Enabling Climate Information Services for Europe

Report

DELIVERABLE 6.12
Climatology of sunshine duration and solar radiation for Sicily

Activity:	*WP6 - Energy*
Activity number:	*Task 6.6 - Past and future solar radiation estimation for Sicily*
Deliverable:	*Climatology of sunshine duration and solar radiation for Sicily*
Deliverable number:	*6.12*
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Summary

The deliverables consists of 13 maps showing the distribution of global radiation monthly and yearly normal values over Sicily. They refer to the standard 1961-1990 reference period. The spatial resolution is 30-arc-second.

1. Introduction

High-resolution datasets of monthly climatological normals (i.e. high-resolution climatologies) have proved to be increasingly important in the recent past, and they are likely to become even more important in the future. They are used in a variety of models and decision support tools in a wide spectrum of fields such as, just to cite a few, energy, agriculture, engineering, hydrology, ecology and natural resource conservation (Daly et al., 2002, Daly, 2006). One of the most important variables for a lot of possible applications (e.g. energy production and agriculture) is solar radiation.

It is therefore very important to develop and to apply methodologies which allow to exploit as much as possible the information contained in solar radiation observational records: they consist both of global radiation and sunshine duration records; the latter have the advantage of a much larger data availability, especially when long-term records are considered

2. Description of the procedure

We have recently developed a methodology, first proposed by Spinoni (2010), which allows to estimate, on the basis of a sparse network of radiation or sunshine duration records, solar radiation climatologies on a high resolution grid, taking into account the slope and the aspect of each cell and considering shading. It consists of i) converting sunshine duration data into global radiation (if global radiation data are not available for the site), ii) decomposing global radiation into a direct and a diffuse component, iii) gridding direct and diffuse components of global radiation, iv) evaluating atmospheric turbidity over the same grid by means of the direct component of global radiation, v) calculating direct, diffuse and reflected components of global radiation for any cell of the used grid, taking into account its slope and aspect and considering shading, vi) calculating the corresponding absorbed radiation by means of land-use-based albedo estimations.

The methodology has recently been applied to the whole Italian territory (Spinoni et al., 2012), using the USGS GTOPO30 Digital Elevation Model grid (USGS, 1996), which has a 30 arc-second spatial resolution. This DEM has also been used to estimate the slope and the aspect of the surface and the rate of shading due to the surrounding areas

The Maps, produced by means of GMT, show the distribution of global radiation monthly normal values ($MJ/day \cdot m^2$) over Sicily for the standard 1961-1990 reference period. They are displayed in Figures 1 and 2.

2. Conclusions

A methodology which allows to grid solar radiation normal values onto a high resolution DEM on the basis of a sparse network of solar radiation or sunshine duration records has been developed. All the points of the methodology have been encoded in an unique FORTRAN code which allows the user to handle the different steps of the calculations. So the maps can easily be refined in the future if the dataset of the observational records will be enlarged. Also the projection on a DEM with higher resolution can easily performed with the same methodology.

References

Daly, C., Gibson, W.P, Taylor, G.H., Johnson, G.L., Pasteris, P.A.: A knowledge-based approach to the statistical mapping of climate. Climate Res., 22, 99–113, 2002.

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Spinoni, J.: 1961-90 High-Resolution temperature, precipitation, and solar radiation climatologies for Italy, Milan University Ph.D. thesis, 2010. Available online at: http://air.unimi.it/bitstream/2434/155260/2/phd_unimi_R07883_1.pdf.

Spinoni, J., Brunetti, M., Maugeri, M., Simolo, C., 2012: 1961-1990 monthly high-resolution solar radiation climatologies for Italy, Adv. Sci. Res, 8, 19-25, DOI: 10.5194/asr-8-19-2012.

USGS: GTOPO30 Digital Elevation Model, 1996. See the website: http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/gtopo30_info.

