Long-term measurement and research on the flow rate in Zhoushan, China

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Abstract. In order to understand the flow rate of the new copper cage to be put into the Zhoushan sea area, this study used a point Doppler flowmeter to measure the flow velocity of the deep-water cage culture in Zhujiajian, Zhoushan, Zhejiang Province for a long time, and measured the sea area as a regular half-day tide, and finally measured the results show that the flow rate shows a significant periodic change. Maximum flow rate is within 3-4 hours before and after the climax, generally between 1.2 m/s and 1.6 m/s, and then the flow rate is rapidly reduced to about 0.2 m/s. At the arrival of the low tide, the flow rate will have a small increase which reached about 0.5 m / s, after the low tide, slightly decreased, until the new climax came. The maximum flow rate during the measurement occurred at the moment when the tide occurred in the month, which was 1.983 m/s (average flow rate of 30 s).

1. Introduction

In order to understand the flow rate of the new cages to be put into the Zhoushan sea area, the project team used a point Doppler flowmeter to measure the flow rate of the new cages in the deep water cage culture area of Zhoushan, Zhejiang Province for a long time. The Doppler flowmeter adopts the principle of acoustic Doppler measurement, which measures the flow velocity by the Doppler shift of sound waves in the flowing liquid. The advantage is that the sound velocity can be automatically calibrated, continuous recording, no moving parts of the instrument, no Friction and hysteresis, measuring induction time is fast, measurement data is high precision, and the instrument itself does not produce zero drift [1]. The measurement results can provide scientific basic data for cage design, placement, offshore setting and anchoring.

2. Materials and Methods

2.1. Flow meter

The flow rate is measured by the Vectrino Veyron Doppler point flow meter from Nortek AS, Norway. The Nortec Vectrino Velocimeter is a high-precision 3D point flow rate produced by Norway Nortek AS. Instrument, small sampling volume (<1 cm^3). Set the sampling frequency of the flow meter to 0-200Hz, and the measuring speed of each measuring point is 15s. You can get 3000 data. Using the Data

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Conversion command in the flow meter, you can convert the flow rate series consisting of 9000 flow values. However, the probe size is small, which greatly reduces the resistance caused by the probe itself.

Vectrino consists of two basic components: the sensor and the processing card inside the probe, so that the data directly output from the probe to the PC or the collector can process the data instead of the original analog signal. Computer software is included with the instrument for parameter instrument setup, file naming, monitoring, and recording flow rate changes over time.

Related parameters:

Flow rate measurement: ±0.01, 0.1, 0.3, 1, 2, 4 m/s (adjustable),

Accuracy: ±0.5%±1mm/s of measured value,

Sampling rate: 1–200 Hz;

Sampling point: distance from the sensor probe (emission ring) 0.05m, diameter: 6mm, height: 3-15mm;

Ambient temperature: -5 ° C ~ 45 ° C;

Acoustic frequency 10MHz,

Resolution 0.45dB,

The intensity range is 60dB;

Input voltage: 12-48 V,

Maximum power consumption (at 200Hz sampling rate): 1.5w.

The 40 cm long 4-arm head-up sensor (head-mounted fixed-rod probe) is equipped with MCBH-12-FS bronze (Impulse), a 12-pin plug-in watertight connector and a 10-meter cable connected to the PC software via a USB to RS232 adapter.

2.2. Power supply for offshore test

In terms of power supply, since the power of the flow meter itself is only 2.5w, the notebook operating power for recording experimental data is not so stable, the maximum power is 125w, the display power is 20w, and the power is estimated to be 50-80w when the flow meter is connected to the data, and The display automatically turns off when recording. Therefore, the power demand of the whole system is low-power uninterrupted power supply for a long time, and the power supply time should not be less than 24 hours. However, the general uninterruptible power supply is generally used in office or emergency situations, and the power supply characteristics are high-power short-time power supply, and the battery is in The life of the small current is also significantly shortened under the condition of long-term discharge, so the consideration of the corresponding battery and uninterruptible power supply has been considered. In particular, according to the discharge current and discharge time of the battery, the final selection of the MT1000S uninterruptible power supply and the use of four Santa 100AH batteries can ensure that the flow meter works continuously for more than 24 hours, replace it daily, and replace the battery. Charging ensures the normal operation of the system.

2.3. Supporting detachable fixing bracket

The fixed bracket needs to be fixed on the existing cage frame on the one hand, and a fixed fixed flowmeter probe on the other hand. The specific size depends on the height of the cage frame, the size of the flow meter, and the flow rate at 4 meters below the surface to be measured. The situation is designed. The material for the material of the bracket is preferably made of the anti-erosion model 316L in the ocean, but the design is not carried out for many years, so the galvanized steel sheet is used for processing. Initially, it was envisaged to use angle steel for the production. In the later stage, the two aspects of the angle steel may not be enough to put the watch on, and the galvanized steel plate was used for processing. Considering the convenience of transportation, each fixed bracket after processing cannot exceed 2 meters in length and 1.5 meters in width. The joints are also not fixed by the usual bolts, mainly considering that the punching will significantly reduce the strength of the fixed bracket, and the risk of breakage under the impact of the current, using a rectangular toothed joint and a galvanized iron wire fixing method.

