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MEASUREMENT AND COMPUTATION OF SEA LEVEL DEPTH FOR THE EVALUATION OF THE EFFECT OF GLOBAL WATER RISING

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Abstract: The contouring technique was utilized in this research using the topo map of the study area. The contour values at the different grids were used in obtaining the values of the various water depths. The depth values for the northern and southern Atlantic oceans were obtained using the United States NCEI GIS for five different locations within the water body. The average value of the locations was used to obtain the general value for the sea depth. From the obtained results, we concluded that through the application of cutting-edge measurement equipment and computational techniques, we may contribute to the global coastal regions' transition to a more sustainable future. We recommended that in light of the unpredictability of sea level depth noted in the research area, we advise stepping up monitoring initiatives to precisely record variations in both space and time. To increase coverage and enhance data resolution, this may entail installing more tidal gauges, satellite missions, or autonomous underwater vehicles (AUVs).
Keywords: Sea Level Rise; Sea Level Measurement; Sea Depth Computation; *etc*.

I. INTRODUCTION

Rising sea levels linked to climate change are becoming a major global problem for ecosystems and coastal people. Sea levels rise as a result of the expansion of seawater brought on by the melting of polar ice caps and glaciers due to rising global temperatures. To assess the effects of global warming and create practical adaptation and mitigation plans, it is imperative to comprehend and precisely measure variations in sea level (NCEI United States 2018). An intricate scientific undertaking, measuring and computing sea level depth requires a multidisciplinary method combining oceanography, geodesy, remote sensing, and data analysis tools. This technique attempts to evaluate variations in sea level throughout time and space, about both long-term trends and short-term fluctuations driven by many elements such as ocean currents, tides, and meteorological conditions (NCEI United States 2018).

In this regard, capturing the subtleties of sea level changes and identifying the fundamental causes of global water availability require precise and trustworthy measurement techniques. Conventional techniques, such as tidal gauge measurements, offer useful localized data, but they might not have the temporal precision or spatial coverage to fully capture global patterns. On the other hand, satellite altimetry has become a potent instrument for tracking worldwide variations in sea level, providing accurate observations with wide spatial coverage and reliable temporal sampling (NCEI United States 2018). In addition, new developments in data processing methods and technology have made it easier to combine many data sources—such as numerical models, in-situ measurements, and satellite observations—to increase the precision and dependability of sea level assessments. These integrated methodologies help scientists better comprehend the complex interactions causing global water rising by allowing them to consider various factors impacting sea level variability, including land subsidence, glacial isostatic adjustment, and ocean circulation patterns (Robert 2023).

Accurate sea level depth measurements and reliable computational techniques for data analysis and interpretation are essential for assessing the impact of global water. Quantitating long-term trends, spotting patterns of variability, and estimating future sea level scenarios under various climate change scenarios all depend heavily on statistical techniques, time series analysis, and modeling frameworks. Furthermore, the evaluation of sea level depth informs coastal management strategies, urban development, and governance in addition to scientific studies (Robert 2023). Precise estimations of sea level are crucial for evaluating the susceptibility of coastal communities, infrastructure, and ecosystems to flooding, erosion, and saline intrusion. Additionally, adaptive measures to reduce hazards and augment resilience against the backdrop of increasing sea levels must be devised. An essential component of comprehending and mitigating the effects of global water is the measurement and computation of sea level depth. Scientists can improve our understanding of sea level dynamics, help with well-informed decision-making, and aid in the creation of long-term solutions for coastal adaptation and climate change mitigation by utilizing cutting-edge techniques and interdisciplinary approaches (Robert 2023).

Sea level rise brought on by climate change poses a serious threat to coastal ecosystems and societies around the world. Evaluating the magnitude and significance of this phenomenon requires precise measurement and computation of sea level depth. The accuracy, dependability, and scalability of current measuring and computing techniques may be inadequate, making it more difficult for us to accurately estimate the rate of sea level rise and its effects. The accuracy with which sea level increases at different spatial and temporal scales may be captured by current measurement techniques, such as satellite altimetry and tidal gauges, which may be limited (Robert 2023). Improved techniques that provide greater accuracy and precision are required to identify even minute variations in sea level depth. The integration of data from many sources, such as satellites, tide gauges, and oceanic models, presents difficulties in synthesis, quality control, and data compatibility. To examine these heterogeneous datasets and obtain a significant understanding of trends and fluctuations in sea level, efficient computational methods are required. High spatial and temporal resolution data are needed to evaluate the effects of sea level rise on local and regional areas. However, in remote or poorly monitored places, traditional methods of measurement and computation may not be able to offer detailed enough information (Robert 2023).

