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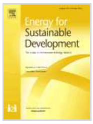

In situ near-shore wave resource assessment in the Fiji Islands

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Highlights

- Near-shore wave assessment was carried out at two sites in the Fiji Islands.
- A Directional Wave Recorder was used for the measurements.
- Both sites have a good potential for wave energy extraction.
- The directional spread at site 1 is considerably less making it a good potential site for a WEC.

Abstract

Directional wave measurements were carried out at two different near-shore locations in the Fiji islands with the help of an underwater pressure transducer — a Directional Wave Recorder. The primary site which is located in the west of the main island in Fiji has a moderate energy potential of 9.81 kW/m at a depth of 15 m. The second site which was the focus of past wave energy measurements was also studied and the new data along with previous measurements show high energy potential at this location. This site near Kadavu Island has a near-shore energy flux of around 28.78 kW/m at a depth of 18 m. The directional spread of the waves and the nature of their occurrence are presented. Additionally, the sea states during a category 2 tropical cyclone passing about 200 km from the measurement location are discussed.

Keywords

Near-shore wave resource; Directional Wave Recorder; Significant wave height; Wave power

Introduction

A mix of renewable energy resources is required to change the current trend of energy production. While wind and solar are proven renewable energy resources, the availability and intensity of these resources vary greatly over the globe. The success of renewable energy will lie in its diversification. Wave energy is an upcoming energy resource that can be a strong component in the renewable energy mix. The global wave power resource in water depths of over 100 m has been estimated to be 3.7 TW (Mørk et al., 2010) while the economically exploitable resource ranges from 140 to 750 TWh/year for current designs when fully mature, and could be as high as 2000 TWh/year if the potential improvements to existing devices are achieved (Survey of Energy Resources, 2007). Estimates suggest that conversion of wave resources alone could supply a substantial part of electricity demand of several countries such as Ireland, UK, Denmark, Portugal, Spain and others. According to the total incident wave power density available to the United States of America is 2100 TWh/year (Bedard et al., 2005). In Asia, country resource assessments of wave energy estimate a high value for this resource. According to the estimation of State Oceanic Administration of the People's Republic of China, about 125 GW of wave energy is technologically available in the near-shore in China (Zhang et al., 2009). In India, wave energy potential is placed at 6 GW for around 5914 km of coastline (Raju and Ravindran, 1997). While there can be a number of energy sources to use, it is important to choose the type of energy after a very detailed assessment of all the resources. In a study by Bağcı (2009) for the best mix for a “zero energy island”, the recommended energy mix after comparing six renewable resources was wind, solar and wave energy. As of 2010, 2 MW of wave energy capacity had been installed by the 18 member countries of the International Energy Agency (IEA) Implementing Agreement on Ocean Energy Systems (Ren21 Report, 2011). Many companies have directed their attention to wave energy. For developing island nations that have a large ratio of sea area to land area, wave energy itself may provide a suitable substitute over diesel for electricity generation. In the Fiji Islands, which has an effective EEZ bounded sea to land area ratio of 70 (Dunn et al., 2000), the deep sea wave resource on average is 26 kW/m (Barstow and Haug, 1994). Having a coastline of 1129 km, the potential for these islands stands at 29 GW. Even if 0.5% of this offshore resource is utilized, it will be enough to meet the entire nation's electricity demand. Similar opportunities exist for almost all island countries in the Oceania region. With less land area to construct utility scale wind and solar systems, wave energy is a better option for developing island nations. The capital costs of WECs are already reasonably low, and these are likely to reduce further as the industry expands and specialized industries emerge for

WEC sub-components (Beatty et al., 2010). Despite the low wave power potential in some locations, it must be stressed that the population's power requirements in these islands are not very high. Near-shore wave sites with naturally low potentials are nevertheless free energy available for extraction. Another issue that plagues these island nations is sea level rise as a result of climate change. With higher sea levels, incident waves are larger and this presents a hazard to low lying islands. Utilization of near-shore wave energy converters will help reduce the impact of waves on the shoreline to some degree as some of the energy will be absorbed by these converters. Wave powered desalination will also prove important to many islands which do not have rivers, receive little rain and/or no other natural source of fresh water. However, before any installations in wave energy are planned or any targets are set, a detailed wave energy resource assessment must be done; this is normally followed by an environmental impact assessment and steps taken to ensure that the impact on the surrounding area as well as on the marine life is minimized. The following sections detail the characteristics of near-shore waves in the Fiji Islands and its energy potential. The near-shore data are also compared against offshore measured data available from previous measurements and the differences are discussed. The near-shore wave energy potential for the Fiji Islands is ascertained and the effects of directional spread are discussed.

