DATA ENHANCEMENT OF TOPOGRAPHY AND VEGETATION IN WRF FOR HIGH RESOLUTION APPLICATION FOR THE FORECAST OF SOLAR AND WIND

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Introduction

The use of solar and wind energy in the Brazilian energy matrix has been growing over the last decade. As a result knowledge on solar and wind resource is very important for the Brazilian energy planning power system management, and serving as a basis for the development of future projects of photovoltaic plants and solar energy utilization by different technologies.

This work presents a methodology using the atmospheric mesoscale model WRF running in mode LES for the prediction of solar energy and wind speed for the State of Ceará by using data of topographic and vegetation in spatial resolution of 90 m and 460 m, respectively. The use of this high resolution aims at reducing uncertainties associated with misrepresentation of ground albedo and altitude and check the improvements on the reliability of wind speed and solar radiation estimates for power generation purposes in the Northeastern region of Brazil.

Material and Methods

Hourly observations of solar radiation and wind speed, acquired in three surface stations, located at Ceará. Observational data was provided by Foundation For Meteorology and Water Resource (FUNCEME) and by Brazilian Institute of Meteorology (INMET). The wind sensors are at 10m height. The location of met stations with their respective, latitude, longitude and height are given in Table 1.

Table 1. Relation between the surface stations from FUNCEME and INMET hourly data of global solar radiation and wind speed to the State of Ceará in the Northeast region.

Site	Location	Manager	Latitude	Longitude	Height
Acaraú	Coast	FUNCEME	-2,87	-39,99	13m
Meruoca	Serra	FUNCEME	-3,54	-40,49	670m
Tauá	Serra	INMET	-6,02	-40,28	415m

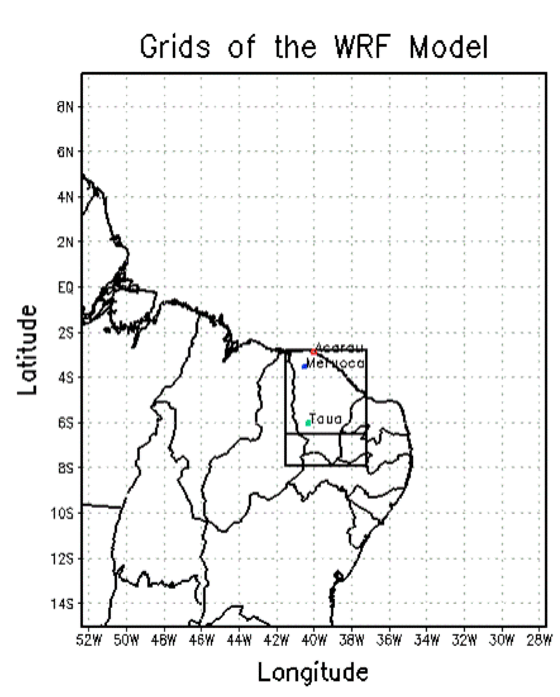

Figure 1. Horizontal Grids and location of met stations: Grid 1 and 2 are black rectangles in the State of Ceará. Acaraú in red, blue and gren Meruoca and Tauá.

