also have very narrow swath coverage, so a large plume or patches of oil may extend past the bounds of the sensor's detection area. For all of these reasons, the analysts at NOAA's Satellite Analysis Branch must use all of the data available to generate a composite over a 24 hour period. Some days, not enough data was available to generate an accurate extent estimate, so those dates are missing from this time series. In addition, these extents show only the surface oil, not the subsurface plumes. This dataset is runs through August 2, two weeks after the leaking well capped.

It's important to think about how the animals and plants of the estuaries in the affected areas were influenced. Booms and other oil absorbing techniques were used to try and prevent oil from reaching estuaries however some damage could not be prevented. Using disasters like this to learn about better ways to prevent and deal with the damages can be as important as learning about the way the ecosystem functions.

