A REMOTE SENSING INFORMATION SYSTEM FOR MARICULTURE ENVIRONMENT PARAMETERS

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KEY WORDS: mariculture areas, environment parameters, remote sensing output, system design

ABSTRACT: The mariculture areas mean the water areas, which use Case II water body from shallow sea, mudflat or harbour to artificially breed the fishes, shrimps, crabs, shellfishes and algae. The mariculture environment parameters like the quantity of plankton, suspended sediment, transparency, water temperature etc. have greatly temporal and spatial variation. It not only affects the manager's choice of aquaculture farming location and scale, but also the breeders scientific arranging the production measures and their economic benefit. Satellite remote sensing is an extremely effective method to achieve the high dynamic monitoring to these parameters. Taking the GuangDong ZhanJiang mariculture area as a demonstration study zone, starting from the actual demand of mariculture production and making full use of high spatial resolution from multi-sensors' respective advantages, a remote sensing monitoring system specially servicing mariculture environmental parameter was established , adopting C# language with great transferability and universality as development language. The system integrated existing remote sensing and regional marine geographic information technology and had monitoring ability on environmental parameters such as chlorophyll-a, suspended sediment, transparency and water temperature which are concerned by mariculture. The system could provide essential data for scientifically arranging farming activities. The system majorly also including below functional modules (1) the selection modes of geometric correction with adopting standardization, which was operated according to the fixed scale topographic map (for example, 1:5000,1:10000,1:25 0000,1:50 0000); (2) the election platform of at least seven kind data sources, including below satellites data such as LANDSAT 8, GF-1, GF-2, GF-4, ZY-1 02, BJ-2, HJ-1 etc. ; (3) providing internationally remote sensing retrieval models of the quality of water parameters such as chlorophyll-a, suspended sediment, transparency and water temperature; (4) remote sensing production output model with the feature of simpleness and operating easily for the demonstration area. The system can offer standardized and longtime series remote sensing production which spatial resolution is 100 meters and time resolution is 3 to 5 days. The system advantage is in that the selection is very flexible, including output plotting scale, interested environmental parameters, and mariculture environmental parameters remote sensing standard production (including specially and vectorization production). Meanwhile, according to the mariculture areas' actual demand, users can mainly track the highly aquaculture production region, conducting targeted long time series research and comparing other regions with the template. Based on the relationship between mariculture environment parameter space variation characteristics and yield, it can assist the fisheries department to find the key cause of low yield and high yield.

1. INTRODUCTION

Mariculture zones is the use of case II water bodies such as shallow sea, beaches and harbor for fish, shrimp, crab, shellfish, algae and other artificial aquaculture. In the zones, breeding environment parameters, such as phytoplankton biomass, suspended sediment, transparency and water temperature; large change temporally and spatially, which affects not only the site selection and the scale planning of breeding considered by managers, but also the scientific arrangements of production measures and economic benefits concerned by farmers. It is the effective method to achieve high dynamic that the satellite RS monitor the parameters (Huang, 2015; Zheng, 2015).

It is early that research and application of marine fishery RS started in Japan. In 1977, Japan Science and Technology Agency and the Fisheries Agency carried out experiment of marine fishery RS, gradually completed the system of fisheries, including satellite, special investigation of aircraft, research vessels, fishing boats, fisheries information service center and communication network (FAN,2013;FAO, 2014).As early as 80s, our country has carried on the research of application of RS marine fishery, but the service system has not been formed. In order to meet the needs of the command and management of fisheries production of Fisheries Department and safeguard the national marine rights and interests, the ocean domain in the National 863 plan during the Ninth Five Year Plan period set up a special project "marine fishery RS information service system technology and demonstration test", developed the service

system with independent intellectual property rights, operation of marine fishery RS, application of geographic information system technology which mainly provides products of sea state rapid report figure weekly and the various kinds of marine fishery information products that made according the needs of users instantly(SHAO, 2003). The Second Institute Of Oceanography, State Ocean Administration, took charge of the project of "key technology research and software development" of the National 863 information field during the “Tenth Five-year Plan”. The project comprehensively utilizes of marine satellite MODIS sensor, SeaWiFS and meteorological satellite NOAA and other RS data, researches of the key technology of inversion the coastal water and lake water quality environmental parameters and develops the operating system of lakes and harbors water environment RS business (Mao,2005). Additionally, it establishes the "Zhejiang coastal water quality RS monitoring and reporting system" which sets the ship measurement, airborne and satellite RS system as a whole body, receives daily real-time ocean satellite data of EOS / MODIS, meteorological satellite data of NOAA, FY-1C and FY-1D etc, and real-time produces the thematic map of offshore water temperature, the concentration of suspended matter and red tide monitoring and figure of key sea area pollute situation (Pan, 2008).

