Geophysical Research Abstracts, Vol. 8, 00733, 2006
SRef-ID: 1607-7962/gra/EGU06-A-00733

Neural Networks applied to solar resources forecast

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Solar energy is one of the most important sources of energy that should be increasingly inserted into the energy matrixes of a large amount of countries, chiefly in tropical and subtropical countries. Although some countries are already partially supplying their energy demands using solar energy, mainly because the reduced environmental damage and also due to the fact that it is a renewable source, this number is yet very reduced. There is a worldwide demand from the energy sector for accurate forecasts of solar energy (and wind as well) so as to manage co-generation systems and energy dispatch in transmission lines. Solar irradiance forecast is also important for agriculture, meteorological studies, and other human activities. However, forecasting solar irradiation, even one day in advance, is a complicated task. Part of the difficulties arises from the solar radiation dependence on clouds and meteorological conditions which intrinsically involves non-linear processes. Other difficulties are related with the inaccuracy of weather forecasts by numerical models, due to the complexity of the non-linear processes involved, and also due to the difficulties of achieving optical properties for the future state of the atmosphere. The Eta model is the current operational mesoscale weather forecast model in the Brazilian *Center of Weather Forecast and Climate Studies* (CPTEC/INPE). The model output for shortwave radiation incidence at the Earth surface presents a considerable bias, probably related to deficiencies in the parameterization of the radiation scheme. Aiming to obtain a more accurate and reliable solar radiation forecast, artificial neural networks (ANNs) have been used. These ANNs (multilayer perceptron – backpropagation training) have been trained with former Eta forecasts outputs, calculated solar radiation at the top of atmosphere, and solar radiation measurements from two ground-based stations of SONDA/INPE Project: Florianópolis (Lat. 27.60ºS, Long. 48.52ºW) and São Martinho da Serra (Lat. 29.44ºS, Long. 53.82ºW). The main purpose of this work is to present and evaluate the performance of ANNs with the goal of forecasting incident solar radiation. It will

be presented some improvements obtained with the use of this tool. Some results have shown that neural networks with just one hidden layer of neurons improve slightly the prediction, reducing bias and the root mean square error (RMSE), and increasing the correlation coefficient between measured and predicted solar radiation. The comparison between ANNs forecasts and the Eta solar radiation output have shown an improvement of about 30% for forecasts of one day, measured with the RMSE skill parameter. In conclusion, with this methodology (ANNs based on Eta outputs) we are able to produce better solar radiation forecasts that can be used by the national energy sector for several energy-related studies from renewable energy supply to electric energy distribution.

Acknowledgments: This work is supported by a grant from FINEP (project SONDA - 22.01.0569.00) and also by a scholarship from CNPq.