Early measurements and offshore wave energy

The wave energy resource assessment program for the South Pacific was initiated by the South Pacific Applied Geoscience Commission (SOPAC) in 1987. In 1991, a Waverider buoy was deployed off the south west coast of Kadavu at a depth of 356 m. The buoy collected useful data for more than two years. The results of this study can be found in the report by Barstow and Haug (1994). This was the first successful ıd was also useful in mapping the wave energy resource of the ırried out short term directional wave resource assessment at /latuku in 1994 (Deo, 1995). Barstow reported wave power ınths of March to July. Energy potential dropped after July and ranged from 15 kW/m to 20 kW/m for the months of August to February. There were significant effects of the El Niño climate phenomena on the results of the study, especially in the year 1992. Numerous cyclones passed over the region and hence influenced the wave characteristics. The study was carried out with the aid of the Norwegian Agency for International Development (NORAD). Following the end of this study in 1995, there was a lull in wave energy research in Fiji until 2002. SOPAC jointly with the US Wave Energy and the Fiji Department of Energy carried out near-shore wave measurements at Muani in Kadavu at a depth of 18 m (Mario, 2003). A bathymetric multi-beam mapping exercise was carried out in this area in the hope of installing a 500 kW wave energy module later. The raw data from the underwater pressure transducer was recovered from the Fiji Department of Energy to ascertain the wave energy potential in this area. A MATLAB code was written to analyze this non-directional data of sampling frequency and surface elevations. Spectral analysis was carried out on the data of six months.

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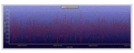
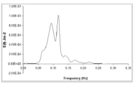
Table 1





The offshore wave energy potential reported by Barstow has been used to represent the wave energy potential in the Fiji Islands. While the offshore wave energy shows moderate potential which is more than required to meet the islands' electricity demands, construction of a wave energy device in offshore locations will be a major challenge for this developing nation. With numerous cyclones crossing the Fiji Islands EEZ, it makes the prospects of an offshore wave energy device to be almost impossible (South Pacific Cyclone Season, Wiki, 2012). While the benefits of wave energy utilization in terms of offsetting fuel imports are substantial, the initial capital investment and the high risk involved in offshore installations have deterred any further activity in offshore wave energy in Fiji. Offshore power plants would have high operation and maintenance costs along with added submarine transmission costs simply due to its distance from land. The devices will have a higher chance of damage or being lost during storms and cyclones. The remote islands are small and pilot-scale projects could be sufficient to meet the requirements of many communities. Offshore installations have higher associated capital input and risks at the gain of only some extra wave energy. For this reason recent studies have been focused mainly on near-shore wave energy resource assessment. Offshore waves can be classed as deep water waves where wave particle orbits are circular while nearshore waves are shallow and intermediate whereby particle orbits tend to be elliptical. Nearshore or shallow water waves are affected by the sea bed profile unlike deep water offshore waves. The shallow water waves are also defined to have a depth which is less than 1/20 of the wavelength of the wave.

Near-shore wave energy

Recent studies have shown that near-shore wave resources are not only easier to exploit but also not significantly lower compared to the offshore values (Folley and Whittaker, 2009, Cornett and Zhang, 2008 and Near-shore vs offshore and Waveroller, n.d). Waves propagating from offshore to near-shore region undergo various transformations such as shoaling, refraction, diffraction and reflection (Kim et al., 2011). The propagation directions of shoaling surface gravity waves change owing to refraction by spatial variations in water depth (Herbers et al., 1999). The near-shore resource has often been considered as simply a less energetic version of the offshore resource. However, the interaction of the seabed with the incident waves and the surrounding landmasses changes the characteristics of the wave climate from the offshore to the near-shore (Mirfenderesk and Young, 2003) so that a simple scaling of the wave climate inadequately describes the near-shore wave climate. The loss in wave energy amounts to around 7–22% of the energy available offshore (Folley and Whittaker, 2009) and can be attributed to the sensitivity of the wave to bottom conditions after a certain depth. This is a very small loss compared to the difference in depths for offshore and near-shore waves. It is inherently important that the mechanism of wave energy loss be understood properly so that a sound decision can be made on the location and design of a possible WEC. Waves propagating over a bed lose energy due to interaction with the bed. One of the most important dissipative mechanisms is associated with bed friction, which causes a thin boundary layer to develop above the ocean bed (Mirfenderesk and Young, 2003). As waves enter shallow water from deeper water, the waves transform and as a result, the height, length and celerity of the wave change. Refraction involves wave direction and height changes due to depth variations (Dean and Dalrymple, 1991). It causes the wave to align to the shoreline and loose its multi-directional propagations. At some locations where bottom configuration suddenly changes (or a barrier is present), a part of the wave is reflected and another part is transmitted (Horikawa, 1978). Wave shoaling causes a reduction in the wavelength and the speed of propagation of the wave. The period of the wave remains unaltered. Shoaling causes an increase in the wave height which in turn increases the wave steepness and leads to wave breaking. The largest energy loss suffered by offshore waves approaching the near-shore region is by energy dissipation through bottom friction. The study by Folley and Whittaker (2009) also reveals a 44% reduction in omni-directional wave resource which is good for directionally sensitive WECs such as the popular oscillating water column (OWC). Iglesias and Carballo (2010) used the SWAN coastal model to transform offshore buoy data to a near-shore region for selection of a wave energy farm using hindcast data. This is a common way to estimate near-shore wave energy resources. The extent to which wave energy reduces from offshore to onshore locations depends on the nature of the seabed and other factors at that location. While it was clear that near-shore wave energy devices are less expensive, easier to maintain and had a much longer lifetime — it can be seen from recent research that near-shore wave power potential differs very little from offshore energy potential. On an overall assessment, which includes the feasibility of installing the first wave farm in a region, a near-shore wave energy assessment is thus more useful. The method of in situ wave measurements for two near-shore sites in Fiji and the analysis of data for these sites are detailed in the following sections.