The present study on mariculture environment parameters that is ongoing is based on the low spatial resolution ocean satellite or meteorological satellite RS data. It is unappeasable that obtaining the environmental parameters, as the low spatial resolution, for marine environmental monitoring and forecasting or the ocean fishery. From the point of the actual requirements of mariculture production, it will recover the lack of that specialized offering of environmental parameters RS products for mariculture zones in our country by the sufficient utilization of respective advantages of high spatial resolution multi sensors, the integration of current RS technology and regional marine geographic information technology, aiming at chlorophyll a, suspended sediment, transparency, water temperature and other environmental parameters that the demonstration area mariculture concerning, the establishment of RS monitoring system that specialized services to mariculture environment parameters, and offering the basic data of mariculture activities for arrange scientifically to demonstration area(ZHANG, 2014; Huang, 2011).

The research indicate that the managers and farmers concerning about the three following cases: A) the annual and interannual variation of the mariculture environmental parameters, which require the long time dynamic monitoring and build the experiential quantitative relationship between the key breeding environment parameters and yield. B) according to the experiential relationship between the breeding environment parameters of long time series observation and yield, to determine the breeding environment parameters is whether suitable for breeding, and according to the environment parameters to abandon and select the new breeding area to reduce losses if it was not suitable. C) presently the waters in the vicinity that are used to breeding shellfish may bring the high yield and quality, but not all. As a result, utilize these breeding high yield regions as a sample, to study long time sequence, and find the key reason for the low yield and high yield by comparing the other region with the sample (Zhang, 2016).

In order to arrange farming activities scientifically, improve the economic benefits of mariculture, it is urgently that managers and farmers should master the main breeding environment parameters in the temporal variation and spatial distribution on the effect of yield and quality. It can solve specific problems in the production radically via the quantitative relationship between the spatial and temporal characteristics and mariculture production through the study of temporal and spatial variation characteristics of mariculture environment parameters.

The system uses a standardized way, namely of all sensors were to fixed scale topographic map for reference of geometric correction; select C# with the good portability as a development language, to construct the RS products output system with the characteristics of simple and easy to operate for demonstration area, and regularly offer the standardized RS products with the spatial resolution of 100m and the temporal resolution of 3-5 days to production units.

2. SYSTEM DESIGN

The whole system mainly includes constructing of the background database and RS image database, selecting of ephemeris table and data source of mariculture zones and RS, the way of RS data display, geometric correction and atmospheric correction, extracting the breeding region, inverting the mariculture environment parameters, and output the RS standard products. The specific design process is shown in Figure 1:

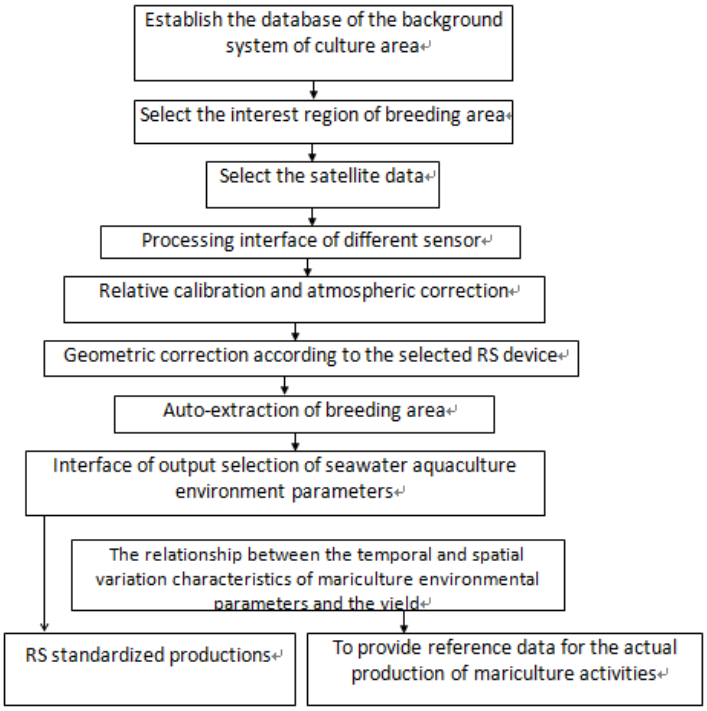

Fig. 1 Technology Roadmap of RS Standardized Product Output System

2.1 The Establishment of System Database

Database system mainly includes background field data breeding area, digital topographic map with different scale, breeding area corresponding satellite database, satellite ephemeris, etc. First of all, through the literature search, data collection, remote sensing image pre extraction, obtain the information of China's coastal aquaculture area since 2000, according to the province, city (county) level, to establish the corresponding database. The contents of the database include: year, month, the name of the province, the name of the city, the name of the sea area, the type of the breed, the area of the breed, the breed. Secondly, the all satellite data of all breeding area have been input to the system that corresponding to the satellite database, and provides the import function, because: A) The new RS image will produce according to the ephemeris which are needed input to the image to the database. B) It may collect previous RS data that can be input by the user and system maintenance staff who have permission. Thirdly, according to the regression or revisit period of the choice of high spatial resolution RS data, arrange the annual satellite ephemeris table. Finally, the different scale topographic digital maps (1:5 million, 1:10 million, 1:25 million, 1:50 million), will be stored in the database.

2.2 Select the Interest Region

After the system is opened, the image area will display a LANDSAT 8 mosaic of Chinese RS image. The system, according to the user's IP address, automatically locates the user's location. The longitude and latitude range input box is shown next to the image region, which can be entered the latitude and longitude by the users according to their needs. After selecting, the interest region will automatically adjust to the range that the user input. If there is no breeding area within the region, of which the system judging according to the selection, pop-up message box with the text ‘the selected area no breeding area, please select again’ to prompt the user.

2.3 Satellite Data Selection Module

After determining the breeding area of interest, can further select the corresponding satellite data in the system which is the module mainly offer the data selection platform of 9 data source – LANDSAT 8, GF-1, GF-2, GF-4, ZY-1 02, ZY-3, CBERS 04, BJ-2, HJ-1. The message box with the introduction of the satellite will be shown after selecting one of the satellites which provide a choice for the users to determine whether it is the satellite or not. If it is, the selection box will be shown with the sensors equipped on the satellite for the users to choose. After determining, the users can click the date with image in the ephemeris for showing the RS image in the image box.

2.4 Determination of Image Display

After displaying the image, menu and toolbox of band selection will display with highlight (if it does not display, they would be gray that means it can't be used). Users can use these functions including band selection, image enhancement, superposition of longitude and latitude, stored as all kinds of image (jpg, TIF, PNG format) as use on ENVI.

2.5 Fixed Scale Geometric Correction Model

After selecting the satellite, firstly, finish geometric correction, then determine the scale including 1:50,000, 1:100,000, 1:250,000, 1:500,000 according the corresponding spatial resolution of the satellite sensors. Table 1 lists the various scales and spatial resolution corresponding to the satellites. Determining the fixed scale, is mainly to provide the basic data for the output of remote sensing standardized products.

Table 1. Various Spatial Resolution and Scales of Products

Sensors	spatial resolution (m)	scales of products
LANDSAT 8	30	1:250000
GF-1	4	1:50000
GF-2	4	1:50000
GF-4	50	1:250000
ZY-1 02	10	1:50000
ZY-3	6	1:100000
CBERS 04	10	1:50000
BJ-2	4	1:50000
HJ-1	30	1:250000

2.6 Remote Sensing Extraction of Breeding Area and Dynamic analysis Module

For the new storage of RS images, it can select the different extraction algorithms, according to different types of remote sensing images. After extraction, it can also automatic calculate of the area, and determine whether the new acquired data will be put in storage by the users. If put, the users should input the corresponding content according the hint. Finally display the thematic maps with the original RS image in the new window. Figure 2 shows the flow chart of breeding area extraction and dynamic analysis module design.

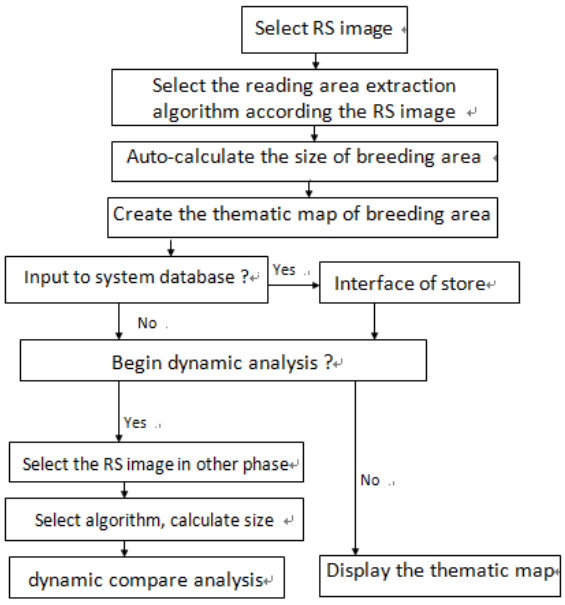

Fig. 2 Flow Chart of Breeding Area Extraction and Dynamic Analysis Module Design

Presently, references to automatic extraction algorithm of breeding area are mainly in include (Ma, 2010; SUN,2010) This paper does not focus on algorithm research but the system design, so for the RS data source with algorithms, should utilize directly the research achievements of others, while for without algorithms, the band set and spatial resolution similar to other satellite algorithm. Based on, for different remote sensing data source, set different breeding area extraction algorithm, so the users should select the corresponding data source only, conveniently obtain the corresponding breeding area distribution image.

