AN OCEAN IN YOUR COMPUTER

4.1 MAPPING THE INVISIBLE: INTRODUCTION TO SATELLITE OCEANOGRAPHY

VIDEO DURATION– 04:59

Satellites, and their unique view from space, from several hundred kilometres above the Earth, are helping to unveil our vast and largely unexplored oceans. This area of research is known as **Satellite Oceanography**.

Professor Meric Srokosz and Dr Fatma Jebri are two researchers at the National Oceanography Centre in the UK, who study ocean physics and biology using data measured from instruments flown on satellites in space.

They will take you through three lectures in which you will learn how satellite oceanography contributes to the understanding of ocean dynamics. In these lectures they will explain a variety of measurement techniques, and examples given of their application to oceanographic studies.

By remotely sensing from their orbits high above the Earth, satellites allow us to collect observations of the ocean 24-hours a day and 7-days a week. Remaining in orbit for several years, with one satellite succeeding another, they can provide long-term observations of physical and biological ocean variables.

The variables measured include ocean colour, sea surface temperature, sea surface salinity, sea surface height and ocean currents.

This unique perspective is made possible as everything around us absorbs, emits and reflects "Electromagnetic radiation" differently, based on its composition. By measuring the emitted or reflected radiation it is possible to infer properties of the ocean.

Electromagnetic radiation is not just what we can see, it consists of many different types – Radio waves, Microwaves, Infra-Red radiation, Visible light, Ultraviolet light, X-Rays and Gamma Rays – together, they make up the *Electromagnetic Spectrum*.

Visible light, which we see with our eyes, includes the Blue, Green and Red portions of the spectrum. From this part of the spectrum we can retrieve ocean colour, which is measured from the reflectance of the ocean in the visible wavelength range.

From ocean colour, we can estimate chlorophyll-a, the plant pigment in ocean algae (known as phytoplankton). This is because its presence changes the ocean colour from blue to green, and this can be detected from satellites. This means that ocean phytoplankton can be spotted from space.

An example is the phytoplankton blooms of the Mediterranean Sea, which expand in spring and disappear soon afterwards, just as plants in a garden bloom, and then die.

Though the rest of the spectrum is invisible to the human eye, instruments can detect Infra-Red and Microwave radiation emitted from the sea surface. From such emissions we can estimate the Sea Surface Temperature.

The Sea Surface Temperature reveals the thermal signature of the major ocean currents and information about how much heat is stored in the ocean.

Different wavelengths of microwaves are grouped into bands that provide different information about the ocean. For example, L-band microwave measurements reveal the variability of Sea Surface Salinity. We estimate salinity by measuring the L-band "brightness temperature" of seawater and use a well-established formula to calculate salt concentration.

Thus, we can remotely sense how the world's largest river impacts the ocean salinity in the Atlantic and see the Amazon plume with its large-scale pulsing.

The measurement techniques we described are known as passive remote sensing, as they detect electromagnetic radiation emitted or reflected (such as sunlight) from the ocean. There are also active techniques, where the instrument sends out pulses of radiation and detects the return signal reflected from the ocean.

One such technique, radar altimetry, typically uses Ku-band microwave radiation to obtain information on sea surface height.

From sea surface height we can derive ocean surface currents using geostrophy, which is a balance between the pressure gradient and the Earth's rotation.

The large-scale fast surface currents transfer warm waters across thousands of kilometres from the tropics to the polar regions (like the Agulhas in the Southern Hemisphere or the Gulf Stream in the Northern Hemisphere), influencing local and global climate.

In this introduction to the Satellite Oceanography module, we have given a general overview of the remotely sensed variables most commonly exploited to study the ocean. More focus on the basic measurements and how they are analysed to study oceanic features will be presented within the next two lectures on: Ocean Colour, and Sea Surface Height and Ocean currents.