Directional wave measurements — method

The Fiji Islands group consists of 332 islands and is situated to the North East of New Zealand. Fiji enjoys a tropical climate with little temperature variation between summer and winter seasons. The summer months are November to April while winter is from May to October (Mataki et al., 2006). The wave energy resource assessment in Fiji has recently been initiated by the University of the South Pacific in partnership with the Fiji Department of Energy to ascertain and map the available wave energy in the country. The data will help in selection and/or design of possible WECs. A Valeport Midas Directional Wave Recorder (DWR) was used for the measurements. The Midas DWR contains a high accuracy piezo-electric pressure sensor for water height measurements. In addition to this, the DWR contains a flux gate compass and a Valeport two axis Electromagnetic current sensor. A PRT type temperature sensor was also active and was used to record temperature readings at the location. The DWR used 32 D-sized batteries which needed to be replaced every month. A rigid frame made of 316-grade stainless steel was used to house the DWR and was light enough to be lowered and raised out of the water for data collection and battery change. Measurements were performed at two sites. The locations of the two sites are given in Table 1. The two sites were chosen based on visual observations of wave activity at the sites, ease of access to the sites (depths were measured along with distance from the shoreline) and the population near these sites. Deeper locations with dangerous underwater rip currents were also viewed but dropped since divers would not be able to access the device easily.

Table 1.

Description of the two wave measurement sites.

Site	Latitude	Longitude	Depth, m	Distance from shore, m
1	18°12′10.32″S	177°39′19.75″E	15	668
2	19°9′52.80″S	178°8′39.34″E	18	900

Table options

Site 1 is located in the west of Fiji near the main island while site 2 is located on the southern side near the island of Kadavu. Measurements started at site 1 and following 14 months of measurements, the second site was investigated. Site 2 has been the focus of wave energy studies in Fiji in the past. It is far away from the mainland and this remoteness allowed only a short period of assessment at this site. The pressure transducer type DWR is more suited to shallow depths, as the strength of the pressure signal reduces and the effect of noise increases with increasing depth. The pressure transducer type of wave measurement device carries an inherent advantage in that it is not likely to be swept away by strong waves unlike surface mounted devices such as buoys. Since the region has frequently occurring cyclones in summer, the underwater pressure transducer reduced the chances of damage or loss of measuring equipment. The individual site depths are shown in Table 1 and the site locations are shown in Fig. 1. The DWR settings were the same for both sites. A sampling frequency of 1 Hz was selected to sample data for 1024 s. A 1 Hz frequency ensures that waves of up to 0.3 Hz (3.33 s) can be recorded accurately. Since waves caused by meteorological events lie in the period range of 7–15 s, this sampling frequency made optimal use of memory and batteries for long term deployment. The DWR had to be resurfaced every month and then submerged after data was retrieved and the batteries replaced. As a result of this planned downtime, there were some gaps in the results. These gaps range from a few hours to a few days. The longer periods of missing records are due to cyclones during the summer. For the times that the DWR recorded cyclone generated waves, these data had been removed to avoid biasing the energy potential at the site. Hence the data recorded during storm activity would not have been useful in characterizing the wave energy potential and these gaps should not be a major influence on the results.