2.7 Production of Environment Parameters RS Standard Products

At present, the method of using remote sensing technology to invert the mariculture environmental parameters is divided into two kinds, namely the empirical formula method and the analytic algorithm based on the model. Empirical formula is established on the basis of experimental data, and established the quantitative relationship between apparent optical properties and environment parameter of the ocean via statistics method. The analytic algorithm based on the model, utilize the bio-optical model to describe the similarity between mariculture environment parameters and water spectral radiation characteristics, and utilize the similarity of radiation transfer model to simulate the propagation of light in water and the atmosphere, and utilize the bio-optical model simulating spectral features the atmosphere above water. The inversion algorithm of this system mainly uses the bio-optical model method. Figure 3 is environmental parameters of the production process of RS standardized products.

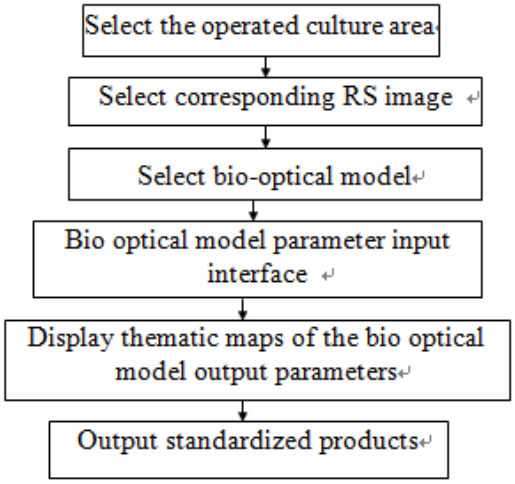

Figure 3. Environmental Parameters of the Production Process of RS Standardized Products

3. CONCLUDING

The present study on mariculture environment parameters that is ongoing is based on the low spatial resolution ocean satellite or meteorological satellite RS data. It is unappeasable that obtaining the environmental parameters, as the low spatial resolution, for marine environmental monitoring and forecasting or the ocean fishery. From the point of the actual requirements of mariculture production, make full use of their advantages of high spatial resolution multi sensor remote sensing technology, integrate current RS technology and regional marine geographic information technology, aim at chlorophyll a, suspended sediment, transparency, water temperature and other environmental parameters that the demonstration area mariculture concerning, estimate RS monitoring system that specialized services to mariculture environment parameters, which not only can offer the basic data of mariculture activities for arrange scientifically to demonstration area, but also recover the lack of that specialized offering of environmental parameters RS products for mariculture zones in our country. Moreover, it can promote the establishment of remote sensing monitoring system of other environmental parameters, which are specially designed to serve the mariculture, so that improving the marine environmental monitoring system of our country.

By using the long-term dynamic monitoring of mariculture environment to obtain the several year accumulation data, it is helpful to select the suitable breeding area in a more scientific way. Such as through years of monitoring to a

breeding area, found mariculture environment parameters change little, production can not be improved, which indicate the area in not suitable for mariculture, so it should select a new area for reduce the economic losses; based on remote sensing of breeding environment parameters information, can also be helpful to guide the new breeding areas.

Focus tracking high yield and quality area that observe by the method of RS, to the breeding for high yield area as a template, and begin targeted the long time series study, comparing with other areas, can help the fisheries sector and find out the key reason of low yield or yield, as well as guide the scientific arrangement of breeding density to improve the breeding level and economic benefits.

Timely obtain the information of chlorophyll a, suspended sediment, transparency and water temperature by remote sensing of high dynamic monitoring, can prevent the disaster incident in advance, and reduce the loss to the minimum.

ACKNOWLEDGEMENT

This work was funded by Provincial Special Funds for Economic Development (use of marine economic development) in 2018 under contract No.GDME-2018E003, National Natural Science Foundation of China under contract No. 41771384, National Key Research and Development Projects under contract No. 2016YFC1401203, Project of Enhancing School with Innovation of Guangdong Ocean University under contract No.GDOU2017052501 and Program for Scientific Research Start-up Funds of Guangdong Ocean University under contract No.E16187.

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