Ocean Energy – Wave Power Potential

description

Ocean energy refers to the energy that can be harnessed from the ocean's tides, currents and waves. Waves are created by ocean winds that form as a response to the differential solar heating of the earth's surface and atmosphere. Because water is denser than air, ocean waves have very high energy densities relative to wind. The power of a wave is determined by its height, speed and length, and by water density.

There are a number of technologies currently in various stages of development designed to harness the energy created by ocean waves. These wave energy generators or devices are used in both the near shore and offshore environments, and capture the energy at the surface of the water or from pressure fluctuations in the water column. Available wave power varies considerably throughout the world's oceans and can also be highly seasonal. However, the north western coasts of the United States and Canada hold some enormous wave energy potential. Wave energy is a significant source of clean and renewable electricity and because waves are energy dense, substantial amounts of energy can be captured in small geographic areas.

There is an estimated 37,000 megawatts of potential wave energy distributed along the 1,000 metre isobath (an isobath is a line on a map connecting points of equal depth) along Canada's Pacific Coast, which is equivalent to over 55% of Canada's electricity consumption (Cornett, 2006). The west coast of Vancouver Island has attracted international interest as an area for potential wave energy development but many of these wave energy exploration sites have yet to prove their commercial viability.

This map shows the results of the Canada Wave Power Resources project led by the National Research Council's Canadian Hydraulics Centre (Cornett, 2006). The project, conducted by Triton Consultants, analysed data from 30 Pacific Ocean direct wave measurement stations (from Fisheries and Oceans Marine Environmental Data Services) and wind-wave hindcasts from the Northeast Pacific generated by the WAVEWATCH-III (WW3) model, a third generation spectral wind-wave model developed by Henrik Tolman, NOAA. (A hindcast is a method of testing a mathematical model by using input data from past events, allowing the model's output to be compared with the known results.) Each direct observation station provided thousands of month-to-month observations over seven years. Only buoys with greater than 300 days of good records were used in the model.

The data shown on the adjacent map were created using points from the WW3 hindcast model. The information on the map is presented as mean annual wave power in kW/m using 9 categories, each of which increases by 6 kW/m. Grey portions of the map are outside of the results of the model. Source data extends beyond the BC Marine Conservation Analysis (BCMCA) study area and was clipped to the BCMCA study area for the purposes of mapping.

PHOTO: JOCELYN MANDRYK

data sources

- Triton Consultants Ltd., for Canadian Hydraulics Centre of the National Research Council, Natural Resources Canada (funded by BC Hydro and Natural Resources Canada)

data resolution

- Points (nodes) from the WW3 model are situated 1 degree of latitude and 1 degree of longitude apart from each other; Closer towards the coastline, the density of sub-grid nodes increases to .25 degrees x .25 degrees.

date of analysis

- 2006

reviewers

- Jessica McIlroy, Ocean Renewable Energy Group
- Participants in the Renewable Ocean Energy Workshop (November 2008) provided comments on this map.

reviewer comments

- The map should be verified against up-to-date resource information found online at the Ocean Renewable Energy Group.
- This data is not reliable enough to use for long term planning due to resolution and the rapid advancement of technologies within the industry.
- This is not "bankable" data, it cannot be used to support appeals for financial investments in ocean projects. However it could be applied to specific locations by taking buoy measurements and applying bathymetry to tune the data in the model.
- There is room for improvement on how to estimate wave height.

caveats of use

- The wave conditions at any one site are highly variable over several different time scales.
- The map represents potential resources, not economically realizable resources. No consideration has been given to environmental impacts, technological developments or limitations, climate change, site location verses power grid accessibility and demand, the effect of potential energy extraction schemes on existing flow conditions / wave regimes, and economic factors.
- The accuracy of the wave energy data breaks down closer to shore, at water depths less than approximately 100-150 metres, due to sheltering and bathymetric effects such as wave shoaling, refraction and diffraction.
- Recommended date of expiry for use of these data in a marine planning context: 2015, although information should be verified against up-to-date information available through the Ocean Renewable Energy Group.

map, feature data and metadata access

- Visit *www.bcmca.ca/data* for more information.

references

- BCMCA *Renewable Ocean Energy Mapping Workshop report.* November 2008. *www.bcmca.ca/document-library*
- Cornett, A. "Inventory of Canada's Marine Renewable Energy Resources." *Canadian Hydraulics Centre, National Research Council.* CHC-TR-041. 2006. *www.oreg.ca/web_documents/chc-tr-041.pdf*
- Ocean Renewable Energy Group *www.oreg.ca*

142°W 140°W 138°W 136°W 134°W 132°W 130°W 128°W 126°W 124°W 122°W

54°N 52°N 50°N 48°N 46°N

Alaska

Nass River

Skeena River

Haida Gwaii

British Columbia

Fraser River

PACIFIC OCEAN

Vancouver Island

Washington

Inset Map 1:500,000*

Note: The inset has been provided to illustrate the level of detail available in the data. The inset is for illustrative purposes only and does not imply any significance to this region.

BCMCA Atlas

Ocean Energy
Wave Power Potential

Legend

Mean Annual Wave Power (kW/m)

- 1.1 - 7.9
- 8 - 13.9
- 14 - 19.9
- 20 - 25.9
- 26 - 31.9
- 32 - 37.9
- 38 - 43.9
- 44 - 49.9
- 50 +
- Area outside of the model results
- 1000 m iosbath

Data Sources:
Triton Consultants Ltd.,
Canadian Hydraulics Centre
of the National Research Council

Base Data:
ESRI Base Data, GeoBase, GeoBC,
NOAA, Natural Resources Canada,
USGS, Washington State Government

Thematic Data:
For more information on data sources and methods please refer to the facing page to this map

Projection: BC Albers NAD83

0 25 50 75 100 125 150
Kilometres

0 25 50 75
Nautical Miles

1:4,250,000 *

* Written scales are approximate and are based on a 11 x 17 inch paper size.

Prepared for:

BC Marine Conservation Analysis

Map template by Caslys Consulting Ltd.

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