Evaluation of Significant Wave Heights in Coastal Zones

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Abstract: Nowadays, the ocean parameter study from the satellite observation became popular. The research has to be concentrated on the satellite images from 1981. Satellite images are useful to infer the nature of physical-chemical parameters. Such efforts lead the scientific community to propound fast predictions. My work enables one to assess the wave height, supposed to be a difficult parameter, as accurate as possible from the images without going for laborious field procedures. It increases the accuracy and automation of prediction of waves, Preparation of atlas because of the easy digitization of wave properties in advance. Altimeter values can be calibrated. It saves time, energy and human error. It saves not only the time of collection but also the huge expenditure warranted. The estimation will be used for recognizing suitable channel for our Navy to navigate particularly nuclear submarine.

Key words: Significant Wave Height • Prediction • Satellite images • Oceanographers

INTRODUCTION

Oceans are major occupants of this planet. A detailed study of their various features and parameters is more complex and a never-ending process. With the recent technology explosion in computing, internet, mobile communications and information technology, interest in the oceans has been rekindled with a need to understand various phenomena, which affect human beings like tsunami on one side and mineral exploration on the other side. This brought in a new interest in research and it got revitalized with easier acquisition, access, storage and processing of various kinds of data related to oceans.

The data collection related to ocean parameters is an expensive, involves greater risk, strain and difficulty. In many occasions, the oceanographers tend to miss continuous observation due to bad weather. However, continuous observation would prove salutary for interpretation and prediction. It is in such a situation the use of electronics comes to the rescue and probability applications in the field of oceanography. In view of this prospect, the researchers have tried to apply electronics to understand the ocean parameters by collection of continuous data irrespective of the weather conditions to the best of their effort.

The field of electronics, measurements, Computer Science and Information Technology have enhanced the knowledge of predictive science more vividly with accuracy for research and development for natural disasters in the phenomena like a tsunami and cyclone. In spite of great advancement in the field of information technology, the scientists still face difficulties in predicting the natural disasters like earthquakes and landslides, the learners and scientists continue to persevere with the hope of predicting in these areas. Hence, it has been chosen to present on one of the above studies. This subject has turned out to be so interesting and important that its part has been successively expanded. The ocean science is currently a hot topic in the research world. Especially evaluating the different techniques used to perform the simulation and getting the optimal solutions for the specific applications like satellite images.

Among the various oceanographic parameters like tide, salinity, temperature and turbidity, the waves and their heights are the most useful parameters but they have not been worked out satisfactorily so far. Because of such lacunae, it is decided to work out the wave heights, with its two distinct components namely wave heights and height added by tides swell. Therefore, the current
research undertakes to study the significance of wave height. The advancement of electronics and Information Technology with Satellite Images, have revealed the predictive science more appropriately and accurately, particularly in the case of cyclone and to a certain extent, Tsunami. Of late, this happened in the advancement of prediction in the various parameters of Science and Technology particularly in the ocean science. This has enabled the scientists to assess many of the ocean parameters from the Satellite Images. The application of altimeter has been coupled with images to assess the elevation of waves. There are few sporadic attempts to assess the Significant Wave Heights. However, no systematic and authentic method of assessment has so far been formulated to include the previous attempt made by OCEANSAT 1 and 2 of our country.

This particular shortcoming induced me to choose the estimation of ocean parameters like Significant Wave Height as a challenge to give perfection. The importance and the need of Significant Wave Height has not been felt prominence ever before the impact of Tsunami 2004 in the Bay of Bengal.

**Objective:** To determine the significant wave height duly extracting and correlating from other ocean parameters obtained from ocean satellite images.

The various inputs extracted from the satellite imagery is compared and validated with the actual waves of data recorded from the study area.

To predict the expected and anticipated potential rise in sea waves [SWH] which would enable the marine community to forecast the future sea weather changes.

**Methodology:**

- The source of Information is obtained by scanning the wave data from the study area.
- Actual data which is collected for 24 hours in coastal area on the day of satellite pass is correlated with the derived data from the satellite imagery.
- Estimation of Significant Wave Height could be determined by taking into consideration the various ocean parameters.
- Comparative study of the significant wave height from the satellite imagery in relation to the actual measurement.
- Predicting the nature of the waves using soft computing techniques.
- Forecasting the significant wave height to another unknown site and to evaluate the error in actual measurement subsequently.
- To work out the various error corrections so as to approach the perfection in assessing the significant heights of the waves.
- Predicted data will be utilized by the local society for the prediction of the significant wave heights to the future periods as well as for the local fishing and the safety of coastal communities.

**Ocean Parameters:** Among the various oceanographic parameters like tide, salinity, temperature, turbidity, etc., Waves and their heights are found to be the parameters which have not been worked out satisfactorily. So by applying in the current research, Significant Wave Height can be estimated. [SWH-Hs].

