

Big Data in Oceanography

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ABSTRACT

This paper will give an overview of how big data is used to collect and process data about our oceans in better ways to understand it and how to solve complex issues surrounding it.

KEYWORDS

ACM proceedings, L^AT_EX, text tagging

1 INTRODUCTION

Ever since man as first seen the ocean, it has always had an air of mystery to it. Even now in the age of information, we still barely know anything about it. This paper is to give an overview of how and with what we are collecting the data and the problems we face in that collection of data. In the hope that we can start to uncover the mysteries that hide below the surface. To collect this data there is a use of many different sensors. [1]

- Acoustic Doppler Current Profiler

This tool measures the speed and direction of ocean currents using the principle of Doppler shift. Measuring currents is a fundamental practice of physical oceanographers.

- Technologies for Ocean Acoustic Monitoring

This technology listens to the ocean for all sounds, boats, sea animals, waves, seismic activity.

- The Bushmaster and the Chimney-master

A collection net used to grab tube worms or living fauna near geothermal vents. These tools are typically attached to a submersible vessel.

- Clod Cards

These plaster cards track the motion of water for benthic organisms. The organisms that inhabit the bottom of the ocean. allowing us to learn more about the harder to reach parts of the ocean.

- Drifters

Drifters, are essentially devices that flow with the current of the ocean. Allowing for them to be mapped and visualized.

- Mapping: Geographic Information Systems

Essentially the creation of 3D modeling within a computer environment of the ocean.

- Satellites

Can detect and observe the ocean characteristics.

- Semipermeable Membrane Devices

Used to collect various microbes for analysis of bacteria environment.

- Sonar

Uses sound to detect area around a submersible, and well as figure out water depth.

- Sonde and CTD

Collect data on a multitude of things, primarily temperature at different depths and conductivity of the water.

. These sensors and technologies are what help make the data we can use to analyze and help predict our oceans health and patterns. All of these tools collect different data, from the directions of currents, temperatures, bacteria, as well as mapping data. With all of this information, it is now becoming a challenge to ask the right questions of it. That is the main issue in the field right now is about asking the right questions. With the oceans being the least explored and mysterious place on earth we are very unsure how the system works as a whole and the cause and effect major events have on it.

2 PROBLEMS THE OCEAN FACES

. The ocean, is a big and complex ecosystem, not only that, but is rather sensitive to change. Given humanity's treatment of the ocean and its inhabitant, it has taken quite a few damaging blows to say the least. As of now there are multiple threats to the ocean. There is the climbing temperatures, which effect the coral reefs and ocean level. The ever present amount of plastic in the ocean. From large vortex patches in the middle of the oceans that are miles wide, to the small micro plastics fish are eating, and intern are being eaten by us. Not to mention the catastrophic effects of the multiple oil spills, and bleaching incidents that are destroying the coral reef habitats. Which coral reefs have two fold purpose, one is the habitat, the second is the reef itself which helps remove a lot of carbon dioxide from the atmosphere. These are the most pressing issues as of right now but there are many more. With the use of big data and collection through the sensor above we can start learning how to take action and where.

2.1 Collection Efforts

. As of right now the collection of data is not a collective effort globally. [2] However there are many organizations that are doing their best to collect and analyze the data. One of these organizations is The National Oceanic and Atmospheric Association. Which is collecting massive amounts of off coastal based laboratories. The use of data is to help get an unbiased amount of data to help predict the health of the ocean and its effect on climate change and rising sea levels. That way it can help coastal cities and states, plan for the future within the next couple decades.

. Even with organizations like this around the globe, there is still not enough data to truly predict and know the health of our oceans. It will take a global effort and many more sensors, and a lot more interest from the public. This will help with funding

for the scientist and the tools that will need to be developed and maintained for future exploration.

. With enough data we could finally see how our planets oceans work. It could help choose the best route for boats, based off currents. It could help prevent major disasters by helping cities, states, countries be prepared for hurricanes weeks in advanced. It would allow us to see how events in different parts of the globe would have an effect elsewhere.

3 THE DATA

. As with any situation where massive amounts of data are involved, things can get bit complicated. In the case of ocean data, you have data from multiple sources. Ranging from satellites, to buoys, to bacterial analysis. Not only that but the complexity with all of this data is that the ocean is one of the most dynamic things on earth. Unlike things on land, though always moving, are usually predictable. The ocean does not give any such luxury as it is all connected and always in motion. Given this fact, it is hard to collect data for the ocean as a whole. At least for right now. However, it is possible to get fairly reliable data for a set area.

3.1 Integration

. Making sense of all this data is the main issue that most scientist face. So integration is a primary concern. When modeling the data especially there is a lot of work to make the data come together and makes sense. In one case for modeling salinity of different parts of coastal regions, they match up GPS data points and observations and time with the data from the sensors that collect it. The matching of all this information allows you to integrate the data together for correct mapping of a given location. [3] This is just a small example of the amount of effort to pull all the data together to produce visualization of those results

4 SOLUTIONS

. Though the efforts have not come together globally as of yet, plans to make that happen are in motion. Just this June, the United Nations met for a week long discussion on how to make our oceans healthier with emphasis on global cooperation. [4] Unlike the pairs agreements for global warming, this meeting will not come to a signed contract, rather an understanding that be every country will to be accountable for some part of the oceans health. And encourage international cooperation to help solve our biggest issues.

4.1 Hopeful Future

. At this point there is no clear cut solution to solve all issues that face our oceans. And we may never collect all the data that we need to make the most informed decision. However with the data collected thus far is clear that we need to do. And though we do not have it all the answers, we have enough data to start asking the important questions to set us on the right track.

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