

Spatial distribution of global radiation on horizontal and on inclined surfaces in Slovenia

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The aim of our study was mapping the monthly mean global and quasi-global irradiation of horizontal and inclined surfaces in Slovenia with a 1 km resolution. The hourly values of global and diffuse solar radiation from the national measurement network for the period 1994-2003 were used as a base. Within this period, the global solar radiation received by a horizontal surface was measured on 14 locations in Slovenia and on 7 of them the diffuse part was measured simultaneously. Due to the geographical position of Slovenia in between the Mediterranean, the Alps and the Pannonian basin there is a large weather and climate variability over quite small distances and the measurement network of 14 locations in an area of 20,000 square kilometres is thus rather sparse. Therefore, solar radiation duration data measured on 15 additional locations in the same period were used as well, to estimate monthly mean global radiation using Angstrom's formula. For those data we used the Meteonorm programme for calculating the mean hourly values of direct and diffuse solar radiation. The Meteonorm validation was done on the basis of data from the locations where all of the three variables (the duration, the global and the diffuse energy) were measured and it was found that the correction factor should be used to reduce diffuse radiation by 20 % on average and to increase the contribution of direct solar radiation by the same amount. The mean decade hourly values were computed for direct and diffuse solar radiation on a horizontal surface for the mentioned 39 locations and these data were used by spatial interpolation into the regular grid with a 1 km resolution. The local regression models considering the geographical position and terrain elevation, with the inverse distance method of spatial interpolation of the regression model's residuals, were chosen as the interpolation method. The direct and diffuse solar radiation data computed for the horizontal surfaces were then used to estimate the global solar radiation on inclined surfaces considering the local geomorphology, which could influence the amount of solar energy received by the surface and the duration of solar radiation. The model

used is based on determining the incidence angle between the normal to the surface tangent plane and the direction of the sun. Two different approaches were used for shade determination – hill shades were determined on the basis of an incidence angle and cast shades were determined by comparison of a sun zenith angle with a zenith angle to the top of an obstacle. It was assumed that the diffuse radiation is isotropic, thus it was reduced proportionally to a sky-view factor. The Slovenian relief was represented with a resolution of 100 m and the final results with a resolution of 1 km were obtained using the median. Finally, the mean monthly values of global solar radiation on horizontal and inclined surfaces were mapped and compared with ESRA and PVGIS data.