

1ST SEMINAR ON THE DEVELOPMENT OF A BRAZILIAN TECHNOLOGY FOR THE WIND ENERGY ASSESSMENT.

2010, April 28 - INPE – São José dos Campos, SP

1. INTRODUCTION

The methodologies and numerical models used in Brazil for wind energy assessment at meso and micro scales are commercial (not open source) and also not adequately adjusted for the meteorological/climatological conditions observed in Brazil. Although this may not be a barrier to the development of wind projects in Brazil so far, it is a weakness in the national chain of the knowledge in this area. Within this framework, the 1^o Seminar was planned as part of the project entitled "Enhancing information for renewable energy technology deployment in Brazil, China, and South Africa" supported by the United Nations Environment Programme (UNEP) and coordinated by (National Institute for Space Research at INPE in Brazil. One of the project targets is to put different organizations (public and/or private) working together in R&D to establish the information technology requirements and to develop national methodology in order to promote the wind energy technology development in Brazil.

At the current stage, the main focus is to establish a genuinely national expertise for the atmospheric modeling applied to wind power micro-siting requirements. The seminar presented a multidisciplinary coverage involving engineering, meteorology, economy, logistics, policy, and resource management. It was also multi-institutional since there are several national institutions with different characteristics, objectives/mission and goals at the scientific, operational and government level. It is important to organize all these activities and groups in order to increase the synergy of knowledge and optimize resources.

The one-day workshop opened with Dr. Carlos Nobre, Coordinator of the Earth System Science Centre of the National Institute for Space Research (CCST/INPE) and Dr. Enio Bueno Pereira, head of the Team of Renewable Energy and Environment at CCST. Both called attention to the importance of the event in the context of the role played by the wind energy sector in planning and designing the public policies for achieving energy security and adaptation/mitigation for the future global warming harms. Dr. Enio also highlighted the event key issues for all participants as follows:

General objective: To establish national expertise to work on a national assessment methodology, adapted to the climate and environmental conditions observed in Brazil, in order to evaluate and/or forecast wind power resources, using the meteorological data available.

Specific Objectives To gather national groups carrying out research in wind energy assessment to establish the development of national competence in this area as a priority activity at the government level

Event Programme:

From 9:00 to 12:30: short presentations (15 min) of scientific research developed by the several groups working on wind modeling

From 2:00 p.m. to 5:00 p.m.: roundtable to discuss the knowledge and information demands from the energy sector in order to establish a joint working agenda for the future actions and research programmes.

2. PARTICIPANTS

The workshop was attended by the following invited experts, all involved with climate modeling, wind data acquisition, energy planning and/or wind power generation.

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PUCRS - Catholic University at Rio Grande do Sul

UENF –State University at the Norte Fluminense

UFSJ- Federal University at São João del Rey, MG

CPTEC – Center for Weather Forecast and Climate Research

CCST – Center for Earth Science System

LAC - Computing and Applied Mathematics Laboratory

UFF – Fluminense Federal University

CEPEL - Electrical Energy Research Center

EPE – Energy Research Corporation

UFAL – Federal University at Alagoas

CTGASER – Center for Gas Technology and Renewable Energy

IAE – Institute of Aeronautics and Space

3. SUMMARY OF THE SHORT PRESENTATIONS

The short technical presentations provided a opportunity for all invited experts to present the research activities under development in their institutions regarding the current status of the data acquisition and atmospheric modeling applied to wind prediction and mapping. The following table describes the key topics addressed in each presentation.

<p>Group of Renewable Energy and Environment, Earth System Science/ INPE</p>

<p>Speaker – Gilberto Fisch (IAE)</p>
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<p>Ongoing activities:</p>

<p>Developing a national methodology for wind resources:</p>
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| <ul style="list-style-type: none">• Data Collection and Quality Control Software –SONDA Network;• Data Collection and recover of historical dataset in partnership with Federal University of Alagoas (UFAL) and Institute for Air Space Control (ICEA);• Developing the Typical Meteorological Year for wind applications;• Mesoscale modeling results;• Developing a methodology to use as a bridge between the meso and microscales approaches; |
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<p>The speaker stressed the importance to integrate efforts from the several groups in order to develop the applied meteorology for wind energy sector. It was also shown the preliminary results achieved in mesoscale modeling by using model BRAMS with spatial resolution of 2.0 km and 0.5 km for a local domain (Alagoas State).</p>
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<p>Center for Weather Forecast and Climatic Studies Center CPTEC/INPE</p>
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<p>Speaker – Chou Sin Chan</p>

