The impact of global climate changes on the wind power density in Brazil

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Brazil's wind energy production has escalated up from 22 MW in 2003 to 602 MW in 2009 thanks to the Proinfa (Program for Incentive of Alternative Electric Energy Sources), which is a government program to encourage the use of wind power, biomass, and small hydroelectric power. An additional 256.4 MW is now under construction. Recently 71 additional projects have been approved as a result of the first wind-only bidding round for energy supply in Brazil of December 2009. The contracts, totaling 1800MW, will start in July 2012 with a supply period of 20 years. Developing wind power in Brazil will help the country to meet its strategic objectives of enhancing energy security, creating more jobs and, at the same time, reducing the country's energy-related greenhouse gas emissions. The potential inland wind power resources in Brazil could reach more than 145,000 MW. In spite of this, the long-term growth of the national wind capacity depends not only on a more competitive price for this energy (today at US$ 84,8MWh) but also on the sustainable domestic development of this technology. Furthermore, since wind contracts are long term, the yet unknown impacts of climate changes on the wind power may possibly cast doubts and uncertainties on the return of investments in this area. This work is an assessment of these impacts in Brazil. We employed climatological time series data from national weather station, and ERA40 reanalysis data from 1960 to 2007 to inspect for trends. We have also produced wind power forecasts by using of the Eta HadCM climate model, employing the A1B climate scenario from the IPCC report for 2010 – 2100. Two target areas were selected on basis of their greater wind energy potential in Brazil and their largest number of wind projects, the Northeast and the South. We first applied a quality-control data screening process to select valid climatological time series. Then we applied the Kendall trend test at 95% confidence level on the validated time series. This analysis shows that about 50% of the 15 selected time series present a statistically significant positive trend against 20% with negative trends. The remaining validated time series did not show any statistically significant trends. The selected time series were also employed to validate the Eta HadCM climate model runs between 1962 and 1990. This period was considered as a reference for the study. Next, we successively compared the runs for the 2010-2040, 2040-2070, and 2070-2100 periods with the reference period. This procedure indicate a tendency for an average of 15% to 30% growth in the wind power density for most of the Northeast region of Brazil, with some regional hot spots exhibiting more than 100% intensification of wind power mainly in the north sector of this region. The South region of Brazil also exhibited this growing trend albeit less pronounced, of about 10%, peaking to more than 20% in some areas. This region also exhibited the strongest seasonal variance, with an overall decrease in the wind power during the austral summer and an increase during the rest of the year with respect to the reference period. Therefore, the overall impact of the global climate change on the wind power in the Northeast and South regions of Brazil are favorable to wind power exploitation on the long run as shown by the Eta HadCM climate model forecast scenarios.