

Sea Current characteristics in Genga Bay of Okinawa, Japan.

University of the Ryukyus
University of the Ryukyus

O Yvette KERSLAKE, Masafumi ONOHARA
Member Eizo. NAKAZA, Yoshihisa AKAMATSU

1 . Introduction

To ensure the sustainable development of coastal areas, the Integrated Coastal Area Management (ICAM) approach has been required. The development of efficient management plans of complex ecosystems subject to significant human pressure cannot occur with the absence of science. The Genga Coastal area located in the northern part of Okinawa Island (Figure 1) is the pilot site to demonstrate how stakeholders can work together to make decisions and develop localized plans. The project also seeks to assist the prefecture government departments in implementing sustainable practices in order to continually protect the coastal area. For the implementation of these plans there is an urgent need to have a scientific understanding of the ocean currents, near shore currents and waves as well as the river current and nutrient supply from the river estuary to the open sea.



Figure 1: Satellite View of Genga bay with observation stations.

2 . Method

Field observations were conducted at four main stations in the Genga bay (Figure 1). The Acoustic Doppler Profiler (ADCP), ADCP-Wave and Wave Hunter apparatus were deployed at the stations as follows. The Station 1 ($26^{\circ}45'00''$ latitude and $128^{\circ}00'00''$ longitude) with a depth of 110m using the ADCP (300 kHz) apparatus. The station 2 ($26^{\circ}43'48''$ latitude and $128^{\circ}01'02''$ longitude) at depth of 60m and also measurement by the ADCP (300 kHz). In station 3 ($26^{\circ}41'42''$ latitude and $128^{\circ}03'39.6''$ longitude) with depth of water at 38m and measurement by the ADCP- Wave (600 kHz). At station 4 ($26^{\circ}37'48''$ latitude and $128^{\circ}03'39.6''$ longitude) with a depth of water 16m and measurement by the Wave Hunter apparatus. For stations 1, 2 and 3, the tidal currents were measured at every 4m layer from the sea bottom to the surface. For station 3, the ADCP installed has a special function for measuring waves. At station 4, the wave hunter equipment was installed with two main functions of measuring wave pressure and tidal current at the bottom layer only. The observation period was of approximately 35 days, from November 8th to December 12th 2006.

3 . Results and Discussions

Meteorological data for the tidal level, atmospheric temperature, wind velocity, wind direction and atmospheric pressure were collected from the Naha Meteorological office. As shown in graphs of figures 2 (a), (b) and 3, the upper most layers are the tidal level followed by the wind velocity. The tidal level is measured at Naha Port but used as a reference guide. Observations in the graphs were for duration of 3 days during the spring tide. At station 1, at a depth of ranging from 14m -54m (figure 2-a) at low tide the direction of current is East and at high tide the current direction is West. At a depth of 62-102m (figure 2-b), the tide direction of current follows the previous depths except for the near sea bottom below 80m depth where there are disturbances of current. The phenomena will be further explained in detail by the temperature variation measurements. Station 3 has a tidal current in the upper layer approximately 20m. In the lower layer there is an observed consistently northward current (figure 3). With reference to figure 1, station 3 is located at the end of the coral reef edge and almost in the middle of the reef channel.

Keywords: Tidal Current, Internal tide, sea temperate, Coral reef, Genka.

Address: Faculty of Engineering, University of the Ryukyus, 1 Senbaru, Nishihara, Okinawa 903-0213, Japan.

Tel : 098-895-8673 E-mail: enakaza@tec.u-ryukyu.ac.jp

The consistent northwest current shows outgoing current from near shore zone flowing through this channel. Wind and velocity current that are averaged in the observation period for the first half of 15 days is shown in figure 4. The surface current is towards the west direction especially at station 1 which is the furthest from the shore. It almost shows the same direction as the wind. However, at the bottom layer for all stations it shows a strong outgoing current from the shore. This outgoing current is assumed to be in compensation for the surface current. Figure 5 shows the distributions of sea temperature for all stations. As observed there is a strong thermocline at the depth of 100m for station 1. An internal tide is usually generated in such a sea temperature distribution field. The phenomena at the bottom layer of station 1, the disturbance of tidal current is assumed to be exerted by the existence of internal tide.

