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Assessment of Ocean Parameters through the Satellite Images - AOOPSI

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***Abstract*—AOOPSI Assessment of Ocean Parameters through the Satellite Image is a new approach in oceanography. To identify enormous number of**

oceanography parameters, and different approaches to codifying them and (for internal dataset use and for metadata) examining the list of parameters like salinity, temperature of the water column, nitrate, nitrite, phosphate, silicate, chlorophyll, oxygen, wave heights, tides, rising of water, pH, etc. The parameters like salinity, tides, chlorophyll, temperature, etc., have already been assessed through images. However, wave heights have not been analyzed from images. In this paper an attempt has been made to propose a multidimensional technology is introduced to derive the values from the images and refining the errors by means of few seasonal observed actual values. Once this attempt is reasonably successful software is plan to be initiated.

***Index Terms*—**A**OOPSI, TIMESAT, Tsoft, ADaM, FFT, FIT, WS and WH.**

I. INTRODUCTION

Advancement in the field of Remote Sensing has gone to an extent of taking the geospatial accuracy to few centimeters. Now-a-days remote sensing has become a tool in the hands of scientific community to develop modelling applied in the projection right from natural disasters. On land, crop evaluation, melting levels of glacier, flood levels, etc., are monitored regularly. Such effort in fore-warning gives fruits in protecting the damages to life and planners in the government to lead the mass in the right direction.

The extraction of data from Remote Sensing techniques is generally coupled with GIS. With GIS, it leads to a complete interpretation leading to the factual condition. By such application Oceanographers and the Meteorologists could track the cyclones, El Nino’s, etc., successfully. Recently, application of Satellite Image interpretation through GIS has been used to infer any oceanographic parameter, which has to be estimated by spending large amount of the money, time and energy. Encouraged by such success of interpretation, scientists are in the ebbing to monitor to routine oceanographic parameters only by images. Of late, fisheries department monitor the fish shoạl movement and provide the tips for the fisherman in he different places the right time to approach good catch. With such efforts in utilizing Remote Sensing and GIS technologies in oceanographic parameters’ evaluation and monitoring, the wave climate has not been attempted to assess the height of the wave in combination to the wind speed. Though there are studies to assess the wave height by continuous measurements along with wind speed, as in [6] correlation (r) between measured wind speeds and significant wave heights is found to be 0.595 (r2 = 0.3541). Image techniques have not been attempted, in spite of the number of unnoticed natural parameters contribute to get a particular wave height. It is rather difficult to assess the wave height for as a 3D phenomenon from a 2D imagery. However an effort is going to be made for measuring the wave heights from the imagery by taking the select site in combination with continuous measurements in the field.

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II. GEOSPATIAL

There is a demand from many applications such as geosciences to extend geospatial information systems (GIS) from traditional systems for processing 2-dimensional static data to systems for processing true 3- and 4-dimensional data—that is, data with a third spatial dimension, and or change over time. GIS may therefore need to include dynamic and multi-dimensional modelling functions.

Image processing is a rapidly growing field. The goal is to probe on a few of its mathematically intriguing problems, and brings researchers to pursue the different mathematical avenues in attaining the solution of them and present the State-of-the-art in their approach. Such effort introduces first a forum in which the results from different angles are being compared to approach perhaps, the best techniques among them.

Further, by making sure of wide variety of mathematics to attain a better position so lure more to get involved in imaging and vision problems. Image analysis leading to modeling is attempted through image space analysis, off shooting the diversification representing the different phases of the image. Such analysis has been approached using the different tools such as spectral analysis, wavelet, statistics, and level-sets. On the other hand, the image processing are the aids to modify the original image, which gets improved and refined in quality by better extraction of information from any given image. For example image restoration, compression, segmentation, shape and texture analysis.

Designing a successful processing technique invariably relies on having a successful model for images themselves. There are three crucial ingredients of image processing and designing namely, modeling, analysis and efficient implementation of processing tools. Mathematicians contribute to solve each one of these issues and therefore, the present work is also designed according to that. In this work, 3 dimensional acquisition is used to capture the ocean Geo spatial image of high-resolution satellite image with the measurements of light intensity, radiation, adsorption, etc., Meteorological data such as pressure, temperature and wind magnitude, recorded over a 3D grid produce 3D sets of data. The utilization of 3D images due to the advances in computer technology and the introduction of manipulation and rendering algorithms. The sample for a one lunar period of 28 days is expected to be recorded to analyze using geospatial image to match the values.