Robust decision-making and risk assessment depend on precisely measuring the uncertainties related to sea level measurements and computations. However, several causes of uncertainty, such as measurement mistakes, gaps in the data, and model limitations, may not be sufficiently taken into account by the present methodologies. It takes a lot of money and manpower to deploy and maintain measurement infrastructure, such as satellite missions and tidal gauges. To optimize sea-level observation networks' coverage and efficacy, resource allocation and monitoring effort prioritization are crucial. It will take an interdisciplinary effort by scientists, engineers, policymakers, and stakeholders to address these issues. Through the advancement of sophisticated measurement methods, computational frameworks, and data analysis approaches, we can improve our comprehension of the dynamics of sea level rise worldwide and lessen the negative effects of rising sea levels on ecosystems and coastal communities. However, globally, it is estimated that about 60% of the population is dwelling in the coastal environments (Prasad and Kumar, 2014; Okolotu and Oluka, 2021).

II Sea Level

Sea level rise has contributed to wetland loss (including agricultural lands) in the past, presently, and estimably in the future years. The past, present, and future sea level advancement and its impact on the availability of agricultural and wetlands are presented in Figure (1) below. Firstly, only marsh vegetation and sea (low sea level) existed about 5000 years ago. Secondly, marsh vegetation and sea (high sea level) exist with buildings which they advance towards upwardly today. Thirdly, no marsh vegetation and sea (higher sea level) exist at the doorstep of the building protected with a bulkhead in future years. These environmental changes/effects prior time in response to the rise in sea level can be seen in Figure (1) below;

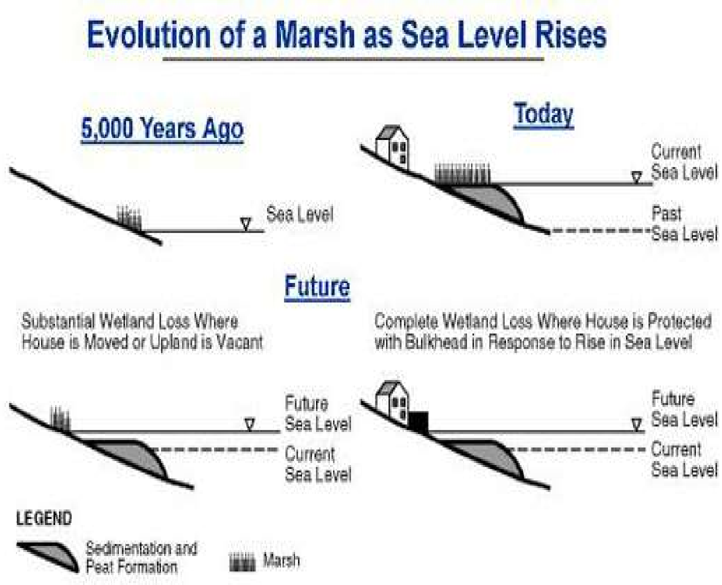
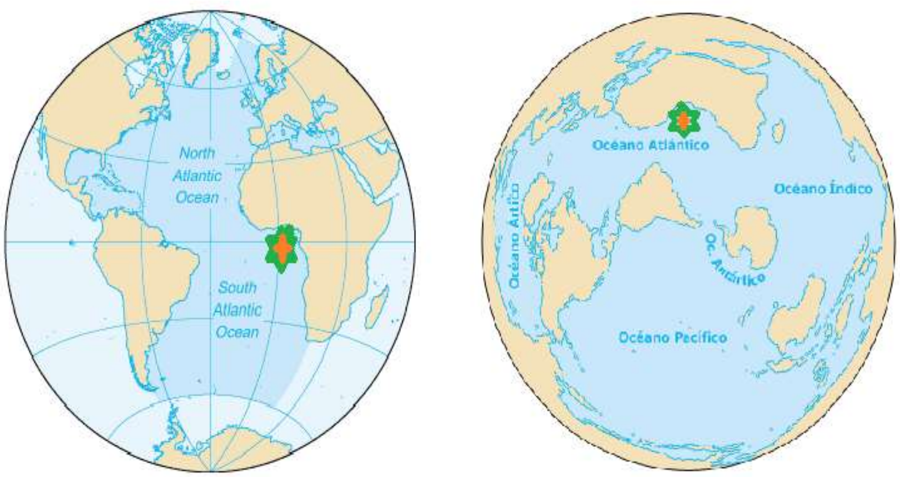


Figure 1: Effect of sea level rise on Wetlands (Titus J.G., 1991).