Links to concrete results: http://www.eclise-project.eu/

References to activity meetings: The objectives of these maps have been presented at the ECLISE Kick-off meeting (De Bilt - 09 March 2011); the methods and results have been presented at the First ECLISE meeting (Norrkhoping - 6-7 March 2012).

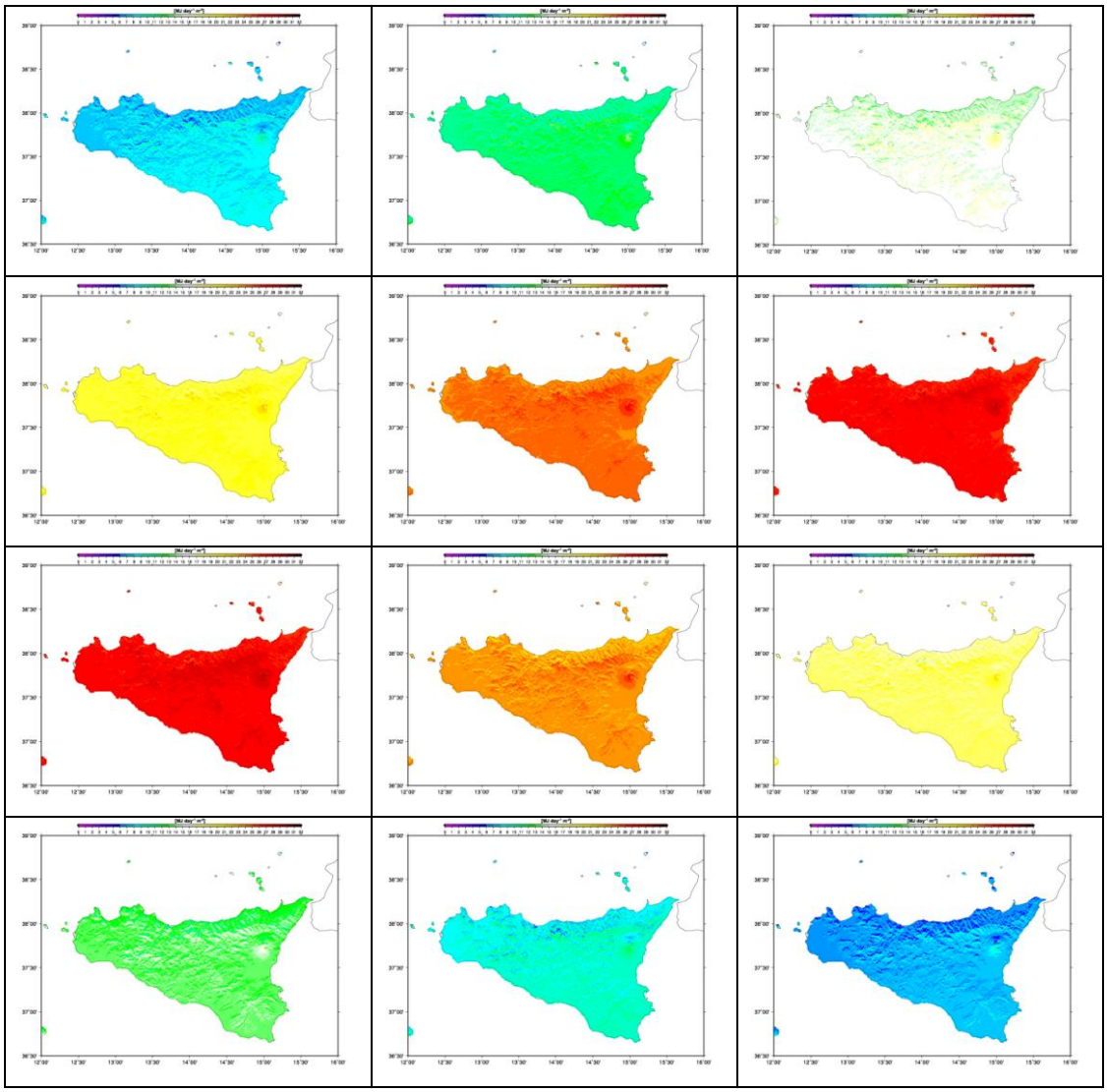

Figure 1 - Global radiation monthly and yearly normal values over Sicily (MJ/day·m^2). First row. January, February, March; second row: April, May, June, Third row: July, August, September, Forth row: October, November, December.