<p>Ongoing activities:</p>

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| <ul style="list-style-type: none">• Wind assessment by using model ETA/CPTEC with spatial resolution of 5 x 5 km. The wind profile was estimate to 50 and 100 m height using the Monin-Obhukov approach;• Use of the methodology MOC (Model Output Correlation) in order to adjust the output from mesoscale model (ETA/CPTEC) for specific sites and partnerships;• Improvement of numerical parameterizations to enhance model performance for higher spatial resolutions (40km, 20km and 5 km) in complex topography areas – better modeling of katabatic winds, and horizontal and vertical advection.• Future challenges:<ul style="list-style-type: none">○ Include vegetation and topography with higher resolution;○ Include atmospheric stability concept/ Monin-Obhukov theory in the ETA/CPTEC operational model (20 X 20 km). |
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Federal University at Alagoas (UFAL)

Speaker – Roberto Lyra

Ongoing activities:

- Wind evaluation were developed using data acquired at wind towers installed by Eletrobras in Alagoas – state located in the Brazilian Northeast region;
- Mesoscale model WRF was employed for wind mapping with nested grid with spatial resolutions in 5 km and 1.6 km.

The preliminary results obtained by using the model WRF for January/2009 are:

- The higher spatial resolution (1.6 X 1.6 km grid) have presented lower bias, although the diurnal cycle was better represented in the lower resolution (5 X 5 km);
- The best model performance (lower deviations) were obtained for Girau do Ponciano where topography is simple;
- The model output did not represent correctly the wind profile within the atmospheric boundary layer;

Catholic University from Rio Grande do Sul (PUC-RS) and Applied Institute of Environmental Sustainability (IASU)

Speaker – Marcelo Moraes (representing Jorge Ale / PUC-RS)

Ongoing activities:

- Development of laboratory tests for wind turbines assessments;
- Anemometry (sensor calibration using wind tunnel);
- Wind Assessment at local and regional sites;
- Expertise in “Micrositing”;
- Studies with mesoscale models (WRF and WindSIM), numerical models for atmospheric pollution dispersion, and wind data acquires in wind towers;
- Project to be submitted to CNPq/RHAE for the software development for wind assessment.

State University at North Fluminense (UENF)

Speaker – Valdo Marques

Ongoing Activities:

- Wind data collection in state of Rio de Janeiro
 - Wind tower measurements at 3 m, 10 m, 15 m, 30 m and 50 m at Campos dos Goytacazes, with a sonic anemometer at the top;
 - 2 wind towers (25 and 50m) at Macaé;
- Development and installation of small wind power units (form 1 kW up to 6 kW).

Past Activities:

- Wind mapping for state of Rio de Janeiro in order to identify favorable areas for wind turbine location.

Federal University at São João Del Rei (UFSJR)**Speaker – Claudio Pelegrini**

Activities:

- Use of the mesoscale model MM5 with nested grid (higher spatial resolution of 1 x 1 km) and input data from NCEP (re-analysis). Calibration and Validation exercise for 2 representative ground measurement site located in Minas Gerais;
- Local (São João Del Rei) and regional (Minas Gerais) Wind Assessment studies;
- Preliminary study to identify the suitable places to install wind farms (the outputs from the model were not validated against observations so far).

Fluminense Federal University (UFF)**Speaker – Geraldo Tavares**

Ongoing Activities:

- The speaker described general aspects (planning, public policies, etc) to increase the wind power share in Brazilian energy matrix. He did not mention explicitly activities related to data collection and/or atmospheric modeling. He also debate about the use of a free wind database as well as a regulatory framework for wind energy activities.

Electric Energy Research Center (CEPEL/ELETROBRAS)**Speaker – Antonio Leite de Sá**

Ongoing activities:

- Described the partnership with CPTEC/INPE in order to develop a dynamic wind map (which will be available for public access at the INTERNET). The wind data is obtained from the mesoscale model ETA/CPTEC running in operational mode at CPTEC/INPE;
- It was mentioned some preliminary activities to assess the wind power at islands.

Petrobras Research Center (CENPES/PETROBRAS)**Speaker – Alcyr Silva**

Ongoing activities:

- Wind Assessment using wind data set (instrument AMONIT) in 40 wind towers (actually only 23 towers are collecting data). The existent data-set is not freely available due to the ELETROBRAS' policy. The wind data may be available for academic and/or public organizations for specific circumstances like the development and calibration of numeric models.