**Ocean WAVES:** Waves are a moving palette of ocean energy. They are vertical expressions of energy. Waves begin far out at sea, where the waves are whipped up by the wind. When they reach shallow water, wavelength decreases. But the waves drag on the bottom of the sea floor. In the view of that, the crest of the wave rises up and traverses as long as there is water and breaking along the beach.

**Definition of Wave Parts:** The highest peak of a wave is the crest and the lowest point of a wave is the trough. The horizontal distance between the two adjacent peaks of the crests. (Or points of the troughs) are the Wavelength. Wave height of the sea is the vertical distance between the lowest point of the trough and the highest peak of the crest.

**Wave Characteristics:** The ocean wave height depends on their various parameters like the ocean wind speed, length of time the wind blows (duration) how far over the water it raises (fetch), the depth of the water and the direction and speed of the tide. If speed decreases, wavelength decreases and the height of the wave increases. If the tide direction is against the wind then that will enhance the wave height, reduce wave length and saturates in the coastal and understanding the more or less the exact impact on the structures. Depending on the impact, their budgeting and method of choosing suitable techniques the proposed project is accomplished.
**Significant Wave Heights:** Accurate prediction of significant wave height can assist the planning of coastal and offshore structures and analysis of statistical parameters so as to evaluate the status of coastal projects and, especially in the design, determination of the economical and social life related to ocean engineering.

**Determining the Significant Wave Height:** Wave height, $H$, is defined as the vertical distance from trough to crest, whereas wave amplitude, $a$, is one half of that distance. Wave period, $T$, is defined as the time elapsed in a fixed locality between the occurrence of one wave crest and the occurrence of the next. Wavelength, $L$, is the horizontal distance from crest to crest or from trough to trough. The term wave velocity, $c$, is applied to a sequence of uniform waves passing a given locality. The wave velocity is equal to the distance travelled by the wave in 1 Sec. If a wave progresses in the $x$ direction and if the crest was at the locality $x = 0$ at the time $t = 0$, it will have advanced one wave length when a time equal to the wave period has elapsed, or when $t = T$. Thus, the wave advances the distance $L$ in the time $T$ and therefore $c = L/T$.

The significant wave height ($H_s$ or SWH) is defined traditionally as the mean wave height (tough to crest) of the highest third of the waves ($H_{1/3}$). For a sine wave, the wave height $H$ is twice the amplitude:

- The variable ‘$t$’-is the time period in which wave height is to be calculated and $x$-the distance covered by the wave on reaching time $t$.
- The formula for finding the Significant wave height $H_{1/3}$ or $H_s$ or $H_{sig}$.

$$H_{1/3} = \frac{1}{1} \left( \frac{1}{N} \sum_{m=1}^{N} H_m \right),$$

(1)

$H_m$ denotes the individual wave heights.

**Applications:**

- Advice to Fisheries Department
- Naval Wing
- Weather forecasting community
- Coastal Zone Management Planning body
- Tourism Department
- Wave energy ports for facing data buoys.
- Boat Channel guide, etc.

Researchers could observe such applications of Information Technology as an observation and monitoring of the various ocean parameters the case of salinity, temperature, number of waves, the movement of the fish, soil, turbidity, etc. However, there is only sporadic attempt in assessing the wave heights which is treated to be one of the important parameters to project the roughness of the sea and the smoothness of the sea bed.

To understand the nature of work to be done in the proposed model, action has been taken only after discussing with the scientists who have done a similar work to other parameters like temp. Salinity, wave, tides, etc., in the following institutions.

- NIOT-Chennai. [National Institute of Ocean Technology]
- NRSC-Hyderabad [National Remote Sensing Center]
- INCOIS-Hyderabad [Indian National Center for Ocean Information system]
- NIO-Goa [National Institute of Oceanography]
- Remote sensing center Anna University-Chennai.
- Remote sensing center M.S.U-Tirunelveli.
- Remote sensing center B.U-Trichy.
Fig. 3: Estimation of SWH-Bay of Bengal.

Fig. 4: Estimation of SWH-Arabian Sea.

Fig. 5: Estimation of SWH-Atlantic Ocean
Fig. 6: Estimation of SWH-Pacific Ocean.

Fig. 7: The SWH Vs the Temperature.

CONCLUSION

In the evaluation of Significant Wave Height still more methods can be adapted to rough weather and fair weather to evolve suitable error correction accordingly. Multidimensional geospatial technology becomes increasing in demand in the 21st century. Major research areas in multi-dimensional geospatial technology in a timely fashion, will stimulate future research in this direction. In the direction of inferring the ocean parameters and their role in the prediction of weather climate. Ocean surface observations are obtained from diverse and useful information through satellite remote sensing, so it is worth of utilizing the surface observations and to work out the various error corrections so as to approach the perfection in assessing the Heights of the Waves. Reanalysis and validation purposes, from past missions or from satellites.

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