

EMPIRICAL MODELS FOR THE CORRELATION OF GLOBAL SOLAR RADIATION WITH SUNSHINE DURATION ON A HORIZONTAL SURFACE IN SERBIA

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ABSTRACT

This paper presents an analysis of the relationship between global solar radiation and the sunshine duration at different locations in Serbia. Several regression methods, which were previously used by researchers, were used to analyze. The global solar radiations estimated from the ten models were compared with the measured values. The estimated values are compared with the measured values in terms of mean bias error (MBE), root mean square error (RMSE), and mean percent error (MPE). Results show that the second and the third regression models performed better than the other used in the paper. The proposed models show a good agreement with measured values of solar global radiation and could be used to other locations in Serbia where solar data are not available.

Keywords: Solar radiation, Empirical models, Sunshine duration

1. INTRODUCTION

The measured data of the solar radiation are the best form of this knowledge, but there are few meteorological stations that measured solar radiation, especially in developing countries. In Serbia, global solar radiation data on a horizontal surface is recorded at only 4 stations. For stations where no measured data are available the practice is to estimate global solar radiation from other measured meteorological parameters [1]. Several empirical models have been used to calculate solar radiation using variables such as extraterrestrial irradiance and measured and theoretical sunshine duration [2-8], air temperature, relative humidity, and wind speed and moisture.

In this an analysis of the relationship between global solar radiation and the sunshine duration at three different locations in Serbia are presented. The first purpose of the present paper is to validate those models for the prediction of monthly average daily global radiation on a horizontal surface from sunshine duration. The second objective is to test the performance of the presented models against the measured global radiation for selected locations.

2. MODELS AND DATA

For this analysis the measured data of monthly average daily solar radiation, sunshine duration and temperature are used from the Study of Energy Potential of Serbia, published by National Ministry of Science. The study was based on data collected over 34 years. Measurements of global solar radiation were performed with Moll-Gorczynsky pyranometers, while for the recording of sunshine duration Campbell-Stokes heliographs were used.

Ten different regression models proposed in the literature were applied in this study and presented in Table 1. Coefficient values for models were calculated from regression analysis between H/H_0 and S/S_0 , where H is daily solar global radiation on a horizontal surface, H_0 is the monthly average daily extraterrestrial radiation, S is the monthly average daily hours of bright sunshine (h), S_0 is the monthly average day length (h), a and b are empirical coefficients, ϕ is latitude and Z is altitude (km). The regression coefficients of the models 1, 6 and 8 for analyzing locations are given in Table 2.