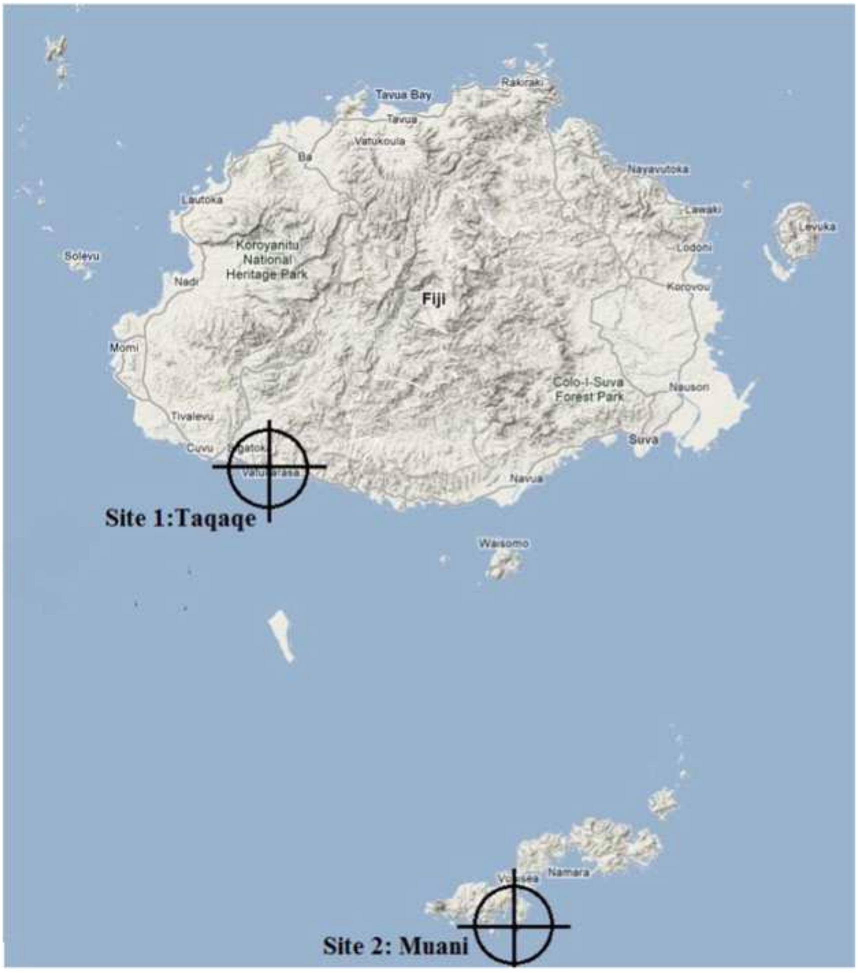


Fig. 1.

The two near-shore wave measurement sites.

Figure options

Bathymetry data was also sourced for site 2 while the bathymetric mapping for site 1 is currently underway. The bathymetry is useful both for the design of WEC and also for explaining the nature of the near-shore waves.

Data collation and analysis

The DWR recorded data were in binary format and these data were analyzed using WAVELOG400 and Wave Express software. This section presents the resulting useful wave data from the DWR for the two sites. The analysis of raw data to give useful characteristics such as significant wave height (Hs), period, and mean direction requires spectral analysis. Fig. 2 shows the variation in wave height for a random set of 1024 samples. Since multiple waves exist in the sample a spectral analysis is done by applying a fast Fourier transform (FFT in most cases). Using the frequency analysis and mean pressure, all raw data were passed through the reverse Fourier transform to back calculate the surface elevation for every sample in the burst. Defining the wave number spectrum E(k) as:

$$E(k)=\int_0^\infty E(k,\theta)d\theta \quad (1)$$

Turn on

where k represents the wave number and θ represents wave direction. Then using the correlation between frequency and wave number from the dispersion relation we can define the frequency spectrum E(f) as:

$$\int_0^\infty E(f)df=\int_0^\infty E(k)dk \quad (2)$$

where f represents frequency. Fig. 3 shows a sample frequency spectrum from a burst of the Kadavu (site 2) wave data measured using the DWR. Noting that Eqs. (1) and (2) are non-directional spectra or 1D spectrum. Based on the wave data analysis in many studies many theoretical expressions for E(f) have been proposed including Pierson–Moskowitz and JONSWAP among many others.

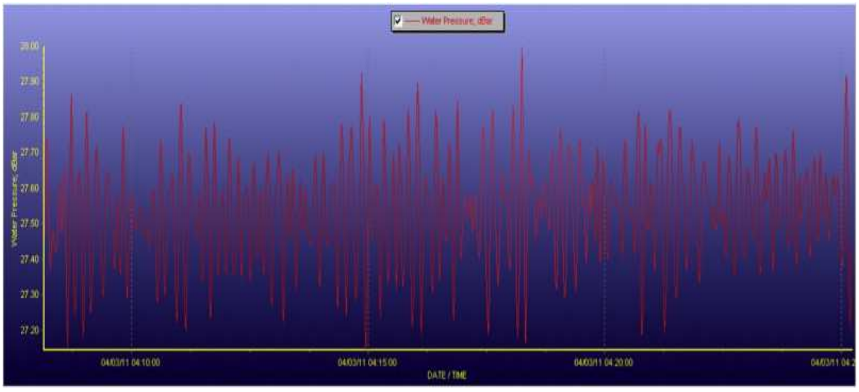


Fig. 2.

Water surface re-creation of bursts by Wave Express software. The atmospheric pressure also adds onto the result and is subtracted for analysis.

Figure options

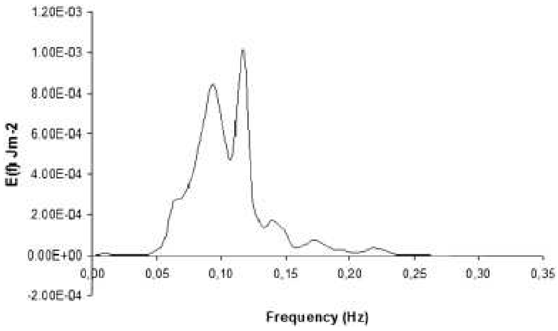


Fig. 3.

Sample wave spectra for site 2 at a depth of 18 m.