In the test, a galvanized steel pipe with a length of about 4 m was added to the vertical arm of the fixed bracket for reinforcement, which effectively prevented the instability of the flow rate measurement caused by the shaking of the vertical arm.

2.4. Specific operations

Install the fixing bracket and firmly fix the reinforced steel tube, and measure the pointing of the fixing bracket through the compass. When fixing the flow meter, pay attention to point the x-axis of the flow meter. After installation, you can confirm that the x-axis of the flow meter data is 30° west to west.

Arrange the battery, UPS and recording computer, and place the UPS and recording computer in the logistics box, and pay attention to the outer edge of the logistics box with the shock-proof foam packaging cloth to prevent the fluctuation of the whole measurement platform during the measurement. Causes the cable to wear out.

On the other hand, the sea conditions were poor and initially attempted to cover the canvas on the recording system, but this did not effectively eliminate the effects of rain and waves, causing the recording computer to malfunction. In the later stage, the large logistics box is covered on the recording system, which better solves the problem of waterproofing. However, the disadvantage of this is that the ventilation of the whole system is poor, and the UPS and the recording computer will continuously emit heat during operation. In the midday when the sunshine is strong, the system will be suspended due to overheating. However, since the measurement time is in the April and May when the temperature is more suitable, this problem is not very prominent.

Since the signal sampling is performed by the Doppler point flow meter, this method can only observe a point of 4 meters underwater for a long time, and the method of moving the flow meter up and down for the flow rate of different water depths. Preliminary measurements were made, but on the one hand, the small Veyron Doppler point flow meter was mainly used for flow field research in the ideal conditions in the laboratory, compared to the Veyron Doppler point for field measurement in similar products. Flow meter (standard configuration is compass, inclinometer, pressure and temperature sensor, self-contained or online measurement.) No compass, tilt meter and other functions, data quality is poor, and the probe is not strong enough, at sea It is dangerous to measure the flow rate of 0-4m, which is easy to damage the probe.

In addition, in terms of sampling rate, this measurement uses the optimal sampling rate of the instrument: 200 Hz. Although it causes certain difficulties for the later processing, it also ensures the quality of the data sampling to the greatest extent, and the wave dynamics in the future. Research, wave trajectory studies, water flow studies in the boundary layer, combined monitoring of waves, water flow, and turbulence studies have preserved better research samples.

In the measurement, it is necessary to take the floating raft or the boat to the measuring platform every day to read the recorded data and replace the battery. From the safety point of view, only the daytime ride can be selected. On the other hand, the floating dock or the storage dock of the dinghy can only travel safely during the period of high tide, and the windy weather, especially the southerly weather, cannot travel, which affects the continuity of the measurement to a certain extent.

3. Results and discussion

3.1. Flow rate changes with time

The currents in this area are mainly affected by the warm current of the Kuroshio tributary.

The world's second largest ocean current Kuroshio, also known as the Japanese warm current, began in the Philippines, crossed the eastern seas of Taiwan, and flowed along the northeast of Japan. After encountering the tidal wave, it merged into the eastward north Pacific ocean current. The flow rate of the Kuroshio is faster and flows along the East Asian island arc. Therefore, the influence of the Kuroshio on the island arc is also significant. However, the tributaries of the Kuroshio deep into the marginal seas of the East Asian continent have also had a certain impact on the mainland.

After the mainstream of the Kuroshio entered the East China Sea from the Strait of the country, it split a branch near Taiwan's Diaoyutai and flowed northwest into the coastal waters of Zhejiang, known as the Taiwanese warm current.

The warm current of Taiwan flows northward along the trough-like depression of the Zhehai Sea, reaching up to the mouth of the Yangtze River, about 31 degrees north latitude. The ocean currents meet in the vicinity of the Zhoushan Islands and the coastal currents formed by the Yangtze River turbulence, forming a distinct front. Since the measurement period is not in the flood season from April to May and is affected by the northeastern islands, the measurement area may be less affected by this[2-3].

Existing flow meters measure tidal currents and constant currents. To accurately measure, it is necessary to suppress the "noise" that interferes with the two motions, that is, the influence of seawater turbulence and waves. Selecting the duration of the observation time is actually using "time filtering." "filters out" "noise". The movement of water in the ocean can be divided into three categories, regular large-scale movements, which can be described independently; extremely irregular small-scale vortex movements must be statistically described; various movements (waves, tides), they all have a certain Some periodicity. The observation of the current requires that the pulsating "accumulation" average is equal to zero, which requires averaging over a certain time interval (function time smoothing). Since the oceanography characterizes the wide spectrum included in various scale motions, it is difficult to say what The smoothing scale is satisfied, but if the average period is not large enough, the average is unstable and the average of each measurement will be significantly different. Generally speaking, from the perspective of noise generation, the short-frequency noise in the offshore area mainly comes from thermal noise and wave noise. The thermal noise time scale is generally about 10 seconds, and the wave noise period is no more than 30 seconds in the ocean, in the shallow sea. It rarely takes more than 10 seconds. The average period used in this test is 10 minutes. For a period of time with a large flow rate, a 30-second reanalysis is theoretically achieved. The 30-second integration time completely eliminates these noises.