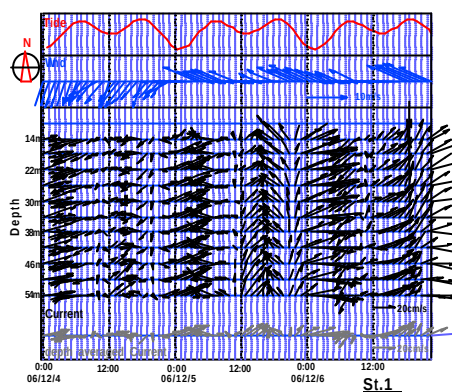


Figure 2(a): Tidal level, wind velocity vector and current velocities at 4m interval for station 1

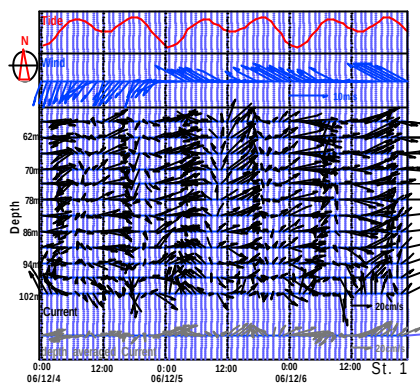


Figure 2(b) Tidal level, wind velocity vector and current velocities at 4m interval for station 1

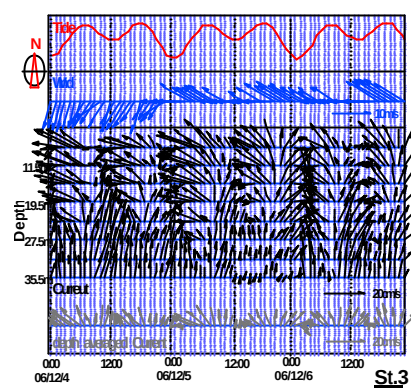


Figure 3: Tidal level, wind velocity vector and current velocities at 4m interval for station 3

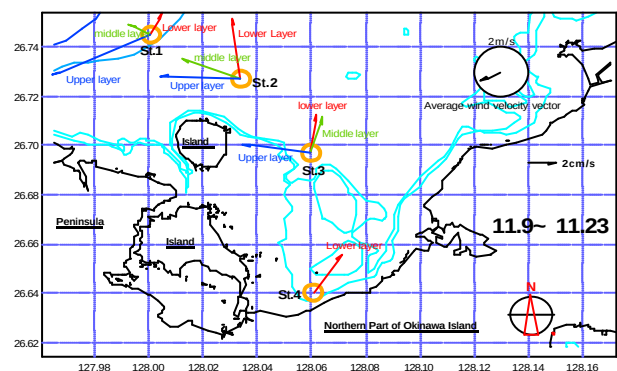


Figure 5: The first 15 days averaged wind and tidal velocities at three different layers, bottom, middle and surface - Observation period of the first half.

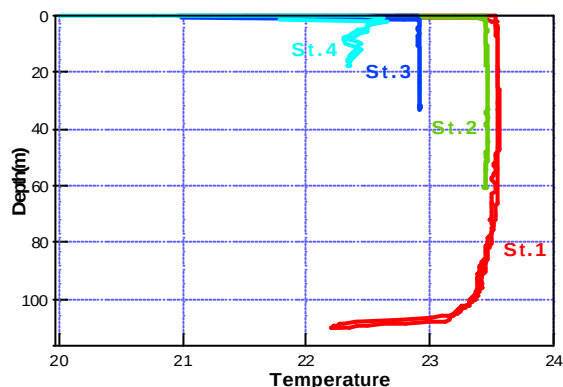


Figure 6: The distribution of water temperature in depth for the 4 stations.

4 . Conclusions

Outside reef, the ocean currents showed eastward and westward tidal currents. In the reef channel the upper layer tidal currents following ocean currents were observed. However, in the bottom layer, consistent outgoing flows were observed. The results of the comprehensive measurement of Genga bay will contribute to development of the pilot project for the ICAM of Okinawa.

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References

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