

# ADVANCED SOLAR RESOURCE RISK MANAGEMENT:

## Solar radiation long term scenarios

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**Keywords: Solar radiation, Renewable Energy, Climate change projections**

### Target groups

### Relevance to the case-study requirements

- **Renewable energy**
- **Professional organisations and federations**
- **Regional authorities**

Solar radiation at the Earth's surface is a key parameter for climate monitoring and drives many natural processes whose understanding and modeling would benefit from a reliable characterization of the variability of the solar resource (e.g. agriculture, forestry, meteorology oceanography). In addition, the assessment of incoming solar energy is essential for applications aimed at converting solar energy into electricity. Since the renewable energy market is expanding, the projection of the availability of resources is becoming an increasingly urgent issue for the quantification of economic gains/losses.

## The approach

Regional Climate Models (RCMs) produce high-resolution (about 20 km) climate scenarios over selected areas by taking the input at the lateral boundaries from coarser resolution (about 100 km) Global Climate Models (GCMs). RCMs enhance the quality of climate projections with respect to GCMs, especially in the presence of complex orography (Artale et al., 2010) and in the proximity of coastal areas (Feser et al., 2011). Under CLIMRUN, we have evaluated output modelling (namely surface downward solar radiation) of today's largest and most consolidated ensemble of RCM simulations produced during the EU-FP6 project ENSEMBLES over Euro-Mediterranean region (van der Linden and Mitchell, 2009).

The table shows the 16 GCMs-RCMs combinations that have been extracted from the ENSEMBLES archive to develop the CLIMRUN products on solar radiation scenarios.

		Global Model					
		HadCM3Q16	ARPEGE	BCM	ECHAM5-MPIOM r3	MIROC3.2 hires	HadCM3Q0
Regional Model	C4IRCA3						
	CNRM-RM4.5						
	DMI-HIRAM5						
	ETHZ-CLM						
	ICTP-RegCM3						
	KNMI-RACMO2						
	METNO-HIRAM						
	METO-HC HadRM3Q0						
	MPI-M-REMO						
	SMHIRCA						
	UCLM-PROMES						

**References:**

Artale et al., 2010. An atmosphere-ocean regional climate model for the Mediterranean area: assessment of a present climate simulation *Clim. Dyn.* doi:10.1007/s00382-009-0691-8

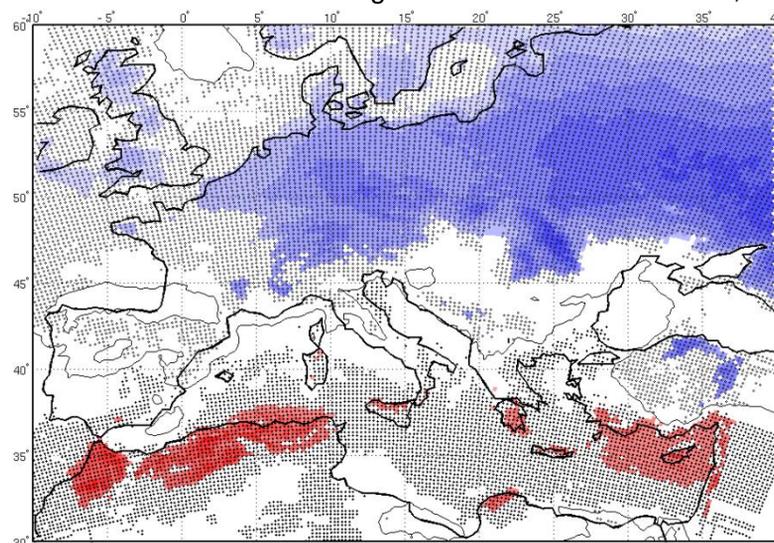
Feser et al., 2011. Regional climate models add value to global model data". *Bull. Of the American Meteorological Society* 92. 1181-1192.

van der Linden P., and J.F.B. Mitchell , 2009. ENSEMBLES: Climate Change and its Impacts: Summary of research and results from the ENSEMBLES project. Met Office Hadley Centre, FitzRoy Road, Exeter EX1 3PB, UK. 160pp

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## The product

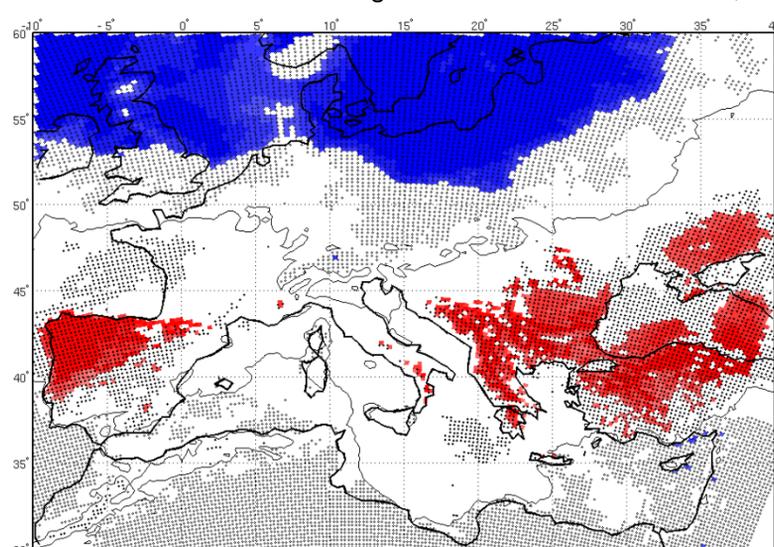
A1B RCMs solar radiation changes 2021-2050 vs 1961-1990; DJF



Mean projected change in surface downward solar radiation  $rsds$  ( $W/m^2$ ) by A1B greenhouse gas emissions scenario from ENSEMBLES for winter (top) and summer (below).

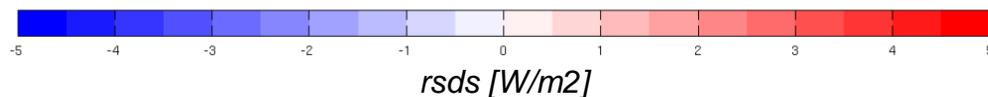
Colours represent the average long-term change in wind speed projected for 2021-2050 with respect to 1961-1990. Red indicates an increase, blue a decrease. Stippled areas represent areas where more than 66% of the 16 models agree in the sign of the long-term change.. The solid lines are for zero contour

A1B RCMs solar radiation changes 2021-2050 vs 1961-1990; JJA



Stippled areas represent areas where more than 66% of the 16 models agree in the sign of the long-term change..

An increasing of  $rsds$  is generally expected over Southern Europe with a corresponding relevant decrease over Central/Northern Europe.



## Making the product usable

The CLIM-RUN team is seeking collaborations with stakeholders in the renewable energy sector to make climate products usable. Areas for potential cooperation include:

- Derive tailored indices based on solar radiation
- Validation of climate models in reproducing observed features of solar radiation
- Statistics of extremes
- Critical thresholds
- Calibrate climate models to specific sites.

*This information sheet was developed in the framework of the CLIM-RUN FP7 EU project. The product it describes should not be used without acknowledging the project and, particularly for any operational use, interaction with the authors is welcome and strongly encouraged.*