Figure options

Using the data from the DWR, there is no need to apply a theoretical spectrum model since the data provides a spectrum to define the sea state in each burst. When the frequency spectrum is given, the nth moment of the spectrum at the origin m_n is defined by:

$$m_n = \int_0^\infty f^n E(f) df. \tag{3}$$

Statistical theory shows that the mean period (T_m) in seconds can be found as:

$$T_m = \sqrt{\frac{m_0}{m_2}} \tag{4}$$

where m_0 and m_2 can be found by replacing 'n' in Eq. (3) with the values n = 0 and n = 2 respectively. For the case of m = 0 the equation becomes

$$m_0 = \int_0^\infty f^n E(f) df = \sum_{n=0}^{\infty} \frac{1}{2} a_n^2 \equiv \frac{E}{2}. \tag{5}$$

Using energy, E, from Eq. (5) the significant wave height ($H_{1/3}$) in meters can be found as (Horikawa, 1978):

$$H_{1/3} = 2.83\sqrt{E}. \tag{6}$$

Different studies have developed different expressions for deriving Hs from the spectrum. Another useful information from the spectrum is the Peak Period (T_p) which corresponds to the peak frequency. Once the wave characteristics had been found, the wave energy density in the area was estimated along with the directional spread of this energy. The wave energy at the sites was estimated using the following equation:

$$P = \frac{1}{8} \rho g H^2 c_g \tag{7}$$

where c_g is defined for any finite depth of water (depth = h) as:

$$c_g = \frac{1}{2}\left[1 + \frac{2kh}{\sinh 2kh}\right] \frac{gT}{2\pi} \tanh(kh). \tag{8}$$

Results and discussion

Gross wave power density

Following wave data analysis to obtain the wave characteristics, the data were checked for quality. Unusually high waves that had resulted from cyclones in the vicinity of the DWR were removed from the data sets. Similarly, the data contained "dry readings" or readings taken by the DWR while it was out of the water. This was due to the fact that the DWR had to be activated before deployment and deactivated after retrieval from the seabed. The early activation and prolonged deactivation had caused the device to take readings while it was out of water. These values were easily discarded as the pressure always corresponded to atmospheric pressure and immensely large periods were recorded. The time for deployment and retrieval was noted and this was also used to cross check the data before discarding. Following quality inspection of the data, the resulting wave height, period and direction were used to characterize the wave energy potential at the sites (Table 2).

Table 2.

Summarized wave power at the two sites.

Site	Hs (mean), m	Hs > 1.5 m (% of time)	P kW/m (mean)	P > 10 kW/m (% of time)
1	1.23	25.6%	9.81	40%
2	2.6	78.5%	28.78	87.5%

Table options

A sample frequency spectrum at site 2 is shown in Fig. 3. The two peaks of the spectra are also interesting to see at this site which is near a surf zone. The peaks arise as the deep water waves transform under shallow water conditions. One of the two peaks may be the cause of second order Stokes type bounded waves (Bendykowska and Werner, 1998).

Fig. 4 and Fig. 5 show the complete data sets of significant wave heights for site 1 and site 2 respectively. Site 1 was selected after visual observation of wave activity at this site. There is a growing population center at site 1 and the demand for electricity is high. Wave activity was monitored and recorded for fourteen months at site 1. From its start in October 2009 to its conclusion in December 2010, site 1 recorded moderate wave occurrence with the exception of occasional swells. The average significant wave height for site 1 was 1.23 m. The highest wave heights were recorded at site 2 with the average significant wave height recorded as 2.6 m with a standard deviation of 0.9178 m. Fig. 6, Fig. 7 and Fig. 8 show the monthly trends at the primary site, site 1. A drop from October to January is shown in 2009 and this corresponds to the hot summer months in Fiji. From January to June, the wave energy increases and slumps in July. Wave heights dropped as summer approached in 2010 and continued to drop till December. The wave period in the same duration had increased (Fig. 7) possibly due to the swells caused by distant storms in this region.

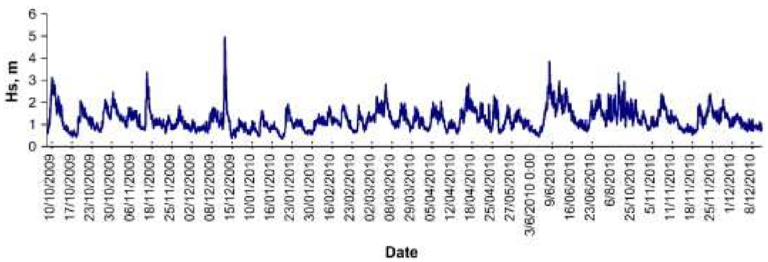


Fig. 4.

Significant wave heights at site 1 for the entire period of measurement.

Figure options

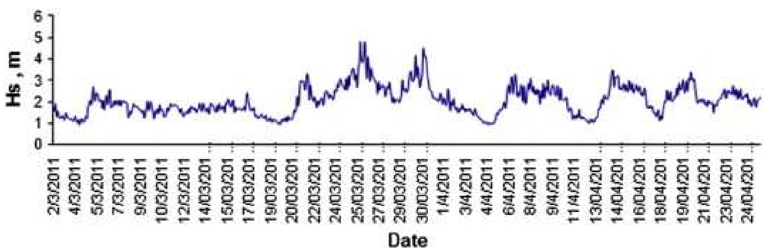


Fig. 5.

Significant wave heights at site 2 for the entire period of measurement.

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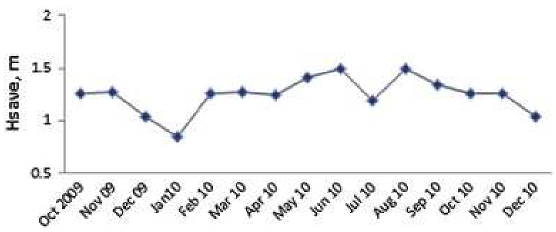

Fig. 6.

