International Journal of Engineering & Technology, 7 (4.38) (2018) 1639-1641

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Application of WERA Radar to the Study of Current Monitoring in Taiwan

Chiu Yung fang, Su Ching ho, Chen Yang Yih, Li Chen Ta, Chang chia ying*

Affiliation
Email:cjy@mail.ihmt.gov.tw

Abstract

The Wave Radar(WERA) system is a shore-based distant sensing system used to overswee ocean surface currents, waves, and wind courses taken by moving objects. The analyzed data span the year 2015. The residual state of circulation is characterized by two different zones separated by approximately 100 m isobaths. In the offshore region the residual currents have a significant dedication to the wind-driven part, while the nearshore region is characterized by a very strong time-independent residual state circulation, featuring one measured anticyclonic eddy north of Taiwan. The acquisition data and demonstrated achievements might be useful for a copy-proof area-defined boundary design and studies of the tidal fronts, local eddy dynamics , and passive tracer carried from one place to another within the area.

The measuring effects are shown in the form of a dimensional map of the current velocity vectors in the examination area (with size of 10 × 10 km2). Some characteristics of the current dimensional and temporal qualities in coastal waters are shown. In particular, the eddy-like constitutions (a few kilometers in diameter) rapidly rise and fall. Because similar eddies are discovered using contact measurement methods, the intricate and variable construction of the surface currents shown through the measurement radar does not appear to be an artefact.

Keywords: *surface currents, WERA, Radar, Taiwan*

1. Introduction

During the last few years, radar systems have had measured success in the mapping of ocean surface currents. The capability to map the surface state of circulation in coastal ocean districts has brought about new insight to the intricaciies of physical courses in nearshore waters, and has permited major advances in our understanding of cycling and oceanographic situations in many coastal areas.

Taiwan strait is one of the areas that has been slap-monitored by radar since 2015 (Fig. 1). The first theoretically careful and thorough inquiry into the act of retrieving wave message from HF radar backscattering was informed by Barrick.

Surface current velocity measurement techniques using radar in the coastal areas of the oceans and seas have been manufactured and used in other countries, including the Taiwan, Canada, and UK, for nearly 50 years. Various companies have output Doppler HF radar, which survey the velocity of the surface currents in coastal regions from 0.5–5 to 20–200 km from the shore, dependent upon the operating frequency range. In the existence of a large quantity of radar devices spaced along the land, it is probable to rehabilitate the velocity field of the surface currents along the coastline, as is being executed in California, USA, for example.

2. Measurement results

A system composed of two high-frequency Wave Radar (WERA) devices that are operational at 12.4 MHz has been disposed along the western coast of Taiwan to monitor the surface currents at up to 10 km offshore.

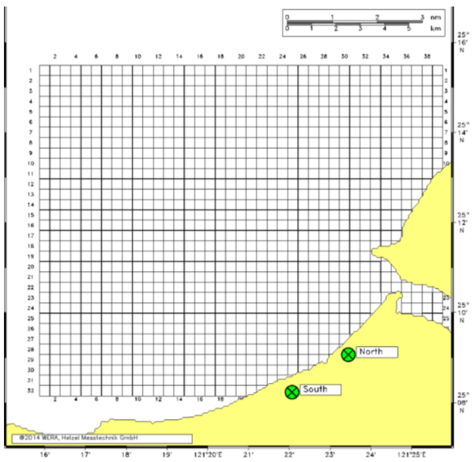


Figure 1: Geographic sampling grid of Taipei, Taiwan

The locations of the radar devices, dubbed South (25◦ 8'N, 121◦ 22'E) and North (25◦ 9'N, 121◦ 23'30''E), are shown in Fig. 1. The circulation in Taiwan Strait is hard to research using in situ methods because it is dominated by tidal currents, often surpassing 0.75 m/s, and is affected by strong north and northeastern winds. The surface currents in the Taiwan Strait are also affected by swells. Strong storms, often occurring during the winter, have given Taiwan Strait the reputation of one of the most adventurous seas throughout Asia.