Cause and Effects of Sea Level Rise: Coastal countries are highly prone to sea level rise, which leads to salt-water intrusion and increased salinity levels in agricultural land (NIBR, 2017). A major cause of sea level rise is the global climate change. Climate change affects agriculture in several ways, including through changes in average temperatures, rainfall, and climate extremes (e.g., heat waves); changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level (Hoffmann, 2013). Sea level rise contributes to aquatic body encroachment on agricultural land especially in flat regions. This reduces the availability of land usable for agricultural activities and other purposes. Sea level rise affects agriculture crops in two major ways: saltwater intrusion and loss of coastal land due to inundation (GOK, 2017).

II. MATERIALS

The main material used in the course of this research is the study area: the Atlantic Ocean. Mullen (2023) and Udom *et al.* (2023) noted that 99.7 percent of global water is in the oceans, soils, icecaps, and floating in the atmosphere. Okolotu *et al.* (2023) noted that precipitation is a major source of natural water bodies. The ocean is a notable natural reservoir. Natural reservoirs include Oceans, glaciers and ice sheets, groundwater, lakes, soil moisture, wetlands, living organisms, the atmosphere, and rivers (encyclopedia, 2023; Akwenuke *et al*., 2023) The location of the Atlantic Ocean can be seen in Figure (2) below;



I. Atlantic Ocean (Brooks, 2023) II. General Ocean Map (Serg!o, 2010)

Figure 2: Global Ocean Maps Showing Northern And Southern Atlantic Ocean, And General Global Oceans On Earth

Other materials include United States NCEI GIS, Contour map: Bathymetric contour of Atlantic Ocean; Ocean contour map; *etc*.

These contour values can be seen in the maps below;

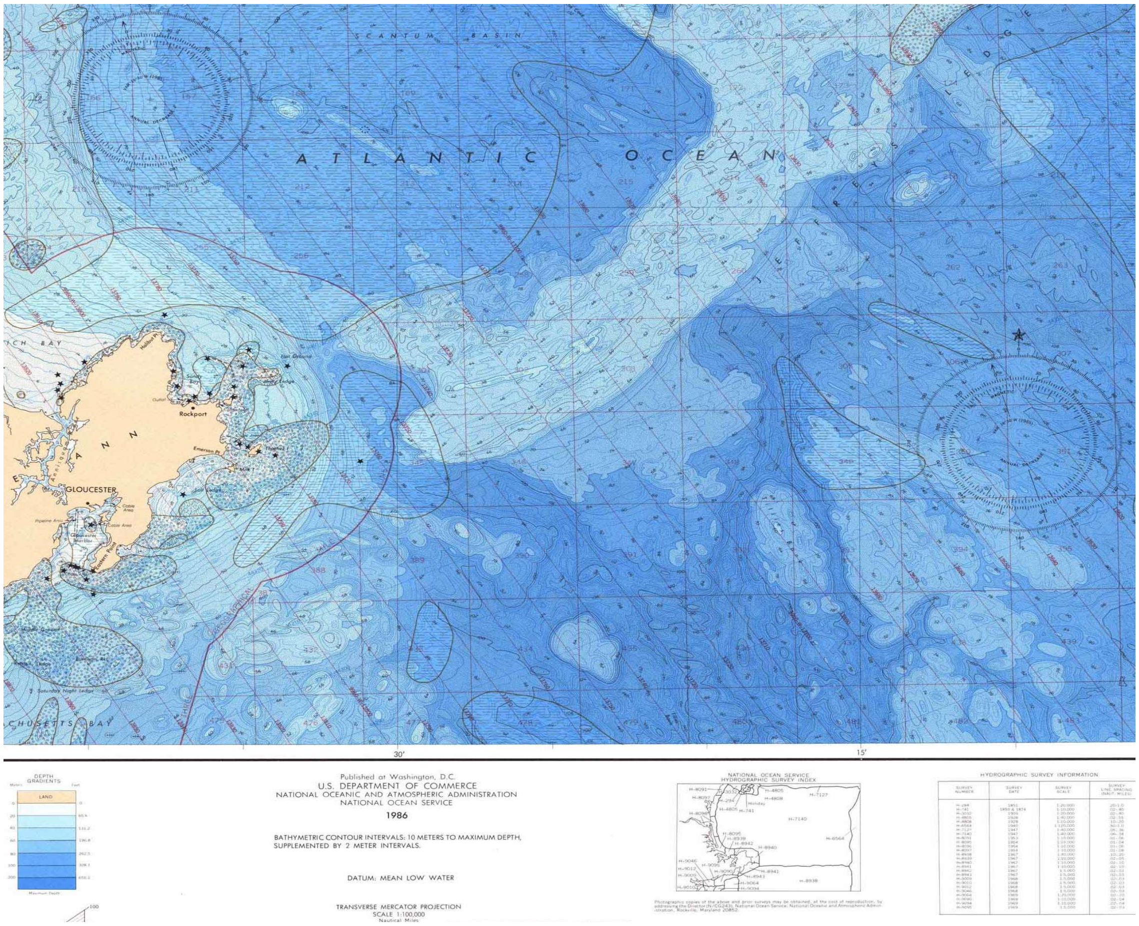


Figure 3: Bathymetric contour of the Atlantic Ocean (NOS, 1986).

