A MODEL FOR WIND FIELD GENERATION ON THE STATE OF PARANÁ - BRAZIL

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ABSTRACT

This work describes an automated model based on interpolation methods for the wind field generation on the State of Parana, Brazil. The model employs the measurements obtained by the stations of the Sistema Meteorológico do Paraná - Simepar. The automated generation of the interpolations is accomplished by a model designed in LISP programming language. The model first decodes the raw wind data, which is then corrected and interpolated. The results are displayed in maps and are allowed to be used as input data to wind driven wave nowcasting systems of lakes and reservoirs.

1. INTRODUCTION

The wind can be seen as the horizontal movement of the air due to the atmospheric pressure gradient. However, its behavior close to the surface is highly influenced by the surface roughness and by the air temperature horizontal gradient near the surface. The wind-surface interaction results in thermo-mechanical processes of different spatial and temporal scales that are monitored by meteorological stations. The low density of the wind monitoring network in the State of Paraná, Brazil, leads to the necessity of the development of computational methods capable of obtaining intermediate values of wind distribution. In the present work, a model that operates based on the measurements obtained by the stations of the Sistema Meteorológico do Paraná – Simepar is presented. The model is automated and written in LISP programming language. The images of the interpolated wind fields are obtained by the execution of five basic operations: (i) raw data decoding, (ii) data correction, (iii) data interpolation, (iv) graphical representation of the data, and (v) online results posting.

2. MODEL CONCEPTION

The model initiates the operation by reading files that contain the wind data. Four pieces of information regarding the available data from the meteorological stations must be provided: latitude, longitude, wind intensity and temperature gradient between water surface and solid surface for the case of stations located on the water. The data should be separated by space or tabulation. The international system of units is adopted for the velocity and temperature and the wind direction follows the meteorological convention (anti-clockwise with origin in the north). The data are corrected based on: (i) the location of the station (i.e. if the station is located on dry land or on the water), (ii) the height of the station (i.e. the reference height is 10 m), (iii) temperature gradient between air and land, and (iv) condition of the atmospheric boundary layer. The data correction for each station is performed by means of adjustment coefficients. Once the data series are corrected, the model performs a multivariate interpolation by a method known as the inverse distance weighting,

$$W = \frac{\sum_{i=1}^{n} \frac{W_i}{h_{ij}^{\beta}}}{\sum_{i=1}^{n} \frac{1}{h_{ij}^{\beta}}} , \qquad (1)$$

where W is the resulting interpolated value to a rectangular grid, W_i is the data value neighbor of the grid cell, h_{ij} is the distance between the grid cell and W_i, β is the weighting exponent and n is the number of points used in the interpolation of each grid cell. The interpolation can be linear, quadratic or cubical and the options of the output files are the wind intensity distribution and the wind vector field.

3. RESULTS

To illustrate the methodology, two images of cubic interpolated wind fields are generated using the data of 4/9/2012 at 10AM. Wind data from the thirteen out of thirty seven stations of Simepar are employed. Figure 1 shows the wind intensity distribution and Figure 2 depicts de wind vector field.

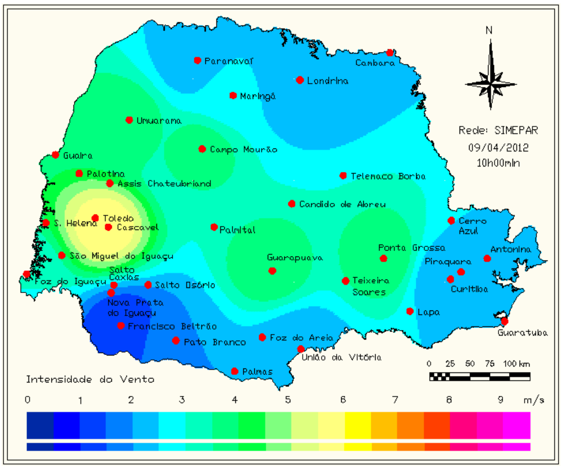

Figure 1 Wind intensity distribution

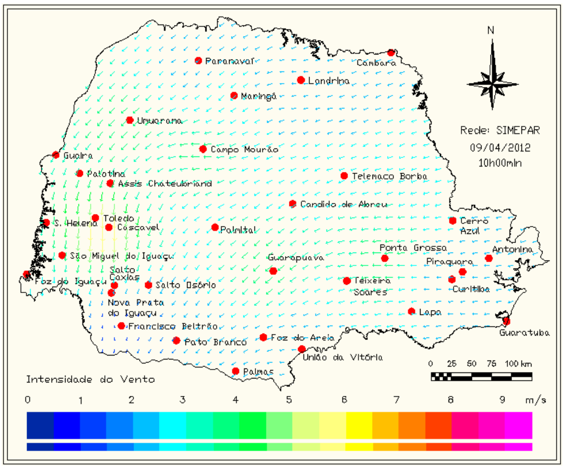

Figure 2 Wind vector field

The relationship between the computational processing time and the grid resolution for both output file formats is shown in Table 1.

Table 1 Relation grid – computational time

Output File	Processing Time (sec)	Grid (km)	Number of cells
Field	330	2	50136
Vector	5	15	882

4. APPLICATIONS TO NOWCASTING

The model can be easily adjusted to other regions independently of the spatial scales involved. The results depend upon the monitoring network density of the area considered. The objective in the future is to apply the model to generate non-uniform inlet wind fields to an empirical wind driven wave nowcasting system currently under development by the authors [1] [2].

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