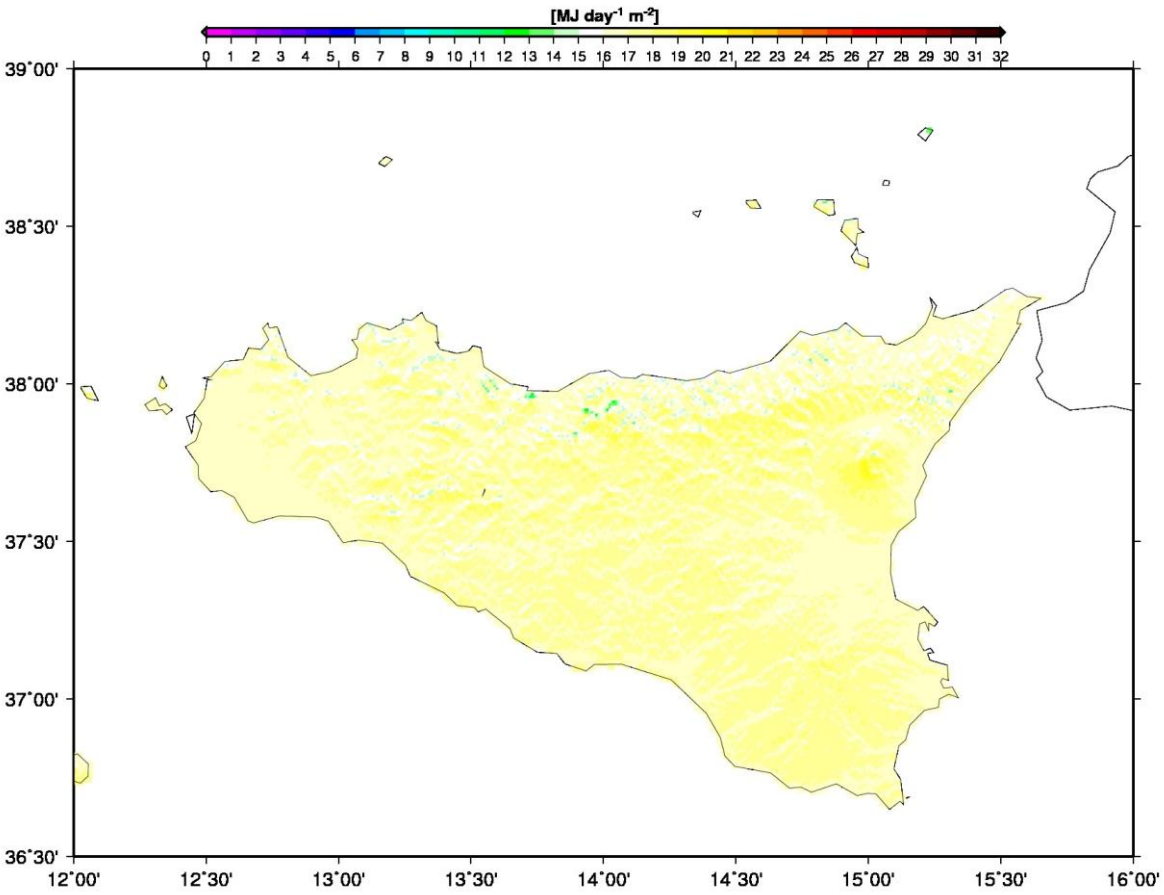

Figure 2 - Global radiation yearly normal values over Sicily (MJ/day·m^2)