Spatio-temporal Behaviour of Wind and Sea States in the Hellenic Seas

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ABSTRACT

In this work, the spatio-temporal behaviour of wind and sea states in the Hellenic Seas is examined and described. The wind and wave hindcast data used in the analysis are in the form of a 10-year long (1995-2004) time series, obtained from the SKIRON-Eta weather model and the WAM wave model. The Gamma, log-normal and Weibull distributions fitted $H_S$ and $U_w$ data fairly well. The assessment of the auto- and cross-correlation functions of $H_S(t)$ and $U_w^2(t)$ revealed a stable behaviour of the wave process memory (3.5 - 4.5 days) and a more complicated behavior for wind speed. By examining the interannual variability of $H_S(t)$ and $U_w^2(t)$, a small ascending trend was found (of the order of 10-12mm per year for $H_S$ and 0.02-0.04m/s per year for $U_w$).

KEY WORDS: Wave and wind climate; process memory; wind and wave statistics; Greek Seas.

INTRODUCTION

In this work, the long-term spatio-temporal behaviour of wind and sea states in the Hellenic Seas is assessed and described. The 10-year period (1995-2004) wind and wave hindcast data for the examined have been generated by the improved non-hydrostatic SKIRON-Eta weather model and the 3rd generation WAM-cycle 4 wave model, using a spatial resolution of 0.1ºx0.1º and a temporal resolution of three hours. The meteorological input used for defining the initial and boundary conditions of the weather model were obtained from the analysis fields, produced at the European Center for Medium-Range Weather Forecasts (ECMWF). The application area of the wave model was extended from $7^\circ W$ to $42^\circ E$ and from $30.25^\circ N$ to $45.25^\circ N$. The particular geographical coverage has been considered adequate for the proper wave development and propagation simulation in the Mediterranean and Black Sea basins. The wind and wave data referring to the Hellenic Seas have been recently presented in the form of a Wind and Wave Atlas; see Soukissian et al. (2007a, 2007b).

The specific geographical area studied here is defined by the coordinates $19^\circ-30^\circ E$, $34^\circ-41^\circ N$ roughly comprising the Hellenic Seas. The most important results of the numerical models (wind speed $U_w$, significant wave height $H_S$ and wave spectral peak period $T_p$) were calibrated by using in-situ measurements referring to a joint time window from 1999 to 2004. The wind and wave measurements were collected from six (6) oceanographic buoys of the POSEIDON network (Soukissian et al., 1999), and used after the following filtering process was applied:

a) Filter out the sensors’ default value in the field of the record, indicating that the measurement procedure was not properly activated or implemented.

b) Exclude values remaining constant for more than three consecutive measurements in every, or some of the data base fields of wave and wind data.

The use of satellite data was avoided, due to the sparse spatial and temporal coverage of the Hellenic Seas from TOPEX/Poseidon and JASON; in addition, the reliability of the satellite data as far as the Aegean Sea is considered, has been described as inadequate (Eurowaves Group, 2000).

14 grid points (indicated as H1-H14 in Fig. 1) scattered over the examined area are selected for the analysis presented hereafter. Nevertheless, due to the need for a concise demonstration of the derived results, three geographically representative grid points (H3, H8 and H12) are finally chosen for analytical presentation. The three datasets corresponding to those grid points are statistically analyzed on an annual and seasonal basis, taking into account the prevailing wind and wave propagation directions.

The structure of this work is as follows: In the next section, a brief description of the main characteristics of the wind and wave climate in the Hellenic Seas is made. In the sequence, the seasonal and annual descriptive statistics of $H_S$, $T_p$ and $U_w$ are presented, along with the modeling of the stochastic structure of $H_S$ and $U_w$ by using the