The data are given to the "Taiwan WERA system" project, using a pair of 8-channel medium range WERA systems possessed by the Harbor and Marine Technology Center (HMTC).

Complications of the physical processes occurring in the Taiwan Strait in relation with the complex terrain make the modelling of the cycle hard to achieve. In consideration of this fact, a distant sensing of the surface currents using WERA radar provides an unmatched occasion to set up a system in the depression on a regular basis.

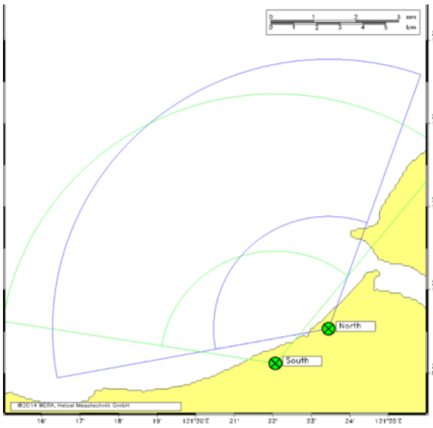


Figure 2: Range and position of radar systems used for the case study in Taipei.

The coastal district and locations of the devices are shown in Fig. 2. Fig. 2 shows a representative current map.

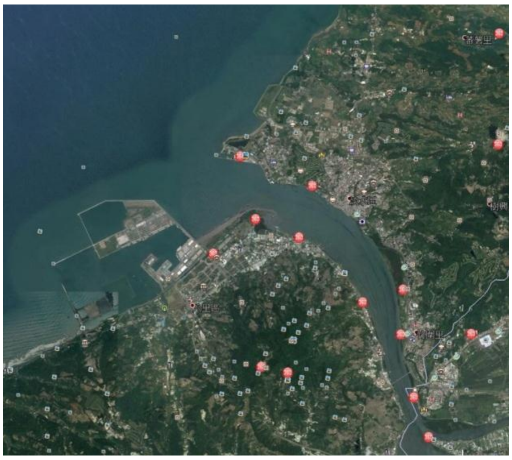


Figure 3 :Location of devices in Taipei

The study location, Taipei, is situated in the extreme northwestern area along the Taiwan Strait (Fig. 3). It is separated from China by the 150-km-wide and 1000-m-deep Taiwan strait. The measurement data of the radar system at the Taipei site from January to December 2015 is shown in Fig. 3.

The interplay of the tidal waves is the leading condition that defines the inconstancy of the currents and sea surface height in the area.

The multitude of freshwater comes from the Tamsui river on the Taiwan coast. The large distance between the Tamsui river orifices and the Taiwan Strait favor fresh water dispersion. The WERA/numerical comparisons for Taipei (Figs. 4) are reasonably good.

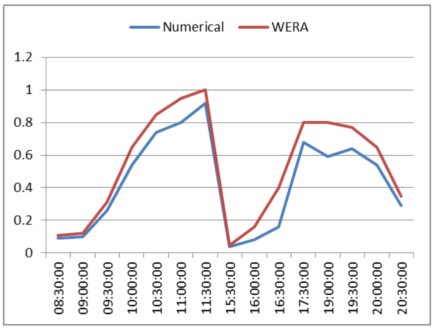
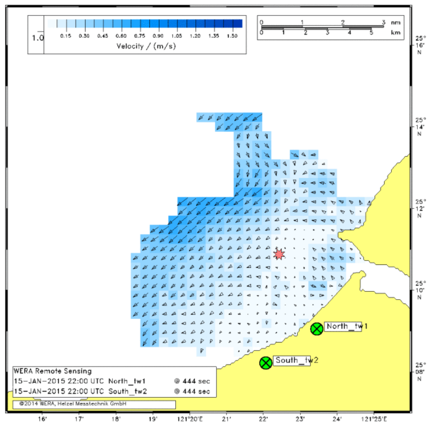
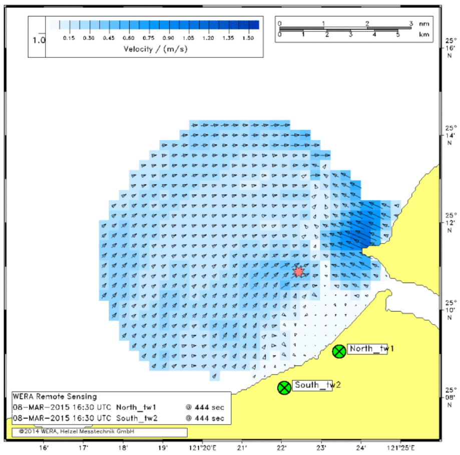