From the results of the measurements, the flow rate showed a significant periodic change. The measured sea area is a regular half-day tide. The flow rate is the largest within 3-4 hours before and after the climax, generally between 1.2 m/s and 1.6 m/s, and then the flow rate is rapidly reduced to about 0.2 m/s. At the arrival of the low tide, the flow rate will be one. A small increase to about 0.5 m / s, after the low tide, slightly decreased, until the new climax.

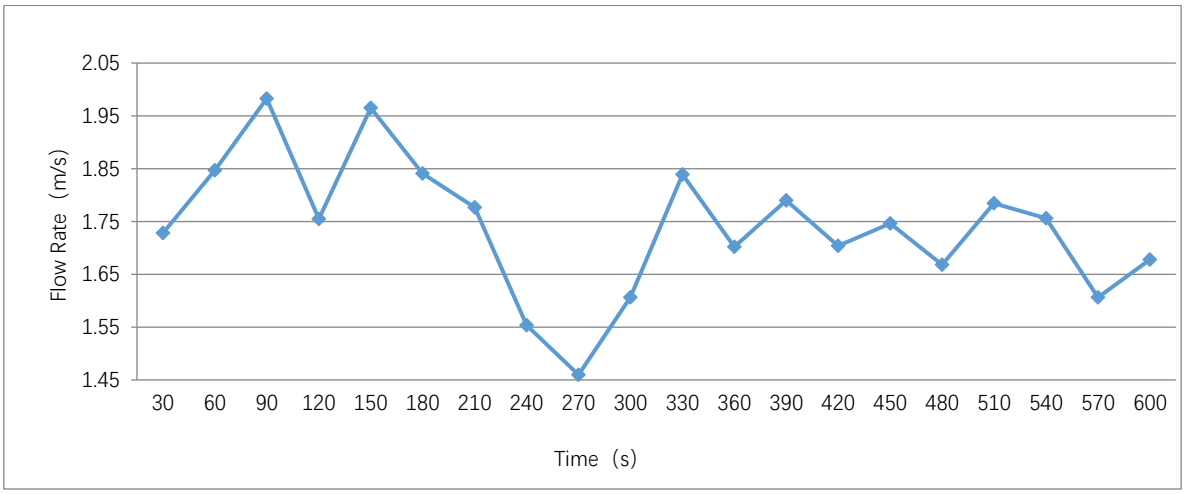


Figure 1 The change within ten minutes of maximum flow rate

Regarding the direction of the flow velocity, the flow direction at the high tide and the low tide is generally southward, sometimes slightly westward, with the only exception being that when the high tide approaches the high tide, the flow direction is northeast. This may be due to the northward current

of the outer sea area being introduced into the warmth of the Taiwanese into the bay by the six-horse island of Zhejiang, the fourth sea area in the southern part of the measuring point, so that the current at the measuring point flows out of the bay most of the time, but when the high tide approaches the climax, the south The current to the north is so large that the current at the measurement point is also out of the bay.

The maximum flow rate occurs at the moment when the tide occurs in the month, which is 1.983 m/s (the average flow rate of 30 s), and the average flow rate at 10 min is 1.739 m/s. In the one-month measurement, the maximum flow rate is about 1.6 m/s at about 50% of the climax, and the highest flow rate is about 1.4 m/s at the other 50% climax (Figure 1).

3.2. Flow rate changes at different depths

In the test, the flow velocity changes at different depths were also measured. The results show that the surface water flow is 1-2m deep and the water flow is 0.05m/s larger than the surface water flow, and the 2.5-4m water depth is 1-2m larger than 0.05m/s.

However, since this measurement is carried out using a Doppler point flow meter, the flow rate for different water depths can only be achieved by moving the flow meter up and down. Since not all water layers are measured simultaneously, good data quality cannot be obtained. In this regard, if further research is required, an acoustic Doppler profile flow meter is recommended.

4. Conclusion

In order to understand the flow rate of the new copper cage to be put into the Zhoushan sea area, this study used a point Doppler flowmeter to measure the flow velocity of the deep-water cage culture in Zhujiajian, Zhoushan, Zhejiang Province for a long time, and measured the sea area as a regular half-day tide, and finally measured the results show that the flow rate shows a significant periodic change. Maximum flow rate is within 3-4 hours before and after the climax, generally between 1.2 m/s and 1.6 m/s, and then the flow rate is rapidly reduced to about 0.2 m/s. At the arrival of the low tide, the flow rate will have a small increase which reached about 0.5 m / s, after the low tide, slightly decreased, until the new climax came. The maximum flow rate during the measurement occurred at the moment when the tide occurred in the month, which was 1.983 m/s (average flow rate of 30 s).

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