PAN AMERICAN MARINE ENERGY CONFERENCE PAMEC 2020

Book of abstracts

Edited by Dr. José Rodrigo Rojas M and Dr. Carlos Meza

PAMEC 2020

Pan American Marine Energy Conference

Costa Rica

PROCEEDINGS OF THE FIRST PAN AMERICAN MARINE ENERGY CONFERENCE

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Contenido: Este libro incluye los aportes presentados en la Primera Conferencia Panamericana de Energía Marina que se desarrolló en San José Costa Rica, del 26 al 28 de enero de 2020. PAMEC 2020 tiene como objetivo fomentar el desarrollo de energías renovables marinas mediante la colaboración entre investigadores, desarrolladores y proveedores de América y otros continentes.

1. ENERGÍA MARINA 2. COSTA RICA 3. INVESTIGACIÓN 4. ENERGÍAS RENOVABLES 5. COOPERACIÓN INTERNACIONAL 6. INNOVACIÓN 7. NUEVAS TECNOLOGÍAS 8. LIBRO DIGITAL

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Content

TECHNOLOGY: PRESENT

TECHNOLOGY: EMERGING

STORAGE AND INTEGRATION

BUILDING SOCIAL AND POLICY SUPPORT

Foreword

Costa Rica is a small country in territory but big in commitment to the environmental future of the planet and has lofty sustainability goals with a running climate change policy, an economy decarbonization strategy, and a long promise to keep producing 99% of clean electricity from hydropower, onshore wind, geothermal, biomass and solar energy. In the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity, the country boost a non-conventional renewable energy portfolio with a road map on offshore energy. We know that ocean energy is still in its infancy, and this sector has to overcome a number or challenges to prove the reliability, affordability and accessibility. Despite this, the oceans represent a source of plentiful energy potential, able to driving a blue economy and provide significant socio-economic opportunities, such as jobs creation, improved livelihoods, local value chains and enhanced synergies between coastal stakeholders.

But before I go further, I have the privilege of presenting the book with the summaries of the first Pan American Marine Energy Conference, PAMEC-2020. An international event, held in last week of January, that we gave high priority from the beginning, not just because it is an important theme for our ministry, it's because we believe in the sustainable use of the ocean as a significant reservoir of renewable energy, resilient to climate change and low in emissions of greenhouse gases effect. In fact, energy is a key component of both the sustainable development and climate goals. PAMEC-2020 served as an effective international vehicle for dialogue, co-operation and coordinated actions to accelerate the uptake of offshore renewable in benefit of the glocal energy transformation. The event provided a forum where those at the forefront of technology development in the sector met, interacted, shared their latest knowledge and debate new ideas and issues related to different perspectives of wave, offshore wind, ocean thermal energy, salinity gradient, currents and tidal energy conversion with a focus on building and strengthening research and development ties in the Americas, and globally.

Finally, I want to re-affirm the Costa Rica government's actual, long-term commitment to ocean energy and the exigency to face, at least, five main bottlenecks: technology development, finance sources, environmental and social acceptance, marine supply chain issues and field data gaps. Now is the time to take actions. Now is the time for bold steps. Now is the moment that we show the planet what can be done. PAMEC-2020 is a great example of governments, academy, NGO´s and private industry running as one to achieve a common ocean energy goal. The progress of the sector we owe to this type of alliance. However, we cannot afford to rest now. The move toward renewable offshore energy is already underway, it is unstoppable and it is inevitable.

Thank you very much for the very kind invitation, which I very much appreciate.

Carlos Manuel Rodríguez E.
Former Minister
Ministry of Environment and
Energy of Costa Rica

MINAE
Ministerio de Ambiente y Energía

Salinity gradient determination on the Mexican Caribbean Coastal zone and the technical viability to generate blue energy

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Keywords: *Mexican Caribbean, fresh water discharging, saline gradient, monitoring, energy potential.*