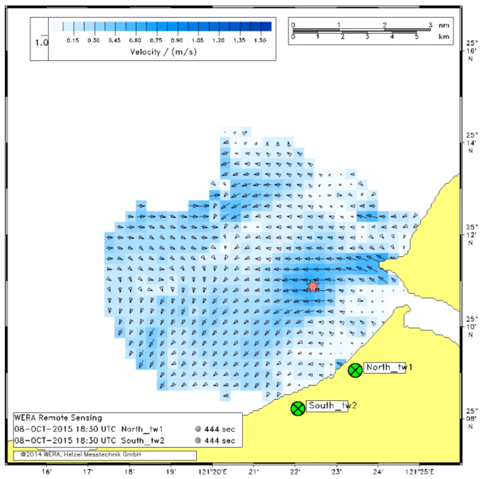
Figure 4: Comparison between WARE and numerical measured current data



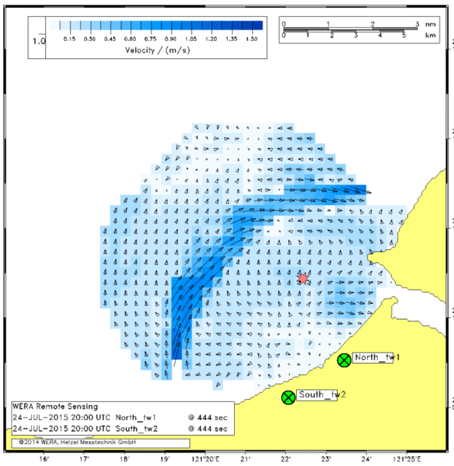
(a) Winter



(b) Spring



(c) Fall



(d) Summer

Figure 5: Pictures of WERA radar-derived mean surface currents for (a) Winter, (b) Spring, (c) Fall, and (d) Summer of 2015.

Fig. 5 shows currents measured using WERA radar. Two different current regimes were noticed throughout the duration of the summer period. The current on January 15 was familiar, arriving from the southern to western directions with moderate speeds of up to 1.3 m/s. On May 8, an anticyclonic vorticity was marked on the current velocity map. Its current velocity was directed chiefly toward the northeast, and its value did not surpass 0.75 m/s. On the picture of currents gained on May 8, the measured district has good coverage of the vortex-like currents (Fig. 5b). The most feature aspect of this picture is the current collection region in the center, which is somewhere less than the whole of the surveyed district, with high a current velocity of the southern course taken by a moving object (at up to 0.75 m/s) in the western section of the cross-section district. Throughout the duration of the late fall period, the winds, which were familiarly stronger, were blowing mostly from the northeastern sectors (Fig. 5c). In late summer, the variable current regime was watched carefully with a small domination of southern to western winds with speeds of up to 1.1 m/s. Some of the two-dimensional space grids are empty, with no currents, chiefly spread out toward offshore. A possible reason for this is the shielding effect of the island, which may narrow the signal as it passes by. However, this is different in the sea areas farther away, which may be ascribed to higher propagating losses in rough seas. The coverage efficiency of the offshore area within 10 km is nearly the same between the two wave maps.