Climatologically and meteorologically phenomena are naturally spatially variable and hence, Geographic Information Systems (GIS) represent a useful solution to the management of vast spatial climate datasets for a wide number of applications. GIS has become a key management component in weather-processing systems allowing instantaneous plotting, interpolation and animation of weather data across any isobaric level of the atmosphere.

The synoptic situation across different levels is then, estimated by a forecaster, from which the GIS is used to rapidly calculate the speed of progression of weather systems. An extreme example of this is the relational positioning and monitoring of tornado's and tropical cyclones, where GIS is used to issue warnings to precise locations using remote sensing signatures.

An alternative use of GIS is the combination of different layers of Weather information in expert classification systems. For example, specific humidity is often compared with wind flow to identify areas of fog, cloud and precipitation in relation to coastal influences. Moreover, interpolated climate datasets are used to set the boundary conditions for numerical weather prediction such as mesoscale forecast models.

Extraction of seasonal parameters

Seasonal data are extracted for each of the fair weather and rough weather seasons of the year. The beginning of a season, marked by (a) in the figure 1, is defined from the filtered functions as the point in time for which the value has increased by a certain number, currently set to 10% of the distance between the left minimum level and the maximum. The beginning of the season is equated to the fair weather (Feb to May) whereas the end of the season is attached to the rough weather (Oct to Dec). The end of the season (b) is defined in a similar way. The mid of a season is difficult to define but a reasonable estimate is obtained as the position (e) between the positions (c) and (d) for which the value of the filtered function has increased to 90% of distance between, the left and right minimum levels and the maximum, respectively. The amplitude (f) of the season is obtained as the difference between the peak value and the average of the left and right minimum values. In TIMESAT, there are two integrals over the growing season. The first integral (h), given by the area of the region between the filtered function and the average level.

This information aids the analysis of the functional and structural characteristics of the global and regional land cover. Based on general principles, the TIMESAT program can be used also for other types of satellite-derived time-series data. There is a demand from many applications such as geosciences to extend geospatial information systems (GIS) from traditional systems for processing 2-dimensional static data to systems for processing true 3- and 4-dimensional data that is, data with a third spatial dimension, and or change over time.

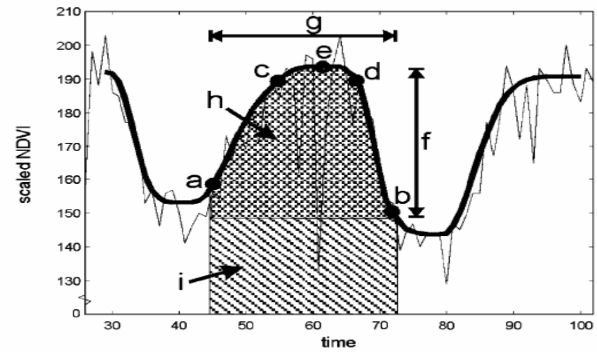

Fig. 1 Some of seasonality parameters computed in TIMESAT: (a) beginning of season, (b) end of season, (c) left 90% level, (d) right 90% level, (e) peak, (f) amplitude, (g) length of season, (h) integral over growing season giving area between fitted function and average of left and right minimum values, (i) integral over growing season giving area between filtered function and zero level

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A. Tsoft

Tsoft, a graphical interactive analysis software package originally dedicated to the analysis and processing of gravity time series. Tsoft can also be used to process and analyze all sorts of time series like seismic or other environmental signals. However, in this Assessment of Ocean Parameters using Satellite Images (Aoopsi) the Tsoft is going to be used to study the wave/tides. [7]

The Tsoft approach has a number of important advantages in the area of pre-treatment of the data (correction of artifacts such as spikes and steps), because the user can always inspect the happenings and intervene manually then and there. The graphical environment is also very convenient for the detection, isolation and analysis of events (e.g. earthquakes). Lastly, errors in the analysis path of the analysis can be easily detected, because the software shows a graphical representation of the results at each stage of the analysis.