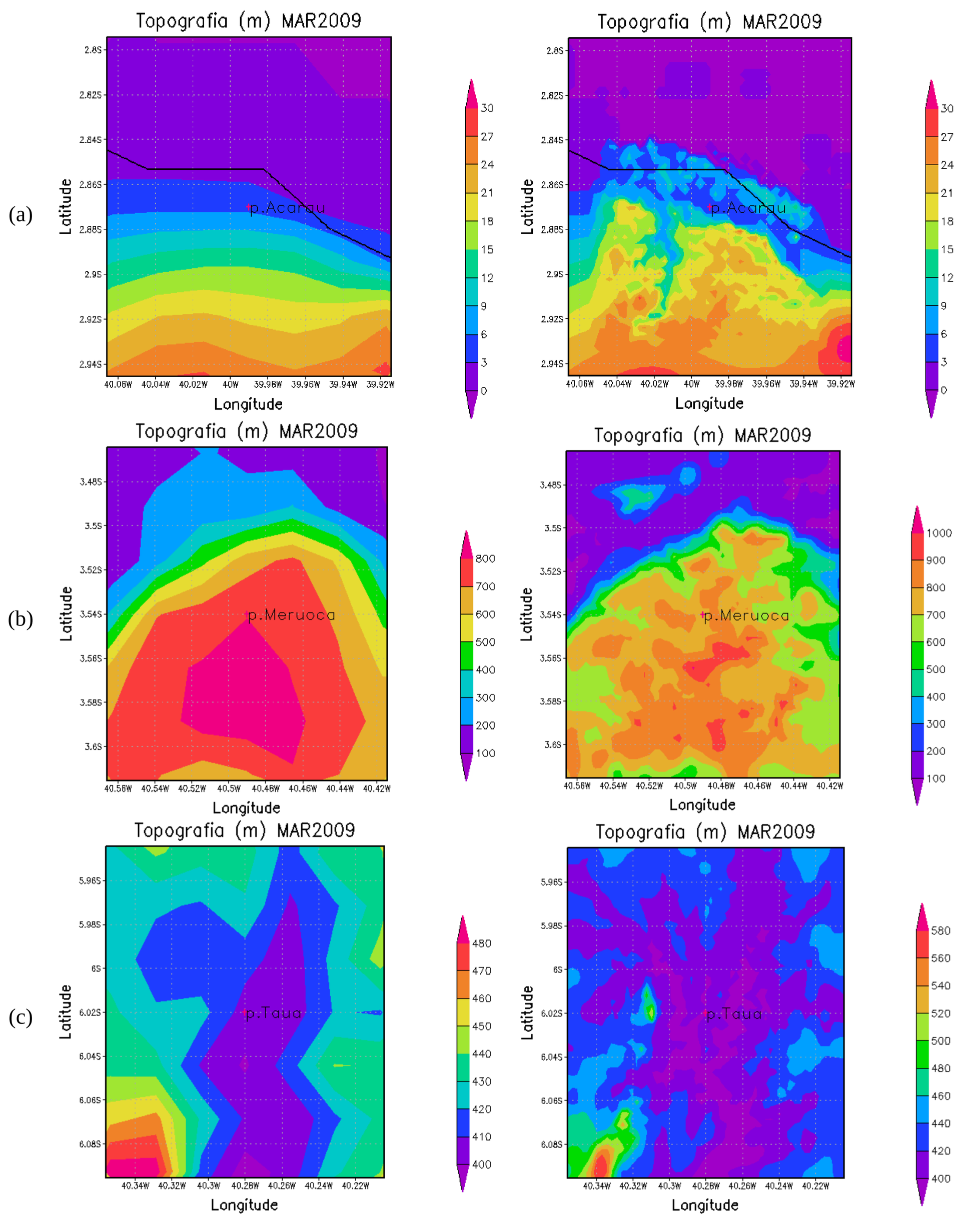

Figure 2. Topography of the WRF model for the G3 and G5 domains for Acaráu region (a), for Meruoca region (b), and for Tauá region (c).

