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Wind Power Energy in Southern Brazil: evaluation using a mesoscale meteorological model

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In recent years, several wind farms were build in the coast of Rio Grande do Sul state. This region of Brazil was identified, in wind energy studies, as most favorable to the development of wind power energy, along with the Northeast part of the country. Site assessments of wind power, over long periods to estimate the power production and forecasts over short periods can be used for planning of power distribution and enhancements on Brazil's present capacity to use this resource. The computational power available today allows the simulation of the atmospheric flow in great detail. For instance, one of the authors participated in a research that demonstrated the interaction between the lake and maritime breeze in this region through the use of a atmospheric model. Therefore, we aim to evaluate simulations of wind conditions and its potential to generate energy in this region. The model applied is the Weather Research and Forecasting , which is the mesoscale weather forecast software. The calculation domain is centered in 32oS and 52oW, in the southern region of Rio Grande do Sul state. The initial conditions of the simulation are taken from the global weather forecast in the time period from October 1st to October 31st, 2006. The wind power potential was calculated for a generic turbine, with a blade length of 52 m, using the expression: P=1/2*d*A*Cp*v̂3, where P is the wind power energy (in Watts), d is the density (equal to 1.23 kg/m̂3), A is the area section, which is equal to 8500 m̂2 , and v is the intensity of the velocity. The evaluation was done for a turbine placed at 50 m and 150 m of height. A threshold was chosen for a turbine production of 1.5 MW to estimate the potential of the site.
In contrast to northern Brazilian region, which has a rather constant wind condition, this region shows a great variation of power output due to the weather variability. During the period of the study, at least three frontal systems went over the region, and thre was a associated variation of wind intensity. The monthly average indicate several small regions with a higher value of energy. Average production higher than 1.5 MW, for the area inland, was of 72.9% for a turbine at 150 m height but only 13.1% for one at 50 m height. This initial study indicates the variability of the region in terms of wind power availability. It can be extended to the study of extreme situations, as the case of very strong winds that knocked down 8 wind turbines in this region on the 20 of December of 2014. Simulations with high degree of spacial details will be the next step in this investigation.