Monthly averaged significant wave heights at site 1.

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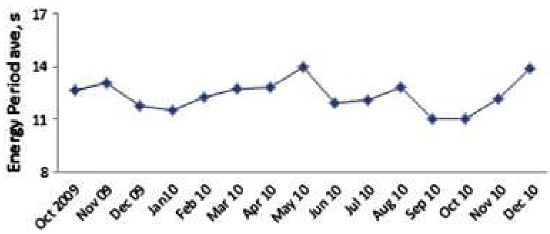

Fig. 7.

Monthly averaged wave periods at site 1.

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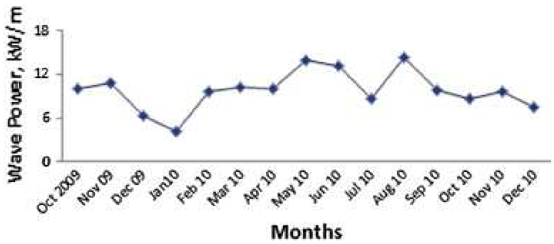

Fig. 8.

Monthly averaged wave power at site 1.

Figure options

Fig. 9 shows the wave power density at site 2. Site 2 has high wave energy potential in the near-shore region. The overall trend of available energy potential is similar to that of site 1. A gradual increase from March onwards in the winter months and a decrease as summer approached. Values as high as 37 kW/m (June 2002) were recorded at site 2 while the lowest measured potential of 24 kW/m (September 2002) is still higher than the average at site 1.

Fig. 9.

Monthly averaged wave power at site 2.

Figure options

The contribution of each sea state to the overall wave power is seen in Fig. 10. The power isobars show how the significant wave height and period affect the available power at the site. For 0.1% of the time, a wave power density of more than 100 kW/m occurs (excluding cyclone generated waves), wave power density of above 80 kW/m occurs 0.2% of the time; 2.2% of measured data showed power above 40 kW/m while 13.52% was above 20 kW/m.

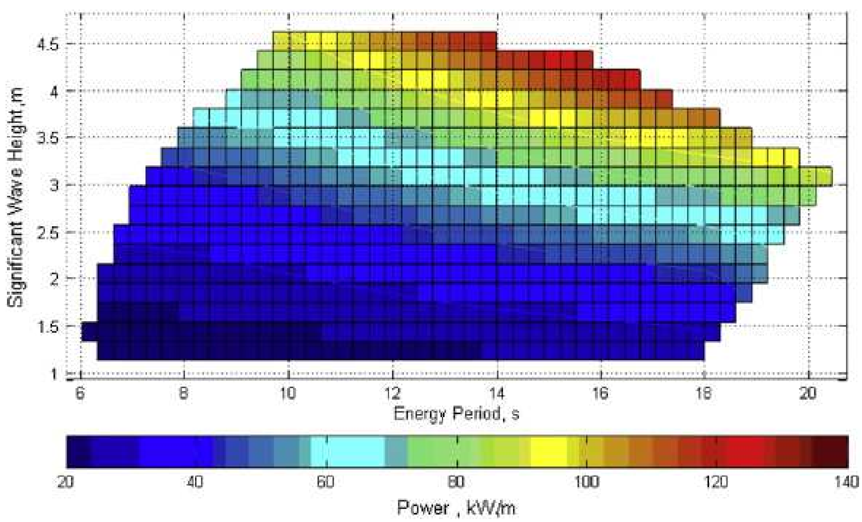

Fig. 10.

Significant wave height and period at site 2 corresponding to the occurrence of different power values characterized by the color of the bins.

Figure options

Fig. 11 shows the seasonal incoming wave direction at site 1. It is natural for near-shore waves to lose their multidirectional nature and converge nearly orthogonal to the shoreline. The directional rose shows that during summer, the waves generally came from the SSW direction but during the winter months the directional spread of incoming waves increased. Wave activity from the SSW combined with SW direction waves. The wave heights were higher as well. During summer months the waves are mostly dominated by mix of sea breeze activity and distance swells which do not disperse the incoming waves so much. During winter the southeasterly winds are stronger and dominant in wave generation, thus creating higher and more directionally spread waves. The wave rose for site 2 (Fig. 12) shows directions spreading from SE to SSW. The waves at site 2 were more energetic than those at site 1, as shown in Fig. 13. This could be due to the fact that while site 1 is located 668 m from the shoreline, site 2 is almost a kilometer out from the shoreline and deeper by 3 m. The effect of bottom friction and other shallow water dissipative mechanisms are bound to be greater at site 1 than at site 2. Hence the waves at site 2 are more similar to offshore waves, being more energetic and multidirectional in nature. The directions are however not as much spread as offshore waves due to some effect of the shallow depth. Similar results are also shown in the scatter plots in Fig. 14.