This research is focused around freshwater discharges to the sea that according to measurements, indicate, at least salinity gradients up to 35 ups with temperatures of approximately 26`C. these discharges (volumetric flow rate) coming from the basin, vary in time: inter-annual, seasonal; it is even different from day to day, mainly because of different forcing that impact the sea level variability due to wind, tides, air pressure or even sea temperature, among other reasons. These freshwater discharges are usually clear in appearance; however, they contain carbonates, pollutants coming from the basin and generally, they have a lower temperature than the sea. It is essential to mention that through Quintana Roo coasts, several discharges with volumetric flow rates can be found, the vast majority of them have not been neither measured nor kept a record, there are not even systematic measurements of physical, chemical or biological criteria, for instance. In this regional context the energy potential evaluation of salinity gradient is a matter that could lead to provide more information t other research areas as well as environmental, social, hydrological areas, etc. measured discharges in this research are in the range of 250 liters per second -Punta Esmeralda en Playa del Carmen-, up to 5000 cubic meters per second, Cenote Manatí close to Tulum- however, other locations with the same or larger scale have been observed. These potential locations were monitored with CTD-Castaway equipment and current meter, both belonging to Universidad del Caribe, data obtained by the CTD profiler were processed in the software Castaway, having graphics related to depth, salinity, and temperature of every and each of the measured spots. The volumetric flow rate was obtained by substituting provided data by the current meter in equations, equation 1 and 2, determined by FAO (2009). Potential values of 191.3kW and 2503.46kW were obtained.

INTRODUCTION

The energy extracted from the ocean is considered as a renewable energy source, with a major potential due to the earth is covered by 70% of the ocean (Siddiqui et al., 2015). Among the types of ocean energy, the generation of energy from saline gradient can be found (Vallejo, 2013).

Mexico has got a wide potential for this resource harvesting due to it is rich in rains that discharge in a large number of rivers that lead to the Pacific Ocean as well as in the Gulf of Mexico (Enríquez et al., 2018).

Although, there is not an existing technology so far, that allows generation of energy from saline gradients at an affordable cost, being familiar with this resource potential in places like Mexico, could call the technological development's world attention in order to make the process of producing blue energy more efficient (Enríquez et al., 2015).

The aim of this study is to focus on a non-performed diagnosis in the state of Quintana Roo, with the aim of taking part in the energy transition performed in the country, due to the performed studies have no generation of energy aims but rather they focus on knowing the quality of water, having an overview about the technical and social viability to generating and implementing equipment that provides blue energy as a result.

This diagnosis will be supported by the determination of the saline gradient in several water discharges, located on the Coastal zone of Quintana Roo, using measurement equipment

and other countries research estimates replica in order to know the technical viability to generate blue energy.

METHODOLOGY

The methodology of this study is divided into three stages, the first one consisting in defining the potential locations of the Mexican Caribbean north zone, creating a database provided by NOAA, Argo, Oceanographic monitoring service, and water quality studies performed on the Coastal zone of Quintana Roo.

On the second stage, saline gradients were measured, as well as temperature and mass flow on the potential locations by replicating the provided methodologies by FAO, (2009), applying the following equations:

$$Q = Ai \cdot V$$

$$\text{Total Area} = \sum (A_1 + A_2 + \ldots + A_9 + A_{10})$$

in monitoring campaigns by means of CastAway-CTD Sontek and WH-50 current meter, both belonging to Universidad del Caribe.

Lastly an energy potential evaluation was made in the monitored locations based on the Van't Hoff's equation:

$$P_{e(v)} = 2n \cdot \dot{m} \cdot c \cdot R \cdot T$$

RESULTS

Cenote Manatí, Tulum and Punta Esmeralda, Playa del Carmen, were the two potential locations monitored during june – october, 2019. Having the following results:

LOCATION	FLOE RATE	CAUDAL	SALINITY GRADIENT	TEMPERATURE	ENERGY POTENTIAL
Cenote Manatí	0.112 m/s	3.654 m^3/s	22 PSU	25.6 °C	2502.46 kW
Punta Esmeralda	0.1305 m/s	0.2142 m^3/s	31.1 PSU	28.1 °C	191.3 kW