Tsoft contains a large set of numerical analysis consisting of tools like FFT [Fast Fourier Transform] spectrum calculation, low-, high- and band - pass filters, multi -linear regressions, determination of transfer functions, etc. Tsoft allows the user to calculate tidal parameters and synthesis tidal signals, which is useful for any gravity measurements. Lastly, Tsoft offers the possibility to write scripts, allowing one to automate and speed up routine tasks considerably.

a. Input and output

Tsoft accepts sample rates from 0.001 sec up to 69 years, which is also the longest possible data series. ‘‘Tsoft

Format’’ is preferred because a lot of meta-data is saved over the data values. They have to be identified according to the channels and as well to be corrected. For this one has bringing the service of filters

b. ***FFT filter Algorithm***

If the type of response is of finite impulse response (FIR) one has to induct FFT filter, which is fitting well in such cases. Here, the user enters two parameters such as the cut-off frequency and the bandwidth.

Now the algorithm proceeds with the following steps:

1. The FFT transform of the signal is calculated;
2. This transform is multiplied by a given filter response function in the frequency domain;
3. The resulting transform is transformed back into the time domain.

As each point of the filtered signal depends on all points of the filtered channel, the results are slightly influenced by the limitations in time of the series and by the presence of gaps. Therefore, the FFT filter should not be used as anti-aliasing filter in the routine decimation of the data, but rather as a powerful tool for analysis and investigation of the data.

c. ***LSQ filter***

The principle of the LSQ [Least Squares] approach is to find a transfer function, which minimizes the total approximation error. This error is calculated from the difference between the actual and the desired (‘‘brick-wall’’) filter impulse response in the time domain. Two parameters must be provided: the cut-off frequency and the number of points of the filter. Provided, they are carefully chosen, the Gibbs’s phenomenon affecting the transfer function (overshoot and ripples on either side of the cut-off frequency) can be greatly reduced. Because of its very good frequency response properties, the LSQ filtering is an appropriate choice as an anti-aliasing filter to decimate a signal. For example, before the decimation of 1min sample interval to 1-hour sample interval, a LSQ filter with cut-off frequency of 12 cycles per day and window size of 480 points can be applied. This filter has a total length of 16 hours and the frequency response curve deviates in the tidal frequency band by less than 0.05% from unity. As it is successfully implemented in tidal frequency it is proposed to be adopted here for wave cycles.

d.Correctors

Raw time series such as long period seismic or gravity recordings can contain undesired events such as spikes, steps, or gaps (missing data). Other events with a geophysical origin, such as earthquakes recorded in gravity or long period seismic measurements, can also cause severe deviations and saturations of the signal for Periods up to a few hours. Whether they are either due to instrumental problems or geophysical origin, these events may corrupt further signal analyses. Moreover, in most circumstances, one cannot just replace the undesired event with missing data. A gap, even one single value, also severely corrupts frequency analysis processes or causes a large gap after decimating the data, due to the anti-aliasing filter. Therefore, it is usually preferable to correct events by interpolating the data, at least for short time periods.

1. Gap Detection

The algorithm uses the following set of Parameters, which can be, choose by the user.

The interpolation type T; which can be

1. Straight connection of points using a linear interpolation;
2. Using a linear interpolation on Fitted points;
3. Using a cubic interpolation on Fitted points,

_ W; the window size;
_ d; the polynomial degree;
_ L; the maximum gap length (in data points). Suppose that Ai are the data points (i ranging from 0 to n _ 1):

1. All the gaps are detected.
2. If T = 1; the last point before each gap and the first point after it, are used to create linear interpolations and the algorithm stops.
3. If T > 1; for each gap, two polynomials of degree d are fitted, one (called P1) on the last W points before, and another (called P2) on the first W points after the gap. If one of the polynomials cannot be fitted (e.g. because the gap occurs at the end of the file), it is assumed to have a constant value, which is equal to the closest value of the other polynomial.
4. If T = 2; a linear interpolation is created using the value of P1 at the start of the gap, together with the value of P2 at the end of the gap.
5. If T = 3; a third degree polynomial interpolation is created, using the value of P1 at the start of the gap and its first derivative, together with the value of P2 at the end of the gap and its first derivative.