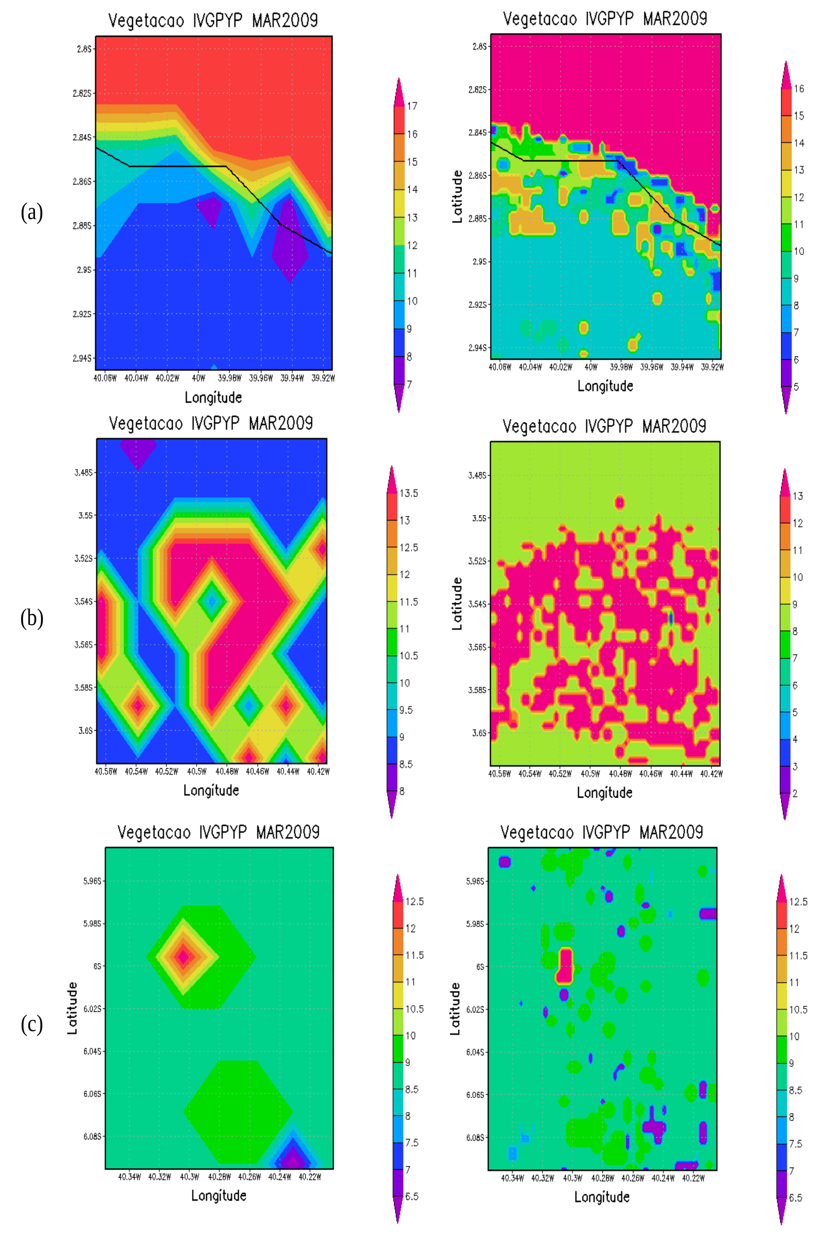

Figure 3. Vegetation type information (a), Acaraú (b) Meruoca (c) Tauá.

