GENERATING A MAP OF WIND IN A GIS

Diego González Ferreiro[1] **and Joaquín Bosque Sendra**[2]

1 MONUC-DPKO. GIS Unit

2 Departamento de Geografía, Universidad de Alcalá

The analysis of the risks produced by the industrial activities and other types of human action requires measurements of the exposition to the dangers of technological origin.

The determination of the territory exposed areas to these dangers is complex, and it varies widely depending on the danger type. That is to say, if the danger spreads in the territory through waters, atmosphere, or other means.

If the danger spreads through the atmosphere, the predominant wind in the place where the danger appears is an element that remarkably affects the boundary of the exposed zones. Therefore, a map of predominant winds (directions and speeds) at each point of the territory is needed in this case.

The weather data available do not usually provide this information. Normally the wind data are measured at concrete points of the territory, the weather stations. In order to obtain a wind map with detailed spatial information it is necessary to carry out a process of space interpolation that compute the data in much more detail.

The interpolation of the wind data encounters a serious problem. The information on direction and wind speed at each point constitutes a vector variable, with a different problematic and more difficult to interpolate than a linear variable.

In this paper a previously proposed procedure to solve the difficulties to interpolate vector variables is used and verified. The procedure essentially consists in the following:

a) The wind vector is decomposed into its two orthogonal components, vertical and horizontal, thus obtaining two linear variables that represent the vector variable.
b) The two linear thus variables obtained are interpolated using some of the several available procedures. In this paper the Weighed average by the inverse of the distance has been used.
c) From the two detailed maps previously obtained, the vector variable (direction and wind speed) in each one of the points of the territory is reconstructed by means of an inversion of vector decomposition made on step (a). This way the problem is solved.

Both procedures decomposition and reconstruction of the vector variable, encounters formal difficulties related to the different terminologies used. First the mathematics related with the vector variables and secondly the way to represent the coordinates in the GIS. If these technical problems are not treated correctly, it can be difficult to obtain a complete and exact solution to the interpolation problem of vectors. This problem is solved with the procedure used in this paper.

As a result of the vector interpolation process made, two detailed maps are obtained that describe the direction and speed of the predominant wind at each point of the territory of the Community of Madrid.

In another section of this paper, an analysis of the error level of the interpolated wind map is obtained. The weather station set has been divided into two groups. The largest station group is used to apply the previous procedure. The second smaller group is used to compare the observed values in these stations with the values generated by the interpolation process. This verification is carried out with the two orthogonal variables that represent the wind vectors. This way the Mean Quadratic Error of both components is obtained. The errors are 2.72 and 5.3 units in the horizontal and vertical components, respectively. Because the meaning of these errors is difficult to interpret, the errors are compared with those observed in other interpolation processes (generation of a Digital Elevation Model —DEM—, for example), and they do not seem to be too high. The error percentage relative to the initial values is similar to that is considered acceptable for a valid DEM. Therefore, it is considered that the interpolation process used generates results sufficiently exact in this case.

In summary, the procedure proposed is relatively simple to be used in a GIS and allows the generation of unusual data in the available data bases. This way a new procedure is available to generate new information very useful in diverse applications of the GIS.