Tsoft unifies two approaches for the correction of perturbations. On the one hand, the programme automatically searches for perturbations in the signal and proposes corrections; but on the other hand, the user can inspect and modify the proposals before applying them. For this purpose, Tsoft uses the concept of ‘‘corrector’’. They can be of four types: (1) linear interpolations, replacing the data points during a certain time interval by a linear function; (2) cubic sp line interpolations, replacing the data by a third degree polynomial; (3) steps, using a constant value to all data points after a given moment in time; or (4) gaps, removing all points during a certain time period. In the last case, gaps are considered as undetermined values in the data files.

Tsoft uses the potential catalogue containing 1200 waves and is accurate to a 0.6-nm/s 2 maximum error in time domain Tsoft is graphical and interactive software for the processing of time series like seismic, gravity, temperature, pressure or water levels recordings. As these environmental data are mostly interdependent, Tsoft is a powerful tool as it allows general manipulations of the data channels, such as the possibility to easily fill a particular channel with a mathematical expression of the other data channels. Moreover, this software provides a wealth of common signal processing applications as well as advanced ones especially dedicated to gravity data. On the other hand, Tsoft is also dedicated to the correction of raw data.

GIS may therefore, need to include dynamic and multi-dimensional modeling functions. Most GIS software can successfully process 2D or 2.5D spatial information, but are weak in handling 3D domains. Yet the real world is 3D, key problems in developing a 3D GIS are 3D model design, modeling, visualization and interaction according to the practical situation.

Reference [6] established the two layered Perceptron based on Kalman Filtering (PKF) technique to estimate the significant wave height (Hs) amounts for future time intervals from the wind speed (V) measurements only as stated in the title and abstract of the paper. However, the authors described the forecasting of Hs and simultaneously based on previous step values as mentioned in their paper. Once the Hs and V are filtered it is proposed to employ Data Mining Techniques to further the processing.

B. ADaM Algorithm Development and Mining

The ADaM tool-kit provides a suite of tools for each of the basic data mining processes, including classification, clustering, association rule mining and preprocessing. Since many data sets of interest to scientists consist largely of images, ADaM also includes tools to extract features from images and, convert data back and forth from image to pattern vector form. The tool-kit is packaged as a series of independent components. Each component can be used either as a standalone executable, or from within the Python scripting language via a wrapper. Python is a general purpose scripting language available at no cost on a wide variety of platforms. The components are designed to be platform independent and versions are available for both MS Windows and Linux operating systems.

The ADaM data mining tool-kit is used both for batch processing and for interactive exploration. In batch processing mode, large data sets are processed for a particular purpose such as identifying large-scale storms or classifying clouds. In this case, the data sets of interest and the operators required are already known. In interactive mode, scientists are evaluating different operators and different parameters for those operators. They want quick feedback and ways to visualize the results of the operators. Since these usage modes are so different, ADaM supports them with different interface mechanisms: scripting for the batch processing environment and graphical user interfaces (GUIs) for interactive exploration.

a. ***Data models***

The capabilities provided by ADaM can be categorized into two basic types: image processing capabilities and pattern analysis capabilities. The image data model is extremely simple. An image is represented as a three dimensional array of pixel values, which are referenced by x, y and z coordinates. Two-dimensional images have z size of one. Multispectral image data can be represented using arrays of single plane images. The image data model provides methods to get and set pixel values, find the size of the image and. read and write binary image files.

b. ***Image Processing Capabilities***

ADaM image processing capabilities can be further subdivided into general utilities, segmentation and shape extraction, texture features, and transformation and filtering tools. ADaM includes basic image operations for changing the size, orientation, scale and other properties of images. It also includes level mapping utilities such as histogram equalization, inversion, thresholding and quantization. ADaM includes utilities the usefulness to find boundaries, contiguous regions and polygons in images. On obtain the hypothetical values deduced from the images one has to overlay the ground measurements over that and refined the proper error correction. If such effort is repeated two or three seasons, one is optimistic to get the close values to the true wave height.

III. CONCLUSION

Multi-dimensional geospatial technology is becoming increasingly in demand in the 21st century. More and more attention is being paid to these issues. It is hoped that this issue presents some results in research areas in multi-dimensional geospatial technology in a timely fashion and that it will stimulate future research in this direction. Such study will enable the Scientific Community to adopt the acquisition of oceanographic parameters from the images and by refining the observations from the actual measurements in a few seasonal observations. From this it is sure to approach the actual values. Such effort will be of great use to the future in understanding the role of physio-chemical parameters in the unapproachable cyclonic conditions and remote continents.

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