Acknowlegments

Results e Discussion

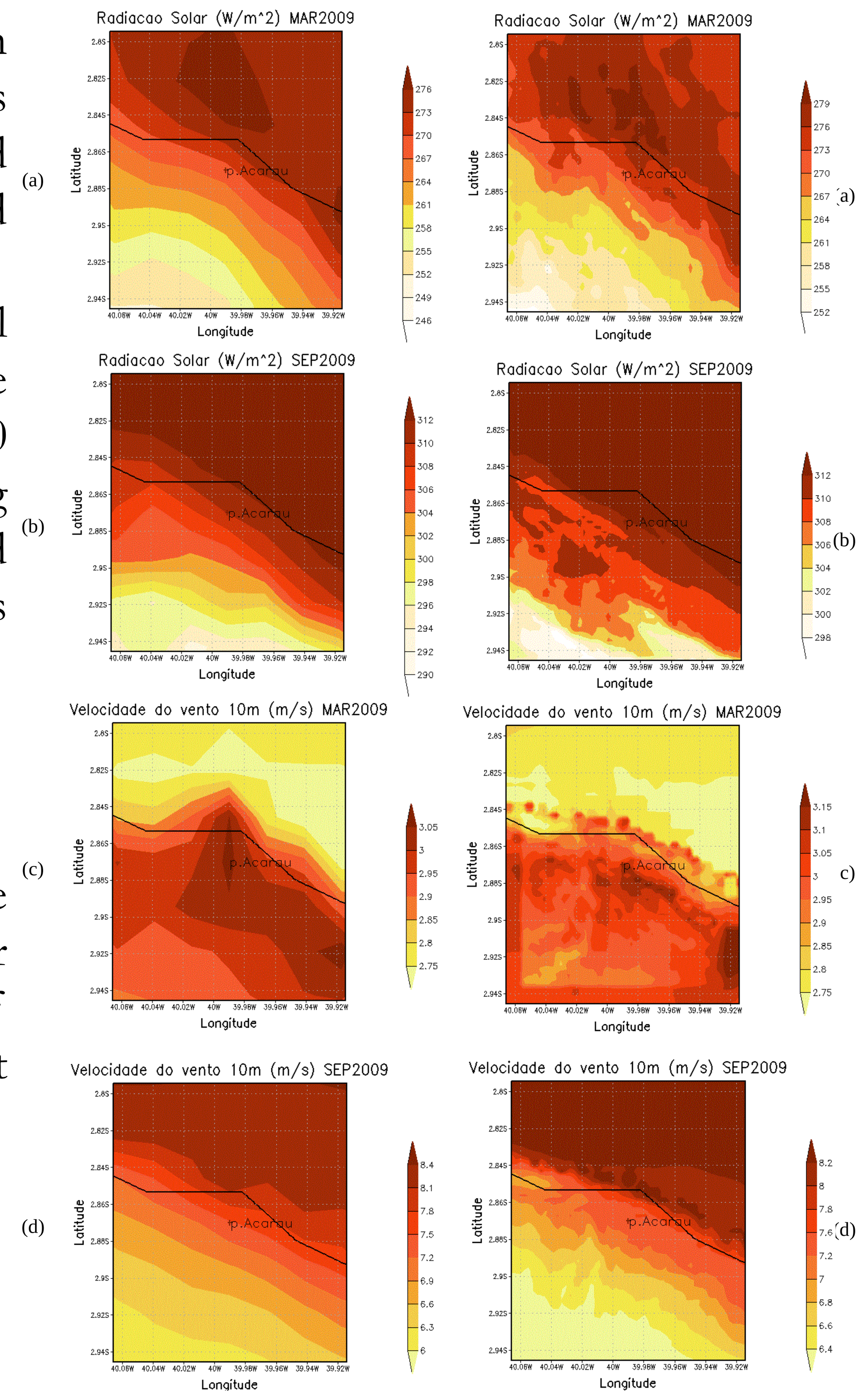

Figure 4. Average Solar Radiation (W/m²), comparison between the domain G3 and G5, for March (a) and for September (b), Average Wind Speed (m/s), comparison between the domain G3 and G5, for the month of March (c) and September (d) for Acaraú.