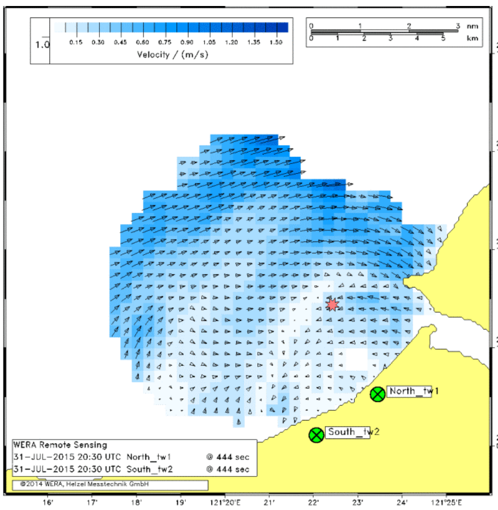


Figure 6: Surface current field from the Taiwan coast near Taipei in 2015, with the average time for acquiring the data was set to 30 min.

On July 31, a comparatively homogeneous distribution of the current velocity was seen. This is a response to an ordinary alongshore carry of the waters from one location to another along the northwestern course taken by moving objects. There is also a turn of the currents toward the shore in the coastal district. The spatial inhomogeneity of the current velocity distribution may be ascribed to changes in the wind situations throughout the measurement duration.

3. Conclusion

The radar system, WERA, supplies high-accuracy measurements, close to the data fabric of buoys, but with a considerably broader ocean surface coverage. The rate of availability of the measurement data is notably high, given that all of the proper tools are used, and an experienced staff is able to execte the first line of retention. With all considerations, It was shown in this study that a professional placement and maintenance of a coastal radar system can continuously provide careful and exact data.

References

[1] Barrick, D. E., Evans, M. W., and Weber, B. L., "Ocean Surface Current Mapped by Radar," Science 198 (1977) 138-144.

[2] Barrick, D. E., "Extraction of Wave Parameters from Measured HF Radar sea-echo Doppler Spectra," Radio Science 12 (1977) 415-424.

[3] Barrick, D.E., Evans, M.W., Weber, B.L., "Ocean Surface Currents Mapped by Radar," Science, [e-journal] 198 (4313), (1977) pp. 138-144. doi:10.1126/science.198.4313.138.

[4] Codar Ocean Sensors. 2016. SeaSonde Remote Unit Specifications and Configuration Op-tions. [online] Available at: http://www.codar.com/SeaSonde.shtml. [Accessed 10 May 2016].

[5] Chia-Ying Chang, Frederick N.-F. Chou, Yang-Yih Chen, et al. "Experiment test of an oscillating water column device of wave energy converter,"Conference on Chinese of Mechanical Engineering , (2014).

[6] Chia-Ying Chang, Frederick N.-F. Chou, Yang-Yih Chen, et al. "Experiment of a new style oscillating water column device of wave energy converter,"AIMS Energy , (2015) 421-427.

[7] Chia-Ying Chang, Frederick N.-F. Chou, Yang-Yih Chen, et al. "Analytical and experimental investigation of hydrodynamic performance and chamber optimization of oscillating water column system," Energy , (2016) 597-614.

[8] Helzel T., Petersen L., Mariette V., Thomas N., "Accuracy and Reliability of Ocean Current and Wave Monitoring with the Coastal Radar WERA," IEEE Oceans Conference Proceedings, Bremen, Germany, May 2009.

[9] Hasselmann, K., "Determination of Ocean Wave Spectra from Doppler Radio Return from the Sea Surface," Nature Physical Science 229 (1971), 16-17.

[10] Information of HR-Radar. 2016. University of Hamburg HR-Radar Home Page. [online] Available at: http://ifmaxp1.ifm.uni-hamburg.de [Accessed: 10 May 2016].

[11] Liu, Y., Weisberg, R.H., Merz, C.R., "Assessment of CODAR SeaSonde and WERA HF radars in mapping surface currents on the West Florida Shelf," Journal of Atmospheric.