El Niño's Powerful Reach

Educational Activities

Science Behind the Story

Summary: Participants learn how El Niño data is collected

Grade level:
Intermediate (grades 5-8)
Secondary (grades 9-12)

Time needed:
30 minutes

Learning Objectives:
- Understand how technology is used to acquire scientific knowledge
- Understand how technology and science can be used to aid society
- Understand technological design

Materials:
- Computer with internet connection

Background

The scientific community was not aware of the last big ENSO (El Niño Southern Oscillation) event in 1982 until it was well underway. The next ENSO was forecast January 1997 so scientists were able to watch it develop from a far earlier stage than has been previously possible. Because El Niño causes such a wide variety of events, many types of remote sensing equipment are used to monitor weather conditions to issue warnings. There are several remotely sensed parameters that are used to monitor an ENSO event.

•**Ocean Surface Winds:** These are measured by a scatterometer. Microwave radiation from the satellite returns a weak signal from a rough (windy) ocean surface, but it returns a strong signal from a smooth surface (not so windy).

•**Radiation:** A radiometer measures radiation reflected from Earth's surface. Strong winds with white caps on the ocean reflect back more radiation than do calmer conditions.

•**Cloud Systems and Rainfall Amounts:** These are monitored by Polar orbiters (NOAA) and geostationary (GOES) satellites. Visual and infrared channels on these satellites allow type, coverage, and thickness of clouds to be determined. Microwave radiation from the satellites will not sense clouds, but will identify larger raindrops, which allow rainfall amounts to be estimated.

•**Sea Surface Height:** The height of the ocean is measured by radar altimeters on the TOPEX/POSEIDON satellite and on the European Remote sensing Satellite (ERS-1). Heights greater than normal in areas such as coastal Peru indicate decreased upwelling.

•**Sea Surface Temperatures:** Temperature of the ocean is measured by the Advanced Very High Resolution Radiometer (AVHRR) on NOAA polar orbiters. They determine temperatures by sensing infrared radiation coming from the sea surface. Current temperatures are updated for 4-day periods.

•**Phytoplankton Productivity:** This is measured by the Coastal Zone Color Scanner (CZCS) on the Nimbus 7 satellite. Areas of productivity change during ENSO events.

Several NASA missions study the effects of El Niño and La Niña with orbiting satellites. The joint U.S.-French TOPEX/Poseidon satellite measures sea surface height; the Sea- Viewing Wide Field-of-View Sensor (SeaWiFS) measures ocean color; and TRMM measures precipitation and sea-surface temperature. The Tropical Atmosphere-Ocean Array consists of nearly 70 moored buoys in the tropical Pacific designed by the National Oceanic and Atmospheric Administration (NOAA). The devices take real-time measurements of air temperature, relative humidity, surface winds, sea surface temperatures, and subsurface temperatures down to a depth of 500 meters. Data from these moored buoys are processed by NOAA and then made available to scientists. TMI is an all-weather measuring instrument that can see through clouds," said Dr. David Adamec, oceanographer at the Goddard Space Flight Center, Greenbelt, MD (http://www.nasa.gov/centers/goddard/home/index.html). "The standard instrument (infrared radiometer), used to measure sea-surface temperature, must contend with clouds and atmospheric aerosols. Clouds block the flow of data, yet an uninterrupted consistent data stream is crucial for long-term climate study." http://eospso.gsfc.nasa.gov/eos_observ/7_8_98/p32.html

A. Match the instrument with the ocean characteristic it is monitoring.

A. Clouds/Rainfall amounts	A. Advanced Very High Resolution Radiometer (AVHRR)
B. Plankton productivity	B.Coastal Zone Color Scanner (CXCS) on Nimbus 7 satellite
C. Sea Height	C. GOES satellites
D. Sea Temperatures	D. Scatterometer (radiometer)

The interaction between the atmosphere and the ocean creates global wind belts and ocean currents that help redistribute energy as a result of the uneven heating of the equatorial air and water. A change in the equatorial sea temperatures causes a global chain of events that begin off the coast of Peru.

B. Write a one page summary explaining the importance and benefits that are gained from monitoring sea conditions.

C. Invent your own scientific instrument. Write a fictional story whose main character is a scientist researching the earth's weather or climate. The scientist must (1) try to answer or explore a particular question about the earth by (2) inventing and using a new scientific instrument. To enhance your story, create a picture or model of your new instrument.