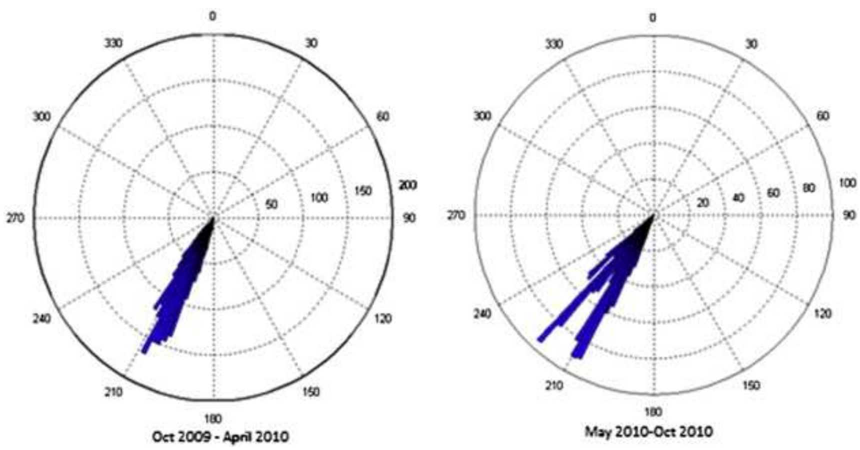

Fig. 11.

The wave rose indicates that most if not all of the waves at site 1 during summer came from the South West.

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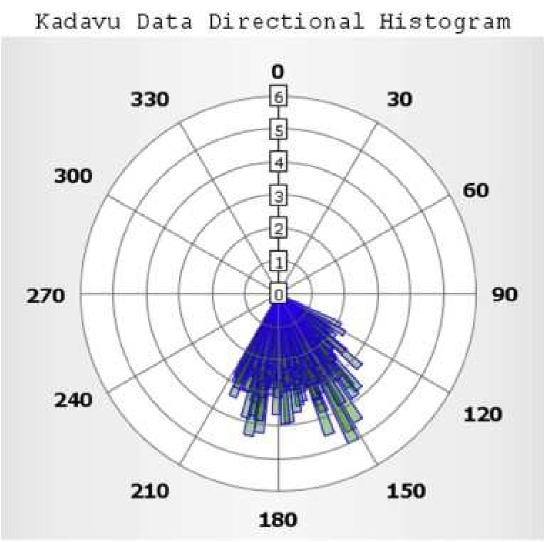

Fig. 12.

Directional rose of incoming waves at site 2.

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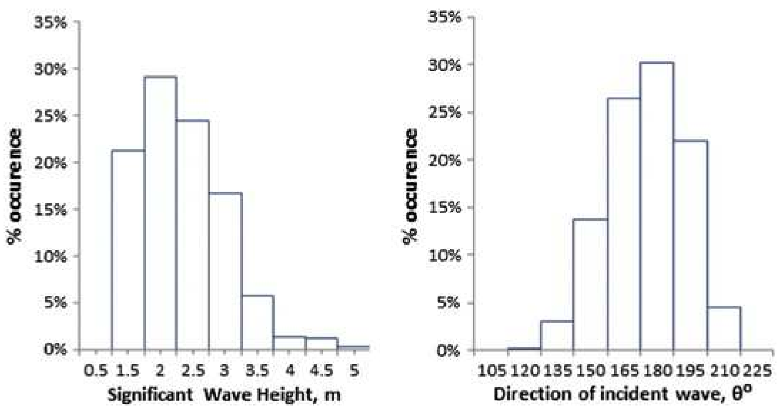

Fig. 13.

Percentage occurrences of wave heights and directions at site 2.

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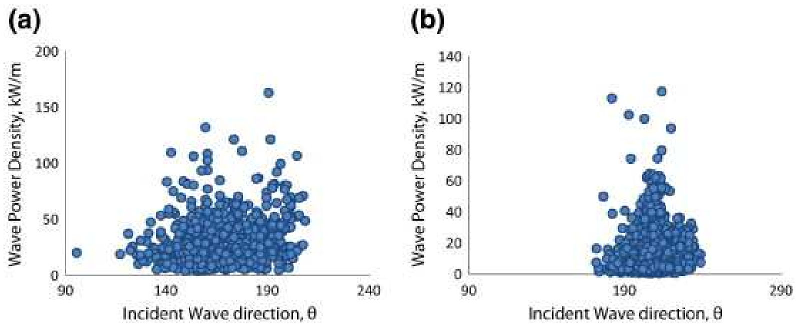

Fig. 14.

Scatter plot of wave power density and incoming wave direction. (a) Site 1 and (b) site 2.

Figure options

While average values of direction and wave heights are important, the statistical probability of a sea state occurring also needs to be established. This can be done by applying different spectral models suitable to this part of the region. However, the occurrence is much more easily and accurately seen through the measurements at the site. At site 2, 29% of the waves has heights between 1.5 m and 2 m while 30% of the waves come in from the south.

