



## Notes on the Solar Map of Asturias

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### Abstract.

The Solar Map of Asturias (SMA) is the result of a research work carried out within the project “Bio-climatic Architecture and Solar Cooling” (PSE-ARFRISOL). It is based on a correlation model, recently published, between solar irradiation and air temperature, and on the application of the software ArcGIS 9.3 for the spatial interpolation among data from 63 meteorological stations.

The paper shows that the SMA estimations predict difficulties to attain in some areas the minimum solar contribution established by the Spanish Technical Code of Building.

Those predictions are compared with the ones obtained by combining experimental data, Geographic Information Systems, and a solar radiation model able of computing the effects of shadows caused by the orography of the ground.

It is expected that the combination of both procedures may contribute to the improvement of future SMA editions.

### Key words

Solar irradiation, correlation models, solar maps, Solar Map of Asturias.

### 1. Introduction

Several authors have shown that monthly average values of global solar irradiation on horizontal surfaces are correlated with air temperature. The models by Hargreaves and Samani [1], Richardson [2], Allen [3] and Chandel et al. [4] assume that the site elevation  $z$  and the distance to sea  $L$  are implicit parameters in factors of proportionality. Those factors of proportionality may also depend on the latitude.

A new approach recently proposed [5] is based on the following equation:

$$\frac{G}{G_0} = f\left(\frac{z}{L}\right) \cdot \left(\frac{\Delta T}{T_{ref}}\right)^{0.5} \quad (1)$$

where  $G$  is the monthly average global solar irradiation on horizontal surface,  $G_0$  is the monthly average extraterrestrial solar irradiation,  $\Delta T = T_{max} - T_{min}$  is the difference between the monthly average maximum and minimum air temperatures,  $T_{ref}$  is a reference air temperature, and the function  $f(z/L)$  must be derived from experimental data.

Due to the wide net of stations with available long-term series of air temperature measurements, the equation (1) seemed to be adequate to be used as the basis for the construction of the SMA [6] at microclimate scale.

This paper summarizes how the model of equation (1) was applied for the construction of the SMA and it shows criteria that may contribute for improving future editions.

### 2. The Solar Map of Asturias

The SMA is the result of a research work carried out within the project “Bio-climatic Architecture and Solar Cooling” (PSE-ARFRISOL), which is sponsored by the Spanish Science and Education Ministry and the European Regional Development Funds. The project aims at demonstrating the potential of bio-climatic techniques and solar systems to provide about 80% reduction for CO<sub>2</sub> emissions and power consumption in five public buildings with very different climate conditions, one of which is located in the Principality of Asturias, a region of diverse orography on the northern Spanish coast.

#### A. Improvement of Correlation by means of a Non-Potential Function

The assumption of the potential model  $f(z/L) = a(z/L)^b$  led to acceptable results for meteorological stations with similar latitude, located either at relatively nearby sites in coastal areas that are close to valleys and mountains, or stations located as far as 100 km away in dry, non-mountainous areas [5].

However, the potential model may lead to uncertainties when it is applied to low elevated sites ( $z \rightarrow 0$ ), which are close to the sea ( $L \rightarrow 0$ ), so it had to be revised in order to obtain results with physical meaning at the definition range limits of  $z/L$ .