4. SUMMARY OF THE ROUND TABLE.

The roundtable section started with Dr. Enio Pereira presenting an overview about the key points made by each institution or research group in the morning section. The proposed agenda was to discuss the demands of information and knowledge for the energy sector.

Initially Mr. Daniel Faro (representative of CTGas & ER) gave a short presentation explaining the partnership between SESI and PETROBRAS to develop calibration procedures for anemometers, to provide capacity building and human resources throughout short courses on Wind Energy and also to provide additional measurements in Wind Farms using the LIDAR technology. He also mentioned the requirement for development of R&D projects in partnership with others organizations (mainly universities and research Centers).

Mr. Juarez Lopez, representing the Energy Research Corporation (EPE), explained the key strategic demands from the point of view of this Government Agency within the proposed agenda:

- requirement for reliable information on wind resource availability in order to plan the wind power insertion on energy grid – the large variability, which hampers planning and increases the costs for system operation (generation and distribution) and reduces the system security;

- requirement for knowledge in relationship between wind and hydroelectric power resources for different regions of Brazil – if these energy resources are complementary, the system planning and security will be enhanced;
- requirement for knowledge on historical wind data series (60-70 years as in hydrology) in order to develop tools for planning the energy system operation;
- analysis of short timescale events (time periods ranging from 10 s up to 1min - turbulent aspects) and how these events affect the penetration of wind power in the electricity matrix, as well as the influence on energy dispatch in energy distribution system;
- requirement for reliable weather forecast (time period of up to 72 hours in advance) – essential to plan energy dispatch into the distribution system;
- requirement for knowledge in relationship between precipitation and wind power in order to evaluate the influence on wind farms management as well as on the distribution system operation;
- establish the infrastructure and logistics for development of wind database by using data delivered to EPE by energy utilities to meet the requirements for participation on energy bids (last one held in Dez/2009). The database should be available to universities and research centers in order to foster scientific research concerning to the models development to short-term forecast and microscale assessment. The EPE aims to make database available from Setembro/2010 through partnerships with public universities and research institutes.
- provide a rules and procedures to ensure "quality control of data wind" in accordance with MEASNET standards. The EPE proposal establishes that all energy utilities should follows this quality control program for data acquired at their wind parks. The proposal suggests the following climate variables should be acquired with sampling rates of 1 Hz and data storage intervals time of 10 min: wind speed and direction at two highs, air temperature and relative humidity. All data include in the database should be submitted to this quality control evaluation.

After the speech from EPE's representative, there was a debate about the issues concerning to the database development and the best way to make it available for energy community. The main suggestions are:

- the quality control procedure used in the SONDA Network is suitable and should be adopted for the proposed database;
- allowance for public access without restrictions to the proposed database, similar to the procedure adopted in access to the SONDA database;
- EPE believes that the proposed database should made available only for research institutes and universities;
- the proposed database should be store and centralized in a public research institution (for instance INPE, CRESESB, EPE) with "mirrors" systems.
- it was pointed out the requirement for financial support for long-term in order to install and operate the computing infrastructure and human resources in the institutions responsible for database management according to the expected demand for applications and data access;
- developing a joint project for data mining concerning to the wind energy (historical data / time series from 1931 to 2000 from FUNCEME, ICEA, INMET, DHN, etc.) and future (Wind Farms) to be integrated in the database described above.

5. CONCLUSIONS

The meeting recognized the absence of an open-source Brazilian methodology for wind energy resource assessment in Brazil. It was concluded that several research groups are presently working independently on

wind modeling using different models and procedures at different stages of development. The research groups represented in this workshop concluded that due to the high complexity and interdisciplinary of this subject there is a need for increasing the synergy between groups to reach this goal quickly and more efficiently.

It was concluded that the further development of the wind power technology in Brazil demands a reliable database in order to foster scientific advances in modeling taking in account the climate conditions observed in Brazil. This database should put together the historical data (climatological series) and the current data collected in wind farms and anemometric (or wind) towers. The data, after evaluation through quality control procedures, should be freely available for the national wind energy community.

It was recommended to organize future meetings in order to put into practice the actions and proposals discussed in this workshop.

6. ANNEXES

Copies of the presentations in PDF format.