

A GLOBAL WAVE ENERGY RESOURCE ASSESSMENT

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ABSTRACT

This paper presents results from an investigation of global wave energy resources derived from analysis of wave climate predictions generated by the WAVEWATCH-III (NWW3) wind-wave model (Tolman, 2002) spanning the 10 year period from 1997 to 2006. The methodology that was followed to obtain these new results is described in detail. The spatial and temporal variations of the global wave energy resource are presented and described. Several parameters to describe and quantify the temporal variation of wave energy resources are presented and discussed. The new results are also validated through comparisons with energy estimates from buoy data and previous studies.

KEYWORDS: global, wave, energy, power, resource, assessment, analysis, modeling.

INTRODUCTION

Global warming, the Kyoto protocol, the depletion of conventional energy reserves and the rising cost of electricity generation have sparked renewed interest in renewable marine energy in many countries. Significant advances in wave energy converters have been made in recent years, and there is a growing realization in many countries, particularly those in Europe, that these technologies will be ready for large scale deployments within the next five to ten years. Despite these exciting developments, the potential wave energy resource in many parts of the world remains poorly defined.

Pontes et al. (1997) observed that since the mid-1980s, numerical wind-wave models had been routinely producing good quality wave estimates and noted that these estimates are of great value for the assessment of offshore wave energy resources. They assessed the performance of two wind-wave models through comparison against buoy data, and selected the WAM model for use in the development of the WERATLAS, an atlas of European offshore wave energy resources.

The WERATLAS is described in Pontes (1998). It includes a wide range of annual and seasonal wave climate and wave energy statistics for 85 offshore data points distributed along the Atlantic and Mediterranean European coasts. The statistics result from analysis of outputs from the WAM wind-wave model, and data from several

directional wave buoys. While wave climate predictions for the Northwest Atlantic featured good accuracy, predictions for the Mediterranean and North Seas were less satisfactory.

Barstow et al. (1998) (also Krogstad & Barstow, 1999) obtained estimates of wave energy resources at a few hundred discrete points in deep water along the global coastline based on an analysis of 2 years of satellite altimeter data from the Topex/Poseidon mission (launched in 1992). In this analysis, significant wave heights H_s were obtained from the altimeter data, while the corresponding wave energy periods T_e required to compute wave power were estimated using a set of direct relationships between significant wave height and energy period. These H_s versus T_e curves were obtained from an analysis of buoy measurements from Norway, Portugal and the South Pacific. On average, one estimate of H_s and the corresponding T_e was obtained every 5 days over a two year period at several hundred points distributed along the global coastline. Despite the relatively short 2-year record length, the coarse 5-day sampling rate, and the somewhat subjective method of estimating wave energy period, the analysis succeeded in generating reasonable estimates of the spatial variation in mean wave energy off most coastlines. The global wave energy estimates obtained by Barstow et al. (1998) are shown in Figure 1.

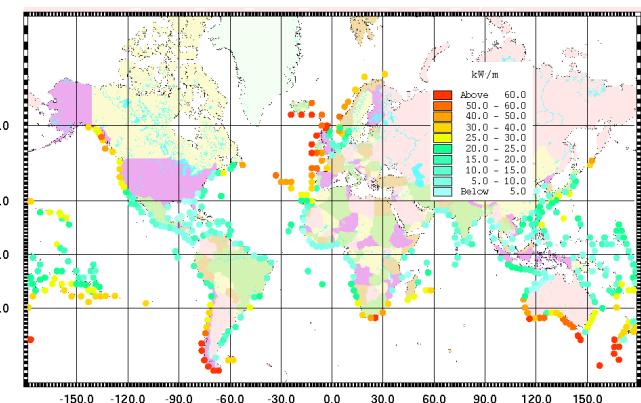


Figure 1. Global wave energy estimates from Barstow et al., 1998.

More recently, several authors have reported on more detailed wave energy resource assessments for particular regions or countries,