Oceanography As Viewed From Space Essay, Research Paper

Oceanography as Viewed from Space

Introduction

At first thought, studying the oceans from space seems to be a bizarre idea. Space observation helps oceanographers do research with manned and unmanned space systems. The space systems can be satellites and/or space shuttles that observe various features of the ocean such as sea-surface winds, sea-surface temperatures, waves, ocean currents, frontal regions, and sea color. Technological advances have greatly improved the ability of oceanographers to gather and use information that is received. Oceanography as viewed from space has and will become more and more valuable as we begin to understand more of the world’s oceans.

Projects

Space oceanography uses a number of different sciences to research the oceans that include physics, geology, biology, chemistry, and engineering (Cracknell 13). This is evident in the projects that send satellites into space for observation of our oceans. In 1992, the Topex/Poseidon project was launched to observe the interaction between the ocean and the atmosphere (Cracknell 17). The Topex/Poseidon mission is to gather information about sea level heights and ocean currents (Cracknell 17). The Topex/Poseidon orbits above the earth at 840 miles and has a 10-day repeating cycle in which it takes pictures of all of the earth (Cracknell 17). Information about the how the sea level changes can tell scientists that there are changes in ocean currents and in climate patterns (Cracknell 25). This information is valuable to both oceanographers and meteorologists because it gives information about the phenomena, El Nino. Figure 1 is a picture of how the Topex/Poseidon works.

Figure 1(NASA)

The Topex/Poseidon receives information as to what it is supposed to do from a beacon on earth. The satellite then gathers the information it is supposed to gather and then sends it to the beacon on earth. The beacon on earth processes this information so that scientists can use it. As the Topex/Poseidon nears the end of observation new developments are being made to continue with similar work. Jason 1 is an observation satellite that will look at extending research about the interaction of oceans with the atmosphere, improving predictions about the climate, continue to monitor El Nino, and observe ocean eddies (Cracknell 26). These satellites are leading the way to a better understanding of our oceans as well as weather on planet earth.

History

Observations of oceanographic features with pictures were first realized with the invention of the camera (Pinet 181). Soon after the invention of the Camera, hot air balloons were used to take high altitude pictures of the land and sea, for mapping purposes (Pinet 181). In World War II, pilots took pictures of large areas of land that were used to develop strategies in the war (Pinet 181). At the beginning of the space age, just after World War II, rockets (although never in orbit) used movie cameras to photograph the surface (Pinet 182). The first manned shuttles took pictures of Earth and realized there were many observations of the oceans to be made (Pinet 182). Soon remote sensing came into action as satellites were sent into orbit (Pinet 182).

Process of Remote Sensing

Remote Sensing involves two types of instruments, passive and active (Gautier 58). Passive instruments detect natural energy that is reflected or emitted from the Sun (Gautier 59). Scientists use a variety of passive remote sensors such as a radiometer, imaging radiometer, and spectrometer. A radiometer measures the intensity of electromagnetic radiation in a band of wavelengths in the spectrum (Gautier 59). The spectrum is a measure of the visible, infrared (heat), and microwaves emitted from the Earth (Gautier 60). An imaging radiometer has the capability to scan an area and provide pixels of an area giving more detailed images of the surface than a radiometer (Gautier 60). A spectrometer detects, measures, and analyzes the wavelengths of the spectrum using prisms to separate the colors (Gautier 61).

Active instruments provide electromagnetic radiation to observe an object (Gautier 69). Satellites that use active instruments send a pulse of energy towards the object being observed, then wait for the energy to be reflected (Gautier 69). This energy is then picked up as weaker or stronger in areas, which can define what features the satellite is looking at (Gautier 70). Some active instruments are radar, scatterometer, and lidar (Gautier 71). Radar uses radio or microwaves to emit electromagnetic radiation upon an object and record the time between when the energy leaves and comes back (Gautier71). A scatterometer uses microwaves the same way as radar, but it can measure wind speed and direction (Gautier71). Lidar uses lasers to transmit a light source on the object being observed, they can calculate a number of elements in the atmosphere (Gautier 71). With all of this scientists are able to determine the heights of the oceans, able to predict weather patterns and the effects on the ocean.

Future

Unmanned space systems are the most cost-effective way to observe the planet (Victorov 109). The human eye however, has the best ability to observe the earth in a visual perspective (Victorov 110). Humans in space play a valuable role in the observation of oceans (Victorov 111). In the future people will be permanently stationed in space stations to observe and research the earth (Victorov 111).

How the satellites work

Satellites that observe the surface of the earth rotate at the same speed as the earth, this enables them to take pictures from pole to pole (Victorov 123). Figure 2 is a diagram of a Geostationary Operational Environmental Satellite (GOES).

Figure 2(NASA)

A “GOES” satellite rotates above the earth at 22,000 miles. The camera on the satellite sends photographs back to earth through its antenna (Robinson 34). Solar panels use the sun to produce energy, and the solar sail and trim tab keep the satellite from spinning out of orbit when the solar wind hits the satellite (Robinson 34).

Ocean color can indicate a number of things to an oceanographer, such as amount of plankton, and amount of vegetation (Gautier 117). The color of the ocean changes slightly, from a bright blue to a dark blue or black (Robinson 118). These changes in color happen when plankton float freely and concentrate in areas (Robinson 119). These concentrations are called blooms and are shown off the coast of Angola in Figure 3.

Figure 3

The ocean color can also turn into a blue-green because of the presence of large amounts of vegetation (Robinson 124). Together, these colors can indicate to scientists the productivity of the oceans and potential for greater amounts to wildlife (Robinson 125). Figure 4 is a false color image that shows the amount of plankton in the ocean.

Figure 4

The microscopic plankton are the basis of the marine food web, without plankton all marine life would suffer. Thus, the importance of the information from the false color images of plankton on the earth becomes more valuable.

Conclusion

Oceanography is a new science that will unleash a lot of new information to us on how planet earth works. Oceanography from space will be a tool for find out more about our oceans, but there are limited things it can do. It is expected that few major developments in oceanography will occur with satellites. The development of satellite oceanography will bring together ideas from all sciences to an overall understanding about oceans and earth as a whole.