III. METHODS

The contouring technique was utilized in this research using the topo map of the study area. Thus, the contour values at the different grids were used in obtaining the values of the various water depths. The depth values for the northern and southern Atlantic oceans were obtained using the United States NCEI GIS for five different locations within the water body. Averaging the values of each single location was used to obtain the general value for the sea depth.

IV. RESULTS

Sea level depths from the ocean contour map are tabulated below;

Table 1: Computed Sea level depth for selected Ocean regions

SN	Ocean Depth along African Shoreline	Ocean Region
1	6521	Northern Atlantic ocean
2	7598	Northern Atlantic ocean
3	7861	Southern Atlantic ocean
4	6611	Southern Atlantic ocean
5	5272	Mediterranean sea

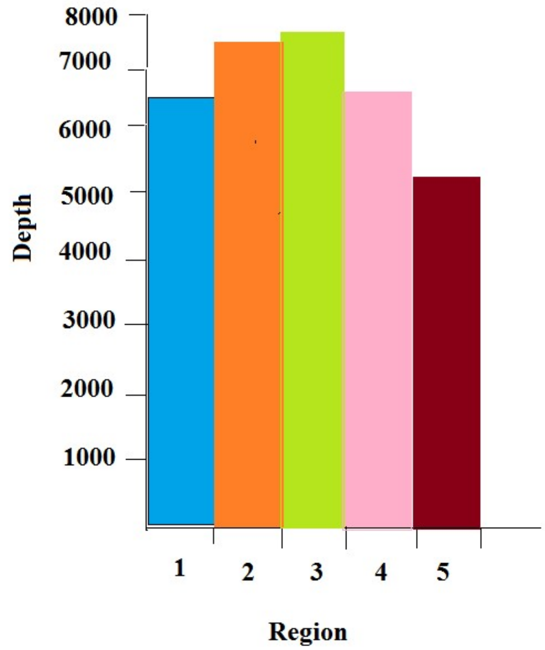


Figure 4: Sea Region Depth

V. DISCUSSION

In obtaining the global sea level value using a contour map or by field measurements, it was observed that it is easier to choose a portion of the sea for data acquisition after which the values can be related to another sea region. This is because obtaining the values for all parts of the seas is difficult, especially with the direct field measurements method since the level of water may vary in various parts of the seas at a particular time due to changes in ocean current movements in the water.

VI. CONCLUSION

In conclusion, determining the depth of the sea level is an essential step in determining how coastal areas will be affected by global sea level rise. Our research has yielded findings that demonstrate the dynamic nature of sea level variations, with the ocean depth in our study region falling between 5272 and 7861. These results highlight how crucial it is to continue monitoring and analyzing data to precisely and accurately track changes in sea level. We can improve our comprehension of sea level dynamics and more accurately predict the difficulties brought on by rising sea levels by utilizing sophisticated measurement methods and computer models. The data also show how complicated and variable sea level patterns may be, highlighting the necessity for all-encompassing strategies to address the many effects of climate change on coastal ecosystems and communities. For stakeholders working to reduce the hazards linked with global water increasing, our findings offer insightful information on everything from adaptation measures to well-informed policies. In the future, more study and cooperation will be necessary to improve our comprehension of the dynamics of sea level rise and create resilient and adaptable plans in the face of continuous environmental change. Through the application of cutting-edge measurement equipment and computational techniques, we may contribute to the global coastal regions' transition to a more sustainable future.

RECOMMENDATIONS

We provide the following recommendations in light of the findings from our measurement and computation of sea level depth, which show that the ocean depth in the research area varies from 5272 to 7861:

i. In light of the unpredictability of sea level depth noted in the research area, we advise stepping up monitoring initiatives to precisely record variations in both space and time. To increase coverage and enhance data resolution, this may entail installing more tidal gauges, satellite missions, or autonomous underwater vehicles (AUVs).

ii. To guarantee the precision and dependability of sea level data, measurement equipment must be routinely validated and calibrated. Standardized procedures for calibration and quality control can be established with the assistance of international organizations, governmental bodies, and other research institutions.

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