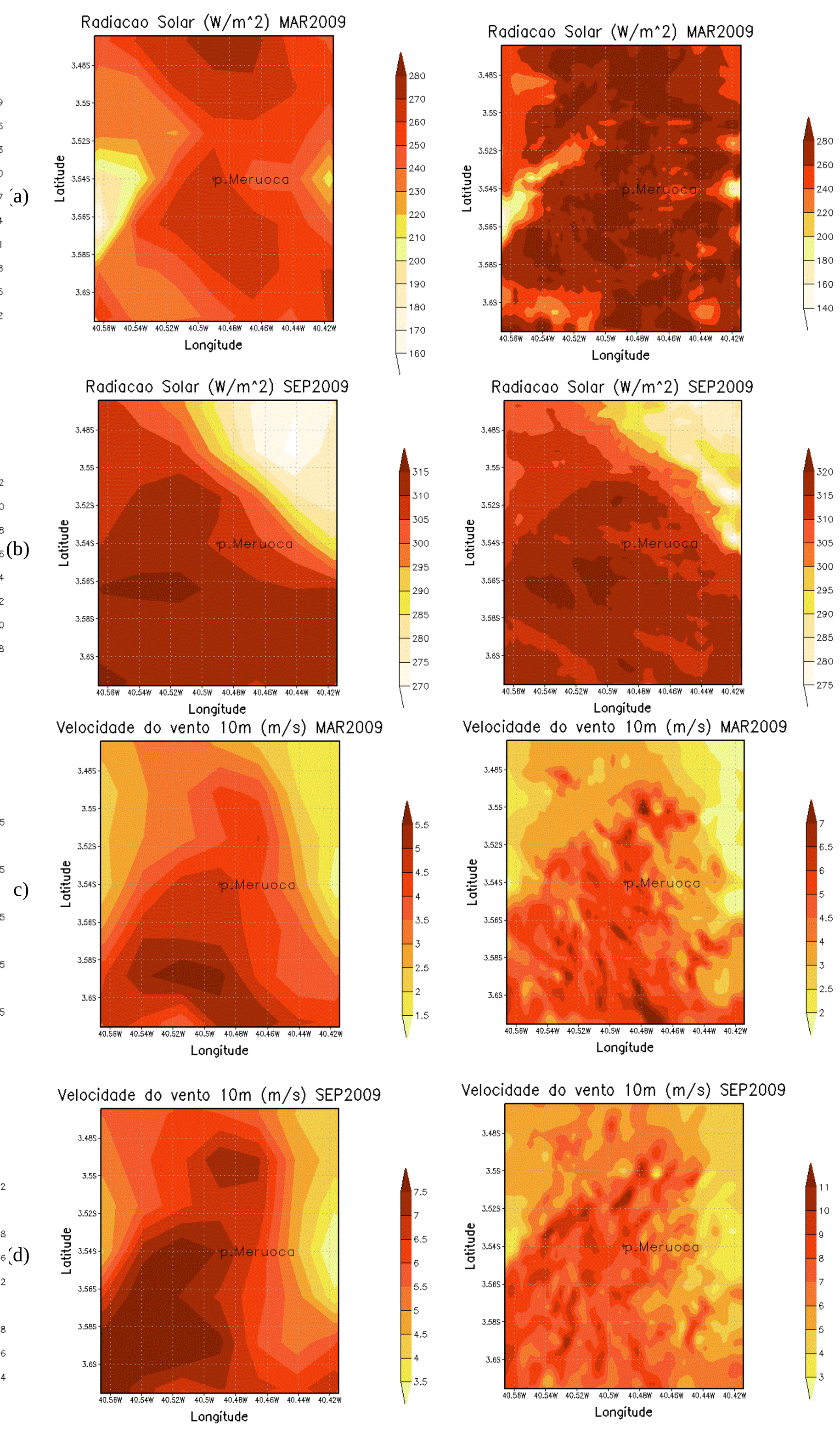

Figure 5. Average Solar Radiation (W/m²), comparison between the domain G3 and G5, for March (a) and for September (b), Average Wind Speed (m/s), comparison between the domain G3 and G5, for the month of March (c) and September (d) for Meruoca.