Cyclones and climate anomalies during this period

Although cyclone season normally starts in November, for 2009 the cyclone season for the South Pacific started in December (South Pacific Cyclone Season, Wiki, 2012) and ended at the start of May. The region experienced 15 tropical disturbances out of which there were 8 tropical cyclones. Of the 8 cyclones in the region, three were category 4 while one was ranked category 5. The El Niño effect was prominent between 2009 and 2010 and this caused an increased number of disturbances and change in the cyclone season. The effects of climate change will continue to affect the weather pattern in this region. The present assessment captured wave data while a category 2 cyclone (TC Mick) passed nearby in December 2009. The cyclone passed approximately 200 km from site 1, making landfall on the main island as it passed. While the wave heights recorded during the cyclone were not included in the estimation of available power, these data are still vital for the development of a WEC. The data give some idea of the conditions that a WEC has to withstand while in operation at the site. Fiji is prone to frequent cyclones and knowledge of the wave characteristics during rough seas is gathered from this data.

The maximum wave heights (Fig. 15) during cyclone Mick reached values as high as 7.7 m. However, these storm waves were short-lived and lasted only a day. The waves were strong enough to do serious damage to coastlines and possible WECs that would be located at the site.

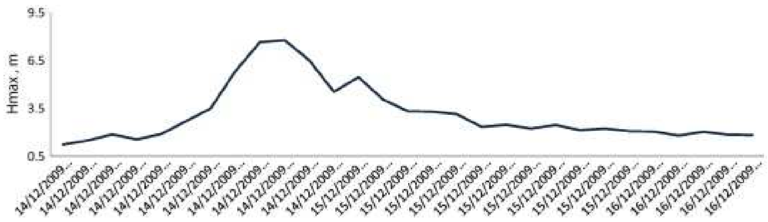

Fig. 15.

Maximum wave heights at site 1 during cyclone Mick.

Figure options

The wave period during the cyclone (Fig. 16) was low. As the cyclone passed, the wave period dropped to as low as 6 s. Naturally as a wave starts, the period is low, and as it propagates with the wind, the period increases. For the storm waves which were generated by cyclone winds very close to the site and hence, while the waves were very high, the periods were low. Similar observations were made by Kumar et al. (2004).

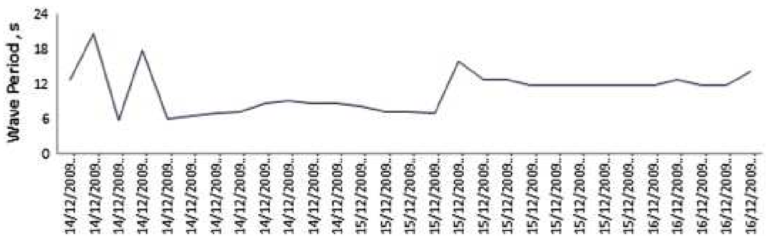

Fig. 16.

Wave period at site 1 during cyclone Mick.

Figure options

In addition to withstanding severe storm winds, any WEC operating in this area will have to be structurally stable to withstand the maximum wave heights of 7.7 m or more. The structure, along with the mechanical and electrical components, must be ready to absorb or control incident wave power flux of the order of 280 kW/m (Fig. 17). Appropriate cut-offs and controls will be required to handle the highly energetic sea states that will occur during cyclones. As mentioned earlier, tropical cyclones are common to this region and any WEC must be built with the nature of these cyclones and storms in mind.

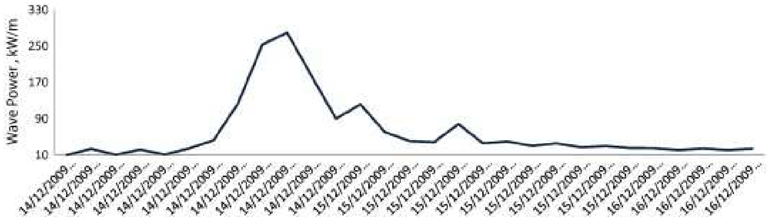

Fig. 17.

Maximum wave power at site 1 during cyclone Mick.

Figure options

Conclusions

The near-shore wave energy resources at two sites in the Fiji Islands are presented and discussed after measurements using directional wave recorders. The underwater pressure transducers which were mounted below 20 m depth showed that the energy available in the near-shore region is sufficient to meet the electricity needs of the nation. The first site (site 1) has an average significant wave height of 1.23 m. This was ascertained after 14 months of measurements. The average power at this site is around 10 kW/m at a depth of 15 m. Due to the near-shore location of the site, the directional spread is reduced and majority of the waves arrive at the site from the west south west (WSW) direction. For 60% of the measurement duration, the wave power was above 10 kW/m at site 1. At site 2, an average power of 29 kW/m is available. For the same site a two month (March to April) directional measurement in 2011 shows average wave power density of 29 kW/m; however, there is greater directional spread between southeast and southwest directions. While the value of the offshore wave energy is reduced in the near-shore region, the extent of reduction is location-dependent. Both site 1 and site 2 hold promise of supporting fixed devices normal to the incoming waves in these shallow depths. Following these studies further analysis will need to be carried out at site 2, which has more energy available to devices. A Bathymetry study of the area is recommended along with feasibility study for installing a pilot WEC. The study also proves beyond doubt that wave energy has a potential for development in Fiji. Devices such as oscillating water columns and the Oyster WEC are mature and suitable for these sites. Recommended further work includes custom designed WEC specific to the two sites as each site has its unique characteristics.

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