Improving solar radiation forecasts from Eta/CPTEC model using statistical post-processing

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Solar radiation forecasts are mainly demanded by the energy sector, besides other applications. Accurate short-term forecasts of solar energy resources are required for management of co-generation systems and energy dispatch in transmission lines. Mesoscale weather forecast models usually have radiation parameterization codes, since solar radiation is the main energy source for atmospheric processes. The Eta model, running operationally in the Brazilian *Center of Weather Forecast and Climate Studies* (CPTEC/INPE), is a mesoscale model with 40 km horizontal resolution. This model has outputs for many meteorological variables, including solar radiation incidence on ground. These radiation forecasts are nevertheless greatly overestimated. As an attempt to improve the forecasts of solar energy resources using Eta model, statistical post-processing models (or refining models) were used. Multiple linear regression (MLR) models were adjusted and artificial neural networks (ANN) were trained, using a statistically selected group of 7 variables predicted by the Eta model (not including the Eta solar radiation forecast itself). This group of variables expresses the future weather and surface conditions. Theoretical solar radiation amount on the top of atmosphere (TOA) was calculated and used as another input. Solar radiation measurements from piranometers (Kipp & Zonen, CM-21) installed on two ground-stations of the SONDA Project were used as the targets to be simulated throughout the adjustment/training of the models. These measurements were also used to evaluate the forecasts by the comparison between the outputs of models and the observed values in the test phase. The ground-stations used were the São Martinho da Serra SONDA station (SMS – Lat. 29.44^{o}S, Lon. 53.82^{o}W – Data from July/2004 to October/2005) and the Florianópolis SONDA/BSRN station (FLN – Lat. 27.60^{o}S; Lon. 48.52^{o}W – Data from January/2002 to October/2005), located in southern Brazil. The evaluation parameters were correlation coefficient (R) between forecasts and observations, the relative bias and the relative root mean squared error (RMSE). Solar radiation forecasts from Eta model presented R-values of about 0.72 (FLN) and 0.78 (SMS), relative bias of 24.6% (FLN) and 28% (SMS), and relative RMSE of 40% (FLN) and 43.2% (SMS). The post-processing, after applying the ANN and or MLR models, yields R-values of about 0.79 and 0.85, respectively for FLN and SMS. For both stations, relative biases were lower than 1% and relative RMSE values were about 27%. ANNs and MLRs did not show significant differences between their forecasts, and their evaluation parameters assumed almost the same values, in both stations (FLN and SMS).

The improvements provided by the post-processing models over Eta solar radiation forecasts, in terms of RMSE, were about 33% and 36%, respectively for FLN and SMS.

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