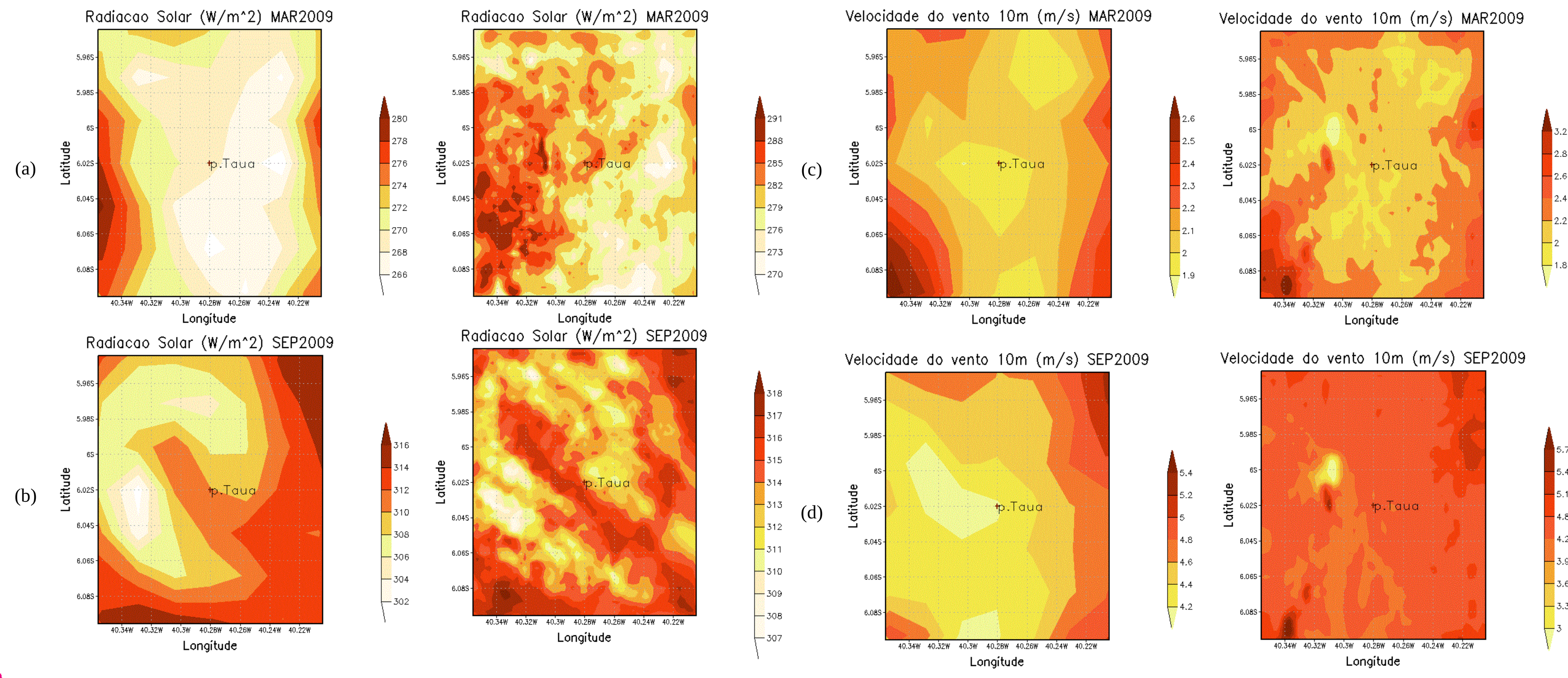

Figure 6. Average Solar Radiation (W/m²), comparison between the domain G3 and G5, for March (a) and for September (b), Average Wind Speed (m/s), comparison between the domain G3 and G5, for March (c) and for September (d) atTauá.

Table 2. **Statistical indexes for Solar Radiation and Wind Speed in Acaraú, Meruoca and Tauá, where *RSME* is the Mean Square Error and *r* is the correlation for the period of March/2009 and September/2009.**

	SOLAR RADIATION					WIND SPEED			
ACARAÚ									
	G3	G5	G3	G5		G3	G5	G3	G5
	MAR		SEP			MAR		SEP	
Bias	0,52	0,54	0,18	0,19	*Bias*	0,55	0,57	0,38	0,40
RSME	0,93	0,95	0,22	0,23	*RSME*	0,80	0,83	0,45	0,47
r	0,67	0,66	0,98	0,98	*r*	0,67	0,67	0,78	0,78
MERUOCA									
	G3	G5	G3	G5		G3	G5	G3	G5
	MAR		SEP			MAR		SEP	
Bias	0,58	0,66	0,20	0,22	*Bias*	0,61	0,59	0,66	0,67
RSME	0,90	0,95	0,30	0,32	*RSME*	0,72	0,72	0,74	0,77
r	0,77	0,77	0,92	0,92	*r*	0,45	0,46	0,31	0,24
TAUÁ									
	G3	G5	G3	G5		G3	G5	G3	G5
	MAR		SEP			MAR		SEP	
Bias	0,26	0,33	0,16	0,17	*Bias*	0,06	0,10	0,23	0,25
RSME	0,68	0,70	0,42	0,42	*RSME*	0,88	0,89	0,63	0,65
r	0,59	0,61	0,79	0,79	*r*	0,34	0,34	0,42	0,42

Conclusion

Confronting the predictions of solar radiation and wind speed it was found that, while the WRF model in its original form showed similar performance when compared the proposed methodology (there was no BIAS and RMSE reduction). Other tests will be made in order to test the proposed methodology and the development of a statistical refinement to improve the quality of forecasts.