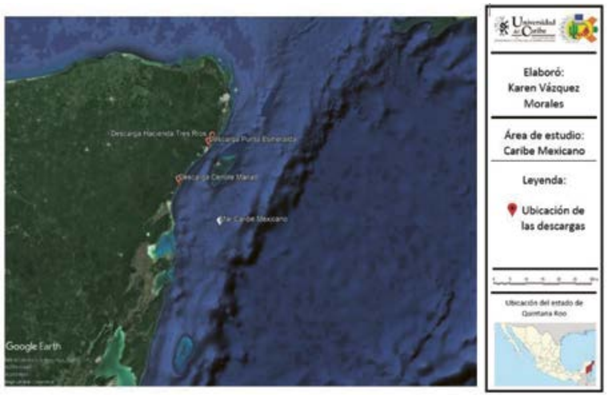

Figure 1. Location of the potential sites

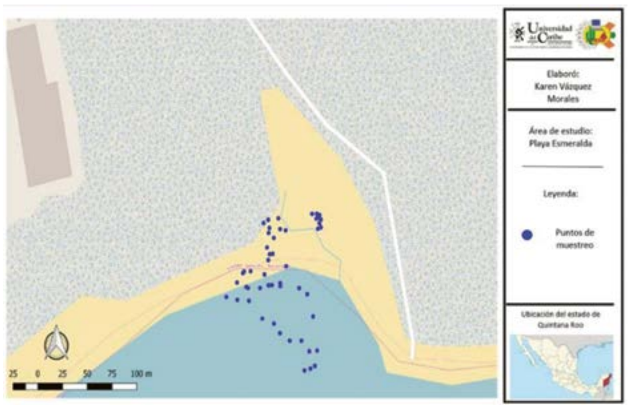

Figure 2. Sampling Sites, Punta Esmeralda.

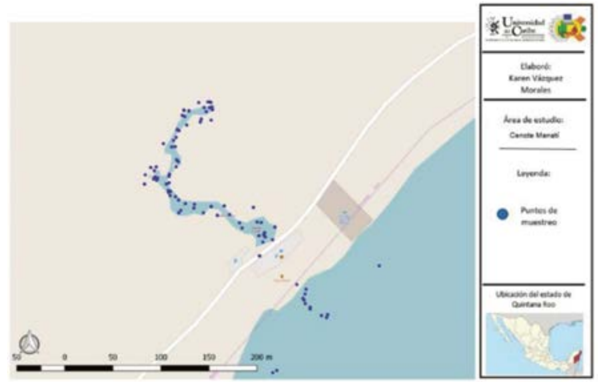

Figure 3. Sampling sites, Cenote Manatí

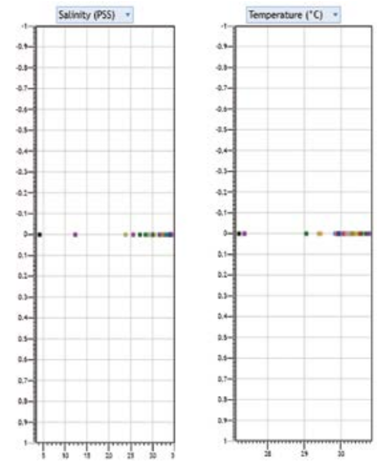

Figure 4. Salinity and temperature profiles, Punta Esmeralda.

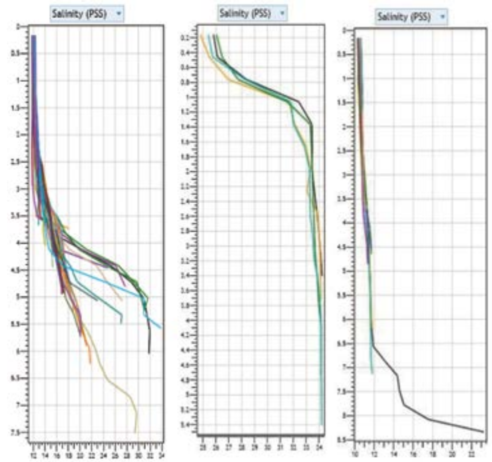

Figure 5. Salinity profiles, Cenote Manatí

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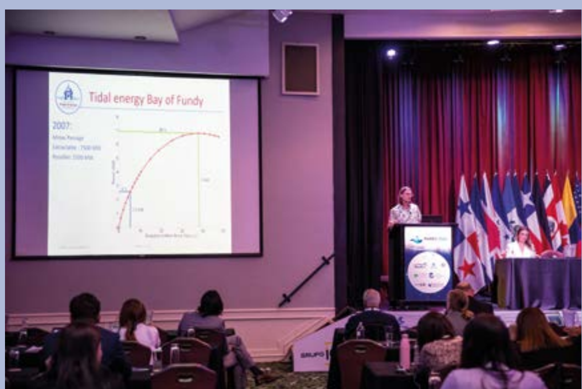
CONFERENCE PHOTOS



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CONFERENCE PHOTOS


FI Facultad de Ingeniería

The Pan American Marine Energy Conference, PAMEC 2020, was held in San Jose Costa Rica, from January 26 to 28, 2020. The conference is aimed to foster the development of marine renewable energy through investigation and cooperation among researchers, developers, and suppliers from America and other continents. Before and after the main event, were organized technical workshops in the University of Costa Rica. These workshops were supported by IMARES, UNED, Marine Renewables Canada, ITCR, UNA, ICE, Dutch Marine Energy Centre, Pacific Northwest National Laboratory, Ocean Energy Systems, MERIC, Acadia University, Sandia National Labs, NREL, FORCE and INORE.

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