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# On the use of GIS to improve MM5 solar radiation estimates in complex topography areas

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The topography is the most important factor in determining the local distribution of the solar radiation on the surface. The variability of the elevation, the surface orientation and the obstruction due to elevations cause great local differences in insolation and, as a consequence, in the climate. Usually, in complex-topography areas, solar radiation estimates are obtained using solar radiation models based on Geographical Information Systems (GIS). The "r.sun", which is based on GIS GRASS free software, is one of the most widely used of these solar radiation models and is able to provide solar radiation estimates taking into account the slope, aspect and elevation. Solar energy resources maps, with resolution up to 100 m, are usually obtained using these models, but the reliability of the maps are constrained by the fact of that these solar radiation models uses as an input synthetic or climatological solar radiation values.

On the other hand, fine-scale non-hydrostatic numerical models, such as the PSU/NCAR MM5 offers the possibility of obtaining solar radiation simulated data outside the observation points and with a horizontal resolution of up to 1 km. Additionally, MM5 is able to consider the effect of slope and aspect on these solar radiation estimates.

In this work we evaluated the combined use of GIS tools as "r.sun" and MM5 solar radiation estimates to improve the reliability of very high (100 m) resolution solar radiation maps in complex topography areas. To this end, we firstly obtained hourly global solar radiation values for clear-sky days based on several 1 km resolution MM5 simulations. The experiment was carried out for an area located within the Sierra-Magina Natural Park (Jaén, Southeastern Spain). This area is characterized by a relatively

complex topography, with elevations ranging from 600 to 2100 m. The experiment was conducted for three winter and three summer clear-sky days collected along the year 2006. Secondly, results of the MM5 simulations were provided to the “r.sun” in order to obtain 100 m resolution solar radiation estimates. Finally, “r.sun” simulations using and not using the MM5 estimates were tested against field data measured at 12 radiometric stations located in an area of 20 km x 20 km inside the Park. The location of these radiometric stations covers a wide range of elevations, aspects and slopes. The results were analyzed on the light of the different topographic characteristics of the 12 stations.

Overall, results showed that a very important improvement is obtained when estimating the solar radiation with “r.sun” based on the MM5 simulations. Finally, results also showed that the difference between the estimated and measured solar radiation increases when the topographic complexity increases.